Table 1
General Roadway Design Criteria

Criteria	*Main Lanes*	*Ramps (see note)*	*Loops*	*Crossing Streets*	*Internal Circulator*
Design Speed (MPH)	60	50	25	45	35
Posted Speed (MPH)	50–55	45	25	40	30
Minimum Radius	1430' (D=4)	850' (D=7)	150 (D=38)	850' (D=7)	440' (D=12)
Vertical Alignment					
k=crest	190–310	80–120	20	80–120	60–80
k=sag	120–160	70–90	30	70–90	60–70
Lane Width (ft)	12	14	variable	12	12
Normal Crown (ft/ft)	0.0208	0.0208	0.0208	0.0208	0.0208
Superelevation	AASHTO	AASHTO	AASHTO	AASHTO	AASHTO
Curb and Gutter	No	No	Yes	Yes	Yes
Graded Shoulder (ft)	12	12	12	10	10
Maximum Grade (%)	4	6–8	6–8	6–8	6–8
Typical Section	Multi–lane	Single/Double	Single/Double	Multi–lane	2 Min
Stage Construction	Yes	Yes	Yes	Yes	As required
Right–of–Way (ft)	Per plan	Per plan	Per plan	Per plan	80' des
Intersections	No	No	No	Allowed	Allowed
Parking	No	No	No	No	No
Sidewalks	No	No	No	Yes	Yes
Bike Lanes	No	No	No	Yes	Yes

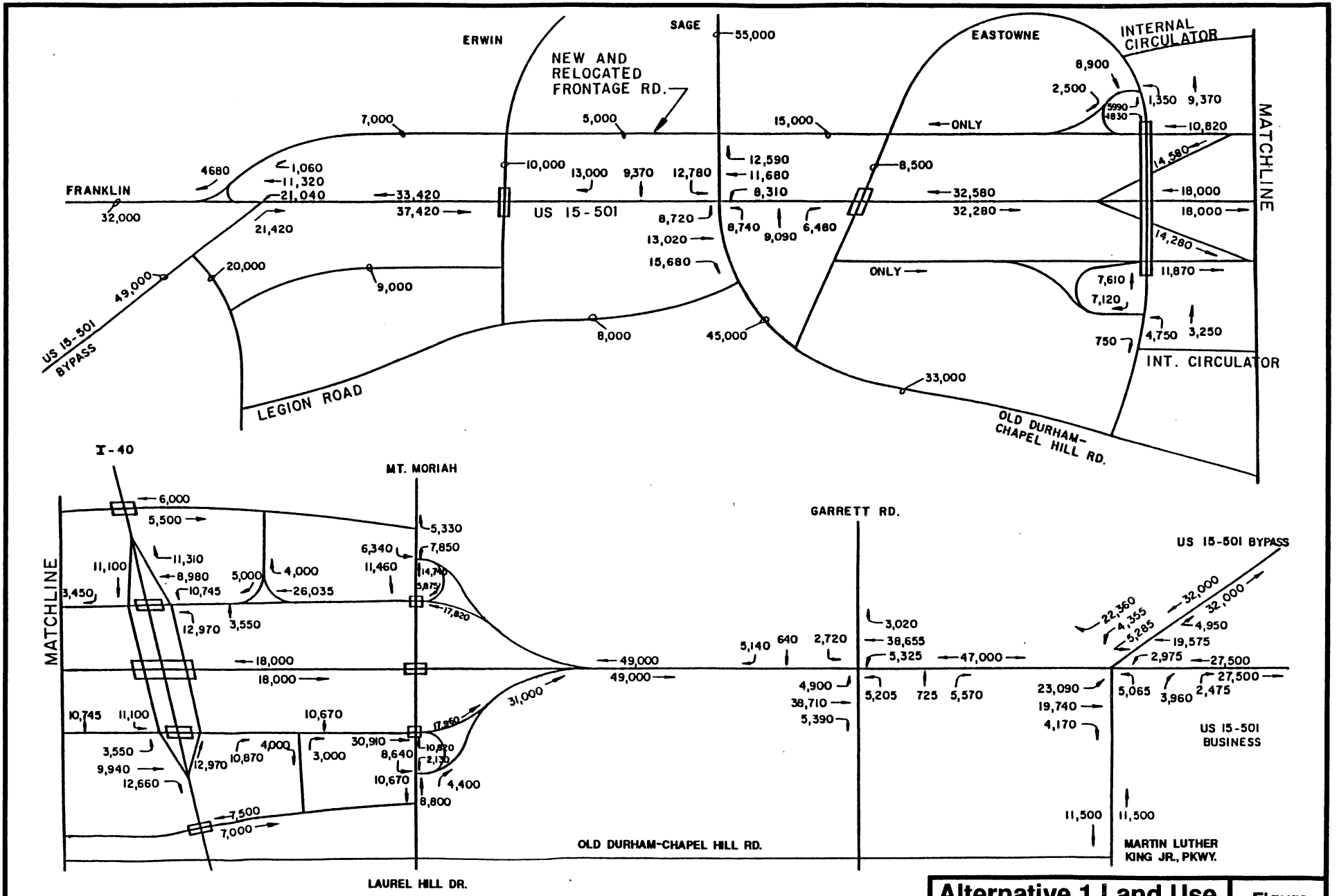
Note: This criteria applies only to mainline ramps.

Figure 4 shows worst case 2010 average daily traffic for the improved roadways (without implementation of the TDM and transit component of the plan). The following paragraphs describe the circulation patterns, typical sections of the improvements, and construction and right-of-way costs of the roadway improvement plan.

3.3.1 Circulation Patterns

The roadway plan in its complete form consists of a controlled access roadway with grade separations, interchanges, collector-distributor roads, and frontage roads. Access to all intersecting roads would be by interchanges.

