6 Options Charrette

On May 24 and 25, 1993, a charrette was held to examine options for managing future travel demand on US 15-501 that could reduce the need for increases in the road's traffic capacity. Both traditional and non-traditional methods were presented by experts in the field of travel management and discussed with charrette participants. Participants in the charrette included the steering committee and other representatives from the sponsoring communities, land owners and interest groups. The objective of these discussions was to select several promising options that were to be tested for their ability to manage travel demand in the US 15-501 corridor.

The charrette involved direct interaction between the participants in an intensive work session so that decisions could be made in a short time frame. The charrette consisted of three parts:

1. Presentation of needs, the highway-only alternative and other non-traditional travel management alternatives for meeting those needs. Non-traditional travel reduction alternatives included: transportation systems management methods, congestion management techniques, Transportation Demand Management (TDM) methods, and transit and transit-oriented development (TOD).

2. Division of the charrette's participants into six teams of approximately eight members each. In addition, to interest group and government representatives, each team included a designated leader and transportation planning experts. Each team was asked to discuss solutions to the corridor's transportation problems. A questionnaire was used by the leaders of each team to help each team form its opinion or position. At the end of the working session, each team leader presented the team's findings to the charrette participants and the study facilitator. Discussion of the highway-only alternative and the other alternatives that appeared to have merit for further consideration.

3. Meeting of the steering committee was held following the charrette to give the study team direction on how to proceed.

6.1 PRESENTATION

The charrette began with the presentation of the base conditions information described in the previous chapter. The findings of the first two steering committee meetings were reviewed. It was noted that the steering committee was seeking:

- A clear decision in regard to the acceptability of an urban freeway solution to meeting travel demand.

- A list of potential means for reducing the extent of needed roadway improvements.

- To endorse for inclusion in the Master Plan, those measures for reducing the extent of roadway improvements that appear to have merit.

- To obtain support for the Master Plan from the area's local elected officials.

Next, the travel reduction strategies described below were presented.

6.1.1 <u>Transportation System Management</u>

The focus of this presentation was on High Occupancy Vehicle (HOV) lanes. HOV lanes are lanes set aside for use by buses and/or automobiles and light trucks carrying two or three or more occupants. When there is a substantial delay on other lanes, they provide an incentive for persons to car pool or use buses by providing a less congested lane exclusively for their use. This in turn reduces the total number of vehicles on the road. The location of HOV lanes is traditionally in the centerline of a median. For urban freeway operations, exclusive ramps are provided at interchanges for HOVs. A regional commitment to their use, not just isolated use is required for HOV lanes to be successful. In addition, park and ride facilities (where persons transfer from single-occupancy vehicles to buses) are often provided.

It was noted that under current projections, which include a relatively low proportion of through trips on US 15-501, an HOV lane within the study limits would be too short to be successful but could be a useful part of a larger system of such lanes. If future modeling or other data shows that the proportion of through trips is in fact higher, or if there is a significant directional bias in the peak periods, an HOV lane contained within the corridor may be feasible. However, typically HOV lanes in short corridors are not feasible without serious congestion and controls on single-occupancy vehicle parking. It was suggested that providing additional median width to accommodate future HOV lanes seemed practicable.

6.1.2 Congestion Management Strategies

The purpose of congestion management strategies is to ensure that highway facilities are used efficiently, i.e., they operate at their theoretical capacity. Congestion management strategies include:

- Incident (e.g., accident and disabled vehicle) detection, surveillance and management.
- Motorist information systems (e.g., warning of conditions ahead, information on alternative routes).
- Controlling traffic demand through such techniques as ramp metering or congestion pricing (e.g., increasing tolls on a toll facility during peak traffic periods).

Congestion management will not, however, increase the theoretical capacity of facilities and the sizing and design of highways generally assumes that incidents that aggravate congestion are rare events.

Intelligent Vehicle Highway Systems (IVHS) systems were also described. IVHS does have the potential to increase highway capacity through use of a new sensing technology that allows vehicles to travel closer together. These technologies are, however, still in the experimental stages and their practical application is unknown.

6.1.3 Transportation Demand Management (TDM)

The focus of this discussion was on ways to use the existing and future transportation infrastructure more efficiently by reducing travel demand though changes in the behavior of travelers. Transportation Demand Management (TDM) strategies can include:

- Employer trip reduction ordinances implementing incentives to reduce the number of single-occupant vehicle (SOV) trips by employees, particularly during peak travel periods.
- Ordinances containing developer incentives and disincentives to build developments that support the regional creation of HOV lanes, park and ride lots and fixed guideway transit.
- Incentives for ridesharing (carpooling and vanpooling).
- Improved transit service and employer-subsidized transit passes.

- Priority treatments for ridesharers (e.g., HOV facilities)
- Parking restrictions and changes in parking pricing.
- Pedestrian and bicycle facilities.
- Changed work hours (flextime).
- Telecommuting.

TDM strategies are described in Appendix A.

The following key points were made regarding TDM:

- TDM is not new and has been in existence for at least 50 years. Many businesses use TDM, e.g. express check out lines at retail stores, telephone peak hour pricing, etc.
- Time and money are the critical items that influence travel behavior.
- Many local governments have a growing experience with trip reduction strategies.
- Changes in legal requirements (ordinances) may be needed, e.g. new parking restrictions, changes in charges for parking and allowances for HOVs. For example, carpooling and transit use increases as parking charges increase. Single-occupant vehicle rates decrease as parking charges increase.
- TDM results depend on the individual situation, including travel patterns, employer/employee work arrangements and commute benefits, the level of congestion, and the availability of transit services. Spending money is not the key to employer sponsored incentive programs. Two different employers with the same single-occupant vehicle rate can have very different programs.
- Small peak-hour trip reductions in the range of one to four percent are possible when only voluntary programs are applied. Larger reductions are possible with mandatory programs that include financial incentives. Some researchers argue that as much as a 30 to 40 percent reduction in commute trips is possible for a work site if mandatory programs are executed with strong incentives.

6.1.4 Transit

Currently Chapel Hill Transit provides bus service as far east as Eastowne, while the Durham Area Transit Authority (DATA) service extends south along US 15-501 to Garrett Road. The Blue Line is operated by Chapel Hill Transit between the University of North Carolina at Chapel Hill and Duke University in Durham. With future development in the corridor, it is likely that service will be extended and increased. In this respect the corridor is well situated to benefit from existing transit service.

The US 15-501 corridor between Chapel Hill and Durham was also one of several analyzed for fixed guideway transit feasibility in a 1990 study (*Research Triangle Regional Transit/Land Use Study*, conducted by Barton-Aschman Associates, Inc. for the North Carolina Department of Transportation). The study concluded that although the 2010 forecast land use in this corridor would not support fixed guideway transit, it could potentially be feasible if projected growth in a two-mile corridor were channeled into a quarter-mile corridor.

A fixed guideway transportation planning and analysis study currently under way by the Triangle Transit Authority will identify feasible fixed guideway corridors in the three-county Research Triangle region. The potential for fixed guideway in the US 15-501 corridor will be determined by this study, and if feasible, supportive land use patterns will be identified. This two-year study has the following specific objectives:

- Identify future land development patterns in the region that minimize the need for travel and support transit utilization.
- Identify development densities and land uses at potential growth centers required to make fixed guideway transit viable and that are market supportable.
- Identify appropriate transit corridors, technologies, and transit operating plans to serve these centers.
- Develop a system plan, including a financial and regional transit organizational plan.
- Develop broad-based consensus in the public and private sectors for the required development patterns and densities, and transit corridors.

The viability of transit is highly dependent on the type, density, and arrangement of land uses. The need for the Fixed Guideway study is a result of growing concern that the quality of life in the Triangle Region is being adversely affected by increasing congestion that will worsen if current trends continue. There is now a recognition that increasing traffic congestion in the Region is a consequence of an urban form characterized by widely-dispersed activity centers, interspersed with low density employment and housing. This form of development is highly dependent on the automobile for mobility, requiring new road construction. Road construction is increasingly expensive and perpetuates urban sprawl and increasing average trip length. Increasing auto use and congestion has also contributed to the region's air quality problems.

Low-density development and dispersed travel patterns cannot effectively be serviced by transit. In seeking solutions in alternative forms of transportation, it has become increasingly clear that there must be significant changes in urban development patterns if transit is to help alleviate some of the region's problems. Because of the substantial growth projected for the corridor, an opportunity exists to shape future development to make transit a viable transportation alternative. The challenge will be the ability to channel this growth, adopt supportive zoning, planning, design and infrastructure policies, and to integrate and balance the land use planning and transportation processes and objectives.

The focus of the transit presentation was on the densities required to generate a reasonable level of transit ridership. Key points were:

- Research has shown that total trips decrease and transit trips increase with increased land use density, i.e., how land is developed has a significant effect on travel behavior.
- Residential densities of six units per acre begin to support transit service, 12 units per acre allows a high level of service to employment centers.
- At residential densities of 24 or more units per acre, walking and transit trips may exceed auto trips.
- A two-million square foot employment center with a high floor area ratio supports the lowest level of transit service. An employment center of 20 million square feet is the minimum threshold for light rail.
- Mixed land uses better balance the number of trip attractions (to destinations) and productions (from origins). The mix must include employment, retail and residential. Internal trip making, of which a high proportion could be pedestrian trips, also can be maximized by mixed use development.
- The design of development is critical to make it pedestrian friendly and transit accessible.

- Travel can be diverted to transit without requiring people to forgo housing preferences, as demonstrated in the *1000 Friends of Oregon* (Portland) study. This study found that it is the location of the housing and jobs that is critical. It also showed that rearranging projected growth can significantly reduce total vehicle trips.
- The Triangle has numerous examples of housing developments and employment centers that would support a high level of transit. They are, however, scattered about the region.

Various transit technologies, such as express bus and light rail transit, were reviewed for their possible application to the corridor.

