(14)

ATTACHMENT 1

AGENDA #9

MEMORANDUM

TO: Mayor and Town Council

FROM: W. Calvin Horton, Town Manager

SUBJECT: Comparison of Bicycle Lanes and Wide-Outside Lanes

DATE: June 11, 2001

This memorandum reviews the issues of providing bicycle lanes and wide outside lanes for bicyclists. We recommend Council adopt Resolution A proposing an implementation policy for constructing bicycle lanes. Resolution A incorporates the recommendations of the Transportation Board. Resolution B proposes an alternative implementation policy incorporating the recommendation of the Bicycle and Pedestrian Advisory Board.

SUMMARY

The Council requested staff prepare a policy to guide the construction of bicycle lanes and wide outside lanes along Town arterial and collector streets. Council also requested that the staff recommendation be presented to the Transportation Board and Bicycle and Pedestrian Advisory Board for comment prior to presentation to the Council.

We reviewed a wide variety of federal, state and local documents dealing with bicycle facility design and concluded that provision of bicycle lanes where appropriate would support the goals of the Town's 2000 Comprehensive Plan to promote greater use of bicycles. While both wide outside lanes and bicycle lanes have operational problems, national studies have found that inexperienced and new bicyclists prefer bicycle lanes to wide outside lanes.

The Transportation Board supported the staff's recommendation that bicycle lanes be constructed where appropriate. The Bicycle and Pedestrian Advisory Committee raised questions about the information used to develop the staff report, suggested additional sources of information and recommended a set of criteria for consideration of bicycle lane construction. In this report we review the recommendations of both advisory boards and offer our conclusions for the Council's consideration.

We believe the policy recommended for adoption by the Council would allow the Town the flexibility to assess the appropriateness of constructing bicycle lanes along Town streets, balancing safety and budgetary considerations with the desire of inexperienced and new bicyclists for separate bicycle facilities.

BACKGROUND

At the December 11, 2000 Council discussion of the draft 2002-2008 Draft Metropolitan Transportation Improvement Program the issue of the appropriateness of bicycle lanes or wide outside lanes for inclusion as part of several roadway improvement projects was raised. For the past several months there has been discussion among Town Advisory Boards, particularly the Transportation Board and Bicycle and Pedestrian Advisory Board, concerning the appropriateness of constructing bicycle lanes rather than wide outside lanes to accommodate bicyclists in Chapel Hill.

The Council requested staff develop a preliminary recommendation for consideration by the Bicycle and Pedestrian Advisory Board and Transportation Board before developing a recommendation to the Council. Staff prepared a report for consideration by the Advisory Boards. (Attachment 1) The recommendations of the Transportation Board and Bicycle and Pedestrian Advisory Board are attached. (Attachments 2 and 3)

DISCUSSION

For purposes of this discussion bicycle lanes are defined as lanes at least 4 feet wide located on the outside of general automobile travel lanes. These bicycle lanes are usually provided on roadways with curb and gutter and are delineated by a solid strip and signed appropriately. Bike lanes can also take the form of 4 foot shoulder sections on roadways without curb and gutter. These bicycle facilities are usually not signed as bicycle lanes.

Wide outside lanes include the provision of 2 feet of extra pavement in each lane on a two lane facility or the outside lanes on multilane facilities, creating a 14 foot lane which is shared by bicycles and automobiles. Wide outside lanes can be provided on roadways with or without curb and gutter.

LITERATURE REVIEW

In considering the issue of bicycle facility design we have reviewed several local, state and federal documents. We have listed below the documents reviewed in preparation of the April 24, 2001 Planning Staff Report:

- Planning For Chapel Hill's Future: The Comprehensive Plan, May 8, 2000
- Durham-Chapel Hill-Carrboro Urban Area Bicycle Plan, 1992
- City of Davis, Public Works Department, Bicycle Plan, May, 1993
- A Report on the NCDOT Pedestrian and Bicycling Safety Summit 2000, North Carolina Department of Transportation, 2000
- National Bicycling and Walking Study, Case Study Number One, Reasons Why Bicycling and Walking Are Not Being Used More Extensively as Travel Modes, US Department of Transportation, Federal Highway Administration, 1992.
- Selecting Roadway Design Treatments to Accommodate Bicycles, US Department of Transportation, Federal Highway Administration, January, 1994

- Bicycle Lanes Versus Wide Curb Lanes: Operational and Safety Findings and Countermeasure Recommendations, US Department of Transportation, Federal Highway Administration, October, 1999

Attachment 1 includes a more detailed summary of the findings and conclusions of these documents.

SUMMARY OF FINDINGS

From our review of the various studies cited we have developed the following conclusions:

- There is considerable evidence, based on rider preference and public opinion surveys, that the majority of individuals who ride a bicycle occasionally or are new bicyclists, prefer bicycle lanes to wide-outside lanes.
- While a variety of factors, including traffic speed, number of intersections and driveways and traffic volumes have a significant influence on the perception of safety along roadways, the evidence also suggests that these bicyclists might be encouraged to ride a bicycle more often if provided with bicycle lanes.
- The provision of bicycle lanes support the goal of the Town's 2000 Comprehensive Plan to encourage greater use of bicycles as an alternative mode of transportation.

We also note that the Durham-Chapel Hill-Carrboro Urban Area 2025 Transportation Plan will include analysis of the potential increase in bicycle use with the construction of new bicycle facilities. Based on national studies that found increased bicycle use with the provision of bicycle paths and bicycle lanes these facilities will be incorporated into the model. Wide outside lanes will not be included in the model analysis. The impact of new bicycle facilities will be tested using the Regional Transportation Model.