In addition to US 15-501 improvements, the plan calls for a new circulator roadway system to serve traffic moving between the four quadrants of the I-40 interchange. This circulator system would reduce the number of trips through the I-40 interchange and accommodate bus, pedestrian and bicycle movements.



Note: Due to complexity, this figure has an exaggerated scale and partially illustrated geometrics.

Alternative 1 Land Use
Year 2010
Average Daily Traffic

Figure 4

3.3.2 Typical Sections

US 15-501
The detailed elements of the typical sections must be designed to meet the requirements of the NCDOT at the time of implementation.

The majority of existing US 15-501 was constructed in accordance with detail A, shown on Figure 5. However, there are variations in several areas, in particular, at and near the I-40 interchange. All future improvements to the existing typical section should be designed in such a way to maximize the use of this existing roadway and therefore minimize the loss of any interim improvements. This could reduce the cost of the ultimate improvements and cause less interference to the traveling public during the construction period.

The existing median is 30 feet wide in most places as shown in detail A of Figure 5. The recommended improvements require a 46-foot median as shown in detail B of Figure 5. This wider median and one additional lane in each direction could establish the basic laneage for the ultimate improvements and be a guide to determine the interim improvements at spot locations. In a few areas this typical section can be contained within the existing right-of-way limits. However, in almost all areas along the project, additional right-of-way will be required because of the following:

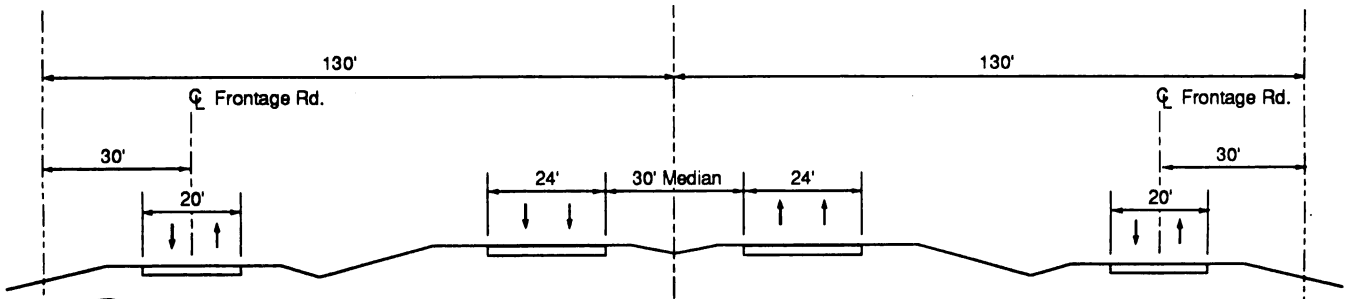
- Grade revisions along US 15-501.
- Crossroad grade and alignment revisions.
- Construction of interchange ramps and loops.
- Frontage road grade and alignment revisions.
- Collector-distributor roads at the I-40 interchange complex.
- Internal circulator system construction.

The 46-foot median is being recommended because it provides greater flexibility for future use. The implementation and staging of roadway improvements could account for future facilities. Detail C in Figure 5 depicts a light rail system (light rail is one example of fixed guideway) being placed within the median. This system would be separated from the roadway by a concrete barrier. Detail D in Figure 5 shows a single reversible HOV facility being positioned within the median. Detail E in Figure 5 reflects the construction of one additional lane in each direction, contiguous with the through lanes and separated by a median barrier. These two additional lanes could be designated as HOV during peak periods and function as normal through lanes at other time periods.

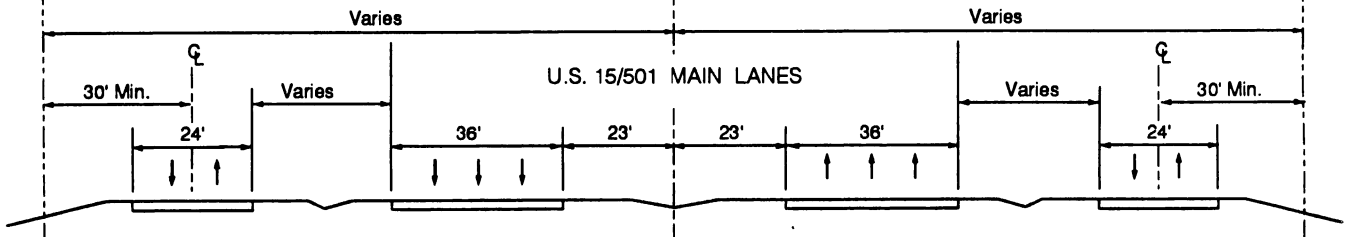
The ultimate improvements at and near the I-40 interchange require the construction of a collector-distributor system. This could require a typical section similar to that shown on detail F in Figure 5.

Crossing Streets
Crossing roadway typical sections must satisfy the traffic demand needs, especially in interchange areas, and mesh with the existing and/or proposed typical sections on the existing street system. Most crossings would be curb and gutter to reduce right-of-way needs and provide sidewalks and bikeways where justified. Detail A in Figure 6 shows a typical section that could be constructed.

Internal Circulator System
This system could enhance traffic movement by providing circulation around the four quadrants of the I-40 interchange. A typical section could be developed to satisfy the need following the standard traffic impact procedures of the two municipalities. Detail B in Figure 6 shows a preferred minimum typical section that provides two 12-foot lanes, two 4- to 6-foot bicycle lanes, curb and gutter and a 10-foot berm with sidewalk. Specific bicycle features will be detailed at the design stage in accordance with appropriate standards. NCDOT standards call for a 14-foot outside lane when providing for cyclists. Local standards recommend a 4-foot striped lane adjacent to a standard 12-foot outside lane. The need for additional lanes (including turn lanes) could be identified based on future studies and development.