6.2 DISCUSSION GROUP AND OTHER PARTICIPANT OBSERVATIONS

Following the presentations on travel reduction strategies, their applicability to the study area was discussed by the six groups of charrette participants and then with the participants as a whole, as described above. The following observations and conclusions related to roadway type, Transportation Demand Management (TDM), high occupancy vehicles, and land use and transit resulted from these discussions.

6.2.1 Roadway Type

The general consensus of the participants was that US 15-501 should be able to satisfy travel demand. The general feeling was that US 15-501 should be improved as an urban freeway if the volumes indicated the need. There was also uniform agreement that improvements to US 15-501 should be made instead of increasing capacity on major parallel facilities (Erwin Road and Old Durham-Chapel Hill Road).

The majority of the work groups felt that US 15-501 should be the same type of roadway on both sides of I-40. One group suggested that the urban freeway should be endorsed in Chapel Hill; however, an expressway should be built first. It would be upgraded to an urban freeway only when volumes and congestion increased to intolerable conditions. The logical location to transition from an urban freeway to expressway was identified as the Eastowne entrance closest to I-40. An interchange would be needed at that location.

6.2.2 Transportation Demand Management (TDM)

It was recognized that TDM could not serve as "the " solution but could be an element within a larger package of transportation improvements. It could help reinforce other strategies, e.g., transit, HOV.

There was an apparent preference for a mandatory TDM program to reduce the magnitude of the roadway improvements required in the study area. This TDM strategy should not be limited to the study area but should include a larger region. There was some willingness on the part of charrette participants to accept a regulatory incentive based approach. Concern was expressed, however, about potential disparities between regulated and non-regulated areas, as well as who would have implementation responsibilities.

It was acknowledged that TDM strategies are more applicable for work related trips than non-work commercial (shopping) trips. There was interest in setting a vehicle trip reduction target for employers (and developers) and giving them a menu of strategies for meeting it. There was an interest in exploring the potential for local governments to allow greater development densities, a reduced number of parking spaces, special design considerations, provisions for other modes, etc., if they are accompanied by TDM actions.

6.2.3 High Occupancy Vehicle Lanes

It was agreed that an HOV lane has limited potential to reduce trips in the corridor. The corridor is too short; current data suggests the proportion of through trips appears too low to support a HOV lane; and the direction of traffic flow is equally distributed in the peak hours. It also was agreed that HOV lanes (both location and mode) should be studied in a regional context in the future. A regional HOV network might include the US 15-501 Bypass in Durham (perhaps to I-85), the US 15-501 study corridor east of I-40 and I-40 east towards Raleigh. It was agreed that space for an HOV lane should be included in the right-of-way of any major US 15-501 improvement.

6.2.4 Land Use and Transit

The charrette participants felt that the study area is in a good location for transit service from Chapel Hill, Durham and the Triangle Transit Authority. A very high proportion of the trips to the study area appear to come from the built-up areas of Chapel Hill and Durham. It was agreed that provisions for future fixed guideway transit should be included in the US 15-501 roadway improvement plan, but like HOV, it should be studied and developed at the regional level. It was also observed that the internal circulator roads included in the highway-only alternative would improve bus access to corridor development, as well as pedestrian and bicycle movement. It was agreed that buses using such roads also should be able to cross US 15-501 to further enhance bus access and to provide for bus service between development and future fixed guideway service.

The charrette participants noted that the major land use issues related to transit feasibility are density, mixed use and amenities associated with transit use. In addition, it was felt that a high proportion of large scale retail (beyond what is required to support local residents and employees) is not conducive to transit use. Thus, more consideration should be given in the future to land use type as a part of study area planning. Finally, it was felt that higher development densities may be acceptable in certain defined locations, if the purpose was to support transit. A buffer may have to be provided between these areas and single-family housing.

6.3 STEERING COMMITTEE INSTRUCTIONS TO THE STUDY TEAM

At the end of the charrette, the steering committee assembled and voiced the following thoughts and concerns:

- The traffic model was not providing a reliable estimation of through trips (which could affect the assessment of the feasibility of HOV lanes in the corridor). There was a lingering doubt that future traffic volumes would be as great as the traffic model forecast. It was asked if the assumption that the study area was fully developed by 2010 might be unreasonable and contributing to traffic forecasts that were unreasonably high.

- There was a request that the interchange concept for Laurel Hill Drive, which was presented in the highway-only alternative, be compared with an alternative concept that would not bisect the proposed Wal-Mart site.

- It was felt that the Master Plan should include the use of TDM strategies, and that an implementation strategy should be developed as part of the Master Plan. The implementation strategy would identify the traffic volumes that will trigger construction of the various components of a roadway improvement plan. In that way, roadway improvements would be built only if they are needed.

- It was requested that the Master Plan should consider provisions for transit alternatives.

The steering committee then instructed the study team to proceed with the following tasks:

1. A sensitivity analysis that would address the issues raised regarding the performance of the traffic forecasting model. The team was instructed to model future traffic three more times using the following different assumptions:

   - No new development within the study area, in order to identify the influence of future development within study area on future traffic. Development elsewhere in the region was assumed to continue.

   - Only 70 percent of the land in the study area develops by 2010. Even if this level of development does not occur until after 2010, it will occur sometime after that and should be planned for given the limited opportunities for other roadway improvements in the study area.

   - The study area is 100 percent developed by 2010 and US 15-501 is improved as an expressway (at-grade intersections) rather than as an urban freeway (interchanges).

2. Prepare a comparison of the interchange concept for Laurel Hill Drive that was presented in the highway-only alternative and an alternative concept that would not bisect the proposed Wal-Mart site.

3. Prepare study conclusions and Master Plan recommendations.

7 Master Plan Development

7.1 LEVEL OF DEVELOPMENT AND TRAVEL DEMAND MANAGEMENT SENSITIVITY STUDY

This analysis consisted of two parts. The first analysis was to test the effect on US 15-501 improvement needs of travel reductions that might result from implementation of one or more travel reduction strategies, including transit. Second, the TRANPLAN model was run for the three land uses and network alternatives requested by the steering committee; no new development in the study area; 70 percent development; and 100 percent development with US 15-501 coded in the model as an expressway instead of a freeway.

7.1.1 Effectiveness of Travel Reduction Strategies

The focus of this analysis was on estimating the range of potential travel reductions that could be achieved with Transportation Demand Management (TDM) and transit strategies.

Trip Reduction Strategies
Trip reduction strategies were categorized into three groups:

1. TDM.
2. Intensive transit service/fixed guideway with transit-oriented developments (TODs).
3. Bicycling.

TDM. The following table gives a range of trip reductions that have been found to be achievable based on TDM case studies of suburban locations.

• Voluntary Modest Program	2% (1-4%)
• Typical Regulatory Program	6% (3-9%)
• Aggressive Mandatory Program	20% (10-30%)

Trip reduction strategies are mostly targeted for peak-hour travel and in particular home-to-work trips. The following discussion applies to travel reduction within the peak hour.

The TDM programs examined included a range of TDM strategies that have been implemented elsewhere on a regional basis. The above reductions can be applied to all US 15-501 peak-hour work trips since it is assumed and recommended that a variety of TDM strategies be applied regionally with the support of all the major local governments and other relevant agencies.

Intensive Transit Service/Fixed Guideway With TODs. Following the charrette, the technical experts agreed that a 1991 study undertaken for the suburban areas of Middlesex, Somerset, and Mercer Counties in New Jersey (MSM study) could provide the best estimate of the likely impact of fixed guideway transit, in conjunction with transit-oriented development, on traffic generation within the corridor (*The Impact of Various Land Use Strategies on Suburban Mobility*, prepared by Howard/Stein-Hudson Associates for the MSM Regional Council, 1991). The primary goal of the MSM study was to test the hypothesis that new growth can be concentrated in such a way as to reduce vehicle miles of travel and attendant congestion.

The study tested the vehicle trip reduction potential of three development patterns termed "constructs", including a transit construct. The transit construct included intensive, high density, mixed use development anchored between a rail transit hub and major highway. Employment and town services were clustered along a main street, while residential areas were connected through a grid pattern for easy pedestrian and bicycle access. The jobs-to housing ratio was assumed to be greater than 2.0 to encourage working and living inside the "town." Floor/area ratios were assumed to be higher than current suburban standards.

Based on the MSM study results, it was concluded that for the US 15-501 corridor major, mixed-use, high density transit-oriented developments (TODs) served by fixed guideway transit (the transit construct) could reduce all peak hour vehicle trips generated by the development by up to 25 percent. This assumes that the TOD area is one of a series on a fixed guideway route. A minimum reduction of 10 percent could be expected with a high level of transit service (not necessarily fixed guideway) and good pedestrian access to the service. The current percent of trips by transit is seven percent and two percent within Chapel Hill and Durham, respectively.

These reductions could translate into an approximately 5 to 10 percent reduction in peak hour work trips in the US 15-501 corridor (in addition to the TDM programs) and a 5 to 15 percent reduction for all other peak hour trips in the corridor.

Bicycling. It was estimated that bicycle use could reduce peak-hour trips by three to four percent of the total corridor trips if the appropriate facilities and amenities are provided. Higher rates (8 to 12 percent) could possibly be achieved by complementing bicycle facilities with TDM and land use strategies. However, studies have shown that bicycle use on rainy days declines by 20 to 50 percent. Since the typical TDM package includes support for bicycling, a range of three to five percent is probably reasonable for all non-work peak hour trips (in addition to TDM reductions which assume relatively high bicycle usage).

