Transportation Plan for Madison/Mayodan

March, 2001

Madison/Mayodan Transportation Plan Technical Report

Prepared by the:

Statewide Planning Branch
Division of Highways
North Carolina Department of Transportation

In Cooperation with:

Town of Madison
Town of Mayodan
The Federal Highway Administration
U.S. Department of Transportation

March, 2001

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Acknowledgements

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Report Cover
Lower Left: Current picture of the intersection of Murphy and Murphy Streets in Downtown Madison
Upper Left: Boxwoods, circa 1910, considered the oldest home in Madison
Upper Right: Walking Trail near the Madison/Mayodan Recreation Center
Lower Right: 1920 picture of the Town of Mayodan
Center: Town Clock in Madison built as a memorial for World War I veterans. One of the few large clocks operated by winding.

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Chapter 1

INTRODUCTION

Overview

The economic and social well being of the Towns of Madison and Mayodan depends upon the quality of the transportation facilities that exist in the area. If people are able to travel about freely in Madison and Mayodan today and as the economy grows, then the transportation system has been planned to properly accommodate existing and future travel. A well planned transportation system will allow for economic growth, while simultaneously providing safe and efficient travel throughout the Towns of Madison and Mayodan.

The Towns of Madison and Mayodan are located in western Rockingham County, between the City of Greensboro and the State of Virginia (see Figure 1). Officials of the Towns of Madison and Mayodan, prompted by a desire to adequately plan for the future transportation needs of area, requested the North Carolina Department of Transportation's (NCDOT) assistance in conducting a thoroughfare plan study. In March 1995, the staff of Statewide Planning met with the local officials to determine the Transportation needs of the area. A public hearing was held in March 1999, which led to the eventual adoption of the Thoroughfare Plan.

The primary purpose of this report is to document the findings and recommendations of the thoroughfare plan studies conducted for the Towns of Madison and Mayodan. The secondary purpose of this report is to document the basic thoroughfare planning principles and procedures used in developing these recommendations. This report can be divided into seven parts:

Chapter 1	Reviews the highlights of the study.
Chapter 2	Recommended thoroughfare plan descriptions
Chapter 3	Implementation of the thoroughfare plan
Chapter 4	Study Procedure and Findings
Chapter 5	Environmental Concerns
Chapter 6	Traffic Model Development
Appendices	Principles of thoroughfare planning, street appendix, cross-sections, etc.

Highlights

Major highlights of the 1999 Towns of Madison and Mayodan Thoroughfare Plan are outlined below. The Thoroughfare Plan map for Madison and Mayodan is shown in Figure 2. Projects

included in the 1998-2004 Transportation Improvement Program (TIP) are shown in parenthesis. The following projects are discussed in detail in Chapter 2.

1. Upgrade US 220 to freeway status (R-2232).
2. Widen US 311 to 3 lanes.
3. US 220 Business - widen to 24' north of Mayodan, with turn lanes at major intersections. Widen section between Market Street and US 220 from 2 to 3 lanes, remove one lane of parking inside of Mayodan.
4. Widen NC 135 from 2 to 3 lanes from US 220 Business to SR 2150 (River Road).
5. Widen SR 1169 (Island Drive) between NC 704 and US 311 from 2 to 3 lanes and rename to NC 704.
6. Construct Chief Martin Street Extension on new location from Chief Martin Street to SR 1169 (Island Drive).
7. Construct Market Street Extension on new location from Market Street and SR 2216 (Cardwell Road).

This thoroughfare plan is a joint effort by the NCDOT and the Towns of Madison and Mayodan. This plan is intended to provide the Towns of Madison and Mayodan with the necessary roadway improvements to satisfy the anticipated transportation needs until the year 2025. The NCDOT and the Towns of Madison and Mayodan are jointly responsible for the proposed thoroughfare plan improvements. Cooperation between the state and local governmental units is of primary concern. All parties have mutually adopted the plan and it is the responsibility of the local governments to implement the plan following the guidelines set forth in Chapter 3.

It should be emphasized that the recommended plan is based on anticipated growth of the urban areas as indicated by current trends. Prior to construction of specific projects, a more detailed study will be required to reconsider development trends and to determine specific locations and design requirements.

GEOGRAPHIC LOCATION MAP

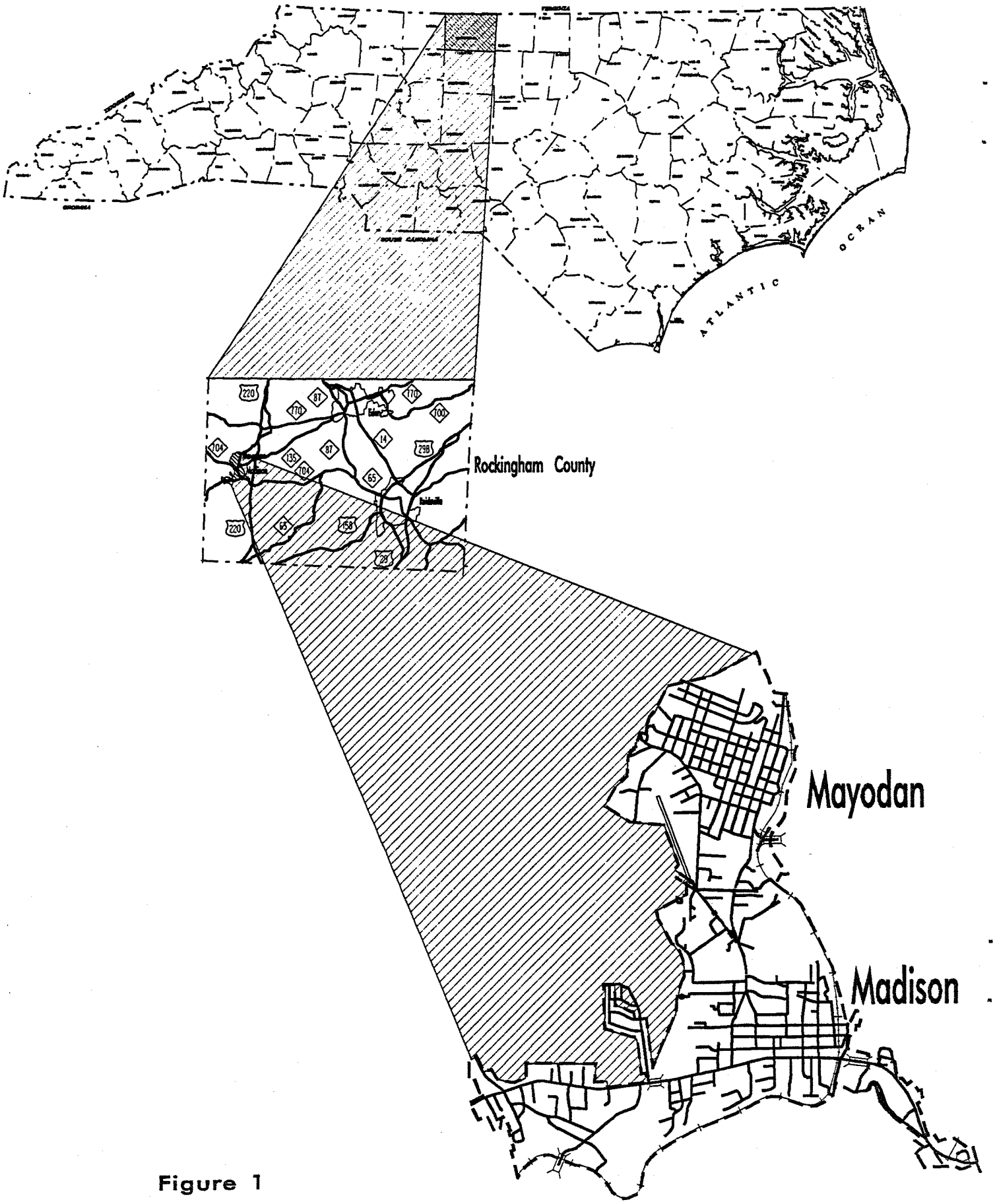
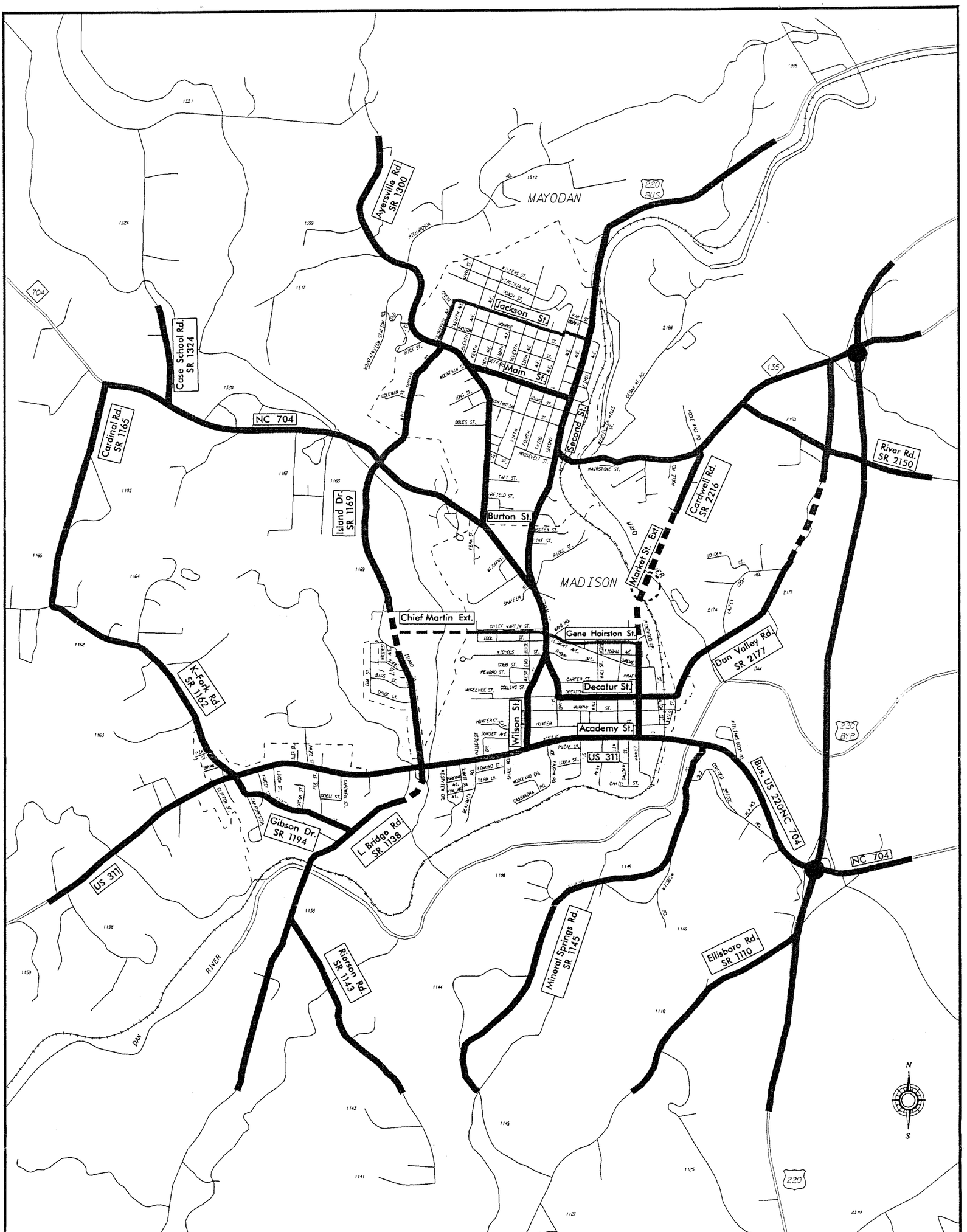


Figure 1



MADISON AND MAYODAN

ROCKINGHAM COUNTY
NORTH CAROLINA

PREPARED BY

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

JANUARY 5, 1999

ADOPTED BY:

TOWN OF MADISON	03-11-99
TOWN OF MAYODAN	03-11-99
PUBLIC HEARINGS	03-11-99
RECOMMENDED BY STATEWIDE PLANNING	03-12-99
N.C. DEPARTMENT OF TRANSPORTATION	04-09-99

Figure 2

SCALE

0 1200 2400 3600 4800
feet

Thoroughfare Plan

Legend

	Existing	Proposed
Major Thoroughfare	———	- - -
Minor Thoroughfare	———	- - -
Interchange	●	◉
Grade Separation	○	◌

Chapter 2

RECOMMENDED LONG RANGE TRANSPORTATION PLANS

Intent of the Transportation Plan

Transportation is the backbone of a region's economic vitality. Without an adequate transportation system people cannot easily reach their intended destination, goods cannot be delivered to market in a cost effective manner, and investors may look to invest in better served areas. Recent trends such as regional economies, "just in time" delivery, increased automobile ownership, and increased migration away from the central cities and towns are taxing our existing transportation system and requiring that we put more emphasis on planning for our transportation future.

The long-range transportation plan is a joint effort by NCDOT and the Towns of Madison and Mayodan. The transportation study uncovers the need for new transportation facilities, which can include roadway, bicycle, pedestrian, and transit needs. The plan is intended to provide the towns with the necessary roadway and other multi-modal improvements to satisfy the anticipated transportation needs until the year 2025. In the case of the Towns of Madison and Mayodan, the transportation plan consists of three elements - the roadway element, which is comprised of the mutually adopted Thoroughfare Plan, and the bicycle element and pedestrian element which is comprised of the Madison/Mayodan Greenway Plan. The transit element was not considered in this area because of economics and the size of the area. The roadway, bicycle, and pedestrian elements of the plan were coordinated to reduce conflicts between the modes.

The transportation plan was developed based upon the current population, employment, and travel trends in the area, as well as the Town's anticipated growth. It is important to realize that the plan is not a rigid set of proposals, but is intended to be flexible enough to account for changes in future growth. This plan should be reviewed regularly order to re-evaluate the conditions in the area and to eliminate any possible adverse impacts of unnecessary transportation proposals. Also, the Towns may at any time request a re-evaluation of their plan if conditions are expected to change differently than those anticipated in the transportation plan.

This chapter presents the transportation plan recommendations based on the ability of the existing transportation system to serve present and future desires as Madison/Mayodan continues to grow. It is the goal of these studies that the recommended plan set forth a transportation system that will serve the anticipated traffic and land development needs for the Towns of Madison and Mayodan. Other goals will be to improve safety, air quality, promote growth and improve overall efficiency of the transportation network.

Roadway Recommendations

The Roadway Element, commonly called the Thoroughfare Plan, is one part of the transportation plan. The process of developing, testing and evaluating alternate thoroughfare plans involved several considerations. These included the goals and objectives of Madison and Mayodan, identified deficiencies (see Chapter 4), environmental impacts, existing and anticipated land development, and travel services. Aerial photography, topographic mapping, field reconnaissance and discussion with local staff, officials, and interested local citizens provided additional basis for identifying and evaluating recommendations of the Madison and Mayodan Thoroughfare Plans. Figure 3 shows the recommended roadway improvements for Madison and Mayodan.

US 220 Upgrading - Purpose and Need

- **Project recommendation:** It is recommended that US 220 be upgraded to a controlled access freeway throughout the Madison/Mayodan planning area as the I-73 corridor. The alignment for this project will follow the existing US 220 corridor, upgraded to interstate standards with access control. The total cost of the project from NC 704 to the Virginia State Line, including construction and right-of-way is $38,220,000 (TIP Project R-2232). The section from NC 704 to NC 68 is not currently in the TIP. The total cost of the project from NC 704 to NC 68, including construction and right-of-way, is estimated to be $26,800,000.

- **Transportation Demand:** The construction of this project is needed to improve north-south highway transportation from Detroit, Michigan to Charleston, South Carolina. Besides being important on a regional scale, US 220 provides citizens of the Towns of Madison and Mayodan with access to Greensboro and Virginia. The traffic on US 220 is projected to increase to 26,400 vpd (vehicles per day) on the southern part of the planning area and 14,000 vpd on the northern sections.

- **Capacity:** The projected average daily traffic (ADT) for the studied corridors was calculated for 1994 and the design year 2025. Estimated future year traffic volumes are based on the Madison/Mayodan traffic model. The projected average daily traffic volumes along this segment of I-73 for the design year (2025) range from 26,400 vpd to 14,000 vpd. Although there were no anticipated 2025 capacity deficiencies with the existing cross section, the improvement to a freeway facility will increase the capacity to an estimated 56,000 vpd.

- **Safety Issues:** The improvement of this roadway to a freeway will decrease congestion and delays that may result in the future on existing roadway. The elimination of driveways on this facility should decrease the accidents due to vehicles slowing to turn into driveways, or slower vehicles turning in higher speed traffic. The construction of this project is also needed to provide better highway transportation for the east coast and the Towns of Madison and Mayodan.

- **Social Demands/Economic Development:** This project will improve interstate travel and access from the north-central states of the United States (Michigan, Ohio, etc.) to the southeastern coast of the United States, ending in South Carolina. Improved access to the state should have a positive impact on economic development, and improve automobile transportation.

- **System Linkage:** The future I-73 corridor will extend from Detroit, Michigan, and Rock Island, Illinois, through North Carolina to Charleston, South Carolina, as mandated by federal legislation.

- **Relationship to Other Plans:** Section 330(a) of the National Highway System Designation Act of 1995 has identified I-73/I-74 as a high priority corridor. The act states that in North Carolina, the I-73 corridor shall generally follow US 220 from the Virginia state line to NC 68 in the vicinity of Greensboro. These highways will extend from Detroit, Michigan, and Rock Island, Illinois, through North Carolina to Charleston, South Carolina. Section 330(b) of the Act designates I-73/I-74 as a future part of the interstate system.

  The NCDOT has appropriated funds for the majority of the I-73/I-74 route through this area, based on the 1998-1999 TIP. A portion of this project is under construction: T.I.P. project R-2232 extends from the US 220 - NC 704 interchange to the Virginia State Line. The section from NC 704 to NC 68 in Rockingham County is not currently funded to be improved. The upgrading of US 220 was not included in the 1982 Madison/Mayodan Thoroughfare Plan.

- **Modal Relationships:** The proposed US 220 / I-73 Corridor has been coordinated with the Madison/Mayodan Bicycle and Pedestrian Plan. No impacts are anticipated with the plan as a result of the US 220 improvement.

US 311 / NC 704 Widening

- **Project recommendation**: It is recommended that US 311 from the Western Planning Boundary to Market Street, and NC 704 from Market Street to the Eastern Planning Boundary be widened from two to three lanes to improve safety and capacity. The recommended cross section is a three lane curb and gutter section, 40 feet wide from face-to-face curbs. No access control is recommended. On some sections with sufficient cross-section (as near Market Street), the additional lane can be accommodated by removing parking and restriping. The existing bridge over the Dan River is not recommended to be widened as part of this project. The estimated cost of this project, including right-of-way and construction, is $5,430,000.

- **Transportation Demand***:* The construction of this project is needed to improve highway transportation for the Madison/Mayodan area and Rockingham County. US 311 in conjunction with NC 704 forms the only major east-west route in Rockingham

County. It connects Madison-Mayodan and Reidsville with the county seat of Wentworth. This route also provides access from Madison/Mayodan to Stokes County.

- **Capacity**: It is anticipated that almost the entire two-section length of US 311 and NC 704 from Market Street to the Eastern Planning Boundary will be over capacity in the future year. The improvement from two to three lanes will improve the capacity of the roadway, as left turning vehicles will be removed from the through traffic lane. Some sections of US 311/NC 704 can be widened to three lanes without new construction - simply by removing parking and restriping the existing cross section. This is especially important that the area of US 311 near Market Street travels through a small historic district. From tax overlay maps, it appears NCDOT owns enough right of way to accommodate the widening (50 ft. to 66 ft.)

- **Safety Issues**: If this project is not constructed, tremendous congestion and delays will result on the existing US 311 / NC 704 section. Left turning traffic on a two-lane highway often subjects motorists to long delays, as vehicles await opportunities to complete the turns. A continuous left turn lane will separate opposing flows.

- **Social Demands/Economic Development**: The US 311/NC 704 widening project is expected to have a positive economic impact in the area. This route contains many of the commercial amenities of the Town of Madison. Prevalent in the corridor are gas stations, car dealerships, other light commercial development, and residential development. This route provides access to every major north-south route throughout the planning area. Because of the development along this route, US 311 is a major east-west "peak hour" commuting route.

- **System Linkage**: US 311/NC704 is the primary east-west facility in the planning area. US 311 in conjunction with NC 704 forms the only major east-west route in Rockingham County, and connects Madison-Mayodan and Reidsville with the county seat of Wentworth. This route also provides access from Madison/Mayodan to Stokes County. There are no other existing facilities that could adequately serve the needs presented above. The proposed US 311 widening should improve conditions in Madison, as the widening will increase the capacity of the roadway.

- **Relationship to Other Plans:** The 1982 Madison/ Mayodan Thoroughfare Plan did not include this project. Funding for this project has not yet been secured on the North Carolina Transportation Improvement Program. This project has been coordinated with the Madison/Mayodan Bicycle and Pedestrian Plan (see Modal Relationships). US 311 is considered a major thoroughfare on the Madison/Mayodan Thoroughfare Plan.

- **Modal Relationships:** The US 311/NC 704 Widening has been coordinated with the Madison/Mayodan Bicycle and Pedestrian Plan. To avoid pedestrian conflicts with the proposed project, a grade separation with the US 311 and the bicycle/pedestrian

facility is proposed at the Bridge on US 311 near Lindsey Bridge Road. (See Madison/Mayodan Bicycle and Pedestrian Plan).

NC 135 Widening

- **Project recommendation**: It is recommended that NC 135 be widened from 2 to 3 lanes on existing location from SR 2150 (River Road) to US 220 Business. This project will increase the capacity on the existing facility and improve access in the northern part of the planning area. The recommended cross section is a three lane curb and gutter cross section, 37 feet wide from face to face of curbs (three lanes eleven feet wide). The bridge over the Mayo River does not need to be widened. The estimated cost of this project is $2,030,000.

- **Transportation Demand**: The construction of this project is needed to provide better east-west highway transportation for Mayodan. The traffic on this facility is anticipated to increase from the 1994 count of 5,600 to a 2025 projected traffic of 9,600 vpd.

- **Capacity**: NC 135 is anticipated to be near capacity in 2025 with an ADT of 9,600 with a roadway capacity of 11,000. If NC 135 is widened, it will improve safety and capacity of the roadway.

- **Safety Issues**: If this project is not constructed, congestion and delays will result. Left turning traffic on a two-lane highway often subjects motorists to long delays, as vehicles await opportunities to complete left turns. By providing a continuous left-turn lane, it will help separate opposing flows.

- **Social Demands/Economic Development**: NC 135 is a primary east-west facility in the planning area, and its widening is anticipated to have a positive economic impact on the area. It provides access to the local high school, residential development, the area's water treatment plant, and connects to US 220, the most important north-south facility in the planning area.