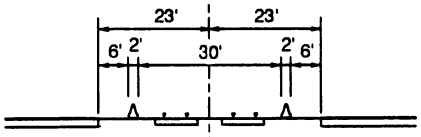


A EXISTING TYPICAL SECTION OF U.S. 15/501

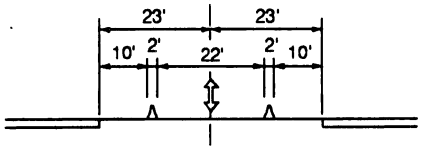


B TYPICAL SECTION OF U.S. 15/501 WITH ADJACENT SERVICE ROADS

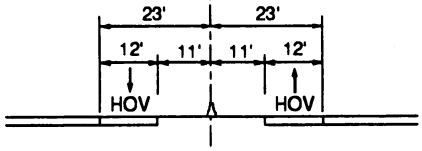
C LIGHT RAIL MEDIAN OPTION



D EXPRESS BUS REVERSIBLE HOV OPTION

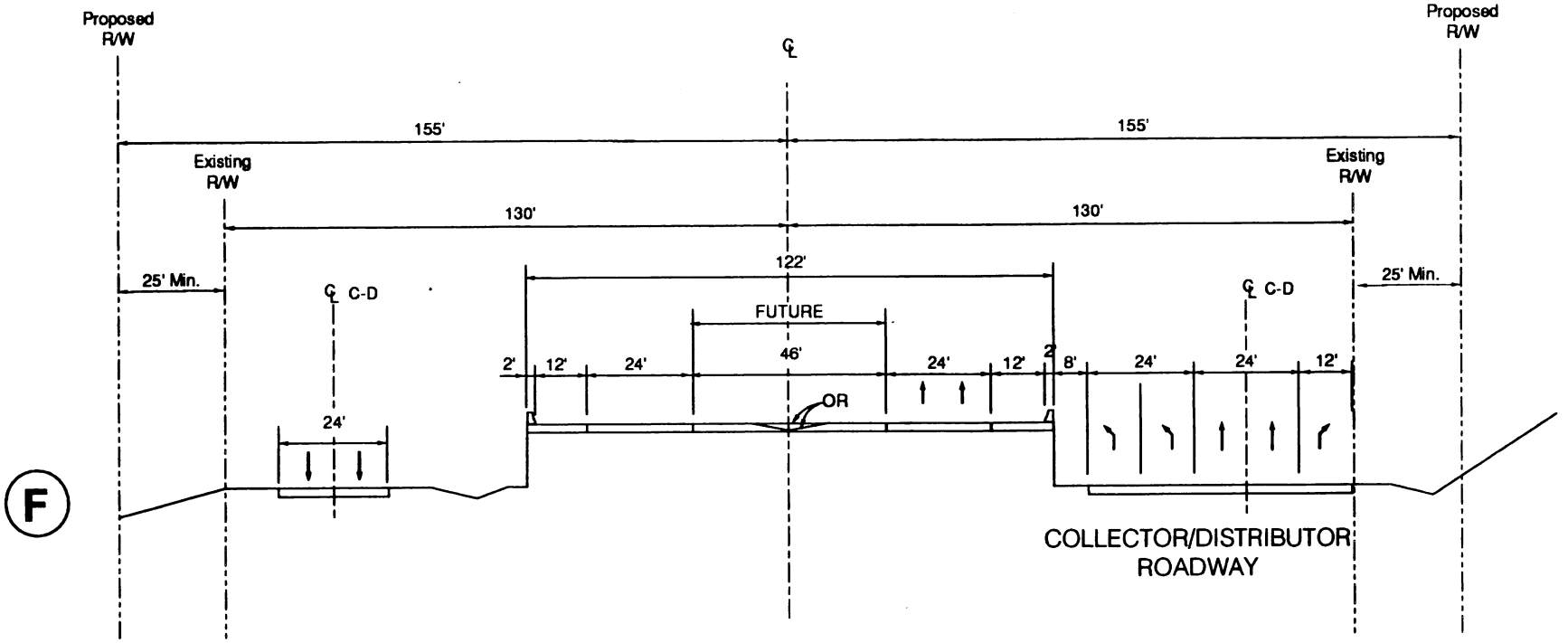


E HOV OR FREEWAY OPTION



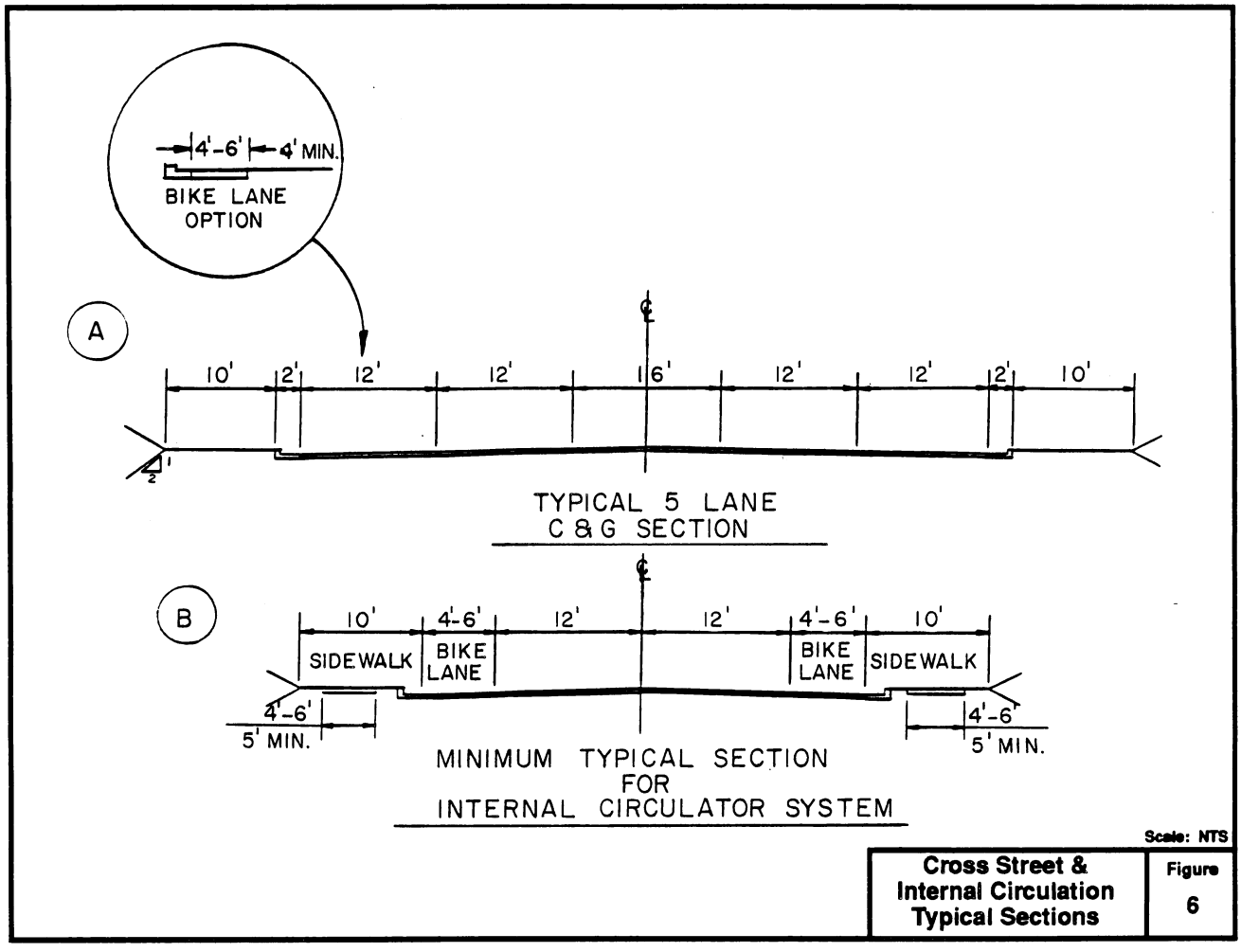
Scale: NTS

US 15-501 Improvement Typical Sections	Figure 5a



Scale: NTS

US 15-501 Improvement Typical Sections	Figure 5b



Typical sections could provide bus stops that conform to the local and regional transit systems.

3.3.3 Interchanges

The interchanges shown in the Master Plan were developed based on the existing conditions and the projected traffic demand. The most important interchange to plan for is the US 15-501 and I-40 interchange because operation at this location controls traffic performance for the two major routes in the study area.