Total Potential Reductions

The following potential reductions can therefore be applied to the forecasted peak hour trips for the US 15-501 corridor:

- Work Trips

TDM	2-20%
Intensive Transit/Fixed Guideway with TOD	5-10%
TOTAL	7-30%

- Non-Work Trips

Fixed Guideway/TOD	5-15%
Bicycle	3- 5%
TOTAL	8-20%

The high end of the range for all strategies should be considered very optimistic and long term, requiring dramatic shifts in attitudes on the part of the public, government, employers, and developers. The high end reductions further assume that:

- The relevant agencies adopt, support and enforce a full range of effective TDM strategies.
- The strategies are applied regionally (i.e., throughout the Triangle).
- A fixed guideway transit system is operating in the corridor, desirably with support from regional feeder bus services.
- Other facilities are provided, including bicycle paths, pedestrian facilities and park-and-ride lots.
- Future development is pedestrian and transit-oriented in terms of mix, location, density, and design. The maximum opportunity should be provided for residents to work, shop and participate in other community or recreational

activities and for employees to conduct personal business, shop and eat lunch without leaving the area. There should be convenient pedestrian and feeder bus access to fixed guideway transit stations with high density development in the immediate area.

- The highway system is congested, thus providing an incentive for using alternative modes to the single-occupant vehicle.

Application of Reduction Rates to Peak Hour Trips
Since trip reduction strategies typically have the greatest effect on peak hour work trips, peak hour work trips as a proportion of the average daily traffic (ADT) were estimated to be:

- A.M. peak hour - 8.0% of ADT
- P.M. peak hour - 9.0% of ADT

Total peak hour work trips were determined based on findings reported in the National Cooperative Highway Research Program Report 187 *Quick-Response Urban Travel Estimation Techniques and Transferable Parameters*. The following breakdown of trips apply in the corridor:

- Approximately 20 percent of all daily trips were considered home-based work (HBW).
- Approximately 20 percent of all HBW trips occur in the A.M. peak hour. Therefore, A.M. peak hour HBW trips represent four percent of all daily trips, or 50 percent of the A.M. peak hour trips.
- Approximately 14 percent of all HBW trips occur in the P.M. peak hour. Therefore, P.M. peak hour HBW trips represent 3 percent of all daily trips, or 33 percent of the P.M. peak hour trips.

Application of the potential trip reduction factors to the peak hour trips for an ADT of 100,000 results in the following overall reductions:

	A.M.	*P.M.*
Total peak hour trips	8,000 (8% of ADT)	9,000 (9% of ADT))
Work trips	4,000 (4% of ADT)	3,000 (3% of ADT)
Non-work trips	4,000	6,000
Reduction in Work trips (7-30%)	280-1,200	210-900
Reduction in Non-work trips (8-20%)	320-800	480-1,200
Total Peak Hour Trip Reduction	600-2,000	690-2,100
% Peak Hour Reduction	7-25%	8-23%

The highest volumes with or without trip reduction would occur in the P.M. peak hour. Therefore, the P.M. peak hour volumes should be used for future roadway planning purposes (with an appropriate directional split factor).

The proportion of work trips that offer the greatest potential for diversion to alternative modes was estimated in this analysis from a national study. If the proportion of work trips for the US 15-501 corridor is higher than one half in the A.M. peak hour or one third in the P.M. peak hour, then potential trip reduction factors could be higher.

7.1.2 Sensitivity of Traffic Demand to Development Levels and Road Improvements

Analysis
To assess the effects of differing development scenarios and highway road networks the following steps were followed:

1. TRANPLAN coding for land use and type facility and re-running of the TRANPLAN model.

2. Reduction of trips by using the results of the TDM effectiveness study described in the previous section.

3. Determination of roadway lane needs as a function of demand and practical capacity.

Traffic Forecasts. The results of the new traffic modeling are shown in Table 3. As expected, they show that the more intense land uses produce higher travel demand. Compared to the no-growth alternative, the full development alternative would produce increased trip rates in the range of 20 percent to 40 percent. The 70 percent development scenario showed increases ranging between 15 percent and 30 percent. The expressway coding for 100 percent development resulted in traffic projections approximately 7 percent to 20 percent lower than urban freeway coding.

TDM Trip Reductions. The TDM trip reduction study described in the previous section concluded that capture rates between 8 percent and 23 percent for the peak hour were achievable.

Number of Lanes and Roadway Type. Tables 4 to 7 show the TRANPLAN results, TDM capture rates (high and low), and roadway type and number of lanes for the major segments of the US 15-501 corridor under a "system" level of analysis adequate to evaluate roadway type (i.e., freeway vs. expressway). Determination of roadway type and general lane requirements was accomplished by beginning with ADT and converting it to one way, design hour volumes. A design hour volume (DHV) factor of 9 percent and a directional distribution of 55 percent was applied to the projections. These numbers reflect a somewhat "even" distribution of traffic along US 15-501 as well as a more urbanized driver behavior.

Identification of roadway type and number of lanes was accomplished by comparing DHVs with level of service D volumes presented in materials from the Florida Department of Transportation. In general, the maximum number of lanes was restricted by practical limits on the numbers of lanes that could be built for a particular type of roadway, five in each direction of travel for urban freeways and four for expressways.

Observations
Roadway Type. The general findings are illustrated in Figure 12. They show the roadway type needed for each land use and TDM strategy. Under a low TDM strategy, all land uses except for the no-growth scenario would need to be served by an urban freeway. Under the low TDM scenario, when coded as an expressway, the roadway type needed remains an urban freeway because the demand on the road exceeds the capacity of a expressway. Under a high TDM strategy, all land uses except for the no-growth scenario, need to be served by an urban freeway for the majority of the study area. Therefore, it can be concluded that corridor travel demand is sufficiently high to warrant an urban freeway regardless of TDM effectiveness.

In addition to the tabular analyses discussed above, closer examination of the traffic volumes revealed high turning movements at each major intersection. For each approach leg, turns would represent between 15 to 40 percent of the approach volume. When considering the numbers of lanes required to eliminate turning and through traffic conflicts, the only practical solution for the intersections would be to provide a grade separation. Thus, the roadway type needed to handle the traffic demand is one with grade separations, an urban freeway.

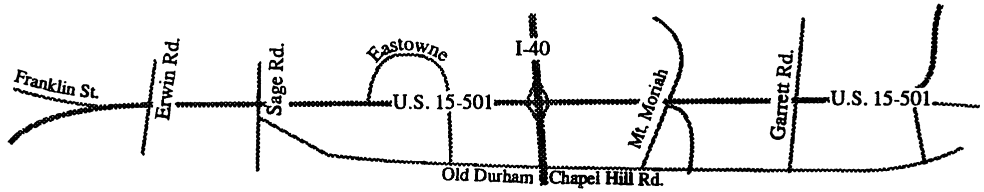


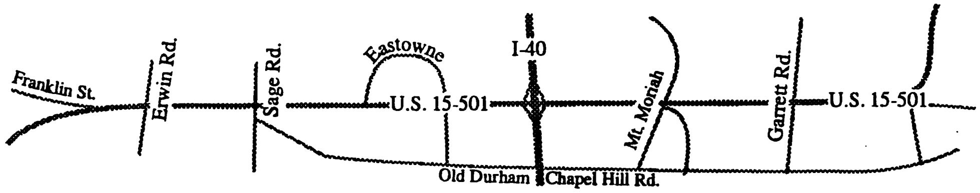
Table 3
Land Use Comparison
Year 2010 Average Daily Traffic

	CH Bypass to Erwin Road	Erwin Road to Sage Road	Sage Road to Eastowne	Eastowne to I-40	I-40 to Mt. Moriah	Mt. Moriah to Garrett Rd.	Garrett Rd. to Durham Bypass	Erwin Rd. over I-40	Durham-CH Rd. over I-40
Freeway with:									
Alternative 1 Development Level	88,000	80,000	90,000	105,000	113,000	107,000	102,000	17,000	29,000
70% Alternative 1 Development Level	82,000	75,000	85,000	99,000	104,000	103,000	98,000	13,000	24,000
0% Alternative 1 Development Level	71,000	66,000	65,000	78,000	78,000	78,000	74,000	8,000	6,000
Expressway with:									
Alternative 1 Development Level	81,000	72,000	73,000	98,000	105,000	96,000	94,000	19,000	30,000

Notes:

1. 100% of Alternative 1 Land Development - Represents "build-out" in the study area based on the Future Land Use Plans of Durham and Chapel Hill. Areas outside of the study area use NCDOT Year 2010 projections.
2. 70% of Alternative 1 Land Development - Based on 70% of the Alternative 1 development potential to estimate Year 2010 development levels in the study area. Areas outside of the study area use NCDOT Year 2010 projections.
3. 0% of Alternative 1 Land Development - Assumes no growth beyond existing development in the study area. Areas outside of the study area use NCDOT Year 2010 projections.

Table 4
Traffic and Lane Needs
Alternative 1 Development Level and Urban Freeway



	CH Bypass to Erwin Road	*Erwin Road to Sage Road*	*Sage Road to Eastowne*	*Eastowne to I-40*	*I-40 to Mt. Moriah*	*Mt. Moriah to Garrett Rd.*	*Garrett Rd. to Durham Bypass*	*Erwin Rd. over I-40*	*Durham-CH Rd. over I-40*
2010 Forecast (No TDM/Transit Trip Capture)									
-Average Daily Traffic (ADT)	88,000	80,000	90,000	105,000	113,000	107,000	102,000	17,000	29,000
-Design Hour Volumes (DHV)	4,356	3,960	4,455	5,198	5,594	5,297	5,049	842	1,436
-Required Lanes and Road Type	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	8 Ln. Freeway	8 Ln. Freeway	8 Ln. Freeway	6 Ln. Freeway	2 Ln. Arterial	4 Ln. Arterial
2010 Forecast with Low (8%) TDM/Transit Trip Capture									
-Design Hour Volumes (DHV)	4,008	3,643	4,099	4,782	5,146	4,873	4,645	774	1,321
-Required Lanes and Road Type	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	2 Ln. Arterial	4 Ln. Arterial
-Change from No TDM/Transit	*None*	*None*	*None*	- 2 Lanes	- 2 Lanes	- 2 Lanes	*None*	*None*	*None*
2010 Forecast with High (23%) TDM/Transit Trip Capture									
-Design Hour Volumes (DHV)	3,354	3,049	3,430	4,002	4,307	4,078	3,888	715	1,220
-Required Lanes and Road Type	4 Ln. Freeway	4 Ln. Freeway	4 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	2 Ln. Arterial	4 Ln. Arterial
-Change from No TDM/Transit	- 2 Lanes	- 2 Lanes	- 2 Lanes	- 2 Lanes	- 2 Lanes	- 2 Lanes	*None*	*None*	*None*

Notes:

1. Design Hourly Volume (DHV) uses a peak-to-daily volume ratio of 9%, and a directional distribution of 55%, i.e. travel in the most heavily travelled direction is assumed to be 55% of total peak hourly volume.
2. Number of freeway lanes in the above table may include auxiliary lanes.
3. Travel Demand Management (TDM) and transit trip reduction percentage applies to the peak hour only. ADT trip reduction is lower.
4. DHV capacity indicated at right is for Level of Service "D" in the peak direction.