- **System Linkage**: NC 135 is the primary east-west facility in the northern planning area. This route provides access from Mayodan to US 220. There are no other existing facilities which would adequately serve the needs presented above. The proposed NC 135 widening should improve conditions in Mayodan, as the widening will increase the capacity of the roadway.

- **Relationship to Other Plans**: This project was not included on the 1982 Madison/Mayodan Thoroughfare Plan. This project is not yet funded on the North Carolina Transportation Improvement Program. This project has been coordinated with the Madison/Mayodan Bicycle and Pedestrian Plan (see Modal Relationships). NC 135 is considered a major thoroughfare on the Madison/Mayodan Thoroughfare

Plan.

- **Modal Relationships**: This project has been coordinated with the Madison/Mayodan Bicycle and Pedestrian Plan. NC 135 does not cross any proposed bicycle and pedestrian corridor.

Chief Martin Street Extension - Purpose and Need

- **Project recommendation:** It is recommended that Chief Martin Street (SR 1198) be extended on new location from its existing termini to the proposed Island Drive (SR 1169) Relocation (see Island Drive (SR 1169)). This two-lane project will help provide an alternate east-west facility in the Town of Madison and improve access to Dillard Primary School, Rockingham Square Shopping Center, and industrial development on Island Drive. The recommended cross section is a two-lane curb and gutter section, 28 feet wide from face-to-face of curbs. A bridge with the Beaver Island Creek and Madison/Madison Greenway is recommended. The bridge is estimated to be 200 feet with a deck width of 40 feet. The estimated cost of this project is $1,236,000.

- **Transportation Demand:** The construction of this project is needed to provide better east-west highway transportation for Madison that is served principally by two roads - US 311 and NC 704. The Madison/Mayodan traffic model shows that this project will provide relief to US 311 and NC 704. The 2025 traffic on Chief Martin Street Extension is expected to be 5,800 vpd (vehicles per day).

- **Capacity:** Currently, to get to Dillard Primary School or Rockingham Square Shopping Center, a motorist must travel inside of Madison to get to Chief Martin Street (SR 1169). Due to the lack of crossings across Island Creek, motorists from the western part of the planning area must use US 311 and NC 704 to get to Chief Martin Street (SR 1169).

  While providing easier access for local traffic to schools and shopping, Chief Martin Street Extension should ease congestion on US 311. The existing two lane US 311 is operating over its capacity of 12,200 vpd with existing traffic of 13,400. Without this improvement, the traffic on US 311 is expected to increase 18,000 vpd in the design year 2025. With this extension, the traffic on US 311 is expected to drop to 12,200 (at capacity), which can be supported by a three-lane section. Without Chief Martin Street Extension, additional lanes will be needed to maintain an adequate level of capacity on US 311. Widening of existing US 311 to five lanes will be difficult, if not impossible, to implement through a historic district near the US 311/NC 704 intersection (see US 311 recommendations).

  The current two lane NC 704 is under capacity with 5,200 vpd and a capacity of 8,000 vpd. Without this improvement, the 2025 traffic is expected to grow to 8,900. With

the construction of Market Street Extension, the 2025 traffic is expected drop to 8,300.

- **Safety Issues:** If Chief Martin Street Extension is not constructed, congestion and delays will result on existing roadways, especially US 311. This congestion will result in increased air pollution due to the stop-start conditions along the roadway, as well as increased accidents due to the high numbers and close proximity of vehicles in the traffic stream. The construction of this project is also needed to provide better highway transportation for the towns of Madison and Mayodan.

- **Social Demands/Economic Development:** The proposed Chief Martin Street Extension is expected to have a positive economic impact on the Towns of Madison and Mayodan. It will offer easier access to schools, shopping, and industries.

- **System Linkage:** This facility, when complete, will link Chief Martin Street with Island Drive (SR 1169). Along with Gene Hairston Street, this will provide an east-west facility inside of Madison. There are no other existing facilities that would adequately link these areas. This route will be important on a countywide and local basis.

- **Relationship to Other Plans:** This project is included in the Madison/Mayodan Thoroughfare Plan, and was on the previous thoroughfare plan in 1982. A variation of this idea was on the 1965 thoroughfare plan. This project is not currently on the NCDOT's Transportation Improvement Program, although a feasibility study has been requested for the project. Chief Market Street Extension is considered a minor thoroughfare on the Madison/Mayodan Thoroughfare Plan. This project has been coordinated with the Madison/Mayodan Bicycle and Pedestrian Plan (see Modal Relationships).

- **Modal Relationships:** The proposed Chief Martin Street Extension crosses the proposed Madison/Mayodan Greenway. To improve safety and continuity at this proposed intersection with bicycle and pedestrian traffic, a grade-separated crossing is recommended. (see Madison/Mayodan Bicycle and Pedestrian Plan - Section A).

Island Drive (SR 1169) Improvements

- **Project recommendation**: It is recommended that Island Drive (SR 1169) be improved to a three-lane facility and renamed NC 704. One section is recommended to be relocated to provide a safe intersection with the proposed Chief Martin Street Extension (see Chief Martin Street). Due to proximity of housing on the southern section, the section between US 311 and the Relocation (0.66 mi.) is proposed to be widened to a three lane curb and gutter section, 37 feet wide from face-to-face of curbs. A 0.27 mile relocated section is also proposed to be constructed as 40 feet

wide from face-to-face of curbs. The section between the relocation is proposed to be widened to a three lane curb and gutter section, 40 feet wide from face-to-face of curbs. The estimated cost of this project is $3,970,000.

- **Transportation Demand**: The construction of this project is needed to provide better highway transportation for Madison and Mayodan. The Madison/Mayodan 2025 traffic model predicts that the traffic on the northern section of Island Drive will increase to 5,100 vpd, and 9,300 vpd on the southern sections. The widening of this facility will increase the capacity and use by the local residents. The renaming of this facility will help attract trucks from traveling inside the towns of Madison and Mayodan, which was one of the complaints of the Town Councils.

- **Capacity**: Island Drive is anticipated to be near or over capacity in the year 2025. The widening of this facility will increase the capacity of this facility and by providing a continuos left-turn lane, it will help separate opposing flows of traffic.

- **Safety Issues**: If this project is not constructed, congestion and delays will result on Island Drive. Left turning traffic on a two-lane highway often subjects motorists to long delays, as vehicles await opportunities to complete the turns. By providing a continuos left-turn lane, it will help separate opposing flows. The relocated section will provide a safer intersection with the proposed Chief Martin Street Extension and eliminate a curve.

- **Social Demands/Economic Development**: The Island Drive widening project is expected to have a positive economic impact in the area. This route currently contains a large industry, with additional sites possible. When widened, this route will become a major north-south route in the area.

- **System Linkage**: Island Drive is the primary north-south facility in the western side of the planning area. There are no other existing facilities which could adequately serve the north-south flows on the western side of the planning area. The proposed Island Drive widening should improve conditions in Madison and Mayodan, as the widening will increase the capacity of the roadway.

- **Relationship to Other Plans:** This project was not included on the 1982 Madison/Mayodan Thoroughfare Plan. This project is not yet funded on the North Carolina Transportation Improvement Program. This project has been coordinated with the Madison/Mayodan Bicycle and Pedestrian Plan (see Modal Relationships). Island Drive is considered a major thoroughfare on the Madison/Mayodan Thoroughfare Plan.

- **Modal Relationships:** The Island Drive Widening has been coordinated with the Madison/Mayodan Bicycle and Pedestrian Plan. No conflicts are anticipated with the any bicycle/pedestrian facilities (See Madison/Mayodan Bicycle and Pedestrian

Plan).

Market Street Extension

- **Project recommendation**: It is recommended that Market Street be extended from the intersection with Gene Hairston Street to SR 2216 (Cardwell Drive) a distance of 1.4 miles. This will create a link between downtown Madison and NC 135 east of Mayodan. The recommended cross section is 28 feet wide from face-to-face of curbs, without access control. A major structure over the Mayo River and Norfolk Southern Railroad is proposed to be approximately 2200 feet long with a deck width of 40 feet. The total cost of the project, including construction and right-of-way, is estimated to be $13,980,000.

- **Transportation Demand**: The construction of this project is needed to provide a link between downtown Madison and NC 135 east of Mayodan. The project will also alleviate traffic along the congested US 220 Business corridor between Madison and Mayodan. The 2025 ADT on this facility is anticipated to be 4,400 vpd.

- **Capacity**: The construction of this project is needed to provide a link between downtown Madison and NC 135 east of Mayodan. The project will also alleviate traffic along the congested US 220 Business corridor between Madison and Mayodan.

- **Safety Issues**: If Market Street Extension is not constructed, congestion and delays will result on existing roadways, especially US 311. This congestion will result in increased air pollution due to the stop-start conditions along the roadway, as well as increased accidents due to the high numbers and close proximity of vehicles in the traffic stream. The construction of this project is also needed to provide better highway transportation for the towns of Madison and Mayodan.

- **Social Demands/Economic Development**: The Market Street Extension project is expected to have a positive economic impact in the area. When constructed, this route will become a major north-south route in the eastern part of the planning area.

- **System Linkage**: Market Street Extension, when constructed, will be a primary north-south facility in the eastern side of the planning area. There are no other existing facilities which could adequately serve the north-south flows on the eastern side of the planning area. The project should improve conditions in Madison and Mayodan, as the widening will decrease traffic on the existing US 220 Business.

- **Relationship to Other Plans:** This project was included on the 1982 Madison/Mayodan Thoroughfare Plan, but with a different alignment. This project is not yet funded on the North Carolina Transportation Improvement Program. This project has been coordinated with the Madison/Mayodan Bicycle and Pedestrian Plan (see Modal Relationships). Market Street and Market Street Extension are both

considered a major thoroughfares on the Madison/Mayodan Thoroughfare Plan.

- **Modal Relationships:** Market Street Extension has been coordinated with the Madison/Mayodan Bicycle and Pedestrian Plan. No conflicts are anticipated with any bicycle/pedestrian facilities (See Madison/Mayodan Bicycle and Pedestrian Plan), as they should pass under the proposed bridge over the Mayo River.

Widening Projects

The following routes are proposed to be widened to improve safety and capacity.

- US 220 Business - Widen the section between the Northern Planning Boundary to the Northern Corporate Limits of Mayodan from 20 ft. to 24 ft. with turn lanes at major intersections.

- NC 704 - Widen the section between the Western Planning Boundary and SR 1169 (Island Drive) from 20 ft. to 24 ft., with turn lanes at major intersections.

- Ayersville Road (SR 1300) - Widen the section between the Northern Planning Boundary and Boswell Street from 18 ft. to 24 ft. with turn lanes at major intersections to increase safety and capacity.

- Dan River Road (SR 2177) - Straighten and widen the section between Market Street and NC 135 from 20 ft. to 24 ft. Complaints about heavy trucks coming around curves on this route prompted the recommendation of straightening this facility.

- Lindsey Bridge Road (SR 1138) - Widen the section between US 311 and the Southern Corporate Limits of Madison from 22 ft. to 24 ft. Widen the section between the Southern Corporate Limits of Madison with the Southern Planning Boundary from 18 ft. to 24 ft. to increase safety and capacity.

- Will Turner Road (SR 1169) - To improve safety and capacity, it is recommended that this route be widened to three lanes.

Other Roadway Recommendations

- US 220 Business - When excessive congestion occurs, remove one lane of parking and restripe to three lanes the section of US 220 Business between Jackson Street and NC 135 in Mayodan.

- Lindsey Bridge Road (SR 1138) - Realign the intersection at US 311 with Island Drive (SR 1169).

- Chief Martin Street - Realign with Piedmont Street to allow for smooth flow.

However, this may be difficult to implement since the proposed alignment has been compromised by the construction of a Service Station during the thoroughfare planning process. This project was an element of the 1982 thoroughfare plan.

Bicycle and Pedestrian Recommendations

The Bicycle Element and Pedestrian Element are two parts of the Transportation Plan. The Madison/Mayodan Greenway Plan was developed by the Towns of Madison/Mayodan and N.C. A&T University. After public input, the Town of Madison adopted the Greenway Plan on April 10, 1997, the Town of Mayodan on April 14, 1997, and the Madison/Mayodan Recreation Commission on April 22, 1997.

However, the Greenway plan did not separate modes of transportation, and the Statewide Planning Branch developed a map which included the existing and proposed Greenway System (which incorporated both the bicycle and pedestrian modes) and the existing and proposed sidewalk system (which is used exclusively for pedestrian mode), and the bicycle and pedestrian interaction with the thoroughfare plan. Although the Greenway Plan was adopted, the Towns of Madison and Mayodan did not adopt the Bicycle and Pedestrian plan, dated January 7, 1999.

The process of developing, testing and evaluating alternate bicycle/pedestrian plans involved several considerations such as zoning, the roadway system, flood plains, and land use. These included the goals and objectives of Madison and Mayodan, identified deficiencies (see Chapter 4), environmental impacts, existing and anticipated land development, and travel services. Aerial photography, topographic mapping, field reconnaissance and discussion with local staff, officials, and interested local citizens provided additional basis for identifying and evaluating recommendations of the Madison and Mayodan Thoroughfare Plans. Figure 4 shows the recommended bicycle and pedestrian plan for Madison and Mayodan.

Madison / Mayodan Greenway System

- **Project recommendation**: It is recommended that a Greenway corridor be constructed to link the cities of Madison and Mayodan.

  The bicycle/pedestrian component of the system connects from the existing section near the NC 704 / Ayersville Road SR 1300 intersection, travels south and intersects US 311 east of Lindsey Bridge Road (SR 1138). The corridor travels south and roughly follows the north side of the Dan River counterclockwise to NC 135 near Mayodan. No cross section for this route has been identified. A detailed cost estimate, including right of way and construction, has not been prepared, although it has been estimated by the municipality to be between $300,000 - $500,000.

The pedestrian component of the system is to link the Greenway with the downtowns of Madison and Mayodan. Existing and proposed sidewalks on Hunter Street and Hunter Street Extension will connect downtown Madison with the neighborhoods and the Greenway System. Sidewalk facilities on Ayersville Road (SR 1300), and a small section of NC 135 will connect downtown Mayodan with the Recreation Department, downtown, and with the school on NC 704. A cost estimate for the sidewalk facilities has not been completed.

- **Transportation Demand**: The construction of this project is needed to provide non-motorized link between neighborhoods, schools, the recreation department, and downtown areas. It may be used by students to go to school, as well as recreational purposes. With a safe off road facility, users can travel to their destination without fear of cars.

- **Capacity**: The project is expected to alleviate a small amount of traffic along existing roadway facilities in the Madison/Mayodan area, especially during warmer weather.

- **Safety Issues**: If Market Street Extension is not constructed, congestion and delays will result on existing roadways, especially US 311. This congestion will result in increased air pollution due to the stop-start conditions along the roadway, as well as increased accidents due to the high numbers and close proximity of vehicles in the traffic stream. The construction of this project is also needed to provide better highway transportation for the Towns of Madison and Mayodan.

  Since this project was coordinated with the Madison/Mayodan Thoroughfare Plan, two conflicts of the Greenway Plan and roadway projects can possibly be prevented via a grade separation. The first crossing conflict is between the proposed Chief Martin Street Extension and the second conflict is between US 311. Both of these grade separations are intended to give a safe crossing for both pedestrian and bicycle traffic from the schools off NC 704 and the neighborhoods and parks south of US 311. The intersection with US 311 would require the extension of the existing bridge, which is expected to be replaced in 2006. The intersection with the proposed Chief Martin Street Extension would be addressed when funding is secured.

- **Social Demands/Economic Development**: The expectations of the citizens of the area are that more natural green spaces need to be preserved. This proposal addresses the need for more open, natural spaces in the form of a Greenway facility. A well-planned and developed Greenway system should make the area more attractive to prospective homebuyers and industry.

- **System Linkage**: This facility, when complete will link the Towns of Madison and Mayodan through a non-motorized facility. The construction of this project is needed to provide non-motorized link between neighborhoods, schools, the recreation department, and downtown areas.

- **Relationship to Other Plans:** This project was coordinated with the Madison/Mayodan Thoroughfare Plan.

Public Involvement for the Thoroughfare Plan

The Town of Madison requested assistance in updating their thoroughfare plan in a letter dated December 16, 1994. Since the Town of Mayodan was included in the previous study, the Town of Mayodan was strongly encouraged to request an update. The Town of Mayodan requested an update in a letter dated February 1, 1995. The initial meetings with the Towns were held in Madison on March 23, 1995 and in Mayodan on April 27, 1995. Socioeconomic data for the Madison/Mayodan area was collected in the summer of 1995. Preliminary recommendations for the Madison/Mayodan area were completed in October, 1996.

Rockingham County and City of Reidsville were concurrently being studied for updated thoroughfare plans along with Madison and Mayodan. However, in 1997 these studies became very controversial (See 1999 Rockingham County Thoroughfare Plan and 1999 Reidsville Thoroughfare Plan). Although these studies were separate from the Madison/Mayodan plan, their progress had a direct effect on the progress of the Madison/Mayodan plan. In the spring of 1997, it was felt that the Madison/Mayodan recommendations should be delayed to avoid being engulfed in the controversy of the Rockingham County and Reidsville studies. The Madison/Mayodan preliminary recommendations were presented to the Planning Boards of both towns on May 20, 1997. The support for the recommendations was very positive.

Public drop in sessions were held for the Rockingham County Thoroughfare Plan in October, 1997, and a public hearing was held in November 12, 1997. After the failure of the public hearing, one of the many comments from the public was to improve public involvement. With a renewed commitment to improve public involvement for a revised Rockingham County Thoroughfare Plan, preliminary plans were revised to include various public involvement opportunities throughout the county. At that time, it was decided to coordinate these County public meetings with the Madison/Mayodan and Reidsville Thoroughfare Plans.

The preliminary recommendations were presented to the Town of Madison on January 8, 1998, and the Town of Mayodan on February 5, 1998, with the intention of holding public involvement with the other area plans. At the Mayodan Town Council meeting, the Town Council asked for some thought be given to improving the US 220/NC 135 interchange from a diamond to a cloverleaf configuration. This idea was studied and due to impacts of to nearby school property, it was recommended that the bridge on NC 135 be widened to allow for an extra turn lane when the traffic delay in the area is excessive.

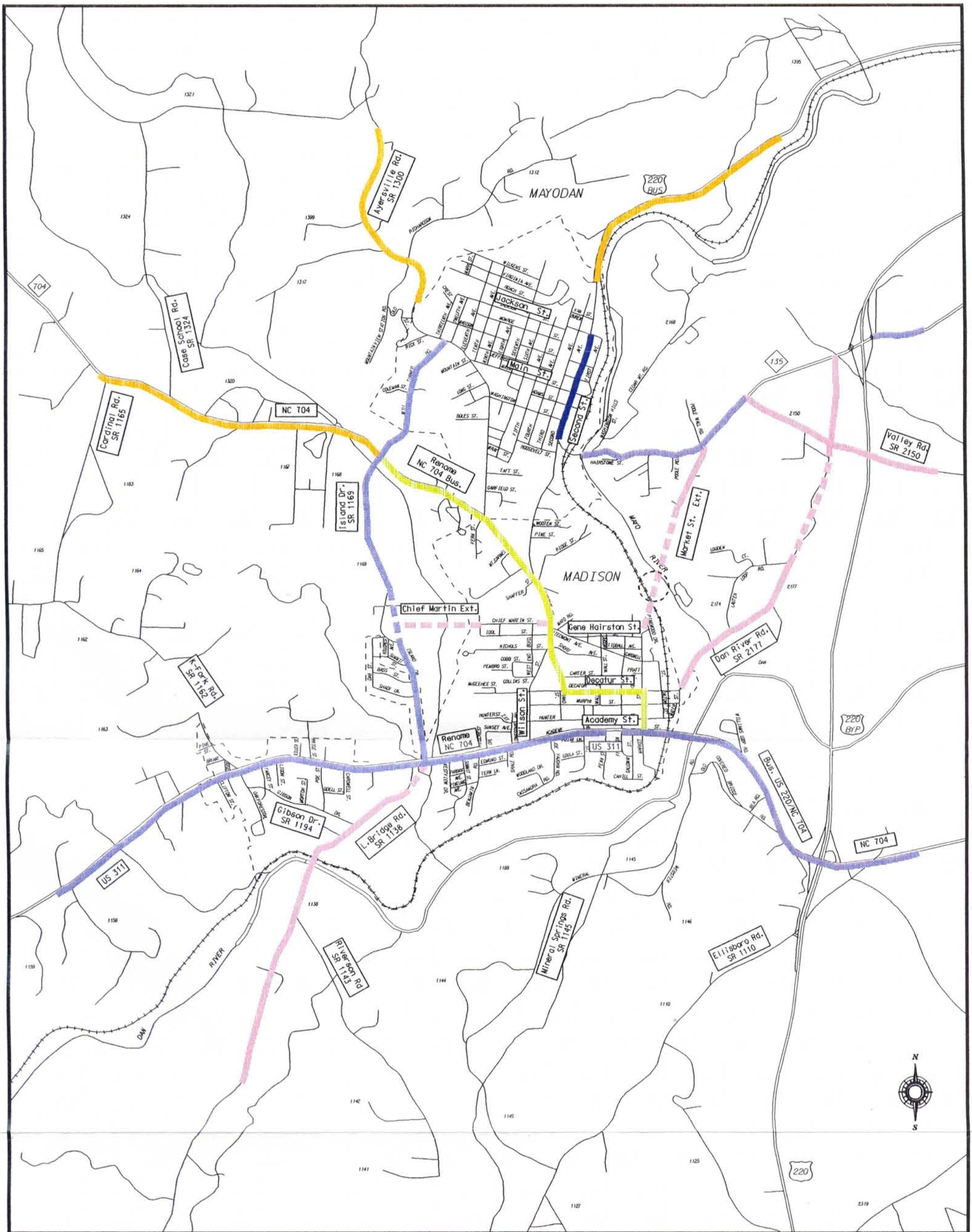
During the summer of 1998, the Rockingham County Commissioners decided to delay any further work on the thoroughfare plan until 1999. This prompted the Statewide Planning Branch

to move forward with the Madison/Mayodan Thoroughfare Plan. Since a long time had passed, the officials of Madison and Mayodan felt it would be beneficial to "review" the thoroughfare plan recommendations. Statewide Planning met with Mayodan on October 8, 1998, and Madison on November 12, 1998. After these review meetings, it was decided to move forward with drop-in in sessions.

The Madison drop-in session was held on December 14, 1998. One member of the public attended. The Mayodan drop in session was held on January 5, 1999. No members of the public attended. A joint public hearing concerning the Thoroughfare Plan was held on March 11, 1999. No members of the public opposed the plan and it was adopted that night. On April 9, 1999, the North Carolina Board of Transportation mutually adopted the plan.

Public Involvement for the Bicycle and Pedestrian Plan

The Towns of Madison and Mayodan, in conjunction with the Madison-Mayodan Parks and Recreation Department held public involvement meetings on their proposed Greenway System in the spring of 1997. The public overwhelmingly supported the Greenway System, which led to its eventual adoption by the Towns of Madison and Mayodan. The Town of Madison adopted the Greenway Plan on April 10, 1997, the Town of Mayodan on April 14, 1997, and the Madison/Mayodan Recreation Commission on April 22, 1997.