The interchange at Sage Road consists of ramps and a loop needed to serve the high travel demand in this area. Next, the design near I-40 requires an interchange at Eastowne East, modification of the existing interchange at I-40 and an interchange at Laurel Hill Drive to serve the traffic needs. All three interchanges are served by a collector-distributor system in order to best serve the area. This system allows the ramps, loops and connections to function at lower speeds, thereby reducing the right-of-way needs to a minimum amount. At Garrett Road, a "single point" diamond interchange is proposed,

which will satisfy the traffic needs and minimize the need for additional right-of-way.

Since this project is an "urban freeway," the access ramps and loops can be designed for speeds less than normally expected on interstate freeways. Thus, a relatively high level of service can be provided at a minimum cost and need for additional right-of-way.

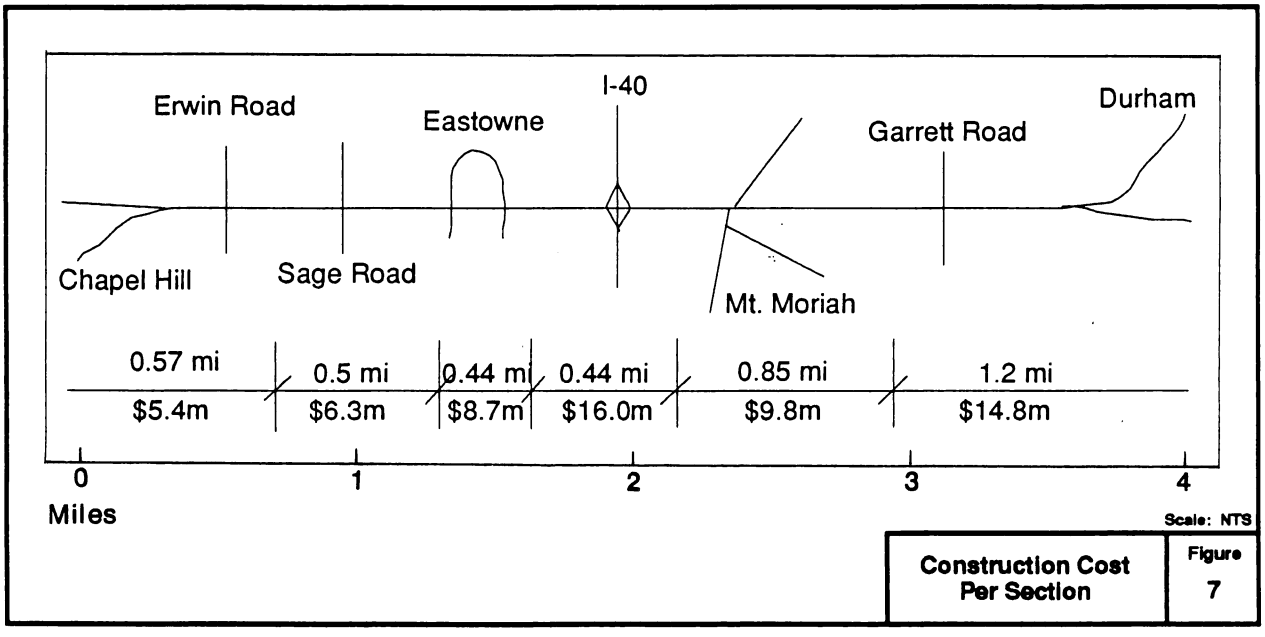
3.3.4 Other Study Area Intersections

The study also determined the future land configuration requirements for the major intersections on Erwin Road and Old Durham-Chapel Hill Road. These are listed in Appendix B.