Capacity Chart

Type of Facility	Design Hourly Volume (DHV)
2 Ln. Arterial	830
4 Ln. Arterial	1,770
6 Ln. Expressway	2,650
8 Ln. Expressway	3,250
4 Ln. Freeway	3,450
6 Ln. Freeway	5,170
8 Ln. Freeway	6,890

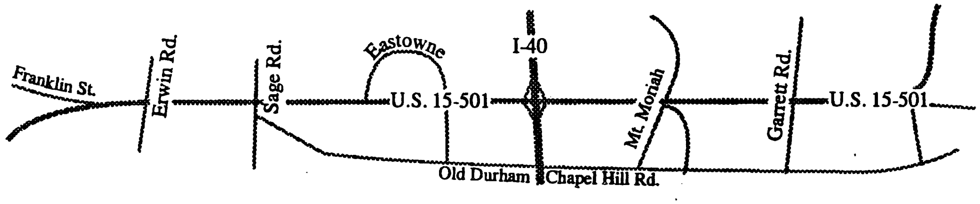


Table 5
Traffic and Lane Needs
70% Alternative 1 Development Level and Urban Freeway

	CH Bypass to Erwin Road	*Erwin Road to Sage Road*	*Sage Road to Eastowne*	*Eastowne to I-40*	*I-40 to Mt. Moriah*	*Mt. Moriah to Garrett Rd.*	*Garrett Rd. to Durham Bypass*	*Erwin Rd. over I-40*	*Durham-CH Rd. over I-40*
70% of 2010 Forecast (No TDM/Transit Trip Capture)									
-Average Daily Traffic (ADT)	82,000	75,000	85,000	99,000	104,000	103,000	98,000	13,000	24,000
-Design Hour Volumes (DHV)	4,059	3,713	4,208	4,901	5,148	5,099	4,851	644	1,188
-Required Lanes and Road Type	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	2 Ln. Arterial	4 Ln. Arterial
70% of 2010 Forecast with Low (8%) TDM/Transit Trip Capture									
-Design Hour Volumes (DHV)	3,734	3,416	3,871	4,508	4,736	4,691	4,463	592	1,093
-Required Lanes and Road Type	6 Ln. Freeway	4 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	2 Ln. Arterial	4 Ln. Arterial
-Change from No TDM/Transit	*None*	- 2 Lanes	*None*	*None*	*None*	*None*	*None*	*None*	*None*
70% of 2010 Forecast with High (23%) TDM/Transit Trip Capture									
-Design Hour Volumes (DHV)	3,125	2,859	3,240	3,773	3,964	3,926	3,735	547	1,010
-Required Lanes and Road Type	8 Ln. Expressway	8 Ln. Expressway	8 Ln. Expressway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	2 Ln. Arterial	4 Ln. Arterial
-Change from No TDM/Transit	*Expressway Possible*	*Expressway Possible*	*Expressway Possible*	*None*	*None*	*None*	*None*	*None*	*None*

Notes:

1. Design Hourly Volume (DHV) uses a peak-to-daily volume ratio of 9%, and a directional distribution of 55%, i.e. travel in the most heavily travelled direction is assumed to be 55% of total peak hourly volume.
2. Number of freeway lanes in the above table may include auxiliary lanes.
3. Travel Demand Management (TDM) and transit trip reduction percentage applies to the peak hour only. ADT trip reduction is lower.
4. DHV capacity indicated at right is for Level of Service "D" in the peak direction.

Capacity Chart

Type of Facility	**Design Hourly Volume (DHV)**
2 Ln. Arterial	830
4 Ln. Arterial	1,770
6 Ln. Expressway	2,650
8 Ln. Expressway	3,250
4 Ln. Freeway	3,450
6 Ln. Freeway	5,170
8 Ln. Freeway	6,890

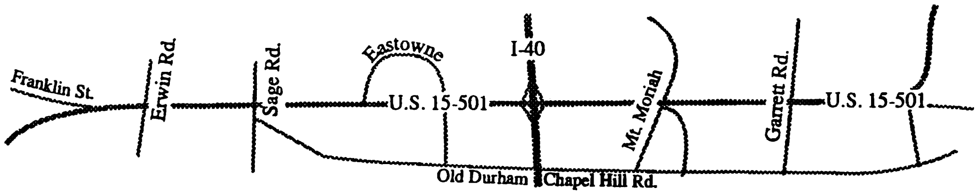


Table 6
Traffic and Lane Needs
No Growth Development Level and Urban Freeway

	CH Bypass to Erwin Road	Erwin Road to Sage Road	Sage Road to Eastowne	Eastowne to I-40	I-40 to Mt. Moriah	Mt. Moriah to Garrett Rd.	Garrett Rd. to Durham Bypass	Erwin Rd. over I-40	Durham-CH Rd. over I-40
No Growth 2010 Forecast (No TDM/Transit Trip Capture)									
-Average Daily Traffic (ADT)	71,000	66,000	65,000	78,000	78,000	78,000	74,000	8,000	6,000
-Design Hour Volumes (DHV)	3,515	3,267	3,218	3,861	3,861	3,861	3,663	396	297
-Required Lanes and Road Type	6 Ln. Freeway	4 Ln. Freeway	4 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	2 Ln. Arterial	2 Ln. Arterial
No Growth 2010 Forecast with Low (8%) TDM/Transit Trip Capture									
-Design Hour Volumes (DHV)	3,233	3,006	2,960	3,552	3,552	3,552	3,370	364	273
-Required Lanes and Road Type	8 Ln. Expressway	8 Ln. Expressway	8 Ln. Expressway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	4 Ln. Freeway	2 Ln. Arterial	2 Ln. Arterial
-Change from No TDM/Transit	*Expressway Possible*	*Expressway Possible*	*Expressway Possible*	*None*	*None*	*None*	- 2 Lanes	*None*	*None*
No Growth 2010 Forecast with High (23%) TDM/Transit Trip Capture									
-Design Hour Volumes (DHV)	2,706	2,516	2,477	2,973	2,973	2,973	2,821	337	252
-Required Lanes and Road Type	8 Ln. Expressway	6 Ln. Expressway	6 Ln. Expressway	8 Ln. Expressway	8 Ln. Expressway	8 Ln. Expressway	8 Ln. Expressway	2 Ln. Arterial	2 Ln. Arterial
-Change from No TDM/Transit	*Expressway Possible*	*Expressway Possible*	*Expressway Possible*	*Expressway Possible*	*Expressway Possible*	*Expressway Possible*	*Expressway Possible*	*None*	*None*

Notes:

1. Design Hourly Volume (DHV) uses a peak-to-daily volume ratio of 9%, and a directional distribution of 55%, i.e. travel in the most heavily travelled direction is assumed to be 55% of total peak hourly volume.
2. Number of freeway lanes in the above table may include auxiliary lanes.
3. Travel Demand Management (TDM) and transit trip reduction percentage applies to the peak hour only. ADT trip reduction is lower.
4. DHV capacity indicated at right is for Level of Service "D" in the peak direction.

Capacity Chart

Type of Facility	Design Hourly Volume (DHV)
2 Ln. Arterial	830
4 Ln. Arterial	1,770
6 Ln. Expressway	2,650
8 Ln. Expressway	3,250
4 Ln. Freeway	3,450
6 Ln. Freeway	5,170
8 Ln. Freeway	6,890

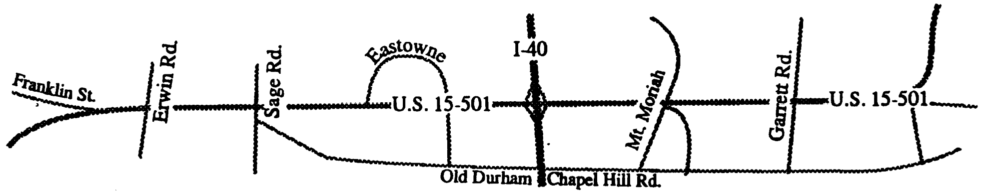


Table 7
Traffic and Lane Needs
Alternative 1 Development Level and Expressway

	CH Bypass to Erwin Road	*Erwin Road to Sage Road*	*Sage Road to Eastowne*	*Eastowne to I-40*	*I-40 to Mt. Moriah*	*Mt. Moriah to Garrett Rd.*	*Garrett Rd. to Durham Bypass*	*Erwin Rd. over I-40*	*Durham-CH Rd. over I-40*
2010 Forecast (No TDM/Transit Trip Capture)									
-Average Daily Traffic (ADT)	81,000	72,000	73,000	98,000	105,000	96,000	94,000	19,000	30,000
-Design Hour Volumes (DHV)	4,010	3,564	3,614	4,851	5,198	4,752	4,653	941	1,485
-Required Lanes and Road Type	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	8 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	4 Ln. Arterial	4 Ln. Arterial
2010 Forecast with Low (8%) TDM/Transit Trip Capture									
-Design Hour Volumes (DHV)	3,689	3,279	3,324	4,463	4,782	4,372	4,281	865	1,366
-Required Lanes and Road Type	6 Ln. Freeway	4 Ln. Freeway	4 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	4 Ln. Arterial	4 Ln. Arterial
-Change from No TDM/Transit	*None*	- 2 Lanes	- 2 Lanes	*None*	- 2 Lanes	*None*	*None*	*None*	*None*
2010 Forecast with High (23%) TDM/Transit Trip Capture									
-Design Hour Volumes (DHV)	3,087	2,744	2,782	3,735	4,002	3,659	3,583	799	1,262
-Required Lanes and Road Type	8 Ln. Expressway	8 Ln. Expressway	8 Ln. Expressway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	6 Ln. Freeway	2 Ln. Arterial	4 Ln. Arterial
-Change from No TDM/Transit	*Expressway Possible*	*Expressway Possible*	*Expressway Possible*	*None*	- 2 Lanes	*None*	*None*	- 2 Lanes	*None*