MADISON AND MAYODAN

ROCKINGHAM COUNTY
NORTH CAROLINA

PREPARED BY

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

Figure 3

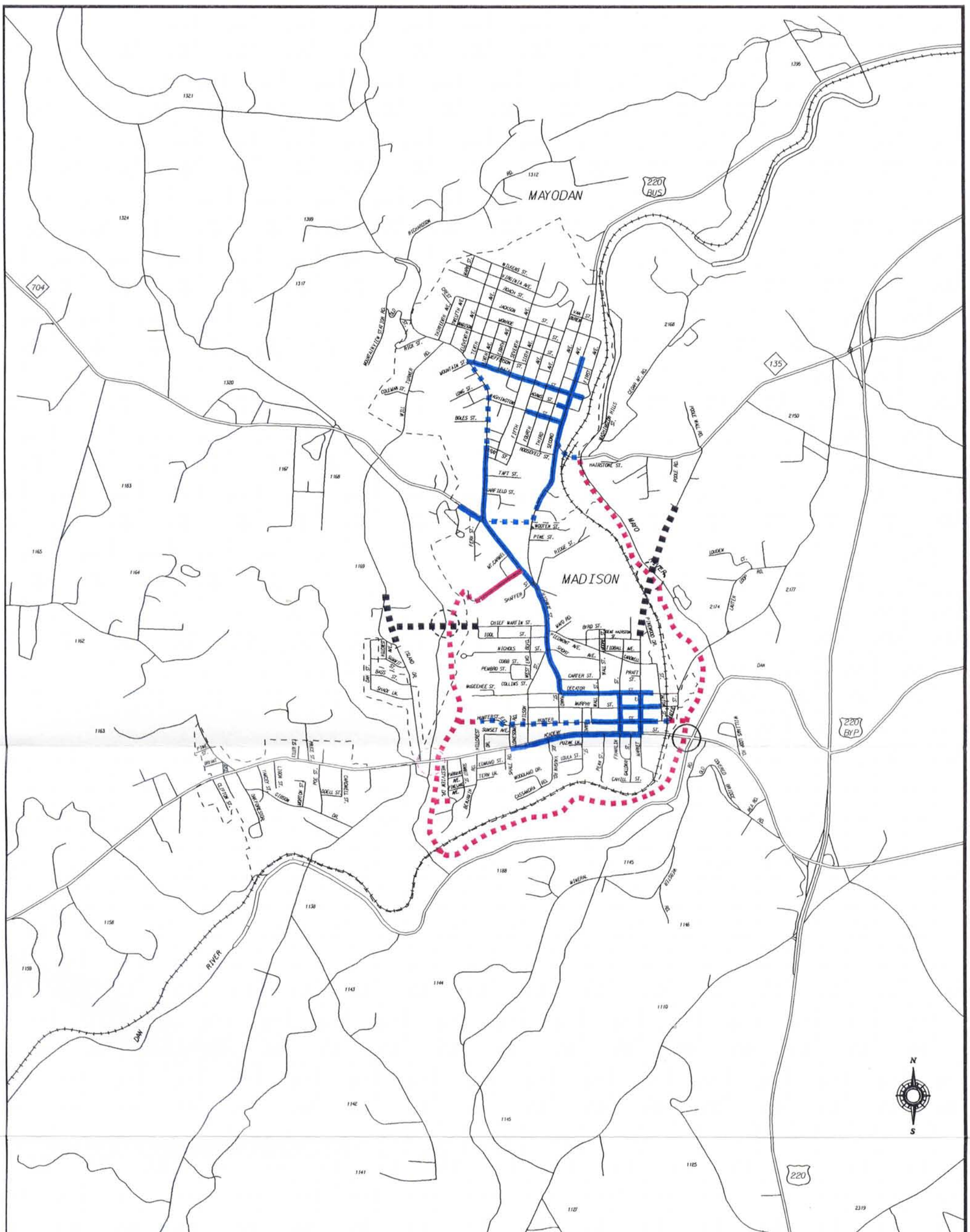
SCALE
0 1200 2400 3600 4800
feet

Recommended Improvements

Legend

# OF LANES (12 FT. WIDE)	WIDENING	PROPOSED
2		
2-In w/center turn lane @ major intersection		
3		
3-In by removing parking		

	EXISTING	PROPOSED
Grade Separation		
Rename US 704 Bus.		
Municipal limit		



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FEDERAL HIGHWAY ADMINISTRATION

ADMINISTRATIVE REPRODUCTION OF GREENWAY PLAN MAP ADOPTED BY THE TOWN OF MADISON, APRIL 10, 1997, TOWN OF MAYODAN APRIL 14, 1997, AND THE MADISON/MAYODAN RECREATION COMMISSION APRIL 22, 1997.

MARCH 5, 1999

Figure 4

SCALE

0 1200 2400 3600 4800
feet

BICYCLE/PEDESTRIAN PLAN

LEGEND

	EXISTING	PROPOSED
SIDEWALKS		
BICYCLE/PEDESTRIAN FACILITIES		
PROPOSED THOROUGHFARE PLAN PROJECTS*		
GRADE SEPARATION		

* NOTE: THE ONLY THOROUGHFARE PLAN PROJECTS SHOWN ON THIS MAP ARE THOSE THAT DIRECTLY IMPACT THE BICYCLE/PEDESTRIAN PLAN

Chapter 3

IMPLEMENTATION OF THE LONG-RANGE TRANSPORTATION PLAN

Once the transportation plan has been developed and adopted, implementation, a local responsibility, is one of the most important aspects of the transportation plan. Unless implementation is an integral part of this process, the effort and expense associated with developing the plan is lost. There are several tools available for use by the Towns of Madison and Mayodan to assist in the implementation of the transportation plan. They are described in detail in this Chapter.

State-Municipal Adoption of the Thoroughfare Plan

The Thoroughfare Plan deals with the roadway element of the Transportation Plan. The Town of Madison, the Town of Mayodan, and the North Carolina Department of Transportation have mutually approved the thoroughfare plan shown in Figure 2. These mutually approved plans serve as a guide for the Department of Transportation in the development of the road and highway system for Madison and Mayodan. The approval of the plan by the towns enables standard road regulations and land use controls to be used effectively in the implementation of this plan. As part of the plan, the Towns of Madison and Mayodan shall reach agreement on the responsibilities for existing and proposed streets and highways. Facilities, which are designated as State responsibility, will be constructed and maintained by the Division of Highways. Facilities, which are designated as municipal responsibility, will be constructed and maintained by the municipality.

Municipal Adoption of the Bicycle / Pedestrian Plan.

Bicycle and Pedestrian Plans are other elements of the Transportation Plan. The Town of Madison and the Town of Mayodan have both approved the 1997 Madison/Mayodan Greenway Plan. These plans serve as a guide for the area in the development of the bicycle and pedestrian facilities for Madison and Mayodan.

However, the Greenway plan did not separate modes of transportation, and the Statewide Planning Branch developed a map which included the existing and proposed Greenway System (which incorporated both the bicycle and pedestrian modes), the existing and proposed sidewalk system (which is used exclusively for pedestrian mode), and the proposed bicycle and pedestrian interaction with the thoroughfare plan. Although the Greenway Plan was adopted, the Towns of Madison and Mayodan did not adopt the Bicycle and Pedestrian plan, dated January 7, 1999.

Subdivision Controls

Subdivision regulations require every subdivider to submit to the Town Planning Board a plan of any proposed subdivision. It also requires that subdivisions be constructed to certain standards. Through this process, it is possible to require the subdivision streets to conform to the thoroughfare plan and to reserve or protect necessary right-of-way for projected roads and highways that are to become a part of the thoroughfare plan. The construction of subdivision streets to adequate standards reduces maintenance costs and simplifies the transfer of streets to the State Highway System. Appendix C outlines the recommended subdivision design standards as they pertain to road construction.

Land Use Controls

Land use regulations are an important tool in that they regulate future land development and minimize undesirable development along roads and highways. The land use regulatory system can improve highway safety by requiring sufficient setbacks to provide for adequate sight distances and by requiring off-street parking.

Development Reviews

Development access to a state-maintained street or highway is reviewed by the District Engineer's office and by the Traffic Engineering Branch of the North Carolina Department of Transportation. In addition, any development expected to generate large volumes of traffic (e.g., shopping centers, fast food restaurants, or large industries) may be comprehensively studied by staff from the Traffic Engineering Branch, the Project Development and Environmental Analysis Branch, and/or Roadway Design Unit of NCDOT. If done at an early stage, it is often possible to significantly improve the development's accessibility while preserving the integrity of the thoroughfare plan.

Funding Sources

Capital Improvements Program

A local capital improvement program makes it easier to build a planned thoroughfare system. A capital improvement program consists of two lists of projects. The first is a list of highway projects that are designated as a municipal responsibility and are to be implemented with municipal funds. The second is a list of local projects designated as State responsibility to be included in the Transportation Improvement Program.

Transportation Improvement Program

North Carolina's Transportation Improvement Program (TIP) is a document which lists all major construction projects the Department of Transportation plans for the next seven years. Similar to local Capital Improvement Program projects, TIP projects are matched with projected funding sources. Every other year when the TIP is updated, completed projects are removed, programmed projects are advanced, and new projects are added.

During biannual TIP public hearings, municipalities, counties, and other interested parties request projects to be included in the TIP. A Board of Transportation member reviews all of the project requests in a particular area of the state. Based on the technical feasibility, need, and available funding, the board member decides which projects will be included in the TIP. In addition to highway construction and widening, TIP funds are available for bridge replacement projects, highway safety projects, public transit projects, railroad projects, and bicycle projects.

Industrial Access Funds

If an Industry wishes to develop property that does not have access to a state maintained highway and certain economic conditions are met, then funds may be made available for construction of an access road.

Small Urban Funds

Small Urban funds are annual discretionary funds made to municipalities with qualifying projects. The maximum amount is $1,000,000 per year per division. A municipality may have multiple projects. Requests for Small Urban Fund assistance should be directed to the appropriate Board of Transportation member and Division Engineer.

The North Carolina Highway Trust Fund Law

The Highway Trust Fund Law was established in 1989 as a plan with four major goals for North Carolina's roads and highways. These goals are:

1. To complete the remaining 1,716 miles of four lane construction on the 3,600 miles of North Carolina Intrastate System.

2. To construct a multilane connector in Asheville and portions of multilane loops in Charlotte, Durham, Greensboro, Raleigh, Wilmington, and Winston-Salem.

3. To supplement the secondary roads appropriation in order to pave, by 1999, 10,000 miles of unpaved secondary roads carrying 50 or more vehicles per day, and all other unpaved secondary roads by 2006.

4. To supplement the Powell Bill Program.

The portion of this bill which will benefit Madison and Mayodan, over the 30 year planning period, is the paving of most, if not all, of its unpaved roads on the State maintained system. Also, there will be an increase in the towns' Powell Bill Funds if these newly paved roads are in their respective Corporate Limits. For more information on the Highway Trust Fund Law, contact the Program Development Branch of the North Carolina Department of Transportation.

Implementation Recommendations

Table 1 provides a break down of the projects recommended in the Madison/Mayodan Thoroughfare Plan and the corresponding funding that would best suit the implementation of the given project.

Table 1
Funding Sources and Methods for Implementation of Projects

	Funding Sources				Methods of Implementation			
Projects	Local Development Funds	TIP Funds	Industrial Access	Small Urban	Thoroughfare Plan	Subdivision Ord.	Zoning Ord.	Review
Island Drive Widening		X			X			X
Market Street Ext.		X			X			X
NC 135 Widening		X			X			X
SR 1138 Relocation		X		X	X			X
US 220 Widening		X			X			X
US 311 Widening		X			X			X

Construction Priorities and Cost Estimates

Construction priorities will vary depending on what criteria are considered and what weight is attached to the various criteria. Most people would agree that improvements to the major thoroughfare system and major traffic routes would be more important than minor thoroughfares where traffic volumes are lower. To be in the North Carolina Transportation Improvement Program, a project should show favorable benefits relative to costs and should not be prohibitively disruptive to the environment. The potential cost estimate of five Madison/Mayodan projects with respect to the user benefits, and the probabilities that economic development will be stimulated and environmental impact will be minimized are given in Table 3. A guide to this table is shown in Table 2.

Table 2
Probability Estimation Guide

Subjective Evaluation	Impact Probability
Excellent - very substantial	1.00
Very good - substantial	0.75
Good - considerable	0.50
Fair - some	0.25
Poor - none	0.00

Reduced road user cost should result from any roadway improvement, from a simple widening to the construction of a new roadway. Roadway improvements should also relieve congested or

unsafe conditions. Comparisons of the existing and the proposed facilities have been made in terms of vehicle operating costs, travel time costs, and accident costs. These user benefits are computed as total dollar saving over the 30 year design period using data such as project length, base year and design year traffic volumes, traffic speed, type of facility, and volume capacity ratio.

The impact of a project on economic development potential is shown as the probability that it will stimulate the economic development of an area by providing access to developable land and reducing transportation costs. It is a subjective estimate based on the knowledge of the proposed project, local development characteristics, and land development potential. The probability is rated on a scale from 0 (representing no development potential) to 1.00 (representing excellent development potential).

The environmental impact analysis considers the effect of a project on the physical, social/cultural, and economic environment. Below are listed the thirteen items that are considered when evaluating the impacts on the environment

* air quality
* water resources
* soils and geology
* wildlife
* vegetation
* neighborhoods noise
* noise
* educational facilities
* churches
* parks and recreational facilities
* historic sites and landmarks
* public health and safety
* aesthetics

The environmental impact analysis also uses a probability rating from 0 (representing no benefit to the environment) to 1.00 (representing a positive impact to the environment.) A negative value is assigned to the probability to indicate a negative impact. The summation of both positive and negative impacts probabilities with respect to these factors provides a measure of the relative environmental impacts of a project. Table 2 shows the probability scale used in the analysis. This table can be used as a guideline for interpreting the "Economic Development" and Environmental Impact" values given in Table 3.

Table 3
Benefits Evaluation For Major Projects

Projects	Benefits (millions)	Costs (millions)	Length (miles)	Benefits/ mile	Economic Development	Environmental Impact
Chief Martin St. Extension	22.88	1.24	0.45	50.84	+0.25	-0.25
Island Drive Improvement	9.35	3.97	1.81	5.17	+0.75	-0.10
Market Street Extension	35.69	13.98	0.70	50.99	+0.45	-0.35
NC 135 Widening	10.83	2.03	1.16	9.34	+0.10	0
US 311 Widening	90.83	5.43	3.09	29.39	+0.50	-0.10

Offsetting the benefits that would be derived from any project is the cost of its construction. A new facility, despite its high projected benefits, might prove to be unjustified due to the excessive costs involved in construction. The highway costs estimated in this report are based on the average statewide construction costs for similar project types. The anticipated right-of-way costs is also included as an average cost per acre for property throughout the Rockingham County according to the respective project. Table 4 provides a break down of total project cost into construction cost and right-of-way cost for the major project proposals for the Thoroughfare Plan.

Table 4
Potential Cost Estimates For Major Projects

Project Description	Construction Cost	Right-of-Way Cost	Total Cost
Island Drive Widening	$3,240,000	$730,000	$3,970,000
Market Street Extension	$13,315,000	$665,000	$13,980,000
NC 135 Widening	$1,900,000	$130,000	$2,030,000
US 220 Widening	$19,800,000	$7,000,000	$26,800,000
US 311 Widening	$5,070,000	$360,000	$5,430,000

Chapter 4

ANALYSIS OF EXISTING ROADWAY SYSTEM

This chapter presents an analysis of the ability of the existing street system to serve the area's travel desires. Emphasis is placed not only on detecting the deficiencies, but on understanding their cause. Travel deficiencies may be localized and the result of substandard highway design, inadequate pavement width, or intersection controls. Alternately, the underlying problem may be caused by a system deficiency such as a need for a bypass, loop facility, construction of missing links, or additional radials.

An analysis of the roadway system must first look at existing travel patterns and identify existing deficiencies. This includes roadway capacity and safety analysis. After the existing picture of travel in the area has been developed, the engineer must analyze factors that will impact the future system. These factors include forecasted population growth, economic development potential, and land use trends. This information will be used to determine future deficiencies in the transportation system.

Current Transportation Plans for Madison and Mayodan

Thoroughfare Plans

Thoroughfare Plans are a tool to aid officials in the development of an appropriate street system. It is important that the Towns cooperate as a team in the development of this transportation system. Plan development and implementation jointly undertaken will help ensure the development of an efficient system for travel throughout the County.

The 1999 Madison/Mayodan Thoroughfare Plan is an update of the 1983 Thoroughfare Plan.

Multi-Modal Transportation Plans

The Towns of Madison and Mayodan have adopted a 1997 Greenway Plan. The Greenway Plan was adopted by the Town of Madison on April 10, 1997, the Town of Mayodan on April 14, 1997, and the Madison/Mayodan Recreation Commission on April 22, 1997. A Bicycle/Pedestrian Plan, dated January 7, 1999, which was coordinated with the thoroughfare plan was not adopted. The Bicycle/Pedestrian Plan was an administrative reproduction of the Greenway Plan.

Transportation Improvement Program Projects

As covered in Chapter 3, the Transportation Improvement Program (TIP) is a seven-year project-planning document that lists the major transportation improvement projects that the Department of Transportation has planned. These projects include not only roadway projects, but also bridge projects, railroad crossings, bicycle facilities, and public

transportation. Graham County has several projects listed in the 2000-2006 TIP, and the major projects are listed below. The project numbers are listed in parenthesis.

1. (R-2232) US 220 Upgrading
2. (B-4252) Replace Bridge on US 311 over Little Beaver Island Creek

Existing Travel Patterns and Deficiencies

Traffic Demand

Travel demand is generally reported in the form of average daily traffic counts. Traffic counts are taken regularly at several locations within the Madison and Mayodan Planning Area. The 1995 average daily traffic counts for the Madison/Mayodan Planning Area are shown in Figure 5.

Capacity Analysis of the Existing System

An indication of the adequacy of the existing street system is a comparison of traffic volumes versus the ability of the streets to move traffic freely at a desirable speed. The ability of a street to move traffic freely, safely, and efficiently with a minimum delay is controlled primarily by the spacing of major devices utilized. Thus, the ability of a street to move traffic can be increased by restricting parking and turning movements, using proper sign and signal devices, and by the application of other traffic engineering strategies.

Capacity is the maximum number of vehicles which has a "reasonable expectation" of passing over a given section of a roadway, during a given time period under prevailing roadway and traffic conditions. The relationship of traffic volumes to the capacity of the roadway will determine the level of service (LOS) being provided. Six levels of service have been selected for analysis purposes. They are given letter designations from A to F with LOS A representing the best operating conditions and LOS F the worst.

The six levels of service are illustrated in Figure 6 and they are defined on the following pages. The definitions are general and conceptual in nature, but may be applied to urban arterial levels of service. Levels of service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them. The 1995 Highway Capacity Manual contains more detailed descriptions of the levels of service as defined for each facility type. The six levels of service are outlined below.

- **LOS A** - Describes primarily free flow conditions. The motorist experiences a high level of physical and psychological comfort. The effects of minor incidents of breakdown are easily absorbed. Even at the maximum density, the average spacing between vehicles is about 528 ft, or 26 car lengths.

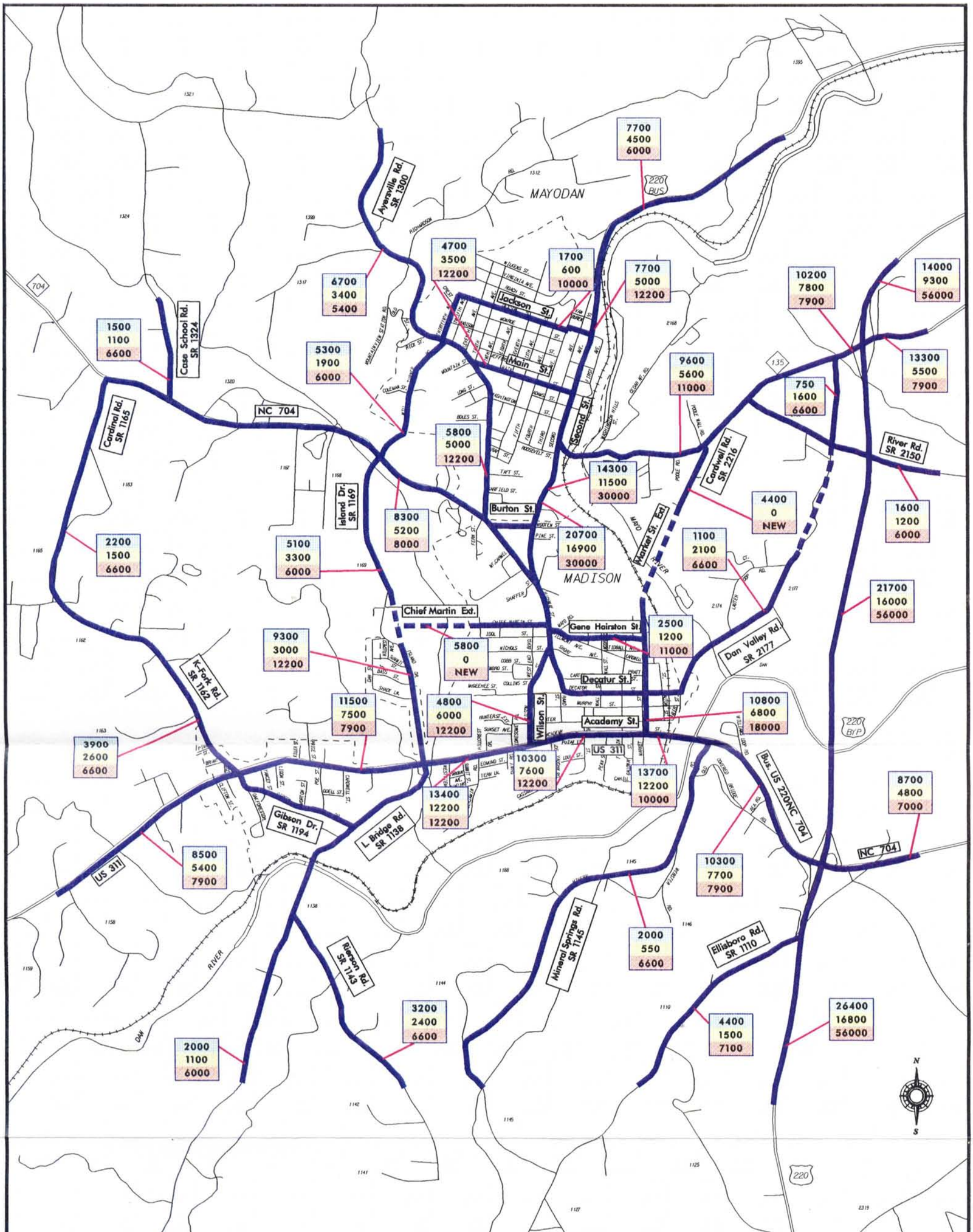
- **LOS B** - Represents reasonably free flow conditions. The ability to maneuver within the traffic stream is only slightly restricted. The lowest average spacing between vehicles is about 330 ft, or 18 car lengths.