3.3.5 Construction and Right-of-Way Cost

Construction Cost
A preliminary construction cost estimate of $61,000,000 was developed by NCDOT. It includes NCDOT's standard multipliers of 30 percent for mobilization and miscellaneous costs and 15 percent for contingencies. This cost is presented by improvement section in Figure 7. Its components are shown in Appendix C.

Right-of-Way
The right-of-way cost for the project, $21,760,000, was developed by the NCDOT Right-of-Way Branch and is summarized in Appendix C.



4 Implementation Strategy

Implementation strategies are grouped into the following categories:

1. Master Plan endorsement.
2. Establishment of a Transportation Management Association.
3. Creation of a transportation corridor overlay zone.
4. Identification of appropriate TDM and transit strategies.
5. Roadway improvement planning, including: a) refined design and environmental impact studies, b) short-term improvements and c) traffic monitoring and triggering of the design and construction process.

4.1 ENDORSEMENT

The recommendation of the US 15-501 steering committee is that the Master Plan presented herein be presented for consideration and endorsement by the Town of Chapel Hill, the City of Durham, the Transportation Advisory Committee, and the North Carolina Department of Transportation. Support of these four bodies is essential to the implementation of the plan.

4.2 TRANSPORTATION MANAGEMENT ASSOCIATION

A Transportation Management Association (TMA) or similar organization should be established specifically for the US 15-501 corridor. The association would be represented and funded by property owners, employers and public agencies. It would monitor Master Plan implementation, support the efforts of those agencies responsible for implementing various aspects of the plan, and coordinate and implement TDM actions in the corridor.

The TMA could be initially comprised of TAC members; however, long-term planning should be under the direction of a dedicated TMA group.

4.3 OVERLAY ZONE

A transportation corridor overlay zone should be established. The TMA should establish the boundary of the overlay zone. The illustrated existing and new right-of-way to accommodate the Master Plan shown in Figure 3 should be identified and protected within the transportation corridor overlay zone. By Town/City ordinances or other land use controls, the overlay zone should:

- Prohibit construction within the footprint of the urban freeway.
- Provide a means to allow development to take place provided that the orientation of the development will not compromise the urban freeway and fixed guideway systems and other aspects of the Master Plan.
- Promote transit accessibility and ridership potential, including transit-oriented development.
- Ensure that development is consistent with an internal circulation and access system that includes streets, bikeway, pedestrian and transit features.

- Identify TDM measures that would be required of development within the overlay zone (e.g., parking limits, designation of a transportation coordinator, etc.).

4.4 TDM AND TRANSIT STRATEGIES

Because the thrust of Transportation Demand Management (TDM) is to change the travel behavior of the public, a successful TDM program requires careful planning, coordination, and commitment. Experience has shown that many TDM strategies may be difficult to implement. Implementation of TDM in the corridor and the Triangle region must be considered a long-term effort, involving a partnership between the private and public sectors. Moreover, for TDM to be most effective in the corridor, strategies aimed at reducing single-occupant vehicles must be developed and implemented regionally. Therefore, TDM programs must be developed within the framework of overall land use and transportation planning for the area.

The following paragraphs describe the steps needed to implement an effective TDM program, including HOV lanes, transit improvements and bicycle/pedestrian facilities.

4.4.1 TDM Implementation

The following steps should be undertaken to initiate effective TDM in the corridor and Triangle region:

- The TAC should coordinate TDM actions requiring regional implementation with the NCDOT, the Triangle Transit Authority (TTA), and the Capital Area Metropolitan Planning Organization (CAMPO).

- Organizations similar to the TMA should be formed in other activity centers and at the regional level, or alternatively, the scope and constituency of existing organizations, such as the TAC or TTA, should be expanded to include these responsibilities.

- TDM initiatives should be developed in concert with the development of the Congestion Management System (CMS), which is being prepared in consultation with NCDOT. The Durham area is classified as an air quality non-attainment area under the 1990 Clean Air Act Amendments (CAAA) and its urbanized population exceeds 200,000. Thus, the Intermodal Surface Transportation Efficiency Act (ISTEA) requires that a CMS be developed for Durham by 1995. The CAAA mandates greater coordination between transportation and air quality planning.

- Ordinances required to implement and enforce TDM actions should be passed by local jurisdictions.

4.4.2 HOV Implementation

Based on current projections of corridor through trips, an HOV lane is unlikely to be feasible in the corridor in the near future since it would need to be part of a larger HOV system. However, future studies may determine that HOV lanes may be feasible at some time, either as part of a regional network or just for the length of the corridor. Thus, HOV implementation within the US 15-501 corridor should be limited at this time to reserving a HOV right-of-way. Provisions could be made for either:

- A single, concurrent flow lane in each direction (i.e., an additional freeway lane for HOV vehicles that is not barrier-separated from the general use lanes). Concurrent flow lanes could be implemented with or without a future fixed guideway system also within the roadway right-of-way.