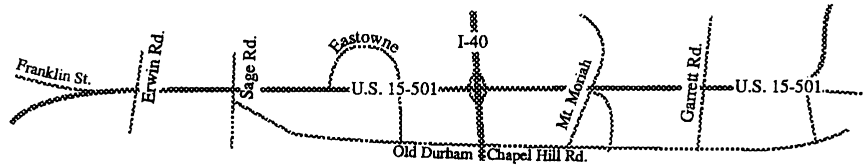
Notes:

1. Design Hourly Volume (DHV) uses a peak-to-daily volume ratio of 9%, and a directional distribution of 55%, i.e. travel in the most heavily travelled direction is assumed to be 55% of total peak hourly volume.
2. Number of freeway lanes in the above table may include auxiliary lanes.
3. Travel Demand Management (TDM) and transit trip reduction percentage applies to the peak hour only. ADT trip reduction is lower.
4. DHV capacity indicated at right is for Level of Service "D" in the peak direction.

Capacity Chart

Type of Facility	**Design Hourly Volume (DHV)**
2 Ln. Arterial	830
4 Ln. Arterial	1,770
6 Ln. Expressway	2,650
8 Ln. Expressway	3,250
4 Ln. Freeway	3,450
6 Ln. Freeway	5,170
8 Ln. Freeway	6,890

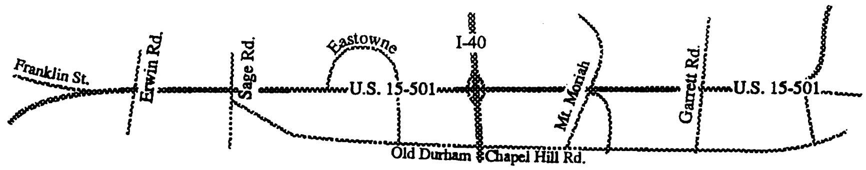
Roadway Requirements - Low Transit/TDM Capture Rate (8%): Freeway | Freeway



Roadway Requirements - High Transit/TDM Capture Rate (23%): Freeway | Freeway

ALTERNATIVE 1 DEVELOPMENT

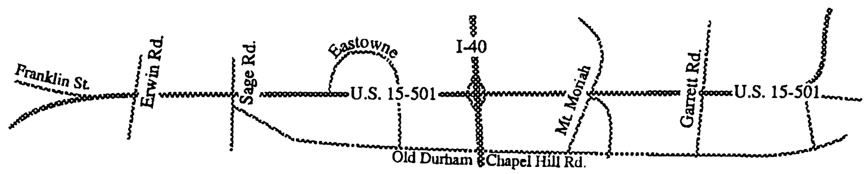
Roadway Requirements - Low Transit/TDM Capture Rate (8%): Freeway | Freeway



Roadway Requirements - High Transit/TDM Capture Rate (23%): Expressway | Freeway | Freeway

70% OF ALTERNATIVE 1 DEVELOPMENT

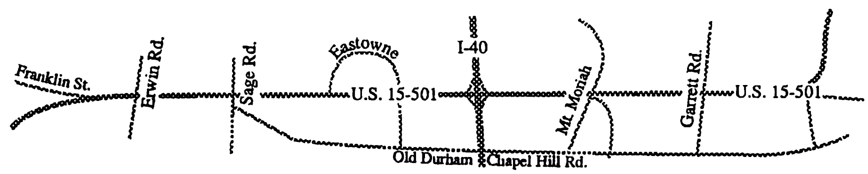
Roadway Requirements - Low Transit/TDM Capture Rate (8%): Expressway | Freeway | Freeway



Roadway Requirements - High Transit/TDM Capture Rate (23%): Expressway | Expressway

0% - NO GROWTH

Roadway Requirements - Low Transit/TDM Capture Rate (8%): Freeway | Freeway



Roadway Requirements - High Transit/TDM Capture Rate (23%): Expressway | Freeway | Freeway

ALTERNATIVE 1 DEVELOPMENT WITH U.S. 15-501 CODED AS EXPRESSWAY

Scale: NTS

Roadway Needs for Alternative Land Use and Road Networks

Figure 12

It is further recognized, however, that the term "urban freeway" as it applies to the US 15-501 corridor does not mean that 15-501 improvements need to be planned for "Interstate" operations and design speeds. When considering existing development and constraints, the ideal facility type is one of grade separations with a lower design criteria than for interstate highways. The designation "urban freeway" is applied by NCDOT to a divided multi-lane road designed to carry traffic at moderate speeds. This type of road provides for continuous flow of traffic through full control of access, including interchanges, grade separations and no at-grade connections between cross roads and the main line.

TDM. Throughout the modeling exercise, the travel demand along the corridor exceeded expressway carrying capability unless no-growth occurred and was accompanied by high TDM capture rates. This condition is highly unlikely under current trends of transportation development because high TDM capture rates have a direct correlation with high land use densities. The higher TDM capture rates assume that aggressive measures are undertaken in regard to other modes of travel. The most noteworthy would be a fully functioning fixed guideway transit system and land use intensities that increase toward transit-oriented development patterns.

Regardless of the level of TDM strategies that are implemented in the study area, even modest trip capture rates will have positive effects on travel demand. Successful TDM strategies will reduce demand for single-occupant vehicles. Promotion of TDM in the study area and the region will provide a means of retarding and delaying the time when the roadway improvements should be implemented.

7.2 LAUREL HILL DRIVE INTERCHANGE LOCATION STUDY

At the request of Wal-Mart and the direction of the steering committee, an alignment revision for the Laurel Hill Drive interchange contained in the highway-only alternative was investigated. The study included discussions between engineers and planners of the study team, McKim and Creed Engineers, P.A. and Kimley Horn and Associates, Inc.

The request involved an approximately 500-foot eastward shift of Laurel Hill Drive toward New Hope Creek and the Garrett Road intersection. After a series of meetings, it was concluded that the alternative alignment offered with the Wal-Mart proposal would have the following characteristics:

- Less spacing for weaving between Laurel Hill Drive and Garrett Road.
- The possibility of reducing construction and right-of-way costs by partial construction of the approach roadway and dedication of right-of-way for the developer-owned portions of Laurel Hill Drive on the north side of US 15-501.
- Use of 31.7 acres of upland slope in the New Hope Creek area, as opposed to 0.3 acres in the original design.
- Impact or require the taking of the William M. Patterson house (historically significant).
- An adequate traffic service function, but poorer operational characteristics because of the introduction of more severe geometric features.

Based upon the above characteristics, the steering committee recommended including the original alignment for Laurel Hill Drive in the Master Plan.

7.3 CONCLUSIONS

The study team reviewed the findings of its studies of base conditions (setting, forecast travel demand, highway-only alternative); the results of the options charrette, the various steering committee meetings and the public meeting; and the findings of various supplemental studies. Based on that review, the study team reached a series of conclusions upon which they based their recommendations. These conclusions are presented below under the headings: general observations/objectives, land use/roadway type, alternative solutions, and needs and assumptions.

7.3.1 General Observations/Objectives

The team observed that, within the existing regional highway network, the US 15-501 corridor serves as the primary transportation facility connecting Durham, Chapel Hill and I-40 and that the adopted Thoroughfare Plan projects traffic volumes that would warrant US 15-501's redevelopment as an urban freeway. The US 15-501 transportation study confirmed similar levels of traffic demand.

The team observed that I-40 has improved accessibility to the study area and consequently enhanced development potential and pressure. This has been demonstrated by recent applications for access, building permits and re-zoning requests.

The team affirmed that the objective of the US 15-501 corridor study is to develop a Transportation Master Plan that will accommodate full development (build-out) within the study area and year 2010 regional growth. A further objective of the US 15-501 corridor study is to prepare a plan that will encourage traffic to use US 15-501 rather than nearby residential and neighborhood streets.

Finally, it was observed that the safety and efficiency of the I-40 interchange is vital since it controls the quality of operations on both I-40 and US 15-501. In order to accomplish this, a degree of access control must be maintained for some distance along US 15-501.

7.3.2 Land Use/Roadway Type

The US 15-501 corridor primarily provides access to adjoining development. Therefore, the type and intensity of development in the study area will ultimately determine the traffic demand and the need for transportation improvements. The high proportion of commercial development, in particular major retail, exceeds the shopping requirements of local residents and workers and will attract a large amount of trips from locations outside study area.

Recognizing that providing access to adjoining development is the primary function of US 15-501, the best type of facility to provide direct access would be an expressway (a road with access to local development at streets that intersect US 15-501 at grade). There are limits (eight lanes or four in each direction of travel), however, to the number of travel lanes that can be efficiently and safely used by through and particularly turning motorists on a road with at-grade intersections. The forecast travel demand on US 15-501 exceeds those limits. Traffic forecasts for the study area indicate there will be high turning volumes at intersecting streets. These volumes require grade-separated interchanges to maintain acceptable levels of service.