- **LOS C** - Provides for stable operations, but flows approach the range in which small increases will cause substantial deterioration in service. Freedom to maneuver is noticeably restricted. Minor incidents may still be absorbed, but the local decline in service will be great. Queues may be expected to form behind any significant blockage. Minimum average spacing are in the range of 220 ft, or 11 car lengths.

- **LOS D** - Borders on unstable flow. Density begins to deteriorate somewhat more quickly with increasing flow. Small increases in flow can cause substantial deterioration in service. Freedom to maneuver is severely limited, and the driver experiences drastically reduced comfort levels. Minor incidents can be expected to create substantial queuing. At the limit, vehicles are spaced at about 165 ft, or nine car lengths.

- **LOS E** - Describes operation at capacity. Operations at this level are extremely unstable, because there are virtually no usable gaps in the traffic stream. Any disruption to the traffic stream, such as a vehicle entering from a ramp, or changing lanes, requires the following vehicles to give way to admit the vehicle. This can establishes a disruption wave that propagates through the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate any disruption. Any incident can be expected to produce a serious breakdown with extensive queuing. Vehicles are spaced at approximately six car lengths, leaving little room to maneuver.

- **LOS F** - Describes forced or breakdown flow. Such conditions generally exist within queues forming behind breakdown points.



MADISON AND MAYODAN

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Figure 5

SCALE

0 1200 2400 3600 4800
feet

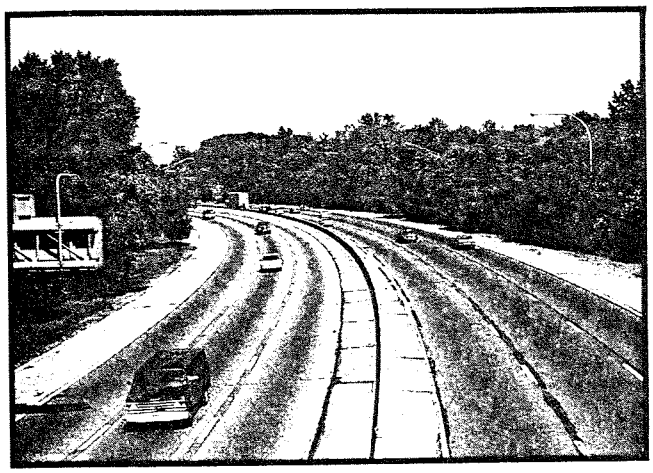
1994 & 2025 Average Daily Traffic & Capacities

Legend

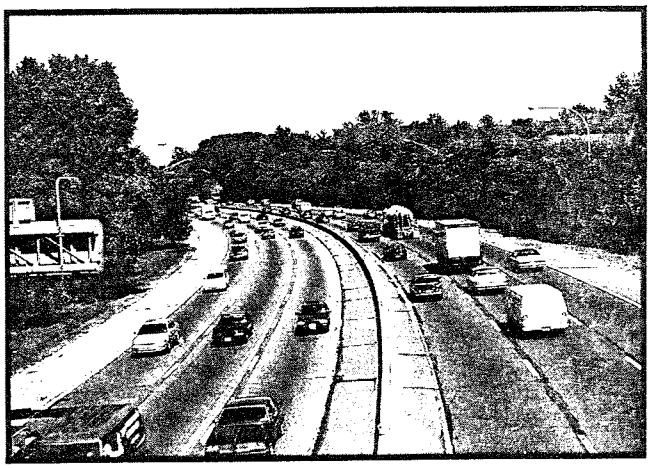
2025 ADT	0000
1994 ADT	0000
Capacity (1994)	0000

Assumes Chief Martin St. Ext. & Market St. Ext. improvements only.

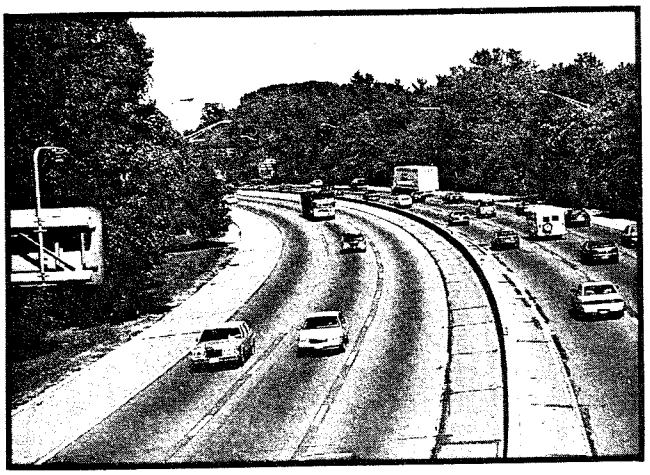
Source: 1994 Highway Capacity Manual



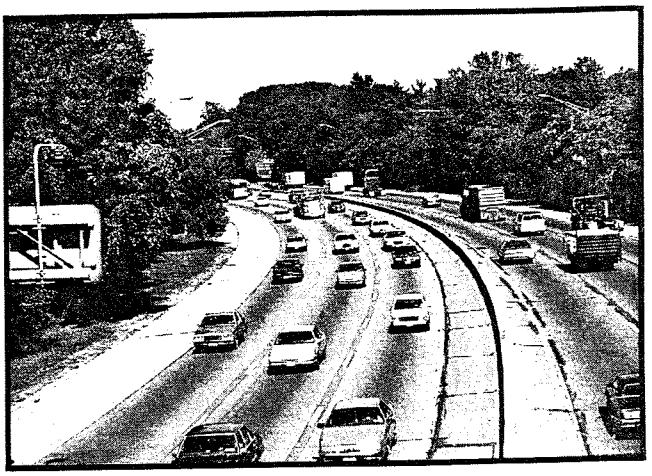
LOS A.



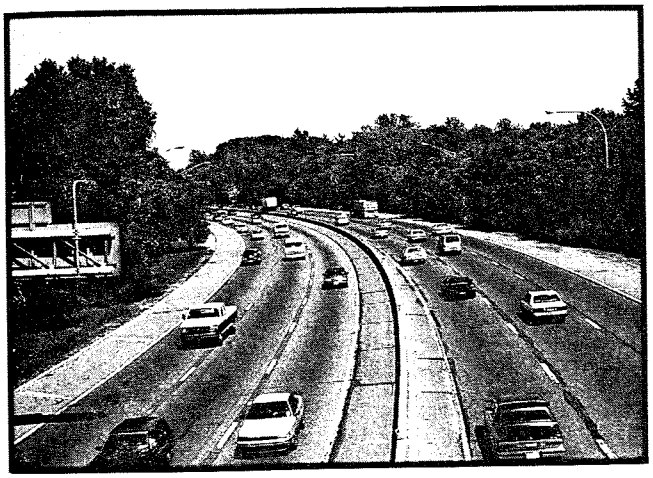
LOS D.



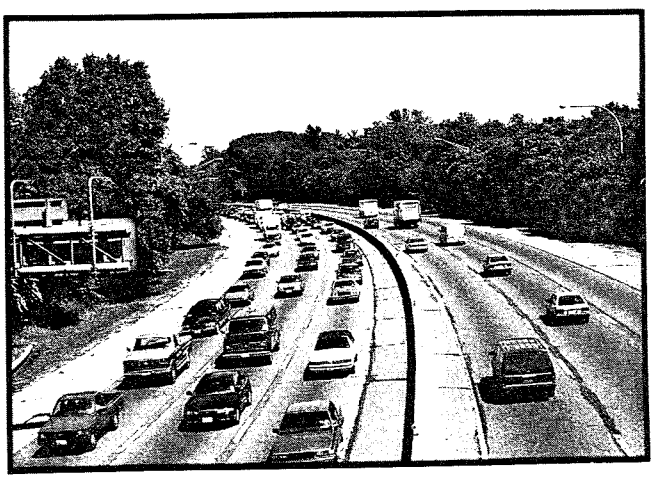
LOS B.



LOS E.



LOS C.



LOS F.

FIGURE 6

LEVELS OF SERVICE

Traffic Crashes

Traffic crashes are often used as an indicator for locating congestion problems. Traffic accident records can also be reviewed to identify problem locations or deficiencies such as poor design, inadequate signing, ineffective parking, or poor sight distance. Accident patterns developed from analysis of accident data can lead to improvements that will reduce the number of accidents.

Table 5 is a summary of the crashes occurring in Madison/Mayodan between October, 1991 to October, 1994. This table only includes locations with 5 or more accidents. The "Total" column indicates the total number of accidents reported within 200 feet of the intersection during the study period indicated. The severity listed is the average accident severity for that location. This list is sorted with the locations with the most accidents near the top, decreasing to locations with only 5 accidents.

Table 5
Locations With Five or More Accidents in a Three Year Period

Locations	Angle	Rear End	Ran Off Road	Left Turn	Right Turn	Other	Total	Severity
Ayersville / Highway	4	8	1	13	-	2	28	11.96
US 220 / US 220B	3	4	5	3	-	3	18	19.06
NC 704 / SR 1169	6	-	2	1	-	2	11	14.16
NC 135 / Second	1	1	-	6	1	1	10	8.24
Market / Murphy	2	-	-	1	1	5	9	1.00
Murphy / Frank	3	2	-	-	-	3	8	12.31
US 220 / NC 704	1	6	1	-	-	-	8	19.10
Academy / Island	-	4	1	1	-	1	7	3.59
Ayersville / Burton	1	1	-	3	1	1	7	5.53
Burton / Highway	-	-	-	4	1	2	7	6.17
Chief Martin / Highway	2	1	-	2	1	1	7	6.17
US 220 / NC 135	1	3	2	1	-	-	7	19.10
Academy / Lindsey Bridge	1	4	1	-	-	-	6	7.03
Decatur / Frank	1	1	-	3	1	-	6	13.07
Academy / Westview	1	4	-	-	-	-	5	20.84
Highway / Idol	-	2	1	2	-	-	5	20.84
Highway / Piedmont	1	2	1	-	-	1	5	8.24
Highway / Wilson	-	2	-	-	-	3	5	4.62

Both the severity and number of accidents should be considered when investigating accident data. The severity of every accident is measured with a series of weighting factors developed by NCDOT's Division of Highways. In terms of these factors, a fatal or incapacitating accident is 47.7 times more severe than one involving only property damage, and an accident resulting in minor injury is 11.8 times more severe than one with only property damage.

Existing Bridge Conditions

Bridges are a vital and unique element of a highway system. First, they represent the highest unit investment of all elements of the system. Second, any inadequacy of deficiency in a bridge reduces the value of the total investment. Third, a bridge presents the greatest opportunity of all potential highway failures for disruption of community welfare. Finally, and most importantly, a bridge represents the greatest opportunity of all highway failures for loss of life. For these reasons, it is imperative that bridges be constructed to the same design standards as the system of which they are a part.

Congress enacted the National Bridge Inspection Program Standards on April 27, 1971, implementing the Federal Highway Act of 1968. These standards require that "all structures designed as bridges located on any of the Federal-Aid Highway Systems be inspected and the safe load carrying capacity computed at regular intervals, not to exceed two years." A sufficiency index number has been calculated for each bridge to establish eligibility and priority for replacement. The bridges with the highest priority are replaced as Federal-Aid fund and State funds become available.

The North Carolina DOT's Bridge Maintenance Unit, with assistance from various consultants, inspect all bridges on the State Highway System. All bridges in Graham County have been analyzed, rated, and inventoried. The resulting data has been reduced to a more readily usable form as a management tool.

A sufficiency rating was used in the analysis to determine the deficiency of each bridge. The sufficiency rating is a method of evaluating factors that determine whether a bridge is sufficient to remain in service. Factors used include:

- structural adequacy and safety
- serviceability and functional obsolescence
- essentially for public use
- type of structure
- traffic safety features

The result of this method is a percentage in which 100 percent represents an entirely sufficient bridge and zero percent represents an entirely insufficient or deficient bridge. A sufficiency rating of 50 percent or less qualifies for Federal Bridge Replacement Funds.

Deficient bridges are categorized as either functionally obsolete or structurally deficient. Bridges in the functionally obsolete category have below average ratings in approach roadway alignment, under clearance, deck geometry, waterway adequacy, or structural condition. Structurally deficient bridges have below average ratings in deck superstructure, substructure, overall structural condition, or waterway adequacy. Table 6

shows the structurally deficient bridges in Madison/Mayodan as of August, 1995. Table 7 shows all the functionally obsolete bridges in Madison/Mayodan.

Table 6
Structurally Deficient Bridges in Madison/Mayodan

Bridge No.	Facility Carried	Location	Rating
63	US 220	Dan River	48.1
249	SR 1165	0.35 Mi S. Jct. SR 1162	20.0

Table 7
Functionally Obsolete Bridges in Madison/Mayodan

Bridge No.	Facility Carried	Location	Rating
67	US 311	Little Beaver Island Creek	45.2
95	US 311	Big Beaver Island Creek	48.3
124	SR 2177	Mayo River	60.2
140	SR 1138	Dan River	62.5
141	SR 1143	0.4 Mi SE Jct. SR 1138	58.9

Of these bridges, one is included in the 2000-2006 Transportation Improvement Program. Included in parenthesis is the TIP project number, and estimated construction date.

- (B-4252) Replace Bridge No. 95 over Big Beaver Island Creek and replace Bridge No. 67 with Culvert. Construction scheduled for 2006.

Chapter 5

FACTORS AFFECTING THE FUTURE ROADWAY SYSTEM

The objective of thoroughfare planning is to develop a transportation system that will meet future travel demand and enable people and goods to travel safely and economically. To determine the needs of an area it is important to understand the role of population, economics, and land use have on the highway system. Examination of these factors helps to explain historic travel patterns and lays the groundwork for thoroughfare planning.

In order to formulate an adequate year 2025 thoroughfare plan, reliable forecasts of future travel characteristics must be achieved. The factors of population, vehicle usage trends, economy and land use play a significant role in determining the transportation needs of the area, and must be carefully analyzed. Additional items may include the effects of legal controls such as subdivision regulations and zoning ordinances, availability of public utilities and physical features of the area.

The first step in the development of the thoroughfare plan is to define the planning period and the planning area. The planning period is typically on the order of 30 years. The base year for Madison and Mayodan was 1995, and the year 2025 was chosen to be the end point of the study period (30 years). The planning area for this study was an area approximately one mile outside the municipal limits.

Population

The amount of traffic on a section of roadway is a function of the size and location of the population which it serves. Investigating past trends in population growth and forecasting future population growth and dispersion is one of the first steps for a transportation planner. See Chapter 6 for a complete analysis of Madison and Mayodan's population projections to the year 2025.

Economy and Employment

One of the more important factors to be considered in estimating the future traffic growth of an area is its economic base. The number of employers and the employee's income or purchasing power influences how much population can be supported in the area and the number of motor vehicles that will be locally owned and operated. Generally, as the family income increases so does the number of vehicles owned, as well as the number of vehicles trips generated per day by each household. An accurate projection of the future economy of the area is essential to estimating future travel demand. See Chapter 6 for a complete analysis of Madison and Mayodan's employment projections to the year 2025.

Factors which will influence economic growth and development in Rockingham County and the Madison/Mayodan area over the 30 year planning period is development along

the US 220 and US 311 corridor. The upgrading of US 220 and renaming it I-73 is expected to spur economic growth and development. This road will provide for more efficient transportation of raw materials and finished goods to and from manufacturers in the Madison/Mayodan area.

For Rockingham County, approximately 43% of the work force is in manufacturing, 49% nonmanufacturing, and 2% in agriculture. Unifi is the area's largest employer, with nearly 1,700 employees.

Land Use

Land use refers to the physical patterns of activities and functions within a Town or county. Nearly all traffic problems in a given area can attributed in some form to the type of land use. For example, a large industrial plant might be the cause of congestion during shift change hours as its workers come and go. However, during the remainder of the day few problems, if any, may occur. The spatial distribution of different types of land use is the predominant determinant of when, where, and why congestion occurs. The attraction between different land uses and their association with travel varies depending on the size, type, intensity, and spatial separation of each.

For use in transportation planning, land uses are grouped into four categories:

1. Residential - all land devoted to the housing of people (excludes hotels and motels)
2. Commercial - all land devoted to retail trade including consumer and business service and office.
3. Industrial - all land devoted to manufacturing, storage, warehousing, and transportation of products
4. Public - all land devoted to social, religious, educational, cultural, and political activities.

The Towns of Madison and Mayodan have most of their commercial development around US 311 and US 220 Business. Industrial development is spread throughout the area, with no central location. Residential and public development is spread throughout the planning area, with the heaviest densities inside the municipal limits.

Forecasted Travel Patterns and Deficiencies

Future Travel Demand

Travel demand is generally reported in average daily traffic counts. Traffic counts are taken regularly in and around the Towns of Madison and Mayodan by the North Carolina Department of Transportation. To estimate future travel demand, a transportation model was built for the area. A complete summary of the traffic model is in Chapter 6.

2025 Traffic Capacity Analysis

Capacity deficient corridors were determined using the volume/capacity ratio (V/C) with the projected traffic over the practical capacity of the facility. A V/C ratio of less than one is tolerable. Based on this analysis, several roadways in Madison/Mayodan are

anticipated to be inadequate by the planning year 2025. These roads are shown in red on Figure 7.

An analysis of the roads in the Madison/Mayodan Planning Area was made to determine if the projected traffic (2025) would exceed the practical capacity of the system, using a traffic model. Based on these analysis, these facilities were projected to be near or exceed their practical capacities within the design period.

- US 311 (entire planning area). This section is recommended to be improved to a three lane section where needed.

- US 220 Business (between NC 135 and Jackson Street). Remove parking to add a turn lane

- US 220 Business (between the northern corporate limits of Mayodan and the northern planning boundary). This section is recommended to have center turn lanes added at major intersections.

- NC 305 (between Mayodan Corporate Limits and SR 2150 (River Road)). This section is recommended to be improved to three lanes.

- NC 704 (between the western planning boundary and SR 1169 (Island Drive)). This section is recommended to have center turn lanes added at major intersections.

- SR 1169 (between the northern corporate limit of Madison and the southern corporate limit of Mayodan). This section is recommended to be widened to three lanes.

- SR 1300 (Ayersville Road) (between the northern corporate limits of Mayodan and the northern planning boundary) This section is recommended to have center turn lanes added at major intersections.

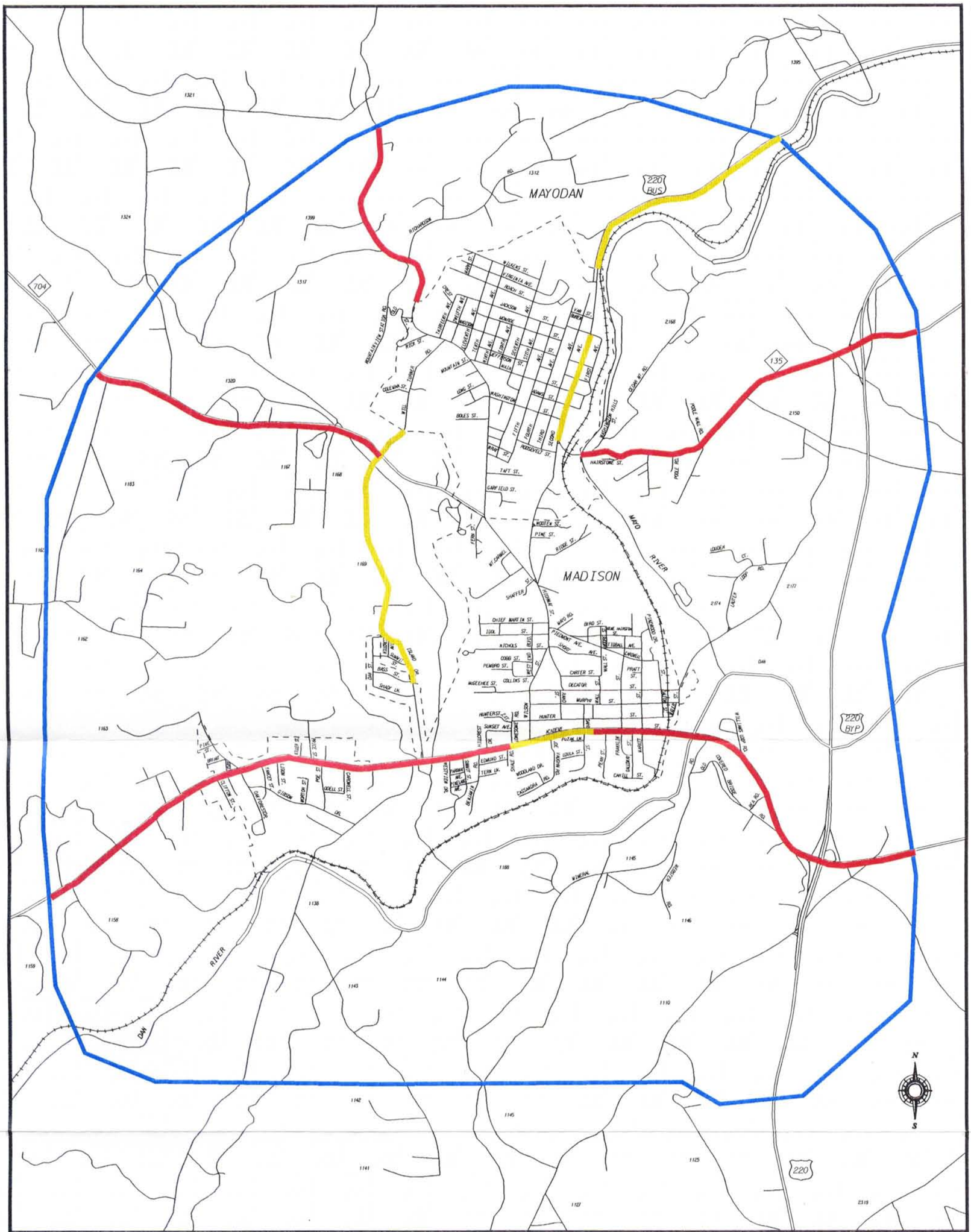
No Build Alternative

Not implementing a thoroughfare plan or elements of it could be called a No-Build Alternative. This means that there would be no new construction or roadway improvements to the Madison/Mayodan Thoroughfare system except for routine maintenance. If no improvements are made to US 311, US 220 Business, NC 135, Island Drive, or the new location projects are not constructed during the planning period, the increase traffic volumes and normal growth will result in a dramatic reduction in transportation quality. In some areas of the county, the operating speed will drop significantly, and the queues of traffic currently experienced behind slow moving vehicles will get considerably longer. The absence of improvements will negatively impact growth, business, and tourist industry in the Graham County and Robbinsville area.