Or

- A single, barrier-separated HOV lane in each direction, which would only be built if a future fixed guideway system were not built within the roadway right-of-way and only a four-lane freeway were ultimately provided. With a six-lane freeway, only a single, reversible barrier-separated HOV lane could be provided.

As part of any HOV or transit study, the potential for park-and-ride lots to support primarily express bus service (and ultimately fixed guideway transit) and ride sharing should be investigated. This could include lots at either end of the corridor to allow riders to park at one end of the corridor (e.g., in Durham) and continue their trip (e.g., to Chapel Hill) through the corridor on transit or by other forms of ride sharing.

4.4.3 Transit Implementation

Bus

Good transit service will be an essential element of any TDM program. The study estimated that a high proportion of trips to land uses within the US 15-501 corridor will originate from areas in Durham and Chapel Hill that are currently served by Chapel Hill Transit and the Durham Area Transit Authority (DATA). As development occurs in the corridor, the respective service guidelines for Chapel Hill Transit and the Durham Area Transit Authority (DATA) should be applied to determine the feasibility, coverage and frequency of local service. Both systems already serve each end of the corridor and could readily be extended farther into the corridor.

New development and roads should be designed to facilitate bus and pedestrian access and circulation. The transit agencies should be consulted during the review of major development proposals or road system improvements.

The feasibility of operating an express service along US 15-501 between Chapel Hill and Durham should be investigated by the Triangle Transit Authority. This route could either supplement or possibly replace the Blue Line operated by Chapel Hill Transit along Chapel Hill Road.

Fixed Guideway Transit

Fixed guideway transit in the corridor, in conjunction with transit-oriented development and as part of a regional transit system, has the potential to ultimately divert a significant number of automobile trips to transit. An earlier study concluded that fixed guideway transit could potentially be feasible in the corridor, if future development were channeled into a quarter-mile corridor centered along the transit alignment and the development were designed to be transit-oriented.

A transit-oriented or transit-friendly development (TOD) is one which consists of land use densities and types that can contribute to the level of ridership necessary for a transit system to be feasible and is within walking distance of a transit stop or station. The layout and design of the TOD must facilitate easy pedestrian access from all parts of the development to the stop or station. Densities would be higher in the immediate environs of the stop or station, and must be significantly higher for fixed guideway than a bus system.

Without more detailed land use, transit and environmental planning, the preferred location of a fixed guideway alignment cannot be determined. Such an alignment could be within the US 15-501 right-of-way, or pass through development on one side of US 15-501. A fixed guideway study currently being prepared for the Triangle Transit Authority will evaluate the potential for fixed guideway transit in the corridor, and may identify the preferred location of an alignment within the corridor. It also will identify development densities and land use types required to make fixed guideway transit viable.

At this time, the following actions should be undertaken to provide for fixed guideway transit within the median of US 15-501:

- Reserve a roadway right-of-way width that allows for a future fixed guideway to be installed within the right-of-way if future studies demonstrate this is the preferred alignment in this corridor. This right-of-way could provide for either barrier-separated HOV lanes or fixed guideway transit. If fixed guideway were implemented within the right-of-way, barrier-separated HOV lanes would not be implemented. Additional right-of-way could be required for stations and other design features depending on the final design of the fixed guideway system.

- Modify the Master Plan, if required, based on the outcome and recommendations of the TTA's fixed guideway study.

- Require future development to be transit-oriented for bus access initially. Transit-oriented development for fixed guideway should be required if the TTA's fixed guideway study designates the corridor as a fixed guideway corridor.

4.4.4 Bicycle/Pedestrian Facilities

Chapter 3 describes the bicycle and pedestrian facilities that should be incorporated into the Master Plan. As part of the TDM strategies and under the guidance of the TMA, any improvements to the roadway network should include the addition of bike lanes as discussed in Chapter 3. Sage, Erwin and Garrett Roads are designated for future bicycle systems. If possible, independent bicycle projects beyond the confines of the transportation overlay zone should be constructed in order to enhance and confirm bicycle route continuity.

4.5 ROADWAY IMPROVEMENTS

The construction of the roadway component of the US 15-501 Master Plan should occur in the stages illustrated in Figures 8 and 9. These stages follow a path of spot intersection improvements, then the addition of expressway lanes and service roads to US 15-501, and construction of each new interchange as warranted by traffic demand.

The timing for the implementation of the components of each phase hinges on observed and forecasted growth, site specific development trends, and the effectiveness of Transportation Demand Management (TDM) strategies.

Interchanges should be added along US 15-501 based on independent need. Interim improvements could tie ramps and loops directly to US 15-501 (see Figure 9) until reconstruction of the I-40 interchange and the associated collector-distributor road occurs. Until the time at which the I-40 interchange is converted as illustrated in Figure 3, the project would function as an expressway.

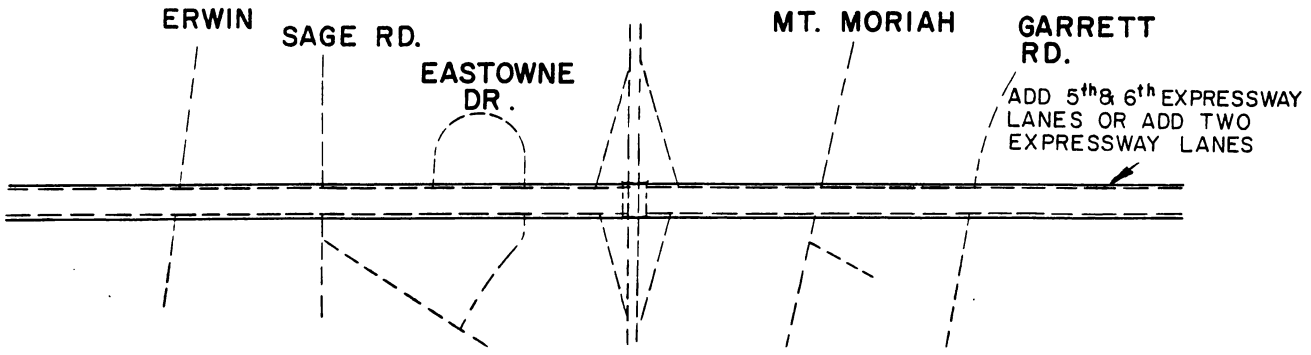
Depending on future traffic and the effectiveness of transit and other TDM measures, the roadway improvement elements should proceed as follows:

1. Improve intersections by adding turn lanes and improving signals.

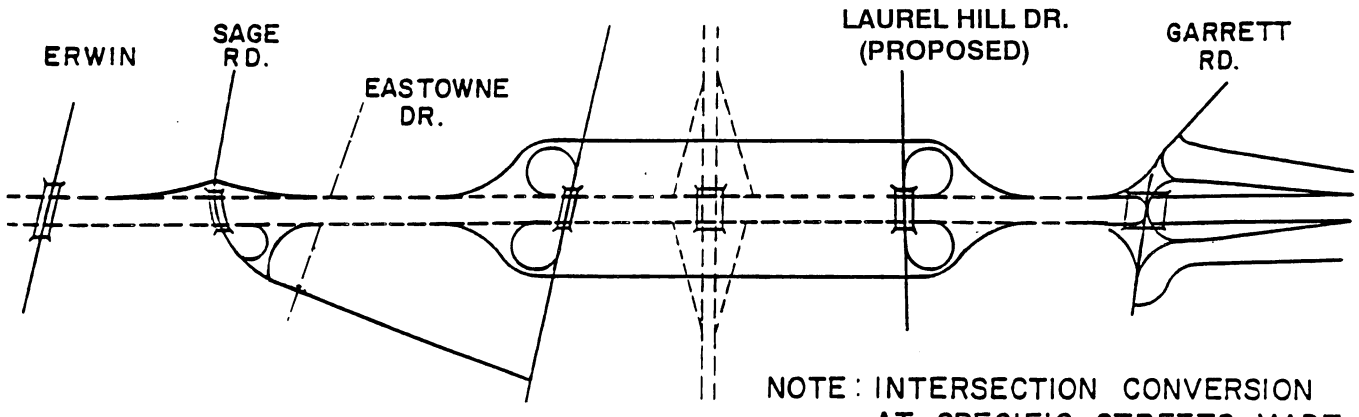
2. Add the fifth and sixth expressway lanes to the project.

3. Construct spot interchanges at problem locations according to triggering volumes and shorter-term traffic impact evaluations.