The study area has an inadequate roadway network for the planned intensity of development. If a capacity adequate to accommodate projected demand is not provided on US 15-501, congestion will occur and traffic will use alternative routes, such as Old Durham-Chapel Hill Road and Erwin Road.

7.3.3 Alternative Solutions

Alternatives that would reduce or delay the need for grade-separated interchanges (to accommodate the high turning volumes) are:

- Reducing land use density or changing the land use mix.
- Applying various travel management strategies, including Transportation Demand Management (TDM) strategies and making provision for future high occupancy vehicle (HOV) lanes and/or fixed guideway transit.
- Providing additional capacity on parallel and intersecting streets.

Land Use Density
Land use density could be reduced through revisions to area comprehensive plans and re-zoning. This would reduce the number of trip attractions and productions in the study area. A balanced mix and changed arrangement of land uses could increase the level of internal trip making. This change would involve devoting a greater portion of new development to residential and office uses and placing less emphasis on retail uses, in combination with development plans that facilitate pedestrian and bicycle trips. These changes would reduce the number of trips to and from points outside the study area and thus, the need to use US 15-501.

Travel Management
The existing transportation infrastructure can be used more efficiently by reducing travel demand though changes in the behavior of travelers. Alternative modes of travel, e.g. fixed guideway transit, can be developed and their use encouraged. A strict, no growth restriction would have to be enforced for the entire study area in order to completely avoid grade separations and interchanges.

Transportation Demand Management (TDM) can alter the relative cost of travel through changes of the behavior of travelers. (Representative types of TDM strategies were presented earlier in the description of the options charrette.) Such strategies would be applicable to the wider region as well.

Provide Additional Capacity on Parallel Corridors or Streets
Turning movements and the need for interchanges at streets that intersect US 15-501 could be reduced by:

- A new internal circulator system around the four quadrants of I-40. This could be required as a part of development plans.
- Additional lanes on Old Durham-Chapel Hill Road and Erwin Road and improving streets that intersect these roads.
- New streets (City or Town) parallel to US 15-501 and between US 15-501 and Old Durham-Chapel Hill Road and Erwin Road.

7.3.4 Needs and Assumptions

The following basic needs and assumptions were derived from the public meeting and steering committee:

- Road improvements within the study area should be focused on adding capacity (lanes) to US 15-501 and not Old Durham-Chapel Hill Road and Erwin Road.
- Improvements or the lack of improvements in the I-40 interchange area must not compromise level of service on I-40 main lanes or ramps.
- Intrusion into the New Hope Creek area should be minimized.
- TDM and transit should be promoted at the local and regional levels, but provision should be made for the worst case roadway improvements in the event that the high end TDM reductions are not achieved.
- Adequate right-of-way should be reserved along US 15-501 for

transportation improvements, including an urban freeway (additional lanes and interchanges), fixed guideway transit and HOV lanes.

- The project should be phased so that improvements are implemented only as they are required.

- Provisions should be made for pedestrian and bicycle use.

7.4 RECOMMENDATIONS

Based on the conclusions presented above, the study team made the following recommendations regarding future transportation improvements, the preservation of right-of-way for such improvements, implementation of transportation strategies that would reduce the potential need for such improvements, and the timing of such roadway improvements.

The study team recommended that if traffic volumes on US 15-501 grow as forecast in this study for the year 2010, US 15-501 should be redeveloped as an urban freeway. US 15-501 would become grade-separated for the entire length of the study area and interchanges would be provided at major intersecting roads.

Second, the team recommended that the City of Durham and the Town of Chapel Hill establish by ordinance, a US 15-501 transportation corridor overlay zone. The ordinance should:

- Adopt a Master Plan that will designate the footprint of the recommended US 15-501 and prohibit development within that footprint.

- Protect a right-of-way within the corridor (but not necessarily the US 15-501 right-of-way) for fixed guideway transit and/or HOV lanes. The location of such a right-of-way should come from the regional fixed guideway study that is currently being prepared by the Triangle Transit Authority.

- Provide for the development of a local circulation system of streets, bikeways and pedestrian ways around the four quadrants of the I-40 interchange. This system would reduce the number of trips through the US 15-501 interchange and serve as a local bus circulation system.

- Require that the orientation of new development support efficient access to the urban freeway and fixed guideway right-of-way.

- Encourage development that provides for convenient access by transit (local bus or fixed guideway) and supports the region's desire to increase transit ridership.

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

Third, the study team recommended that TDM and transit strategies should be implemented to the fullest extent possible in order to delay and possibly avoid the need to rebuild all of US 15-501 as an urban freeway. Such strategies should be aimed at reducing single-occupant vehicle (SOV) trips. In addition to the representative strategies described under the earlier discussion of the options charrette, the study team recommended the formation of a Transportation Management Association (TMA) whose mission would be to spearhead the development of TDM strategies for the corridor.

Fourth, the study team recommended that the roadway improvements included in the Master Plan be implemented in phases. They recommended that a decision to implement any single phase be triggered by US 15-501 traffic growth and increases in delay. The rate of growth in traffic volumes and delay should be reduced by the proposed TDM strategies and these strategies could be successful in eliminating the need for some components of the planned urban freeway. Any implementation of partial capacity improvements should not, however, compromise the other components of the Master Plan, including the planned urban freeway.

7.5 STEERING COMMITTEE MEETING 3

The steering committee met on June 17, 1993. The purpose of this meeting was to review the findings of the level of development and travel demand sensitivity study, the study team's recommendations for the Master Plan and the Laurel Hill Drive interchange location study.

7.5.1 Level of Development and Travel Demand Sensitivity Study

The study team briefed the steering committee on the study findings presented earlier in the chapter. The following comments were made by members of the Steering Committee about the study team's estimates of the potential success of travel reduction strategies:

- The traffic model's estimation of through trips was believed to be low.
- The peak hour factors (percent of daily trips that would occur during the peak hour) used (eight percent in the A.M. and nine percent in the P.M.) were thought to be low.
- It was felt that the capture rate for home based to work trips was low and as a result produced low TDM-related travel reductions.
- The committee asked that the study team's final report discuss the difference between the three new development patterns (constructs) examined in the Middlesex, Somerset and Mercer County (New Jersey) Suburban Mobility Study and the land uses being considered for the study corridor.

The uncertainty surrounding the ultimate success of TDM strategies, as expressed in the steering committee's first three comments, affirmed both the need to provide for an urban freeway and the importance of building the components of the urban freeway only as traffic demand warrants. The comparison requested in the fourth comment was included in the description of the level of development and travel demand management sensitivity studies presented at the beginning of this chapter.

7.5.2 Master Plan Recommendations

Based on the conclusions and recommendations of the study team, the steering committee made the following decisions on the parameters of the Master Plan:

- Transportation Corridor Overlay Zone. Endorsed the establishment of a transportation corridor overlay zone that will protect right-of-way for future roadway and other possible transportation improvements, guide development and provide a mechanism for implementing Transportation Demand Management (TDM) strategies in the corridor.
- Transportation Management Association. Endorsed the formation of a Transportation Management Association.
- TDM Strategies. Approved support of the full range of TDM strategies, including incentive/disincentives for single-occupancy vehicle travel, increased bus service, HOV lanes, and fixed guideway systems.
- Development. Approved the assumption that 100 percent of the undeveloped lands in the study area will develop (if not by 2010, some time after that) and that development will contain the land use

mix assumed for the traffic modeling (Alternative 1).

- Right-of-Way. Rejected a motion that the overlay zone right-of-way be for roadway purposes only. They approved reservation of the right of way for the urban freeway, HOV lanes and/or fixed guideway transit, and the internal circulator system.

- Roadway Type. Adopted the urban freeway concept for the entire length of the project. They requested that this roadway include interchanges and an internal circulator system (designed to American Association of State Highway and Transportation Officials specifications) in the four quadrants of the I-40 interchange.

- Funding. Recommended that the planning and design phases of US 15-501 be programmed for funding in the Transportation Improvement Program (TIP) immediately and that right-of-way acquisition and construction phases be programmed for funding in the later years of the seven-year TIP, and if necessary, beyond the seven-year horizon of the TIP.

7.5.3 Laurel Hill Drive Interchange Location Study

This evaluation was presented to the steering committee. After discussion of advantages and disadvantages, the motion for endorsement of an interchange and approach road design that skirted rather than passed through the proposed Wal-Mart site failed. The reason for this decision was that although the alternative interchange could function, the original design is less environmentally damaging, has fewer curves and provides better geometric features.

7.6 TRIGGERING MECHANISMS FOR ROADWAY IMPROVEMENTS

7.6.1 Short-Term Improvements

Currently, intersections at Erwin and Sage Roads in Chapel Hill and Garrett Road in Durham are experiencing congestion warranting remediation. From field observations, congestion at these locations results primarily from a combination of the following factors:

- Insufficient left turn storage lanes and length for US 15-501 traffic.

- Insufficient numbers of lanes on the intersecting streets and roadways to accommodate left and right turning movements.

- Poorly constructed turn-lane geometrics.

In the short-term, a separate study should develop a plan to modify these intersections, adding additional lanes and accompanying signal improvements. The NCDOT is presently investigating improvements for the Garrett Road intersection.

7.6.2 Long-Term Triggering Volumes

The Master Plan calls for the implementation of the project in phases and based on traffic demand. Given the large undeveloped tracts of land in the study area and the planned implementation of TDM strategies, it is difficult to predict when major modifications to US 15-501 will be required. It is however, possible to predict traffic volume thresholds that would indicate when improvements should be implemented.

An analysis was undertaken to examine volume and delay relationships for the major intersections on US 15-501 as they evolve from their present four expressway lanes to six- and possibly eight-lane expressways and then to their final conversion as interchanges.