These sections are expected to exceed capacity without future improvements:

- US 311 (entire planning area).
- US 220 Business (between NC 135 and Jackson Street).
- US 220 Business (between the northern corporate limits of Mayodan and the northern planning boundary).

- NC 305 (between Mayodan Corporate Limits and SR 2150 (River Road)).
- NC 704 (between the western planning boundary and SR 1169 (Island Drive)).
- SR 1169 (between the northern corporate limit of Madison and the southern corporate limit of Mayodan).
- SR 1300 (Ayersville Road) (between the northern corporate limits of Mayodan and the northern planning boundary



MADISON AND MAYODAN

ROCKINGHAM COUNTY
NORTH CAROLINA

PREPARED BY

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

Figure 7

SCALE

0 1200 2400 3600 4800
feet

2025 CAPACITY ANALYSIS

LEGEND

OVER CAPACITY

NEAR CAPACITY

PLANNING AREA BOUNDARY

Consideration of Environmental Factors

In the past several years, environmental considerations associated with highway construction have come to the forefront of the planning process. The legislation that dictates the necessary procedures regarding environmental impacts is the National Environmental Policy Act. Section 102 of this act requires the execution of an environmental impact statement, or EIS, for road projects that have a significant impact on the environment. Included in an EIS would be the project's impact on wetlands, water quality, historic properties, wildlife, and public lands. While this report does not cover the environmental concerns in as much detail as an EIS would, preliminary research was done on several of these factors and is included below.

Wetlands

In general terms, wetlands are lands where saturation with water is the dominant factor in determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrata that is at least periodically saturated with or covered by water. Water creates severe physiological problems for all plants and animals except those that are adapted for life in it or in saturated soil.

Wetlands are crucial ecosystems in our environment. They help regulate and maintain the hydrology of our rivers, lakes, and streams by slowly storing and releasing flood waters. They help maintain the quality of our water by storing nutrients, reducing sediment loads, and reducing erosion. They are also critical to fish and wildlife populations. Wetlands provide an important habitat for about one third of the plant and animal species that are federally listed as threatened or endangered.

In this study, the impacts to wetlands were determined using the National Wetlands Inventory Mapping, available from the U. S. Fish and Wildlife Service.

Wetland impacts have been avoided or minimized to the greatest extent possible while preserving the integrity of the transportation plan. A map of the Madison and Mayodan area wetlands can be found in Figure 8.

Threatened and Endangered Species

A preliminary review of the Federally Listed Threatened and Endangered Species within the Madison and Mayodan area was done to determine the effects that new corridors could have on the wildlife. These species were identified using mapping from the North Carolina Department of Environment, Health, and Natural Resources.

The Threatened and Endangered Species Act of 1973 allows the U. S. Fish and Wildlife Service to impose measures on the Department of Transportation to mitigate the environmental impacts of a road project on endangered plants and animals and critical wildlife habitats. By locating rare species in the planning stage of road construction, we are able to avoid or minimize these impacts.

No threatened and endangered species are anticipated to be adversely impacted by any of the thoroughfare plan recommendations.

A detailed field investigation is recommended prior to construction of any highway project in this area.

Historic Sites

The location of historic sites in Graham County was investigated to determine the possible impacts of the various projects studied. The federal government has issued guidelines requiring all State Transportation Departments to make special efforts to preserve historic sites. In addition, the State of North Carolina has issued its own guidelines for the preservation of historic sites. These two pieces of legislation are described below:

- **National Historic Preservation Act -** Section 106 of this act requires the Department of Transportation to identify historic properties listed in the National Register of Historic Places and properties eligible to be listed. The DOT must consider the impacts of its road projects on these properties and consult with the Federal Advisory Council on Historic Preservation.

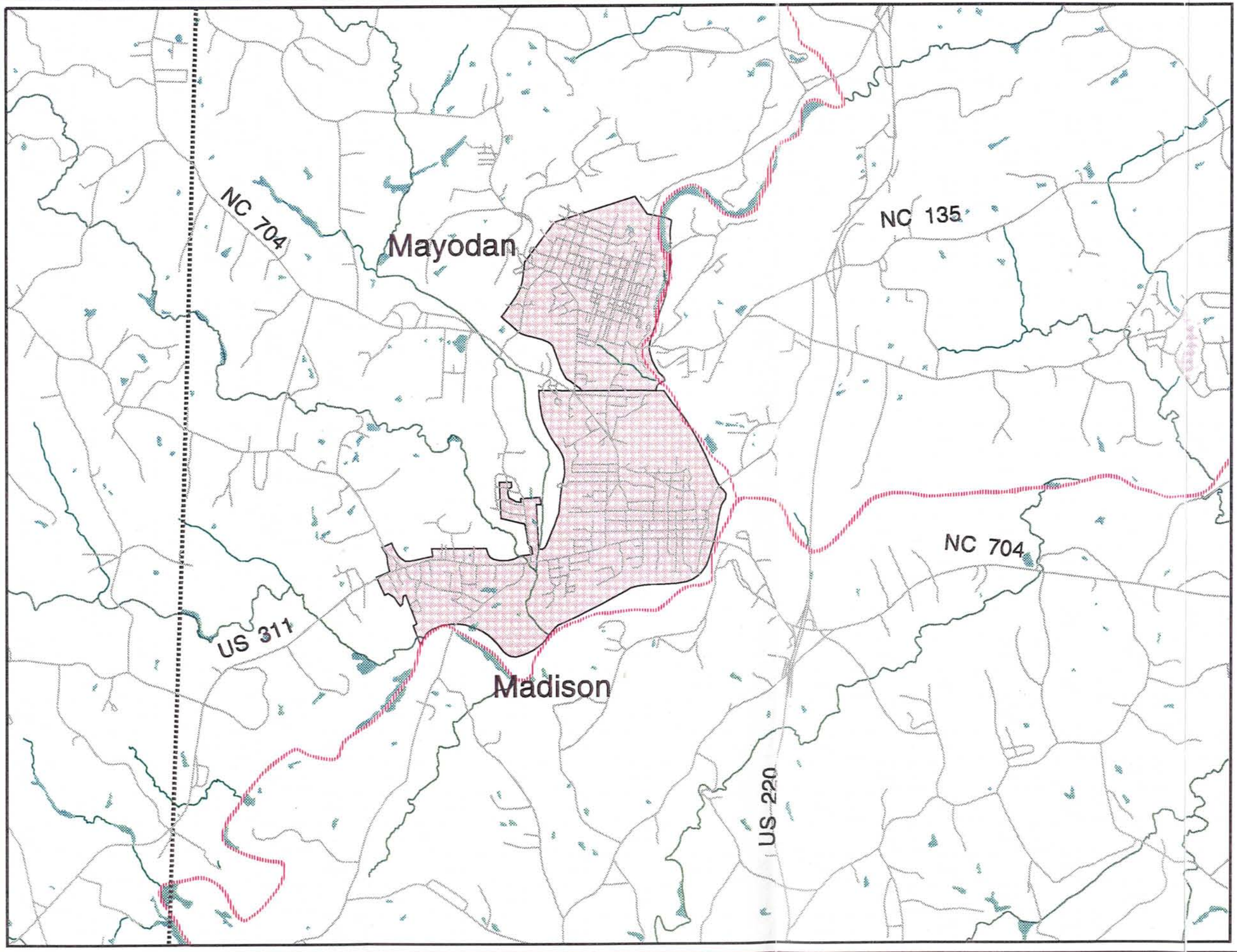
- **NC General Statute 121-12(a) -** This statute requires the DOT to identify historic properties listed on the National Register, but not necessarily those eligible to be listed. DOT must consider impacts and consult with the North Carolina Historical Commission, but it is not bound by their recommendations.

There is currently only one property inside of Madison on the National Register of Historic Places. This property is not anticipated to be impacted by any Thoroughfare Plan Recommendations.

The US 311 improvement to three lanes thoroughfare plan proposal goes through a small historic district near the US 311/Market Street intersection. It is anticipated that parking can be removed to accommodate for the three-lane section, and no historic properties impacted.

Care should be taken to make certain that all historic sites and natural settings are preserved. Therefore, a closer study should be done in regard to the local historic sites prior to the construction of any proposal.

MADISON & MAYODAN AREA WETLANDS



Roads (100K TIGER DATA)
County Boundary (Statewide 100k)
County Boundary
State Boundary
Shore Line
National Wetland Inventory (Eastern)
E1 Estuarine
E2 Estuarine
L1 Lacustrine
L2 Lacustrine
M1 Marine
M2 Marine
P Palustrine
P- Palustrine
R1 Riverine
R2 Riverine
R3 Riverine
R4 Riverine
R5 Riverine
U URBAN
Z OTHER
National Wetland Inventory (Eastern)
E1 Estuarine
E2 Estuarine
L1 Lacustrine
L2 Lacustrine
M1 Marine
M2 Marine
P Palustrine
R1 Riverine
R2 Riverine
R3 Riverine
R4 Riverine
R5 Riverine
U URBAN
Municipal Boundaries (Statewide)
Municipal Boundaries

Figure 8

N
W E
S

0.79 0 0.79 Miles

Chapter 6

Traffic Model Development

In order to develop an efficient thoroughfare plan for the Towns of Madison/Mayodan it was necessary to develop and calibrate a traffic model of the Towns. To develop a traffic model the following things are necessary: define the study area, and project socioeconomic data to the design year. Once the socioeconomic data has been projected the model may be used to evaluate various street system problems and alternate solutions to the problems.

The Study Area

The study area of Madison/Mayodan consists of the two Towns and some additional outlying areas (Figure 9). This area was divided into 48 zones for data collection and aggregation. These zones reflect similar land use throughout the planning area. The data for the dwelling units and employment for 1995 was collected from windshield surveys. The projections of socioeconomic data to the future year was done based on past trends in cooperation with both of the planning boards of Madison and Mayodan.

The Base Year Network

The purpose of the traffic model is to replicate the conditions on the Town street system. Therefore it is necessary to represent the existing street system in the model. There is a balance between having too many streets on the model to allow it to be calibrated and not having enough streets to realistically duplicate existing conditions. Generally, all the major arterials and some of the major land access or collector streets need to be represented.

Street capacity is an important component of the model. The volume/capacity ratio (v/c) gives us our best indication of present and future traffic congestion.

Speed and distance are the major factors that define the minimum time paths from zone to zone. The model uses the minimum time paths as the basis for assigning traffic to streets. In general, the the speeds assigned to links of the street system are at or slightly below the posted speed limit. Figure 10 shows the model network overlaid on the actual street system.

Data Requirements

In order to produce an adequate traffic model of the study area, two additional types of data are required. First, traffic counts on routes used in the model provide a basis for calibrating the model. These traffic counts show a snapshot of traffic conditions in the study area. Second, socioeconomic data (housing counts and employment estimates) are necessary in order to

generate traffic for the model. The housing and socioeconomic data for the model are shown in Figures 12 and 13.

Traffic Counts

The model must be calibrated against existing conditions in the study area. In order to calibrate the model traffic counts must be taken at various locations around the study area. The counts for much of the Madison/Mayodan study were collected during September, 1995. Traffic count locations are found in Figure 11.

Also, volumes on all routes crossing the planning boundary were counted. These counts show how much traffic is entering and exiting the study area.

Socioeconomic Data

The required data consists of a housing counts and employment estimates. The housing counts are used in the model as the generator of trips and employment is used as the attractor of trips.

The best indicator of the average number of trips made from a household income. Since there is no adequate method for determining household income, the type and quality of housing was used as an indicator of household income. The Statewide Planning staff conducted a windshield survey in September 1995, to collect housing and employment data. The housing inventory was divided into five categories: excellent, above average, average, below average, and poor. Each of these categories was assigned a slightly different trip generation rate. Figure 13 shows the housing counts for each traffic zone.

The employment data that was collected was broken out by Standard Industrial Code classification and grouped into five categories: industry, special retail, retail, office and services. The number of employees of each business was estimated, with the exception of larger employers which were contacted for an exact employee count. This data was used with a regression equation developed from an origin and destination survey of a similar size town to produce an attraction factor for each zone. Figure 12 shows total employment by traffic analysis zone.

Commercial Vehicles

Commercial vehicles have somewhat different trip generation characteristics than do privately owned vehicles. Due to the small size of this study, commercial vehicle data was not collected.

Trip Generation

The trip generation process is the process by which external station volumes, housing data, and employment data are used to generate traffic volumes that duplicate the traffic volumes on the street network. The technical definition of a trip is slightly different then the definition of a trip used by the general public. Technically a trip only has one origin and one destination while the layman will often group, or chain, several short trips together as one longer trip.

Traffic inside the study area has three major components: through trips, external-internal trips, and internal trips. Through trips are produced outside the planning area and pass through enroute to a destination outside the planning area. Internal-external trips have one end of the trip outside of the planning area. Internal trips have both their origin and destination inside the planning area. For clarity the internal trips are further subdivided into trip purposes. The trip purposes for Madison/Mayodan are home-based work; other-home based, and non-home based.

Through Trips

The Through Trip Table for this study was developed based on Technical Report 3 (Synthesized Through Trip Table for Small Urban Areas By Dr. David G. Modlin, Jr.).

Once these volumes were developed the Fratar balancing method was then used to balance the trip interchanges so that the total number of through trips at each external station is consistent with the total number of through trips at every other station. Generally five iterations are sufficient to balance the estimate between external zones.

External - Internal

The external-internal trip volume was determined by subtracting the through trip volume at each station from the total traffic volume at that station. See Table 12 for external-internal and through trip values.

Internal Data Summary (IDS)

IDS is the process that takes the external-internal traffic volumes, housing data, employment data, generation rates, and regression equations and generates the trip productions and trip attractions required by the gravity model. Housing units were stratified to account for differing trip generation rates for each classification. Trip attractions were produced using regression equations. The regression equations considers trip attractions to be related to the employment characteristics of the traffic zones. The regression equations for Madison/Mayodan are:

$$\text{OHB } Y = 0.80X_1 + 3.7X_2 + 8.8X_3 + 3.4X_4 + 3.4X_5$$
$$\text{NHB } Y = 0.90X_1 + 3.7X_2 + 8.8X_3 + 3.4X_4 + 3.4X_5$$
$$\text{EXT } Y = 1.30X_1 + 3.7X_2 + 8.8X_3 + 3.4X_4 + 3.4X_5$$

Where:
- Y = Attraction factor for each zone
- X_1 = Industry (SIC codes 1-49)
- X_2 = Retail (SIC codes 55,58)
- X_3 = Special Retail (SIC codes 50-54, 56, 57, 59)
- X_4 = Office (SIC codes 60-67, 91-97)
- X_5 = Services (SIC codes 70-76, 78-89, 99)

The output of the IDS program are trip productions and trip attractions for each zone divided into four trip purposes: home-based work, non-home based and external-internal. The trips are segregated into trip purposes because different trip lengths are associated with each trip purpose.

Internal Trip Distribution

Once the number of trips per traffic zones is determined, the trips must still be distributed to other traffic zones. The preferred method of distributing internal and external-internal trips, called the 'Gravity Model', states that the number of trips between Zone A and Zone B is multiplied by a travel time factor. The gravity model takes the form:

$$T_{ij} = \frac{P_i \times A_j \times F_{ij}}{\text{Sum } x=1,n \text{ of } A_x \ F_{t,x}}$$

T_{ij} = The number of trips produced in zone I and attracted to zone j.
P_i = The number of trips produced in zone i.
A_j = The number of trips attracted to zone j.
F_{ij} = The travel time factor.
n = The total number of zones.
i = The origin zone number.
j = The destination zone number.
x = Any zone number.

The travel time factor or friction factor (F) is critical to the gravity model distribution and must be derived empirically. The friction factor is dependent on the distance between the traffic zones and the time necessary to travel these distances. This factor is also dependent on the trip purpose. In order to derive this factor a gravity model calibration program is run with an initial friction factor and trip length frequency curve for each trip purpose. The initial friction factors used in the Madison/Mayodan model were 100 for all trip purposes and time increments. Table 14 shows the actual values used for the friction factors and trip length frequency curves.

Model Calibration

The purpose of a traffic model is to predict the traffic on a street system at some future point in time; however, if the model is not accurate, it is useless for this purpose. Therefore the model must duplicate the existing traffic pattern. The actual calibration of the model is an iterative process in which incremental changes are made either in the trip generation, tip distribution, or the street network. The purpose of each change is to allow the model to more accurately reflect the real world conditions upon which it is based. Only when the model can adequately reflect the existing traffic pattern should it be used to predict traffic in the future. The model was calibrated with 1995 Traffic Counts on all routes that it was available.

Accuracy Checks

There are three checks made on the model. The first is to follow trips through all the steps involved in the model. The purpose of this check is to insure that no trips have been accidentally added to or subtracted from the model, and that no trips have been counted twice.

The second check is to compare the model generated trips on the screenlines with the ground counts taken at the screenlines. A model is considered to accurately reflect the overall patterns if the trips it generates are from 95% to 105% of the ground counts on the screenlines. Table 8

compares the ground counts with the model traffic volumes on the screenlines. See Figure 10 for screenline locations.

The final check for the model is to match the traffic volumes on the links in the model with the ADT at the same locations. The 'link counts' can be used to find particular places in the network where there are problems. Comparing the link counts with the ground counts for those links did not reveal any significant problems with the model.

Table 8
Actual vs. Model Screenline Total

Screenline	Ground Count	Model Volume	Percent
North - South	39300	38319	0.98
East - West	39500	38007	0.96

Data Projections to the Design Year

In order to make use of the model the base year data must be modified to reflect assumed conditions in the design year. These projections and the previously developed regression equations were used to produce trip productions and attractions in the same manner as the base year.

The first step in the population projection process is the gathering of past population data. Table 9 gives the historic trends for both Madison and Mayodan and Rockingham County.

Table 9
Past Population Data for the Planning Area

Area	Year	Persons/dwelling unit	Population
Rockingham County	1970	3.20	72,402
	1980	2.79	83,426
	1990	2.55	86,064
	1992	-	86,897
	1994	-	87,692
Madison	1970	-	2,018
	1980	2.71	2,806
	1990	2.50	2,371
	1992	-	2,327
Mayodan	1970	2.96	2,875
	1980	2.40	2,627
	1990	2.14	2,471
	1992	-	2,455

Data obtained by the NC State Data Center

Data for the 1995 population of Madison/Mayodan was unavailable when the projections were prepared. At that time, the most recent population for the Town of Madison/Mayodan is 4,782 (2,327 + 2,455) in 1992. Using a growth rate of 0.70% (which is outlined on the next page), the 1995 Madison/Mayodan population was estimated to be 4,883. A 1995 windshield survey was done to determine the number of houses outside the city limits, but inside the planning area. 942 homes were counted outside the corporate limits, but inside the planning area. 2,213 houses were counted inside the corporate limits. The persons per dwelling unit (du) of the population inside the Towns of Madison and Mayodan was estimated at 2.21 for 1995 (4883/2213 = 2.21) but this number seems low when compared to the 1990 values for Rockingham County (2.55) and Madison (2.50). With the Rockingham County 1990 persons/du being 2.55, an estimate of 2.40 was used for 1995. Multiplying 2.4 by 942 gives us a population of 2260, which is the estimate of the number of people outside of the corporate limits but inside the planning area.

Therefore:

2,260	1995 Population outside Corporate Limits
+ 4,883	1995 Population of Madison/Mayodan
=====	
7,143	1995 Total Planning area Population

Before beginning to project the base year employment and population data that was collected by the Statewide Planning Staff, a target population for the design year 2025 was developed. Much like determining an interest rate, a population growth rate had to be determined. To do this historic population data was gathered from the NC State Data Center for Rockingham County and the Towns of Madison/Mayodan from 1970 to 1994 (See previous page).

Using the known data a growth rate was determined with the formula $F=P(1+r)N$ where:

F = future population
P = present population
r = rate of growth
N = number of years

Rockingham County showed a growth rate of 0.57% per year from 1970 to 1992. Over the same period the Towns of Madison/Mayodan had an average population loss of 0.07% per year; but signs of development are occurring and industry are increasing. Therefore a growth rate of 0.70% was used to give a 2025 planning area population of 8,806.

The planning area population data obtained above then needed to be converted to future housing. From the extrapolation of past trends, 2.12 persons per dwelling unit was estimated for 2025. Using these numbers, it is estimated that there will be 4154 homes by the design year in 2025. Subtracting the design year homes from the base year homes will give an estimated home growth of 999 (4154-3155 = 999).

Data for each employer in the Madison/Mayodan Planning Area was collected. Employment figures for the 1995 Planning Area were determined to be 5,821 jobs. This total was based on employment data obtained from the Employment Security Commission and Statewide Planning Branch estimates when no data was available. Shown below are the numbers and percentages of jobs divided into several job types based on the Standard Industrial Code (SIC) numbers:

SIC 1-49	Industry	3450 Jobs	59%
SIC 50-54,56,57,59	Retail	710 Jobs	12%
SIC 55, 58	Special Retail	512 Jobs	9%
SIC 70-76, 78-89, 99	Service	308 Jobs	5%
SIC 60-67, 91-97	Office	841 Jobs	15%

To determine jobs in this area for the future, a ratio was taken with the present number of jobs over the 1995 population of the planning area.

1995 employment / 1995 population = 5821/7143 = 0.815

For purposes of this report, and with the slow job growth trends in the area, we will assume that the employee to population ratio will remain the same as the population of the planning area increases. Therefore:

8806 x .815 = 7177 → 2025 employment

An increase of 1356 jobs are projected to occur by the year 2025 (7177 - 5821 = 1356). Assuming the categories of employment remain constant, the following employment projections are made for 2025:

Table 10
Employment Projections

	%	1995 Estimated Employment	2025 Projected Employment	Increase
Industrial	59	3450	4234	784
Retail	12	710	861	151
Special Retail	9	512	646	134
Service	5	308	359	51
Office	15	841	1077	236
Totals	**100**	**5821**	**7177**	**1356**

The planning area results are shown in the following table:

Table 11 Planning Area Results				
	Population	Persons Per Dwelling Unit	Dwelling Units	Employment
1995	7114	2.25	3155	5821
2025	8806	2.12	4154	7177

From Table 11, we find that 999 dwelling units are projected to be added by 2025, and 1356 Jobs are projected to be added before 2025. The Statewide Planning Branch and the planning boards of Madison/Mayodan distributed the increases in socioeconomic data to the zones they anticipated employment growth. Those projections were added to the 1995 data. Employment projections throughout the planning area indicated steady growth. Figure 12 compares the classification of employment data in 1996 with the assumed classification in 2025.

External and Through Trips

For the design year, external and through trip were projected from the base year using a linear projection of the past growth rate at each external station. Cordon Station Data can be found in Table 12.