4. Depending on location, construct additional frontage roads as shown on the Master Plan.

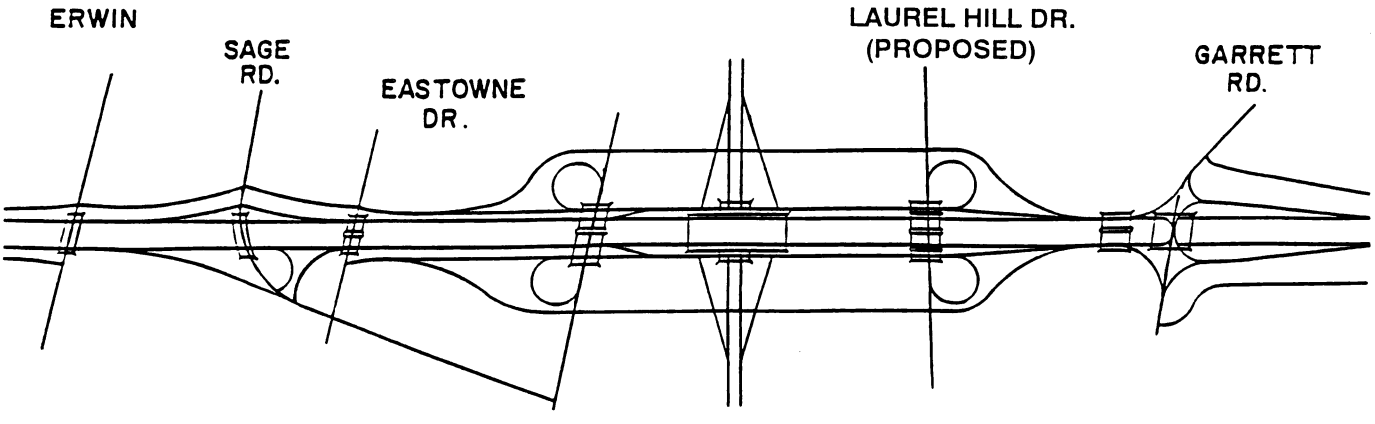


STAGE 1 - ADD EXPRESSWAY LANES



NOTE: INTERSECTION CONVERSION AT SPECIFIC STREETS MADE ACCORDING TO TRIGGER VOLUMES

STAGE 2 - INTERSECTION ELIMINATION

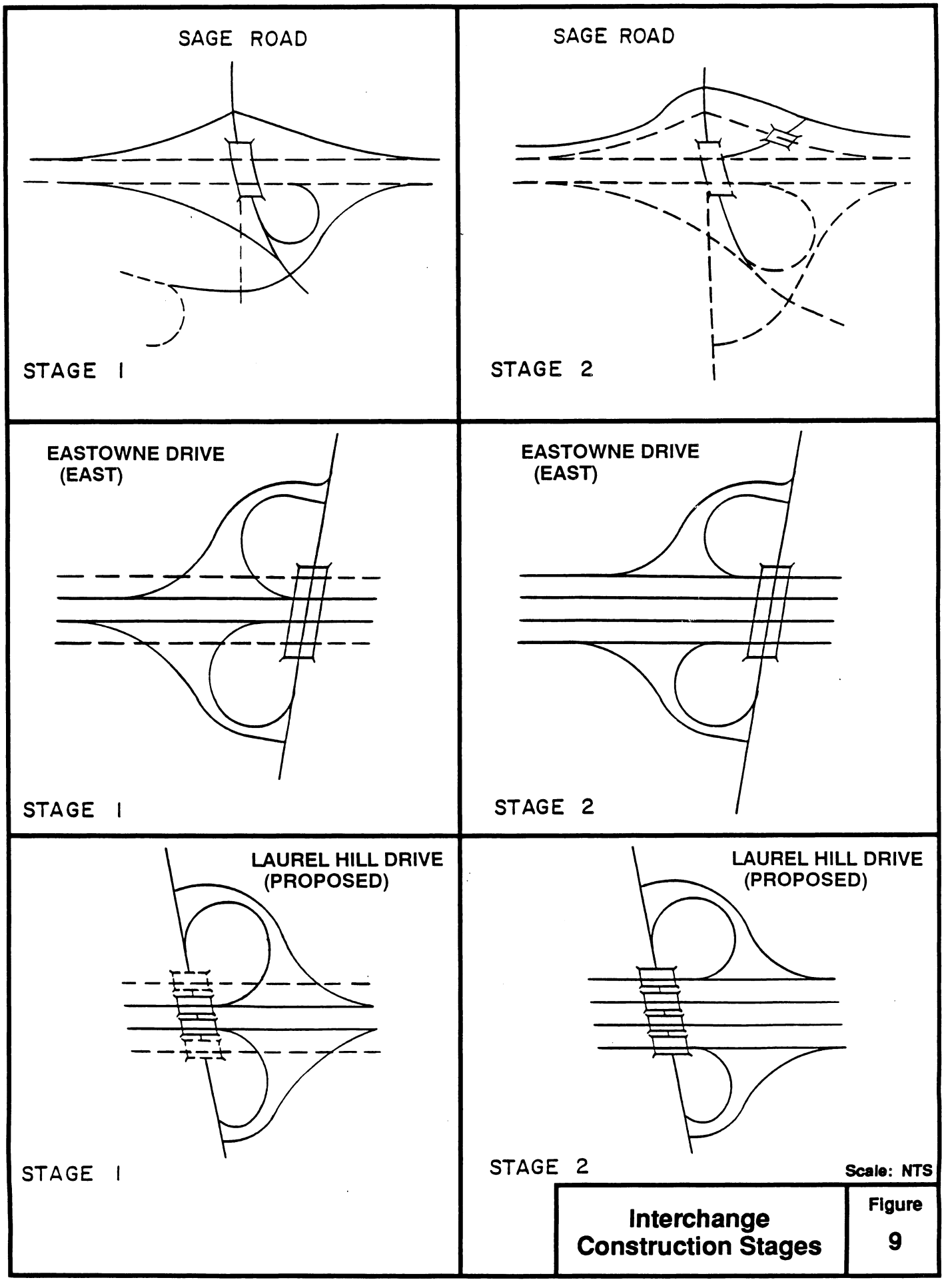


STAGE 3 - I-40 INTERCHANGE CONVERSION AND FULL IMPLEMENTATION

Scale: NTS

Roadway Construction Stages

Figure **8**



Interchange Construction Stages

Figure 9

5. Construct the internal circulator roads and bridges across I-40 and thereby complete the system surrounding the I-40 interchange.

6. Reconstruct the I-40 interchange with collector-distributor roadways and complete any additional remaining aspects of the project. At this time the project will become an urban freeway.

It is noted that items 3, 4 and 5 are highly dependent on development and therefore could occur in different sequence or happen simultaneously.

4.5.1 Refined Design and Environmental Documentation

Before major roadway improvements can be implemented, the NCDOT must refine the conceptual plan of Figure 3 in order to prepare the necessary environmental documents.

For the roadway design elements, the engineering concepts of the Master Plan will need expansion and detailing to include ground control surveys, photogrammetry and development of preliminary plans to sufficient detail that more precise environmental impacts can be defined. It is assumed that the design will follow NCDOT procedures.

It is envisioned that the environmental document will be prepared for the implementation of the ultimate roadway plan. Isolated interchange additions and other capacity improvements can then be staged depending on the effectiveness of TDM and trigger volumes. Supplemental environmental documents will be prepared as required by the Federal Highway Administration and according to National Environmental Policy Act regulations.

4.5.2 Short-Term Improvements

US 15-501 is presently operating at a poor level of service and needs improvements at existing intersections, in particular Sage and Erwin Roads in Chapel Hill and Garrett Road in Durham. It is suggested that improvements to the intersections include addition of turn lanes at major intersections with signal improvements and that these features be implemented immediately. These improvements may not require environmental studies.

4.5.3 Triggering Mechanisms for the Roadway Improvements

A more detailed discussion on when to plan for (trigger) and implement phases of the Master Plan is provided in Chapter 7. The results of this study indicate that a critical point is reached when the average volumes of the intersecting roadways total 75,000 vehicles per day. When short-term forecasted volumes at intersections approach this level, a decision must be made whether to continue the project as an expressway by addition of expressway lanes or to convert the intersection to an interchange. The short-term projections should be based on a planning horizon of about seven years. This duration would allow adequate time to effect programming, design, environmental documentation, right-of-way acquisition and construction. From short-term studies near I-40 (Chapter 5) and observed existing volumes, it appears that planning should begin now to provide interchanges at Eastowne Drive (East), Mt. Moriah Road (Laurel Hill Drive) and Garrett Road.