The volume of traffic passing through these intersections that would no longer provide adequate travel service is an indicator of when additional improvements must be considered.

The most critical event to determine is when consideration of interchange conversion is necessary. This is because implementation of the interchange requires significant time for programming, acquisition of right-of-way, environmental documentation and construction.

Figure 13 illustrates typical expressway intersection volumes for US 15-501 at level of service D and a corresponding traffic signal cycle length. Level of service D is defined as the point at which long delays begin to occur within an intersection. Individual signal cycle failures are noticeable and the average delay to each vehicle that passes through an intersection is between 25.1 and 40 seconds. Practical maximum cycle lengths were chosen based on problem intersections elsewhere in the Triangle area.

The figures were created by analyzing intersections under varying traffic demand and numbers of expressway and side street lanes. A minimum five-lane side street approach was chosen for the analysis and it is presumed that side street improvements will be in place according to Section 7.6.1, "Short-Term Improvements." Delay calculations were developed as prescribed in the Highway Capacity Manual. Cycle lengths were developed by converting intersection approach volumes to critical lane movements and then calculating green time for a four-phase signal system.

Figure 13 shows that a six-lane expressway becomes congested (either in terms of delay or cycle length) when the sum of expressway ADT and intersecting roadway volume is approximately 75,000. A eight-lane expressway experiences congestion when combined volumes approach 105,000 ADT.

At present, the volumes recorded along US 15-501 range between 35,000 and 45,900 vehicles per day and the average intersecting street volumes range between 6,000 to 12,000 vehicles per day. Combined volumes total between 41,000 and 51,000 vehicles per day for typical intersections. The road could be widened and operate as an eight-lane expressway until the combined intersection volumes approach 105,000 vehicles per day. However, at this volume significant delay would remain until the intersection was rebuilt as an interchange. To prevent congestion, programming, planning and construction must take place prior to the time when combined intersection volumes reach 105,000 vehicles per day.

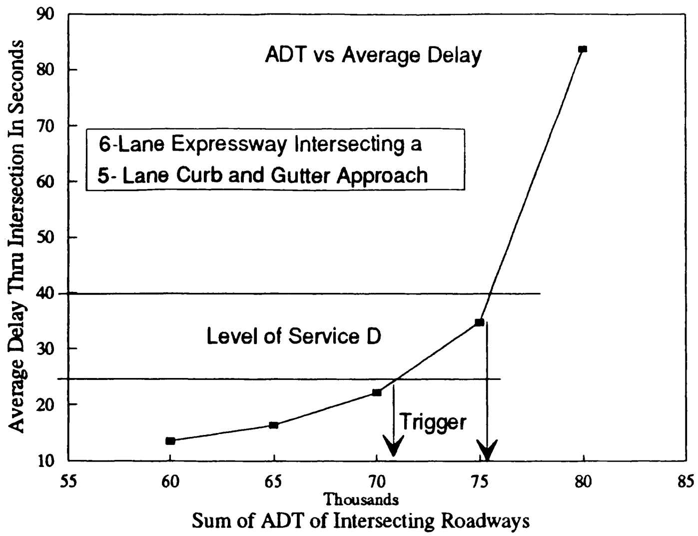
For the US 15-501 project, programming, design and construction would likely proceed as follows:

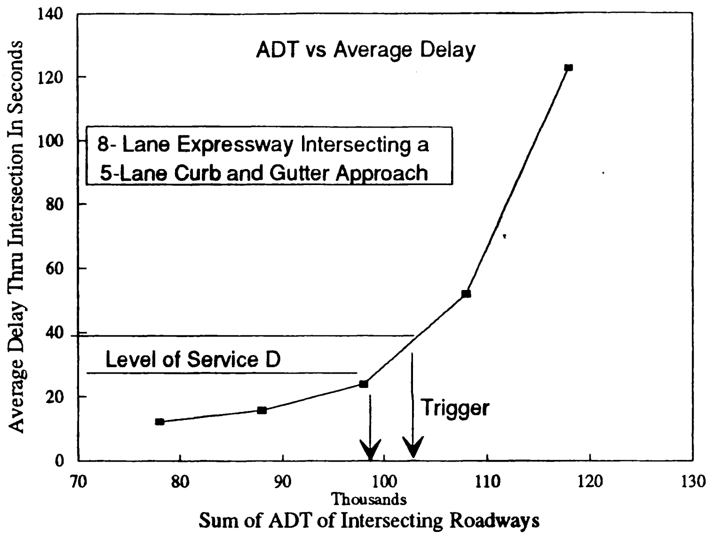
1. Identify project need and commence design process — 6mos-1yr

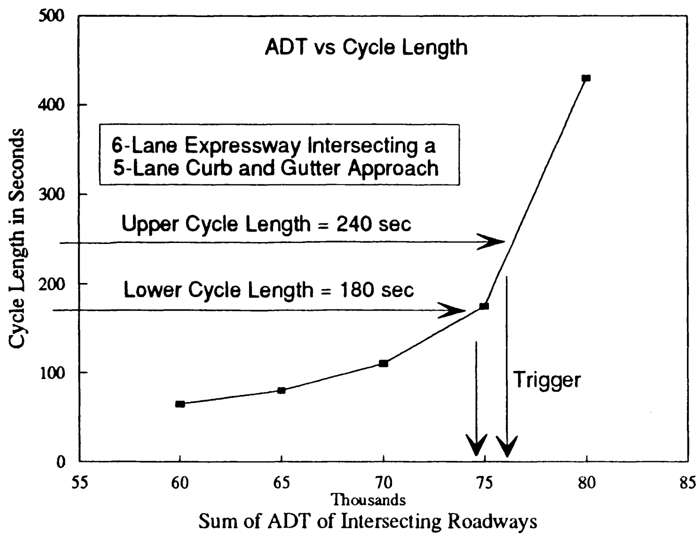
2. Conduct field surveys, prepare environmental documents, design project, acquire right-of-way, obtain permits — 18mos-3yrs

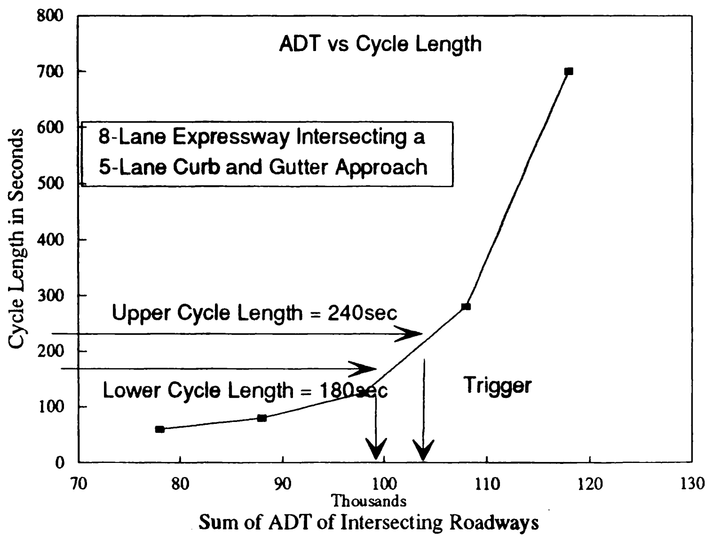
3. Construct the project — 2yrs-3yrs

The total duration for the project would consequently range from four to seven years. These steps are highlighted in Figure 14 and illustrate the relationship between projected triggering volumes (75,000 VPD) and programming. Annual field counts should be made and compared against forecast trigger volumes. Some intersections may grow erratically as illustrated by the hypothetical "Intersection 3". Individual adjustments to timing may be necessary. As the trigger volume is approached, site specific (seven-year) traffic impact statements are the best mechanism to test if the trigger volume will be exceeded. Once the trigger is reached, programming and design should begin for the interchange. Interchange planning and design does not preclude individual intersection improvements or installation of additional