Table 12
Cordon Station Travel

External Station	Base Year 1995			Future Year 2025		
	Total ADT	Thru Trip Ends	Ext-Int Trips	Total ADT	Thru Trip Ends	Ext-Int Trips
61	9300	8940	360	14500	13946	554
62	5500	4994	506	13400	12135	1265
63	1200	174	1026	1600	235	1365
64	4800	3724	1076	8700	6740	1960
65	800	96	704	1100	130	970
66	16800	16216	584	26200	25296	904
67	1500	238	1262	2700	430	2270
68	350	38	312	500	52	448
69	2400	466	1934	3200	630	2570
70	1100	160	940	2000	290	1710
71	5400	2452	2948	8400	3826	4574
72	1600	252	1348	2200	340	1860
73	2800	570	2230	5100	1032	4068
74	1100	160	940	1500	216	1284
75	2700	554	2146	4900	1002	3898
76	4500	1138	3362	6100	1536	4564

Table 13
Travel Model Input Variables

Trip Percentages By Purpose		
	Internal of Total	95%
	Home Based Work	22%
	Other Home Based	54%
	Non-Home Based	24%
Persons/Dwelling Unit		
	1995	2.25
	2025	2.12

Table 14 Friction Factors				
Time Interval	Home Based Work	Other Home Based	Non-Home Based	External - Internal
1	15370	19423	3412	5527
2	20981	14440	8221	13213
3	18258	12037	12233	17554
4	11433	10645	12350	14606
5	5681	9450	9291	8577
6	2470	7967	5720	4006
7	1037	6037	3166	1676
8	463	3889	1730	708
9	243	2016	1026	341
10	165	795	724	210
11	160	226	669	187

Secondary NHB Trip Development

Secondary Non-Home Based Trips are non-home based trips made inside the planning area by vehicles garaged outside the planning area.

Secondary NHB Trips =
Total Ext-Int Trips - Ext-Int Trips Garaged Inside Planning Area X Factor

Trips Produced By Housing: 25,399 (1995) 34,117 (2025)
Percent Internal of Total: 0.95
External-Internal Trips: 21,678 (1995) 34,264 (2025)

1995 Secondary Trips = 21678 - (25399 - 25399(0.95)) x .735 = 15,000

2025 Secondary Trips = 34264 - (34117 - 34117(0.95)) x .735 = 23,930

The breakdown of internal trips by purpose and total of non-home based trips generated externally are shown in Table 15.

*Assumed NHB trip making rate per each one-way external-internal trip by vehicles garaged outside the planning area.

Table 15 Travel Data Summary		
Type	**1995**	**2025**
Average Daily Trips Per Du	8.05	8.21
Internal Trips	24,129	32,411
Home Based Work	5,308	7,130
Other Home Based	13,030	17,502
Non-Home Based	5,791	7,779
Non-Home Based Secondary	15,000	23,930
Internal-External	21,678	34,264
Through Trips	40,172	67,836

MADISON AND MAYODAN

ROCKINGHAM COUNTY
NORTH CAROLINA

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FEDERAL HIGHWAY ADMINISTRATION

Figure 9

SCALE

0 1200 2400 3600 4800
feet

Planning Area And Zones

Planning Area Boundary

Zone Line

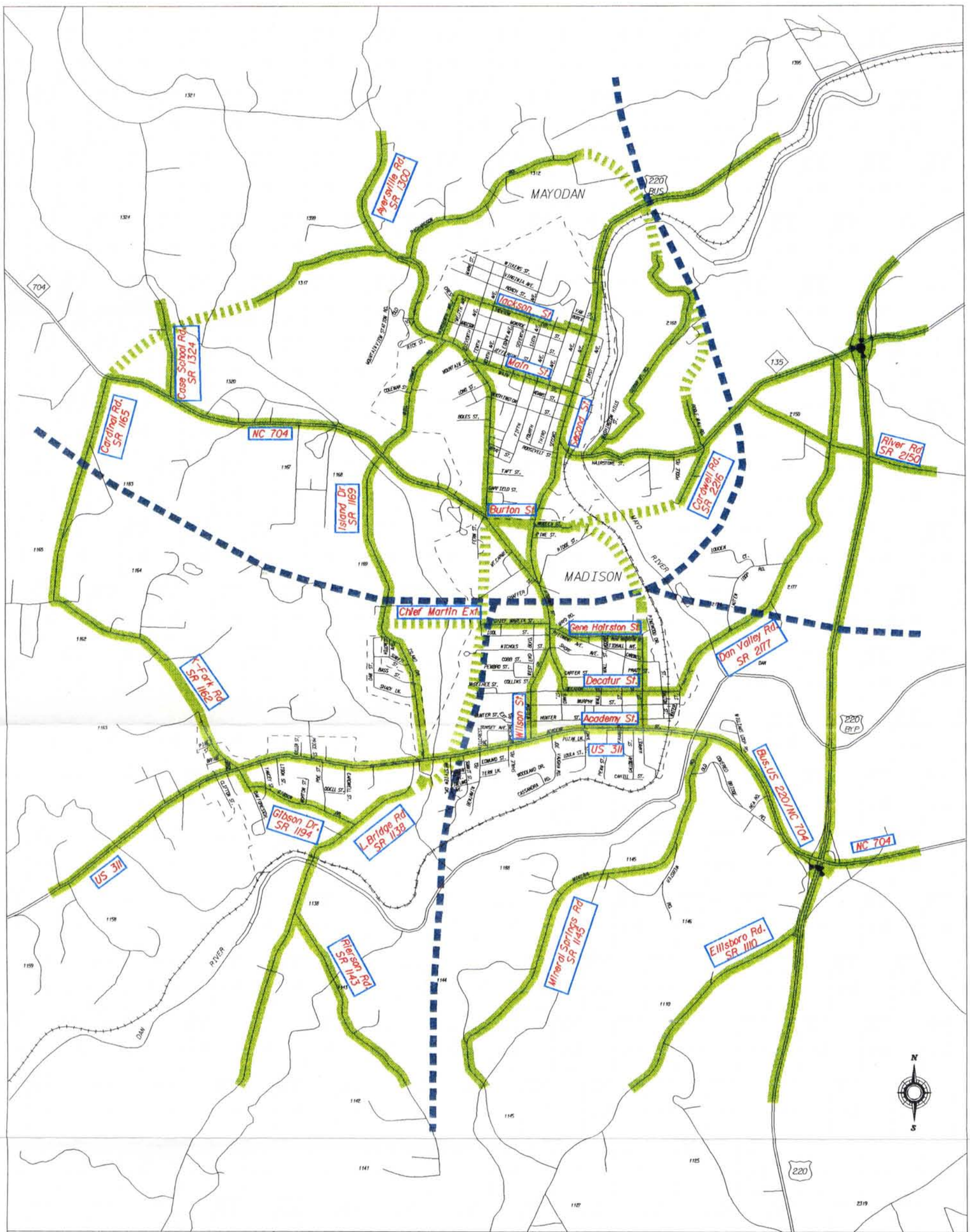

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FIGURE 10

SCALE

0 1200 2400 3600 4800
feet

Tranplan Network And Screenlines

Legend

Modeled Network

Old Thoroughfare Plan

Screenlines

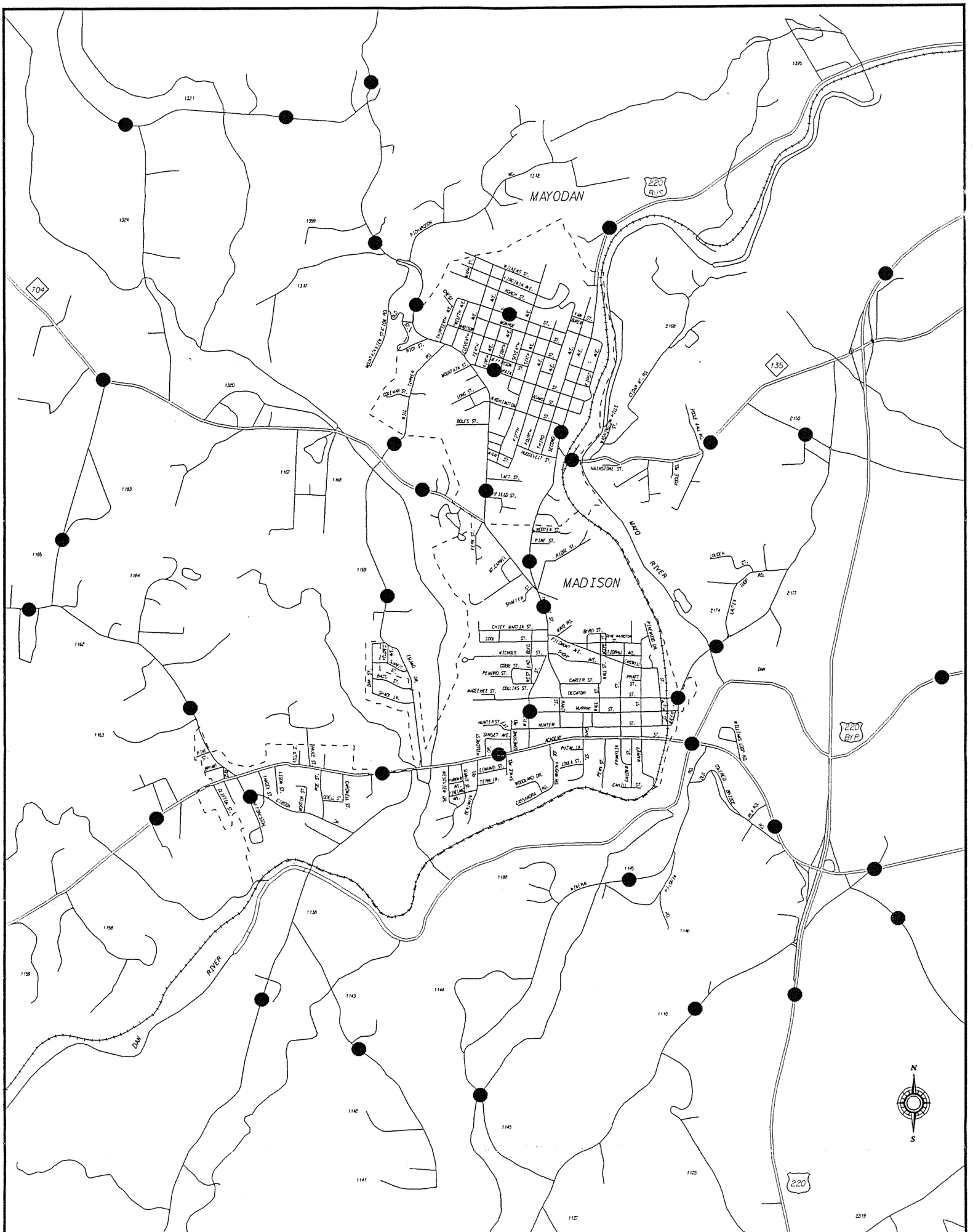

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Figure 11

SCALE

0 1200 2400 3600 4800
feet

TRAFFIC COUNT LOCATIONS

●

(ALL COUNTS ARE ON MAJOR AND MINOR FACILITIES)

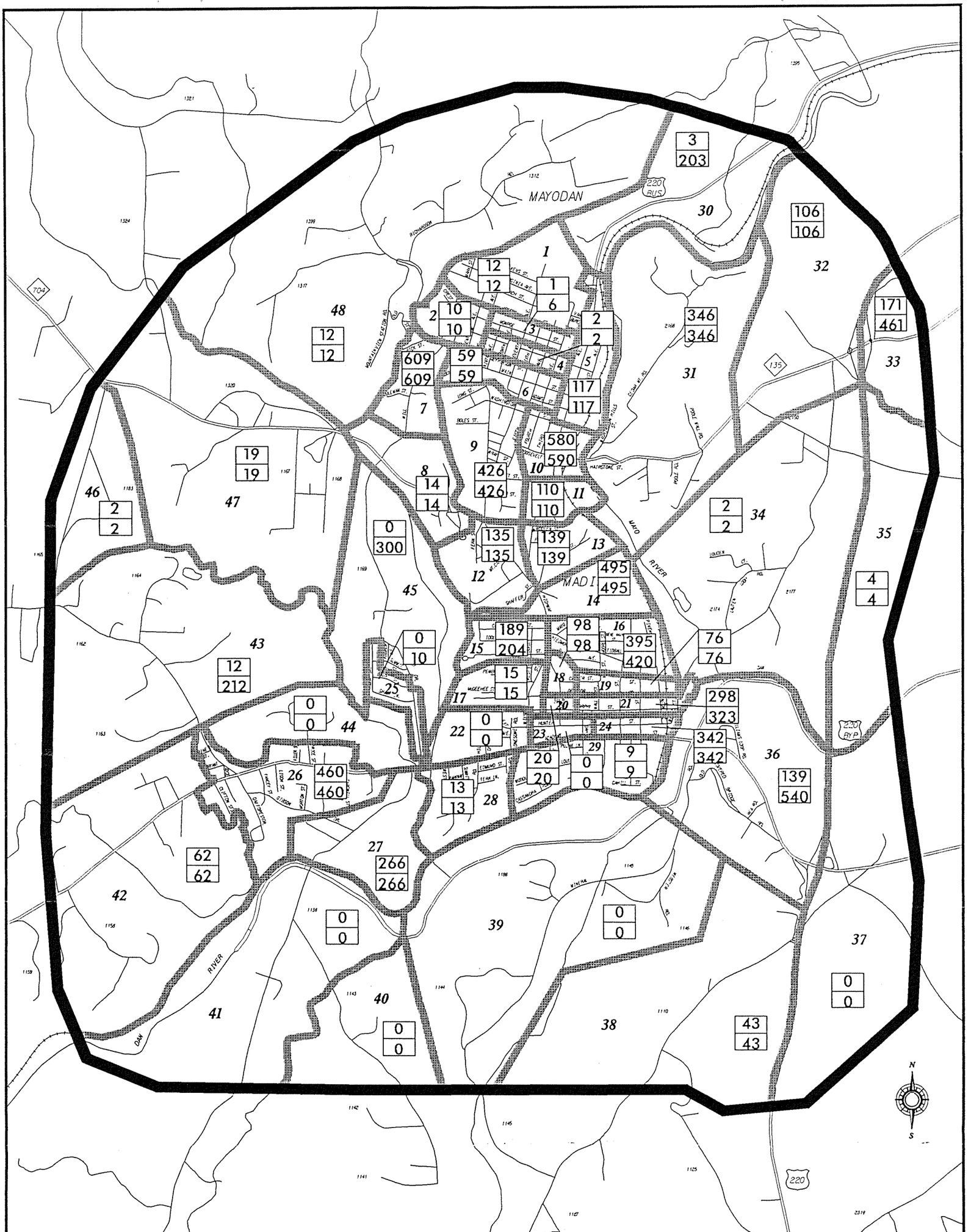

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Figure 12

SCALE

0 1200 2400 3600 4800
feet

Employment Data By Zone

Planning Area Boundary

Zone Line

Base Year 000
Design Year 000

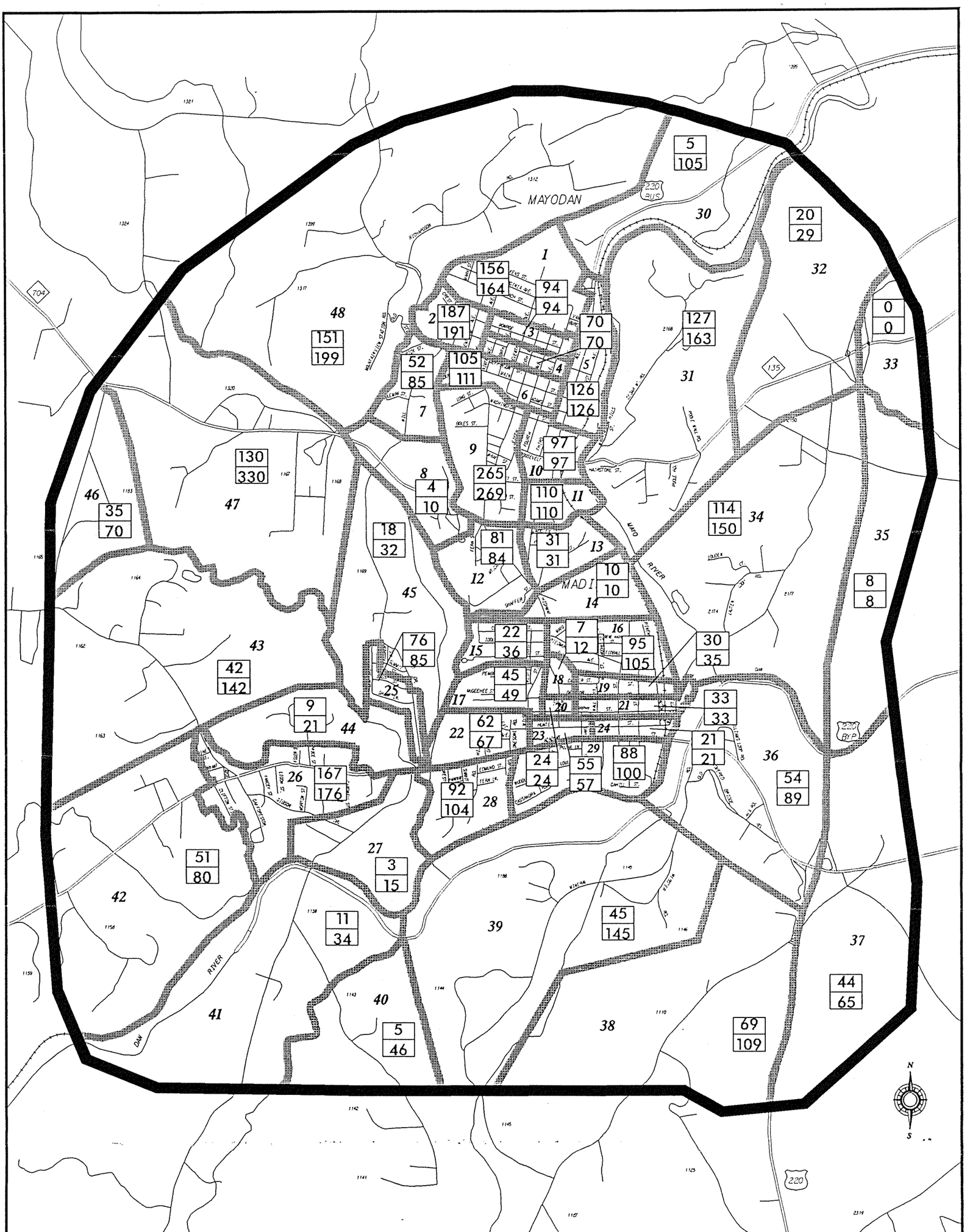

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Figure 13

SCALE

0 1200 2400 3600 4800
feet

Housing Data By Zone

Planning Area Boundary

Zone Line

Base Year 000
Design Year 000

Appendix A

THOROUGHFARE PLANNING PRINCIPLES

There are many advantages to thoroughfare planning, but the primary mission is to assure that the road system will be progressively developed to serve future travel desires. Thus, the main consideration in thoroughfare planning is to make provisions for street and highway improvements so that, when the need arises, feasible opportunities to make improvements exist.

Benefits of Thoroughfare Planning

There are two major benefits derived from thoroughfare planning. First, each road or highway can be designed to perform a specific function and provide a specific level of service. This permits savings in right-of-way, construction, and maintenance costs. It also protects residential neighborhoods and encourages stability in travel and land use patterns. Second, local officials are informed of future improvements and can incorporate them into planning and policy decisions. This will permit developers to design subdivisions in a non-conflicting manner, direct school and park officials to better locate their facilities, and minimize the damage to property values and community appearance that is sometimes associated with roadway improvements.

Thoroughfare Classification Systems

Streets perform two primary functions, traffic service and land access, 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 developed 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 that permits travel from origins to destinations with directness, ease and safety. Different streets in this system are designed and called on to perform specific functions, thus minimizing the traffic and land service conflict.

Urban Classification

In the urban thoroughfare plan, such as the Town of Robbinsville, elements are classified as major thoroughfares, minor thoroughfares, or local access streets.

Major Thoroughfares

These routes are the primary traffic arteries of the urban area and they accommodate traffic movements within, around, and through the area.

Minor Thoroughfares

Roadways classified under this under this type collect traffic from the local access streets and carry it to the major thoroughfare system.

Local Access Streets

This classification covers streets that have a primary purpose of providing access to the abutting property. This classification may be further classified as either residential, commercial and/or industrial depending upon the type of land use that they serve.

Idealized Major Thoroughfare System

The coordinated system of major thoroughfares that is most adaptable to the desired lines of travel within an urban area and that is reflected in most urban area thoroughfare plans is the radial-loop system. The radial-loop system includes radials, crosstowns, loops, and bypasses (Figure A-1).

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 that 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 side to follow the area's border. It also 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 business or 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. 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 traffic that 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.

Objectives of Thoroughfare Planning

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 the changing traffic patterns. A thoroughfare plan will enable street improvements to be made as traffic demands increase, and it helps eliminate unnecessary improvements, so needless expense can be averted. By developing the urban street system to keep pace with increasing traffic demands, a maximum utilization of the system can be attained, requiring 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 development affect 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:

- To provide for the orderly development of an adequate major street system as land development occurs;
- To reduce travel and transportation costs;
- To reduce the cost of major street improvements to the public through the coordination of the street system with private action;
- To enable private interest to plan their actions, improvements, and development with full knowledge of public intent;
- To minimize disruption and displacement of people and businesses through long range advance planning for major street improvements;
- To reduce environmental impacts, such as air pollution, resulting from transportation, and
- To increase travel safety.

These objectives are achieved through improving both the operational efficiency of thoroughfares, and improving the system efficiency through system coordination and layout.

Operational Efficiency

A street's operational efficiency is improved by increasing the capability of the street to carry more vehicular traffic and people. In terms of vehicular traffic, a street's capacity is defined by 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, nature of traffic, and weather. Physical ways to improve vehicular capacity include:

- **Street widening** - widening of a street from two to four lanes more than doubles the capacity of the street by providing additional maneuverability for traffic.
- **Intersection improvements** - increasing the turning radii, adding exclusive turn lanes, and channelizing movements can improve the capacity of an existing intersection.
- **Improving vertical and horizontal alignment** - reduces the congestion caused by slow moving vehicles.
- **Eliminating roadside obstacles** - reduces side friction and improves a driver's field of sight.

Operational ways to improve street capacity include:

- **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.

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

- **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.

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

- **Signal phasing and coordination** - Uncoordinated signals and poor signal phasing restrict 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:

- **Carpools** - 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.

- **Alternate mode** - Encourage the use of transit and bicycle modes.

- **Work hours** - Encourage industries, businesses, and institutions to stagger work hours or establish variable work hours for employees. This will spread peak travel over a longer time period and thus reduce peak hour demand.

- **Land use** - Plan and encourage land use development or redevelopment in a more travel efficient manner.

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 to the user. Improvements in system efficiency can be achieved through the concept of functional classification of streets and development of a coordinated major street system.

Application of Thoroughfare Planning Principles

The concepts presented in the discussion of operational efficiency, system 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 area and is constrained by 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.

Through the thoroughfare planning process it is necessary from a practical viewpoint that certain basic principles be followed as closely as possible. These principles are listed below:

1. The plan should be derived from a thorough knowledge of today's travel - its component parts, and the factors that contribute to it, limit it, and modify it.