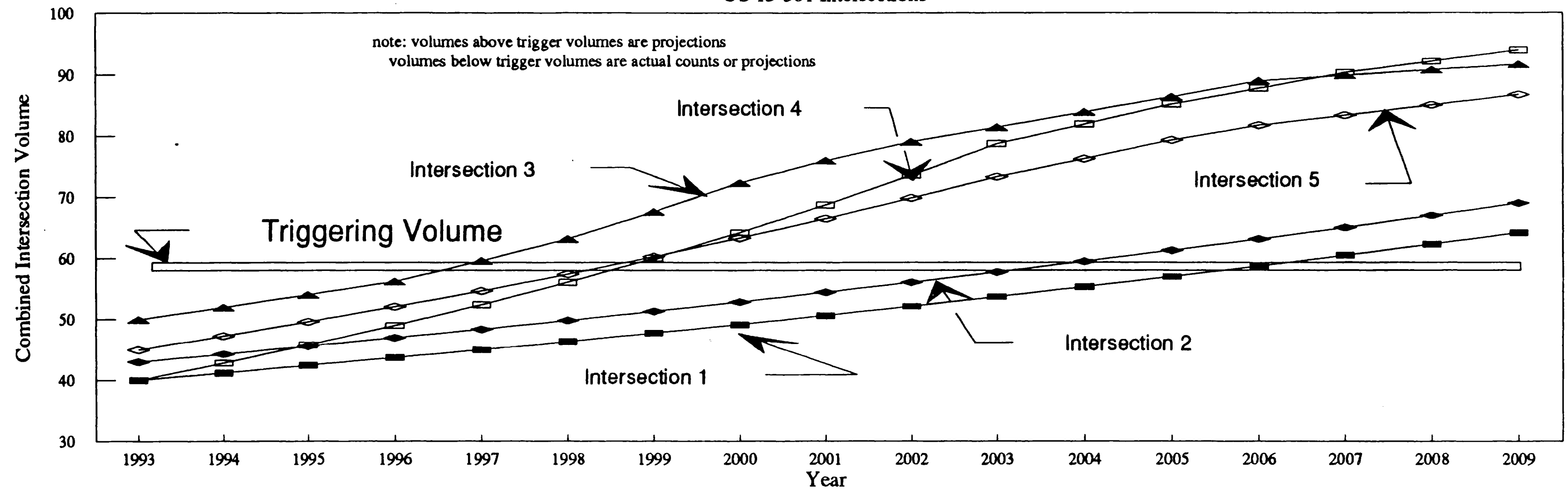
US 15-501 Improvement Trigger

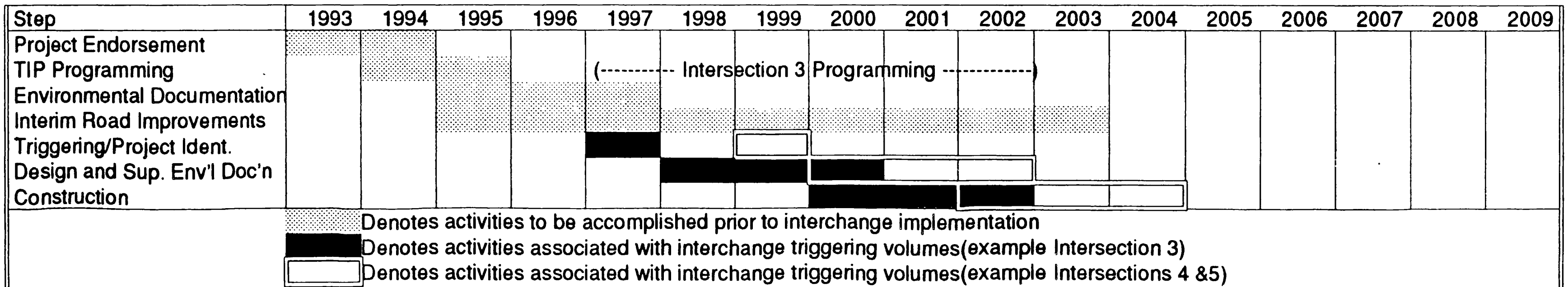
Figure 13

Hypothetical Intersection Growth (see note)

Intersection	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	40.0	41.2	42.4	43.7	45.0	46.4	47.8	49.2	50.7	52.2	53.8	55.4	57.0	58.7	60.5	62.3	64.2
2	43.0	44.3	45.6	47.0	48.4	49.8	51.3	52.9	54.5	56.1	57.8	59.5	61.3	63.1	65.0	67.0	69.0
3	50.0	52.0	54.1	56.2	59.6	63.2	67.6	72.4	76.0	79.0	81.4	83.8	86.3	88.9	89.8	90.7	91.6
4	40.0	42.8	45.8	49.0	52.4	56.1	60.0	64.2	68.7	73.5	78.7	81.8	85.1	87.7	90.3	92.1	93.9
5	45.0	47.3	49.6	52.1	54.7	57.4	60.3	63.3	66.5	69.8	73.3	76.2	79.3	81.7	83.3	85.0	86.7

US 15-501 Intersections





note: This figure is an illustration of the relationship between intersection volumes and timing for project design and construction. Intersection traffic volumes will vary according to development and regional growth.

Hypothetical Improvement Timing

Figure 14

expressway lanes. These activities can usually be accomplished in shorter durations.

Steps

1. Conduct annual traffic counts at intersections.

2. Conduct a short-term (seven years) traffic impact evaluation.

3. Determine if the 75,000 vpd trigger will be met within seven years.

4. If trigger is met, decide if volumes will exceed 105,000 vpd.

5. If projections indicate 105,000 vpd will be met, initiate the planning process for interchange conversion.

6. If 105,000 vpd will not be met, decide whether to plan for an eight-lane expressway or an interchange.

7.7 US 15-501 PROGRESSION OF IMPROVEMENTS

The roadway improvement phasing is illustrated in Figure 8. The progression and evolution of US 15-501 under the assumption that TDM measures are ineffective is as follows:

1. Construct fifth and sixth expressway lanes along the entire length of the project. (This should be done regardless of TDM activities because the existing level of service is poor.)

2. Concurrent with step 1, prepare environmental documents and design roadway improvements for the project as an urban freeway.

3. Monitor traffic through actual counts and short-term (seven-year) traffic forecasts. For locations where trigger volumes are exceeded, conduct longer-term projections. Decide whether to initiate planning for interchanges and urban freeway or eight-lane expressway.

4. Supplement environmental documents for specific projects, conduct detailed design and effect programming.

5. Construct the project.

7.8 MASTER PLAN AND ADOPTION OF THE MASTER PLAN

Based on the steering committee's Master Plan recommendations, the Master Plan and implementation strategies presented in Chapters 3 and 4, respectively were developed. The steering committee recommends that this Master Plan 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 and that it ultimately be incorporated in State and local Transportation Improvement Programs.

Glossary

American Association of State Highway and Transportation Officials (AASHTO). An organization of engineers dedicated to developing nationwide roadway and bridge design standards.

Average Daily Traffic (ADT). Average weekday traffic was used in the 15-501 study. This is the total traffic volume carried Monday through Friday over the course of a year divided by the number of weekdays in a year.

Capital Area Metropolitan Planning Organization (CAMPO). The governmental organization responsible for transportation planning in the Raleigh urban area.

Capture. The trips that shift from an existing mode of travel (e.g. automobile) to an alternate mode of travel (e.g. transit).

Charrette. A problem-solving process that brings together all essential interests in an attempt to reach a mutual agreement on an overall plan.

Clean Air Act Amendments (CAAA). Amendments made to the federal Clean Air Act in 1990. The CAAA mandates greater coordination between transportation and air quality planning.

Congestion Management System (CMS). A program for reducing congestion and the growth of congestion on the existing highways of a metropolitan area. The Intermodal Surface Transportation Efficiency Act (ISTEA) requires that a CMS be developed by 1995 for urbanized areas with populations exceeding 200,000 that are air quality non-attainment areas, as defined by the 1990 Clean Air Act Amendments (CAAA). Durham is such an area.

Design Hourly Volume (DHV). The greatest forecast hourly traffic volume that must be served by a proposed highway improvement. The 30th highest daily traffic volume expected during a year 15 to 20 years in the future is often used.

Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO). The governmental organization responsible for transportation planning in the Durham-Chapel Hill-Carrboro urban area.

Express Bus. A bus service where only a limited number of stops are made enroute.

Expressway. A road with partial control of access. Partial control of access means that preference is given to through traffic by providing intersections at only selected public roads and by prohibiting direct private driveway connections.

Fixed Guideway (for Transit). A road used exclusively by buses or a track used by rail transit.

Freeway. A road with full control of access. Full control of access means that preference is given to through traffic by providing interchanges with selected public roads. There are no intersections with public roads and direct private driveway connections are prohibited.

Grade-Separated Design. A design that calls for one road to pass over another on a bridge. Ramps can be used to accommodate movement between the two roads. See "interchange."

High Occupancy Vehicle (HOV). A motor vehicle carrying the driver and at least one passenger.

Interchange. A system of interconnecting major roadways that uses ramps to provide for the movement of traffic between the roadways. Traffic signals are eliminated on either the primary roadway or both roadways.

Intermodal Surface Transportation Efficiency Act (ISTEA). The 1991 federal law that amended federal transportation funding policies and programs.

Intersection. An area where two or more highways join or cross.

Level of Service (LOS). "Level of service" defines the quality of traffic flow. Level of service A is defined as free flowing traffic. A stable flow with few restrictions on operating speed is level of service B. Level of service C is also considered a stable flow but with more restrictions on speed and lane changing. Level of service D approaches unstable conditions and passing becomes extremely difficult. Level of service E defines the capacity of the highway. Under level of service E conditions, passing is virtually impossible and speeds can drop substantially. Heavily congested flow with traffic demand exceeding road capacity is classified as level of service F.

Light Rail Transit (LRT). A transit mode characterized by an overhead electric power source and by its ability to operate in both an at-grade and/or a grade-separated environment.

Single Occupancy Vehicle (SOV). A motor vehicle whose only occupant is the driver.

System Planning. A term used to categorize a generalized, broad planning process to identify roadway type and lane requirements for an area's highways.

Traffic Impact Analysis (TIA). A study to determine how a proposed development project would affect traffic movement on adjoining streets. These studies are generally short-term in their planning horizon (three to five years).

Transportation Advisory Committee (TAC). A committee appointed to advise elected officials on transportation policy. The TAC in the 15-501 project area is the Durham/Chapel Hill/Carrboro Transportation Advisory Committee.

Transportation Demand Management (TDM) Strategies. Activities carried out to influence the travel decisions made by the public. They are generally focussed on reducing peak hour trips in motor vehicles containing only the driver. Examples of TDM strategies include ridesharing, placing stricter requirements on the use of parking, adopting local ordinances that address the "drive alone" habit of the public, spreading the work day into alternative hours, encouraging work at home or in proximate remote workplace locations, and development of transportation management associations (TMA's).

Transportation Improvement Plan (TIP). A multi-year transportation improvement funding plan. A seven-year TIP is prepared annually by the North Carolina Transportation Board and by Transportation Advisory Committees.

Transportation Management Association (TMA). An organization represented and funded by property owners and employers in a transportation corridor and by public agencies. In the 15-501 corridor, a TMA 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.

Triangle Transit Authority (TTA). The government body established to plan, finance, organize, and operate a public transit system for the Research Triangle area.

Urban Freeway. A road with full control of access (the road may be entered or left only by interchange ramps) that serves an urban area. Compared with a rural freeway, an urban freeway is generally designed for slower speeds and has a narrower right-of-way. Interchanges are generally more closely spaced. Frontage roads are often a part of an urban freeway.

Weaving Section. The common segment of two contiguous interchange ramps where entering vehicles move from their entrance ramp onto the freeway and exiting vehicles leave the freeway and enter their exit ramp.