2. Traffic demands must be sufficient to warrant the designation and development of each major street. The thoroughfare plan should be designed to accommodate a large portion of major traffic movements on a few streets.

3. The plan should conform to and provide for the land development plan for the area.

4. Certain considerations must be given to urban development beyond the current planning period. Particularly in outlying or sparsely developed areas that have development potential, it is necessary to designate thoroughfares on a long-range planning basis to protect rights-of-way for future thoroughfare development.

5. While being consistent with the above principles and realistic in terms of travel trends, the plan must be economically feasible.

IDEALIZED THOROUGHFARE PLAN

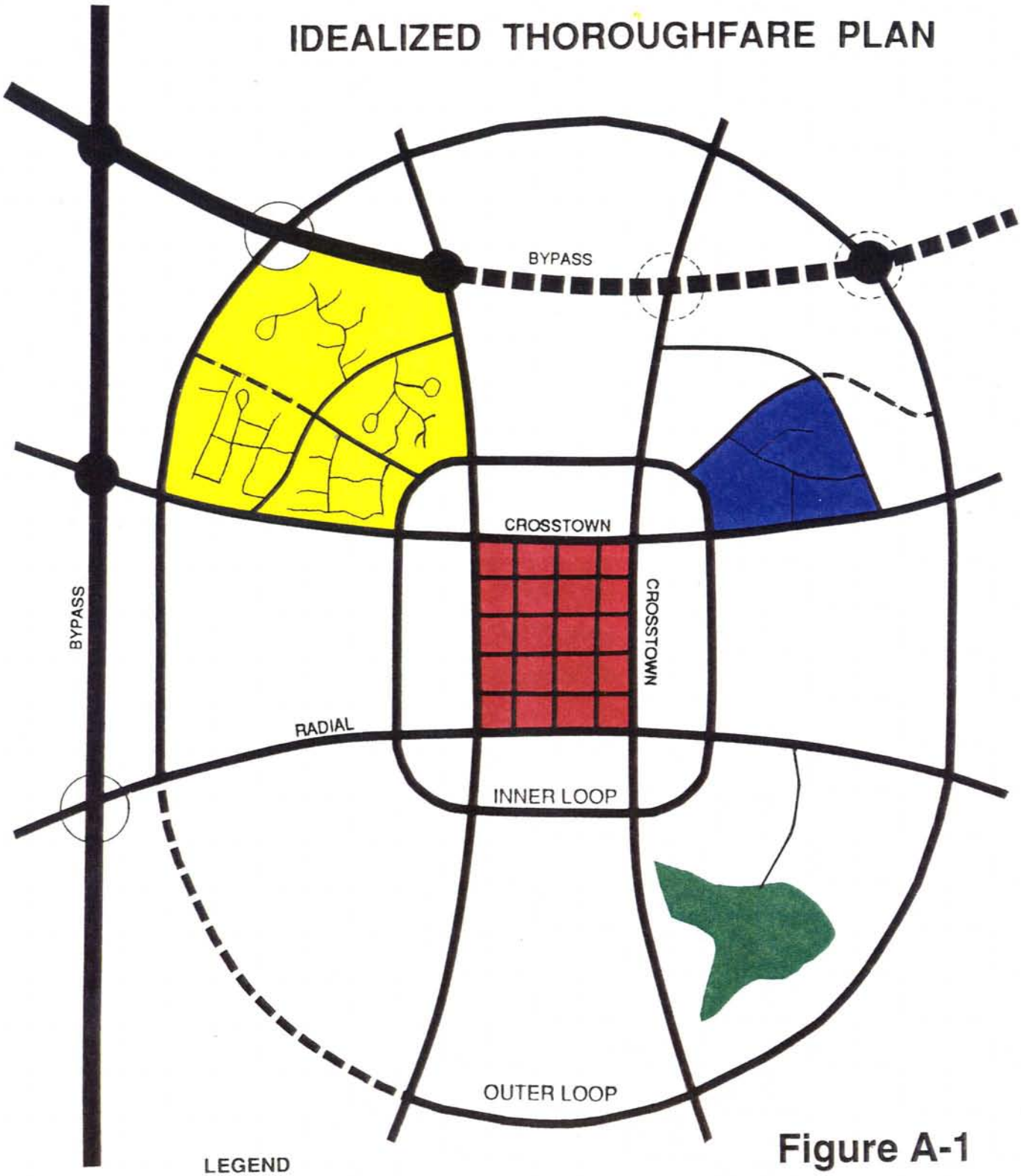


Figure A-1

LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARE FREEWAY		
MAJOR OTHER		
MINOR THOROUGHFARE		
LOCAL ROAD		
INTERCHANGE		
GRADE SEPERATION		

LAND USES

- COMMERCIAL/BUSINESS
- RESIDENTIAL
- INDUSTRIAL
- PUBLIC/INSTITUTIONAL

Appendix B

THOROUGHFARE STREET TABULATION AND RECOMMNEDATIONS

This appendix includes a detailed tabulation of all streets identified as elements of the Graham County Thoroughfare Plan and the Town of Robbinsville Thoroughfare Plans. The table includes a description of each section, as well as the length, cross section, and right-of-way for each section. Also included are existing and projected average daily traffic volumes, roadway capacity, and the recommended ultimate lane configuration. Due to space constraints, these recommended cross sections are given in the form of an alphabetic code. A detailed description of each of these codes and an illustrative figure for each can be found in Appendix C.

The following index of terms may be helpful in interpreting the table:

NCL - Northern Corporate Limits

SCL - Southern Corporate Limits

SR - State Road

N/A - Not Available

TL - Turning Lane

ADQ - Adequate

Madison/Mayodan Thoroughfare Plan Thoroughfare Plan
Street Tabulation and Recommendations

FACILITY & SECTION	DIST MI	1995 CONDITIONS RDWY FT	ROW FT	NUMBER OF LANES	CURRENT CAPACITY (VPD)	1995 AADT	2025 CONDITIONS RDWY FT	ROW FT	NUMBER OF LANES	PROPOSED CAPACITY (VPD)	2025 AADT	REC. CROSS SECT.
US 220							**Future I-73 Corridor**					
SPB Madison - SR 1110	0.95	48	200	4	50,000	16,800	ADQ	ADQ	ADQ	56,000	26,400	ADQ
SR 1110 - US 220 Bus.	0.41	48	200	4	50,000	16,800	ADQ	ADQ	ADQ	56,000	26,400	ADQ
US 220 Bus. - SR 2150	2.32	48	250	4	56,000	16,000	ADQ	ADQ	ADQ	ADQ	21,700	ADQ
SR 2150 - NC 135	0.62	48	200	4	56,000	16,000	ADQ	ADQ	ADQ	ADQ	21,700	ADQ
NC 135 - NPB Mayodan	0.57	48	200	4	56,000	9,300	ADQ	ADQ	ADQ	ADQ	14,000	ADQ
US 220 Business												
US 220 - US 311	(named US 220 Business (Academy Street))											
Academy - Decatur St.	(named US 220 Business (Market Street))											
Market - Highway St.	(named US 220 Business (Decatur Street))											
Decautur - Madison CL	(named US 220 Business (Highway Street))											
Madison CL-May. NCL	(named US 220 Business (Second Avenue))											
NCL Mayodan- SR 1313	0.31	20	60	2	6,000	4,500	24	ADQ	2 w/ TL	8,000	7,700	K
SR 1313 -NPB Mayodan	0.95	20	60	2	6,000	4,500	24	ADQ	2 w/ TL	8,000	7,700	K
US 220 Business (Academy Street)												
US 220 - SR 1145	1.05	24	60	2	6,900	7,700	36	ADQ	3	12,000	10,300	H
SR 1145 - Market Street	0.42	24	60	2	6,900	7,700	36	ADQ	3	12,000	10,300	H
US 220 Business (Market Street)												
Academy St.-Hunter St.	0.07	42	60	2	18,000	6,800	ADQ	ADQ	ADQ	ADQ	10,800	ADQ
Hunter St. - Decatur St.	0.15	42	60	2	18,000	6,800	ADQ	ADQ	ADQ	ADQ	10,800	ADQ
US 220 Business (Decatur Street)												
Market St. - Franklin St.	0.11	40	66	2	12,200	4,500	ADQ	ADQ	ADQ	ADQ	8,200	ADQ
Franklin St. - Wall St.	0.12	40	66	2	12,200	4,500	ADQ	ADQ	ADQ	ADQ	8,200	ADQ
Wall St. - Highway St.	0.24	40	66	2	12,200	4,500	ADQ	ADQ	ADQ	ADQ	8,600	ADQ
US 220 Business (Highway Street)												
Decatur - Carter St.	0.08	40	60	2	12,200	4,500	ADQ	ADQ	ADQ	ADQ	8,600	ADQ
Carter St. - Short Ave.	0.17	40	60	3	16,100	4,500	ADQ	ADQ	ADQ	ADQ	8,600	ADQ
Short Ave. - Piedmont	0.10	44	60	4	24,400	4,500	ADQ	ADQ	ADQ	ADQ	9,100	ADQ
Piedmont - Ayersville	0.26	50	60	5	30,000	16,900	ADQ	ADQ	ADQ	ADQ	20,700	ADQ
Ayersville - Madison CL	0.37	50	60	5	30,000	16,900	ADQ	ADQ	ADQ	ADQ	20,700	ADQ
US 220 Business (Second Avenue)												
Mayodan CL - NC 135	0.48	50	60	5	30,000	11,500	ADQ	ADQ	ADQ	ADQ	13,100	ADQ
NC 135 - Washington	0.13	37	60	2	18,000	11,500	ADQ	ADQ	3	16,000	10,400	H
Washington - Madison	0.17	38	60	2	12,200	10,500	ADQ	ADQ	3	16,000	10,300	H
Madison - Jackson St.	0.18	35	60	2	12,200	5,000	ADQ	ADQ	3	16,000	7,700	H
Jackson St.- Van Buren	0.09	45	50	2	12,200	5,000	ADQ	ADQ	ADQ	ADQ	7,700	ADQ
Van Buren - NCL May.	0.30	45	60	2	12,200	5,000	ADQ	ADQ	ADQ	ADQ	7,700	ADQ
US 311												
WPB - WCL Madison	0.58	24	60	2	7,900	5,400	36	ADQ	3	12,000	8,500	H
WCL Madison - Market	(named US 311 (Academy Street))											
Market St. - US 220	(common to US 220 Business (Academy Street))											

Madison/Mayodan Thoroughfare Plan Thoroughfare Plan
Street Tabulation and Recommendations

FACILITY & SECTION	DIST MI	1995 CONDITIONS RDWY FT	ROW FT	NUMBER OF LANES	CURRENT CAPACITY (VPD)	1995 AADT	2025 CONDITIONS RDWY FT	ROW FT	NUMBER OF LANES	PROPOSED CAPACITY (VPD)	2025 AADT	REC. CROSS SECT.
US 311 (Academy Street)												
WCL Mad. - SR 1138	1.41	24	60	2	7,900	7,500	36	ADQ	3	12,000	11,500	H
US 311 (Academy Street)							**Renamed US 311/NC 704 (Academy Street)**					
SR 1138 - Benjamin Rd.	0.18	24	var	2	12,200	12,200	36	ADQ	3	16,100	13,400	H
Benjamin - Lonesome	0.19	24	50	2	12,200	12,000	36	ADQ	3	16,100	10,400	H
Lonesome Rd-Penn St.	0.53	37	50	2	12,200	7,600	ADQ	ADQ	3	16,100	10,300	H
Penn St. - Franklin St.	0.08	42	66	3	16,100	7,600	ADQ	ADQ	ADQ	ADQ	10,300	ADQ
Franklin St. - Market	0.12	44	66	2	12,200	7,600	ADQ	ADQ	3	16,100	10,200	H
NC 135												
US 220 Bus. - ECL May.	0.14	24	40	2	11,000	6,600	33	ADQ	3	15,000	9,600	H
ECL May. - Cedar Mtn.	0.08	33	60	2	11,000	6,600	33	ADQ	3	15,000	9,600	H
Cedar Mtn. - Wall Rd.	0.66	24	60	2	11,000	5,700	33	ADQ	3	15,000	9,600	H
Wall Rd. - SR 2150	0.28	24	60	3	13,000	5,700	ADQ	ADQ	ADQ	ADQ	11,900	ADQ
SR 2150 - US 220 Byp.	0.72	24	60	3	13,000	7,800	ADQ	ADQ	ADQ	ADQ	10,600	ADQ
US 220 Byp.- SR 2178	0.36	24	60	3	6,400	5,500	36	ADQ	3	16,100	10,200	H
NC 704							**Renamed NC 704 Business**					
WPB - SR 1169	1.74	20	60	2	6,000	2,800	24	ADQ	2 w/TL	8,500	5,100	K
SR 1169 - WCL Madison	0.45	32	40	2	6,500	5,700	ADQ	60	2 w/TL	8,500	8,300	K
WCL Madison - US 220	(named NC 704 (Ayersville Road))											
Highway St. Section	(common to US 220 Business (Highway Street))											
Decatur St. Setion	(common to US 220 Business (Decatur Street))											
Market St. Section	(common to US 220 Business (Market Street))											
Market - US 220	(common to US 220 Business (Academy Street))											
US 220 - ECL Madison	0.19	24	60	2	7,900	4,800	36	ADQ	3	12,000	9,200	H
ECL Madison - EPB	0.34	24	60	2	7,900	4,800	36	ADQ	3	12,000	8,700	H
NC 704 (Ayersville Road)							**Renamed NC 704 Business (Ayersville Road)**					
WCL Madison- US 220	0.48	48	60	5	30,000	5,200	ADQ	ADQ	ADQ	ADQ	11,900	ADQ
SR 1110 (Ellisboro Road)												
US 220 - SPB Madison	1.10	22	60	2	7,100	1,500	ADQ	ADQ	ADQ	ADQ	4,400	ADQ
SR 1138 (Lindsey Bridge Road)												
SPB Madison -SCL Mad.	1.29	22	60	2	6,000	1,100	24	ADQ	ADQ	7,000	2,000	K
SCL Mad. - Relocation	0.67	18	60	2	7,100	3,100	24	ADQ	ADQ	8,000	5,800	K
Relocation Section	0.23	-	-	-	-	-	24	60	2	8,000	6,400	K
SR 1143 (Rierson Road)												
SR 1138 - SPB Madison	1.04	20	60	2	6,600	2,400	ADQ	ADQ	ADQ	ADQ	3,200	ADQ
SR 1145 (Mineral Springs Road)												
US 220 Bus - SPB Mad.	2.94	20	60	2	6,600	550	ADQ	ADQ	ADQ	ADQ	2,000	ADQ
SR 1152 (Wilson Street)												
US 311 - Decatur St.	0.30	37	40	2	12,200	6,900	ADQ	ADQ	ADQ	ADQ	4,600	ADQ
Decatur St. - US 220 B.	0.30	40	50	2	12,200	6,900	ADQ	ADQ	ADQ	ADQ	5,100	ADQ

Madison/Mayodan Thoroughfare Plan Thoroughfare Plan
Street Tabulation and Recommendations

FACILITY & SECTION	DIST MI	1995 CONDITIONS RDWY FT	ROW FT	NUMBER OF LANES	CURRENT CAPACITY (VPD)	1995 AADT	2025 CONDITIONS RDWY FT	ROW FT	NUMBER OF LANES	PROPOSED CAPACITY (VPD)	2025 AADT	REC. CROSS SECT.
SR 1155 (Gibson Drive)												
US 311 - Oak Forest Dr.	0.35	20	60	2	6,600	1,900	ADQ	ADQ	ADQ	ADQ	1,000	ADQ
SR 1162 (K-Fork Road)												
SR 1165 - US 311	1.70	20	40	2	6,600	2,600	ADQ	ADQ	ADQ	ADQ	3,900	ADQ
SR 1165 (Cardinal Road)												
SR 1162 - NC 704	1.30	20	60	2	6,600	1,500	ADQ	ADQ	ADQ	ADQ	2,200	ADQ
SR 1169 (Island Drive)							**Renamed NC 704 (Island Drive)**					
US 311 - Shady Lane	0.38	20	40	2	12,200	3,000	33	50	3	16,000	9,300	H
Shady Lane-Summit St.	0.18	20	50	2	12,200	3,000	33	ADQ	3	16,000	9,400	H
Summit - Relocation	0.10	20	60	2	12,200	3,000	36	ADQ	3	16,000	9,400	H
Relocated Section	0.27	-	-	-	-	-	36	60	3	12,000	9,400	H
Relocation - NC 704	0.88	20	60	2	6,000	3,000	36	ADQ	3	12,000	4,200	H
SR 1169 (Will Turner Road)												
NC 704 -SCL Mayodan	0.18	24	50	2	6,000	1,900	36	ADQ	3	12,000	5,300	H
SCL Mayodan - Coleman	0.20	38	50	2	13,000	1,900	ADQ	ADQ	3	16,000	5,300	H
SCL Mayodan-Ayersville	0.35	24	50	2	12,200	1,900	36	ADQ	3	16,000	4,000	H
SR 1194 (Gibson Drive)												
Oak Forest - Morton	0.33	20	40	2	6,600	1,900	ADQ	ADQ	ADQ	ADQ	1,000	ADQ
Morton St. - SR 1138	0.30	20	30	2	6,600	1,900	ADQ	ADQ	ADQ	ADQ	1,000	ADQ
SR 1198 (Chief Martin Street)												
Highway St - Cure Dr.	0.40	n/a	60	2	12,200	n/a	ADQ	ADQ	ADQ	ADQ	5,800	ADQ
Extension	(see Chief Martin Street Extension)											
SR 1300 (Ayersville Road)												
NPB - SR 1312	0.88	18	60	2	5,400	2,700	24	ADQ	2 w/TL	7,500	5,000	K
SR 1312 - Boswell St.	1.22	18	50	2	5,400	2,700	24	ADQ	2 w/TL	7,500	6,700	K
Boswell St. - Wray St.	0.14	36	50	2	9,600	5,000	ADQ	ADQ	ADQ	ADQ	6,500	ADQ
Wray St. - NC 704	0.35	20	20	2	11,500	5,000	ADQ	ADQ	ADQ	ADQ	6,500	ADQ
SR 1324 (Case School)												
SR 1300 - SR 1321	1.50	20	60	2	6,600	1,100	ADQ	ADQ	ADQ	ADQ	1,500	ADQ
SR 2150 (River Road)												
NC 135 - EPB	1.14	18	60	2	6,000	1,200	24	ADQ	ADQ	7,500	1,600	K
SR 2177 (Dan Valley Road)												
NCL Mad.- Relocation	0.95	20	50	2	6,600	1,100	24	60	ADQ	7,500	1,100	K
Relocated Section	0.60	-	-	-	-	-	24	60	2	7,500	1,100	K
Relcoation - NC 135	0.55	20	50	2	6,600	1,100	24	60	ADQ	7,500	1,100	K
SR 2177 (Water Street)												
Decatur St. - NCL Mad.	0.20	22	40	2	6,600	1,100	24	60	ADQ	7,500	1,100	K

Madison/Mayodan Thoroughfare Plan Thoroughfare Plan
Street Tabulation and Recommendations

FACILITY & SECTION	DIST MI	1995 CONDITIONS RDWY FT	ROW FT	NUMBER OF LANES	CURRENT CAPACITY (VPD)	1995 AADT	2025 CONDITIONS RDWY FT	ROW FT	NUMBER OF LANES	PROPOSED CAPACITY (VPD)	2025 AADT	REC. CROSS SECT.
SR 2216 (Cardwell Road)							**Renamed Market Street**					
NC 135 - Dead End	0.40	18	45	2	6,000		24	60	ADQ	7,500	4,400	K
Market St. Extenison	(see Market Street)											
Burton Street												
US 220 Bus - NC 704	0.25	33	40	2	5,600	n/a	ADQ	ADQ	ADQ	ADQ	2,400	ADQ
Chief Martin Street Extension												
Chief Martin St.-SR 1169	0.45	-	-	-	-	-	24	60	2	7,500	5,800	K
Decatur Street												
Highway St. - Market St.	(common to US 220 Business (Decatur Street))											
Market St.- SR 2177	0.20	28	50	2	11,000	1,100	ADQ	ADQ	ADQ	ADQ	2,100	ADQ
Fourth Avenue												
Jackson - Jackson St.	0.01	33	60	2	12,000	600	ADQ	ADQ	ADQ	ADQ	1,700	ADQ
Gene Hairston Street												
US 220 Bus.-Market St.	0.55	20	50	2	11,000	1,200	ADQ	ADQ	ADQ	ADQ	2,500	ADQ
Jackson Street												
Second - Third Ave.	0.10	18	40	2	10,000	600	ADQ	ADQ	ADQ	ADQ	1,700	ADQ
Third Ave. - Fourth	0.09	26	50	2	12,000	600	ADQ	ADQ	ADQ	ADQ	1,700	ADQ
Fourth - Thirteeth	0.63	26	50	2	12,000	600	ADQ	ADQ	ADQ	ADQ	1,700	ADQ
Main Street												
Ayersville - Second St.	0.60	36	60	2	12,200	3,500	ADQ	ADQ	ADQ	ADQ	4,700	ADQ
Market Street												
Academy - Decatur St.	(common to US 220 Business (Market Street))											
Decatur - Pratt St.	0.10	22	60	2	11,000	n/a	ADQ	ADQ	ADQ	ADQ	4,400	ADQ
Pratt St.-Gene Hairston	0.21	22	60	2	11,000	n/a	ADQ	ADQ	ADQ	ADQ	4,400	ADQ
Extension	0.70	-	-	-	-	-	24	60	2	7,500	4,400	K
Extension - NC 135	(common to SR 2216 (Cardwell Road))											
Thirteenth Avenue												
Jackson - Ayersville	0.28	26	60	2	10,000	600	ADQ	ADQ	ADQ	ADQ	1,700	ADQ

Appendix C

TYPICAL CROSS SECTIONS

Cross section requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each street section must be individually analyzed and its cross section requirements determined on the basis of amount and type of projected traffic, existing capacity, desired level of service, and available right-of-way. Typical cross section recommendations are shown in Figure C-1. These cross sections are typical for facilities on new location and where right-of-way constraints are not critical. For widening projects and urban projects with limited right-of-way, special cross sections should be developed that meet the needs of the project.

The recommended typical cross sections shown in Appendix C, Figure C-1 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, adequate right-of-way should be protected or acquired for the ultimate cross sections. Ultimate desirable cross sections for each of the thoroughfares are listed in Appendix B. Recommendations for "ultimate" cross sections are provided for the following:

1. thoroughfares which may require widening after the current planning period
2. thoroughfares which are borderline adequate and accelerated traffic growth could render them deficient
3. thoroughfares where an urban curb and gutter cross section may be locally desirable because of urban development or redevelopment.

Recommended design standards relating to grades, sight distances, degree of curve, super elevation, and other considerations for thoroughfares are given in Appendix D.

A - Four Lanes Divided with Median - Freeway

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 14 m (46 ft), but a wider median is desirable.

B - Seven Lanes - Curb & Gutter

This cross section is not recommended for new projects. When the conditions warrant six lanes, cross section "D" should be recommended. Cross section "B" should be used only in special situations such as when widening from a five lane section and right-of-way is limited. Even in these situations, consideration should be given to converting the center turn lane to a median so that cross section "D" is the final cross section.

C - Five Lanes - Curb & Gutter

Typical for major thoroughfares, this cross section is desirable where frequent left turns are anticipated as a result of abutting development or frequent street intersections.

D - Six Lanes Divided with Raised Median - Curb & Gutter
E - Four Lanes Divided with Raised Median - Curb and Gutter

These cross sections are typically used on major thoroughfares where left turns and intersection streets are not as frequent. Left turns would be restricted to a few selected intersections. The 4.8 m (16 ft) median is the minimum recommended for an urban boulevard type cross section. most instances, monolithic construction should be utilized due to greater cost effectiveness, ease and speed of placement, and reduced future maintenance requirements. In special cases, grassed or landscaped medians result in greatly increased maintenance costs and an increase danger to maintenance personnel. Non-monolithic medians should only be recommended when the above concerns are addressed.

F - Four Lanes Divided - Boulevard, Grass Median

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 7.3 m (24 ft) is recommended with 9.1 m (30 ft) being desirable.

G - Four Lanes - Curb & Gutter

This cross section is recommended for major thoroughfares where projected travel indicates a need for four travel 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. This cross section should be used only if the above criteria is met. If right-of-way is not restricted, future strip development could take place and the inner lanes could become de facto left turn lanes.

H - Three Lanes - Curb & Gutter

In urban environments, thoroughfares which are proposed to function as one-way traffic carriers would typically require cross section "H".

I - Two Lanes - C&G, Parking both sides
J - Two Lanes - C&G, Parking one side

Cross section "I" and "J" are usually recommended for urban minor thoroughfares since these facilities usually serve both land service and traffic service functions. Cross section "I" would be used on those minor thoroughfares where parking on both sides is needed as a result of more intense development.

K - Two Lanes - Paved Shoulder

This cross section is used in rural areas or for staged construction of a wider multi-lane cross section. On some thoroughfares, projected traffic volumes may indicate that two travel lanes will adequately serve travel for a considerable period of time. For areas that are growing and future widening will be necessary, the full right-of-way of 30 m (100 ft) should be required. In some instances, local ordinances may not allow the full 30 m. In those cases, 21 m (70 ft) should be preserved with the understanding that the full 30 m will be preserved by use of building setbacks and future street line ordinances.

L - Six Lanes Divided with Grass Median - Freeway

Cross section "L" is typical for controlled access freeways. The 14 m (46 ft) grassed median is the minimum desirable median width, but there could be some variation from this depending upon design considerations. Right-of-way requirements would typically vary upward from 70 m (228 ft) depending upon cut and fill requirements.

M - Eight Lanes Divided with Raised Median - Curb & Gutter

Also used for controlled access freeways, this cross section may be recommended for freeways going through major urban areas or for routes projected to carry very high volumes of traffic.

N - Five Lanes/C&G, Widened Curb Lanes
O - Two Lane/Shoulder Section
P - Four Lanes Divided/Raised Median, C&G, Widened Curb Lanes

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 the bicycle facilities. The North Carolina Bicycle Facilities Planning and Design Guidelines should be consulted for design standards for bicycle facilities. Cross sections "N", "O", and "P" are typically used to accommodate bicycle travel.

General

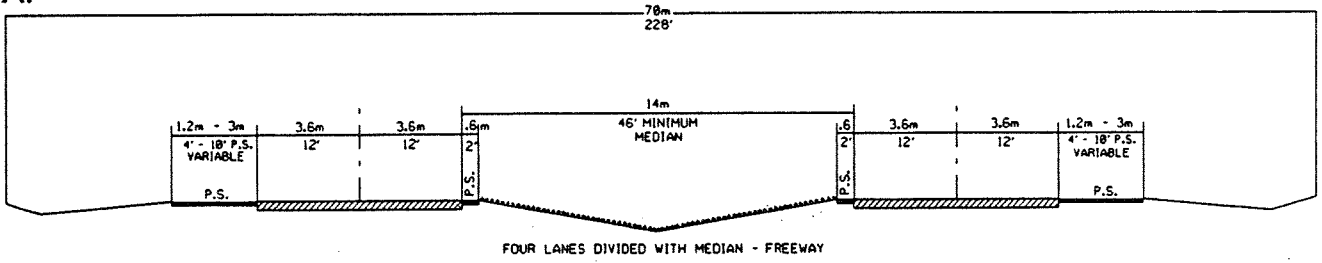
The urban curb and gutter cross sections all illustrate the sidewalk adjacent to the curb with a buffer or utility strip between the sidewalk and the minimum right-of-way line. This permits adequate setback for utility poles. If it is desired to move the sidewalk farther away from the street to provide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

The right-of-ways shown for the typical cross sections are the minimum right-of-way 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.

TYPICAL THOROUGHFARE CROSS SECTIONS

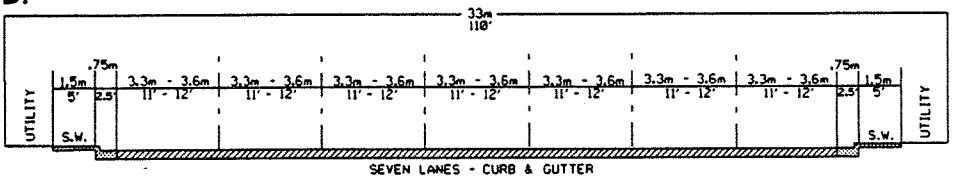
FIGURE C-1

A.



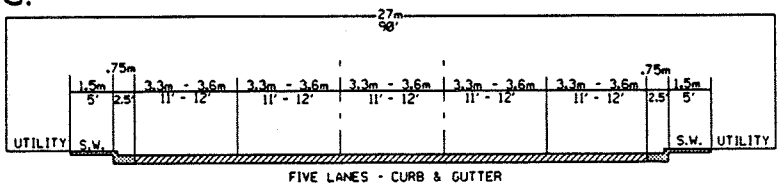
FOUR LANES DIVIDED WITH MEDIAN - FREEWAY

B.



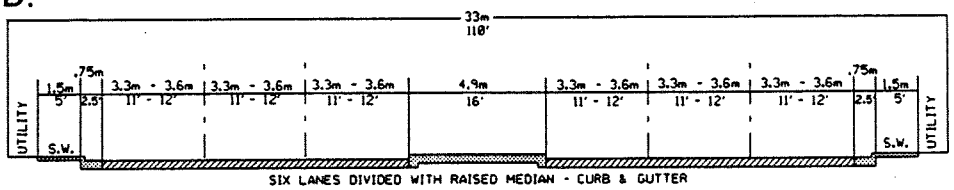
SEVEN LANES - CURB & GUTTER

C.



FIVE LANES - CURB & GUTTER

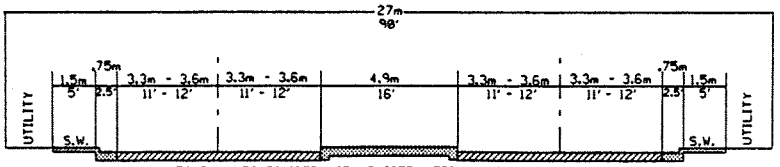
D.



SIX LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

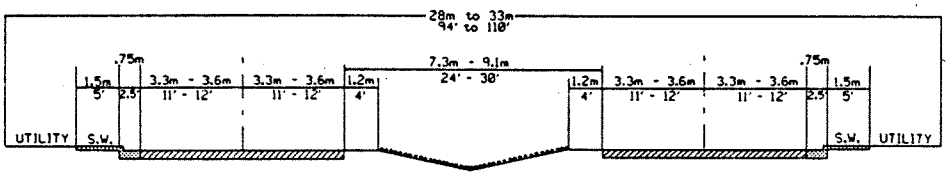
TYPICAL THOROUGHFARE CROSS SECTIONS

E.



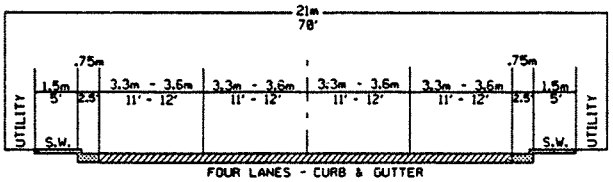
FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

F.



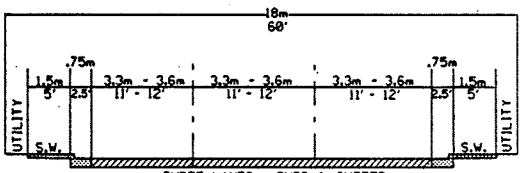
FOUR LANES DIVIDED - BOULEVARD
GRASS MEDIAN

G.



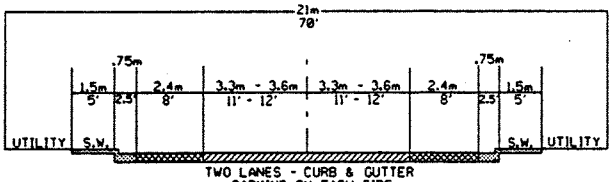
FOUR LANES - CURB & GUTTER

H.



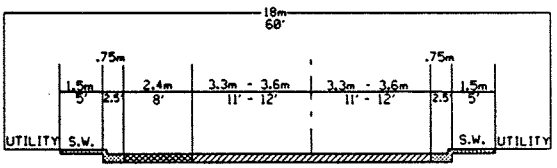
THREE LANES - CURB & GUTTER

I.



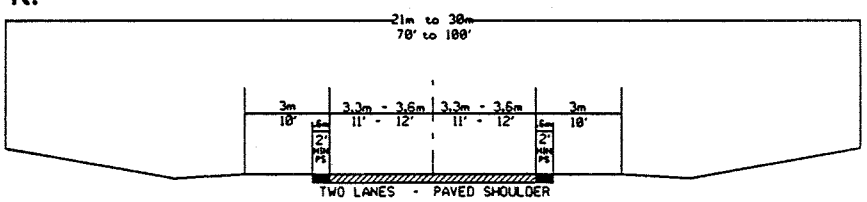
TWO LANES - CURB & GUTTER
PARKING ON EACH SIDE

J.



TWO LANES - CURB & GUTTER
PARKING ON ONE SIDE

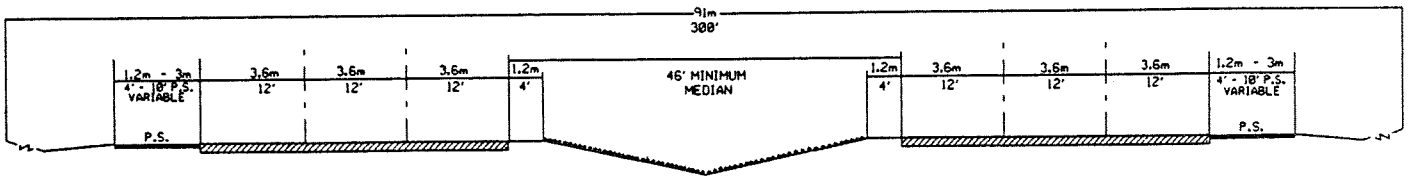
K.



TWO LANES - PAVED SHOULDER

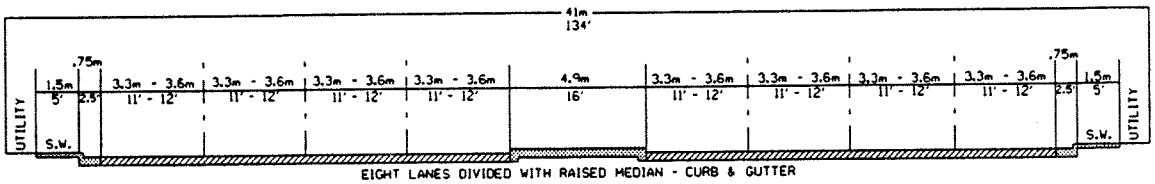
TYPICAL THOROUGHFARE CROSS SECTIONS

L.



SIX LANES DIVIDED WITH GRASS MEDIAN - FREEWAY

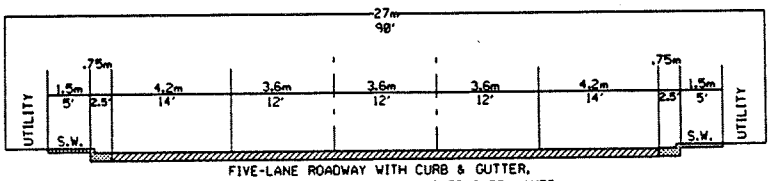
M.



EIGHT LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

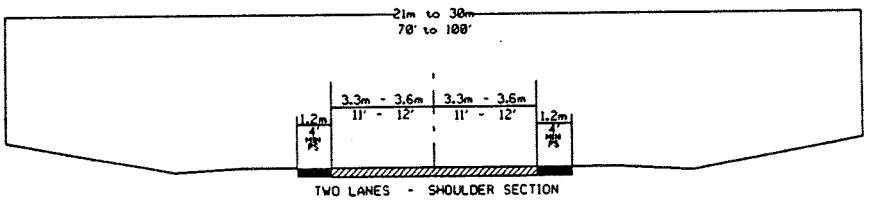
TYPICAL THOROUGHFARE CROSS SECTIONS FOR ACCOMMODATING BICYCLES

N.



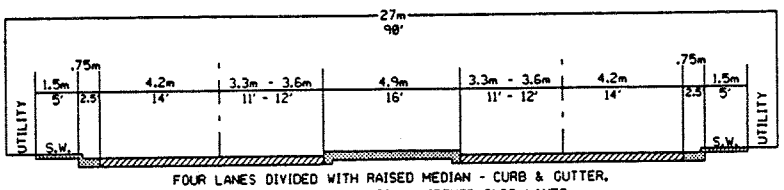
FIVE-LANE ROADWAY WITH CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

O.



TWO LANES - SHOULDER SECTION

P.



FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

Appendix D

RECOMMENDED SUBDVISION ORDINANCES

Definitions

Streets and Roads

Rural Roads

- **Principal Arterial** - A rural link in a highway system serving travel, and having characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This network would consist of Interstate routes and other routes designated as principal arterials.

- **Minor Arterial** - A rural roadway joining cities and larger towns and providing intra-state and inter-county service at relatively high overall travel speeds with minimum interference to through movement.

- **Major Collector** - A road which serves major intra-county travel corridors and traffic generators and provides access to the Arterial system.

- **Minor Collector** - A road which provides service to small local communities and traffic generators and provides access to the Major Collector system.

- **Local Road** - A road which serves primarily to provide access to adjacent land, over relatively short distances.

Urban Streets

- **Major Thoroughfares** - Major thoroughfares consist of Inter-state, other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.

- **Minor Thoroughfares** - Minor thoroughfares 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 minor through traffic movements and may also serve abutting property.

- **Local Street** - A local street is any street not on a higher order urban system and serves primarily to provide direct access to abutting land.

Specific Type Rural or Urban Streets

- **Freeway, expressway, or parkway** - Divided multilane roadways designed to carry large volumes of traffic at high speeds. A *freeway* provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. An *expressway* is a facility with full or partial control of access and generally with grade separations at major intersections. A *parkway* is for non-commercial traffic, with full or partial control of access.

- **Residential Collector Street** - A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets 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 1.0 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 only one end open to traffic and the other end being permanently terminated and a vehicular turn-around provided.

- **Frontage Road** - A road that is parallel to a partial or full access controlled facility and provides 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, which is intended as a unit for transfer of ownership or for development or both. The word "lot" includes the words "plat" and "parcel".

Subdivision

Subdivider

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

Subdivision

All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, 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.

The following shall not be included within this definition nor subject to these regulations.

- The combination or re-combination 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
- the division of land into parcels greater then 10 acres where no street right-of-way dedication is involved
- the public acquisition, by purchase, of strips of land for the widening or the opening of streets
- the division of a tract in single ownership whose entire area is no greater than 2 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. The dedication is made by written instrument and is completed with an acceptance.

Reservation

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

Design Standards

Streets and Roads

The design of all roads within the Planning Area 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 Officials' (AASHTO) manuals.

The provision of street rights-of-way shall conform and meet the recommendations of the Thoroughfare Plan, as adopted by the municipality. 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.

Right-of-way Widths

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

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 a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major thoroughfares, principle and minor arterials, and major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width right-of-way, not less then 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 sub-divided, the remainder of the full required right-of-way shall be dedicated.

Table D-1
Minimum Right-of-Way Requirements

Area Classification	Functional Classification	Minimum ROW
Rural	Principal Arterial (Freeway)	350 feet
	Principal Arterial (Other)	200 feet
	Minor Arterial	100 feet
	Major Collector	100 feet
	Minor Collector	80 feet
	Local Road (see note #1)	60 feet
Urban	Major Thoroughfare	90 feet
	Minor Thoroughfare	70 feet
	Local Street	60 feet
	Cul-de-sac (see note #2)	variable

1) The desirable minimum right-of-way is 60 feet. If curb and gutter is provided, 50 feet of ROW is adequate on local residential streets.

2) The ROW dimension will depend on radius used for vehicular turn around. Distance from edge of pavement of turn around to ROW should not be less than distance from edge of pavement to ROW on street approaching turn around.

Street Widths

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

- **Local Residential**
  - Curb and Gutter section - 26 feet, face to face curb
  - Shoulder section - 20 feet to edge of pavement, 4 feet for shoulders

- **Residential Collector**
  - Curb and Gutter section - 34 feet, face to face of curb
  - Shoulder section - 20 feet to edge of pavement, 6 feet for 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 Speed** - The design speed for a roadway should be a minimum of 10 km/h (5 mph) greater than the posted speed limit. The design speeds for subdivision type streets are shown in Table D-2.

- **Minimum Sight Distance** - In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provide and calculated using the parameters set forth in Table D-3.

- **Superelevation** - Table D-4 show the minimum radius and the related maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter is 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06, with 0.04 being desirable.

- **Maximum and Minimum Grades**
  - the maximum grades in percent are shown in Table D-5
  - minimum grade should not be less then 0.5%
  - grades for 100 feet each way from intersections (measured from edge of pavement) should not exceed 5%

Table D-2 Design Speeds				
Facility Type		Design Speed (mph)		
		Desirable	Minimum	
			Level	Rolling
Rural	Minor Collector Roads (ADT over 2000)	60	50	40
	Local Roads (ADT over 400)[1]	50	50*	40*
Urban	Major Thoroughfares[2]	60	50	40
	Minor Thoroughfares	40	30	30
	Local Streets	30	30**	20**
[1] Local Roads including Residential Collectors and Local Residential				
[2] Major Thoroughfares other than Freeways and Expressways				
* Based on an ADT of 400 - 750. Where roads serve a limited area and small number of units, can reduce minimum design speed.				
** Based on projected ADT of 50 - 250. (Reference NCDOT Roadway Design Manual page 1-1B)				

Table D-3 Sight Distance					
Design Speed (mph)	Stopping Sight Distance (feet)		Minimum K Values (feet)[1]		Passing Sight Distance (feet) for two lanes
	Desirable	Minimum	Crest Curve	Sag Curve	
30	200	200	30	40	1100
40	325	275	60	60	1500
50	475	400	110	90	1800
60	650	525	190	120	2100
Note: General practice calls for vertical curves to be multiples of 50 feet. Calculated lengths shall be rounded up in each case. (Reference: "NCDOT Roadway Design Manual" pg.1-12 T-1)					
[1] K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length of vertical curve which will provide the desired sight distance. Sight distance provided for stopped vehicles at intersections should be in accordance with "A Policy on Geometric Design of Highways and Streets, 1990".					

Table D-4 Superelevation Table						
Design Speed (mph)	Minimum Radius of e[1]		Maximum	Maximum Degree of Curve		
	e = 0.04	e = 0.06	e = 0.08	e = 0.04	e = 0.06	e = 0.08
30	302	273	260	19 00'	21 00'	22 45'
60	573	521	477	10 00'	11 15'	12 15'
80	955	955	819	6 00'	6 45'	7 30'
100	1,637	1,432	1,146	3 45'	4 15'	4 45'
[1] e = rate of superelevation, foot per foot						
Reference: "NCDOT Roadway Design Manual," pg. 1-12 T-6 thru T-8						

Table D-5 Maximum Vertical Grade					
Facility Type		Design Speed (mph)	Minimum Grade in Percent		
			Flat	Rolling	Mountainous
Rural	Minor Collector Roads*	20	7	10	12
		30	7	9	10
		40	7	8	10
		50	6	7	9
		60	5	6	8
		70	4	5	6
	Local Roads*[1]	20	-	11	16
		30	7	10	14
		40	7	9	12
		50	6	8	10
		60	5	6	-
Urban	Major Thoroughfares[2]	30	8	9	11
		40	7	8	10
		50	6	7	9
		60	5	6	8
	Minor Thoroughfares*	20	9	12	14
		30	9	11	12
		40	9	10	12
		50	7	8	10
		60	6	7	9
		70	5	6	7
	Local Streets*	20	-	11	16
		30	7	10	14
		40	7	9	12
		50	6	8	10
		60	5	6	-

* For streets and roads with projected annual average daily traffic less than 250 or short grades less than 500 feet long, grades may be 2% steeper than the values in the above table. (Reference NCDOT Roadway Metric Design Manual page 1-12 T-3)

[1] Local Roads including Residential Collectors and Local Residential

[2] Major Thoroughfares other than Freeways or Expressways

Intersections

Streets shall be laid out so as to interest as nearly as possible at right angles, and no street should intersect any other street at an angle less than sixty-five (65) 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 the 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. Intersections which cannot be aligned should be separated by a minimum length of 200 feet between survey centerlines.

Cul-de-sacs

Cul-de-sacs shall not be more than 500 feet in length. The distance from the edge of pavement on the vehicular turn around to the right-of-way line should not be less than the distance from the edge of pavement to right-of-way line on the street approaching the turn around. 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 provisions are mode 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 20 feet.

Dead-end alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turn around facilities at the dead-end as may be required by the Planning Board.

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 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 form the edge of pavement. On 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

All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

Horizontal Width on Bridge Deck

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

- **Shoulder section approach**
    - under 800 ADT design year - minimum 28 feet width face to face of parapets, rails, or pavement width plus 10 feet, whichever is greater.
    - 800 - 2000 ADT design year - minimum 34 feet width face to face of parapets, rails, or pavement width plus 12 feet, whichever is greater
    - over 2000 ADT design year - minimum width of 40 feet, desirable width of 44 feet width face to face of parapets or rails
- **Curb and gutter approach**
    - under 800 ADT design year - minimum 24 feet face to face of curbs
    - over 800 ADT design year - with of approach pavement measured face to face of curbs.

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 curbs, and in crown drop. The distance from face of curb to face of parapet or rail shall be a minimum of 1.5 feet or greater if sidewalks are required.

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. (shoulder width 8 feet minimum, 10 feet desirable.
- **Curb and gutter approach** - Width of approach pavement measured face to face of curbs.