ISSUES RAISED BY ADVISORY BOARDS

During the course of their review of the staff analysis the Bicycle and Pedestrian Advisory Board and the Transportation Board identified several additional issues.

<u>Bicycle and Pedestrian Advisory Board</u>

The Bicycle and Pedestrian Advisory Board raised several issues concerning wide outside lanes and bicycle lanes.

1. Limited literature review: The Board suggested that the staff had not included a discussion of studies or reports that supported the provision of wide outside lanes and suggested several books by John Forester, a noted bicycling advocate.

<u>Staff Comment</u>: In the course of preparing this report we have reviewed information from federal, state and local websites and bicycle advocacy groups. We have also reviewed reports from the Federal Department of Transportation. We have noted those reports that included any

information on either bicycle lanes or wide outside lanes. We have not found any source of information that dealt exclusively with the benefits of wide outside lanes.

We have reviewed Effective Cycling, 1984 and Bicycle Transportation, 1994, by John Forester. Attachment 4 is Chapter 9, "The Effect of Bikeways on Traffic" from Bicycle Transportation. Mr. Forester makes several points when considering bicycle lanes, including:

- "…there is the possibility that bikeways increase accidents, either by increasing the number of some types that have been occurring or by creating entirely new types."
- "Crossing and turning relationships during traffic maneuvers are involved in 95% of car-bike collisions, while failure of such separation as can be achieved is the cause of less than 5% of car-bike collisions. Bikeways, in other words, are aimed at a problem that is insignificantly small while they fail to address the great majority of car-bike collisions."
- "The phrase 'perceived safety' is used in the strictly propaganda sense of claiming that greater safety exists in a form that appears obvious to new cyclists, without bothering to test whether the opinions accurately reflect the true safety situation. In actual fact, of course, the so called perception of safety is, for nearly all persons concerned, merely the natural outward show of the cyclists inferiority superstition."
- Bicycle lanes pose problems for cyclists and motorists at intersections, particularly in situations where bicyclists must move into the left lane to turn.

Staff Comment: Mr. Forester does raise important design and operational issues, particularly regarding the problems of interaction between motor vehicles and bicyclists at intersections and during turning movements. We note that many of these problems are inherent to bicycles operating on roadways rather than a unique element of bicycle lanes and should be addressed through driver and cyclists education programs.

We also note that both books were written before much of the recent federal and State research had been completed. Although Bicycling Transportation was updated in 1994, it was originally published in 1976 and most references in the book were published in the 1970's and 1980's. We believe that many of the concerns raised by Mr. Forester have been addressed by recent federal evaluations of bicycle lanes and wide outside lanes and through the evolution and refinement of bicycle lane design practices.

2. Funding: The Bicycle and Pedestrian Advisory Board cited the cost of constructing bicycle lanes as a problem and suggested that wide outside lanes could be implemented without cost to the Town.

Staff Comment: The general policy of the North Carolina Department of Transportation is to request local funding of bicycle lanes while providing funds for wide outside lanes as "incidental" features of roadway widening.

The Town has been successful in utilizing Surface Transportation Program Direct Allocation funds, provided by the Metropolitan Planning Organization, for partial funding of bicycle lanes as part of roadway widening projects. The Town has had to provide a 20% local match.

The Metropolitan Planning Organization has requested the North Carolina Department of Transportation provide full funding for bicycle projects. They have also requested that the State provide the local match for those bicycle projects that utilize Direct Allocation funds.

While the State will consider providing additional pavement width for wide outside lanes, it is usually in conjunction with roadway widening projects. It is unclear whether the Town will pursue any additional roadway widenings beyond those now included in the 2002-2008 Metropolitan Transportation Improvement Program.

3. Criteria: The Bicycle and Pedestrian Advisory Board did agree that they might consider bike lanes if all of the following criteria are met:

- Roads with 35 mph and 45 mph speed limits
- Intersections are minimal, with limited cross traffic
- Few driveway cuts
- Limited turning movements
- Descents with high speeds (>25 mph) are not an issue
- Commitment to keep bicycle lanes free of debris

Staff Comment: We agree that roadways with speeds 35 mph or higher should be candidates for bicycle lanes and the Town should attempt to keep bicycle facilities clear of all types of debris. We believe that the feasibility of implementing bicycle lanes should be evaluated for each corridor, reflecting the unique characteristics of the roadway. We agree that the number of intersections, driveway cuts, turning movements and grade should all be included in the evaluation, along with an assessment of current bicycle use in the corridor and potential for encouraging increased bicycle use. We do not believe that all the criteria set forth by the Bicycle and Pedestrian Advisory Board must be met before a roadway could be considered for bicycle lanes.

Transportation Board

1. Collector Streets: The Transportation Board recommended that bicycle lanes be implemented only on those collector streets with higher speeds or traffic volumes.

Staff Comment: We agree that both arterial and collector roadways be evaluated prior to implementation of bicycle facilities. Factors such as traffic speed and volume, current bicycle use, roadway grade and other safety issues should assessed.

RECOMMENDATION

We believe the Town should reaffirm the policy included in the 2000 Comprehensive Plan to pursue the construction of bicycle lanes on arterial and collector streets within the community.

This policy is intended to accommodate existing bicyclists and to encourage more individuals to use bicycles on a regular basis, particularly for commuting to work or school.

Wide outside lanes would be provided on local and those collector streets that have low speed limits and traffic volumes. Bicycle lanes would be appropriate for collector streets with higher speeds or traffic volumes. In cases where the Council wished to minimize the impact of arterial roadway widenings on adjacent properties wide outside lanes could be included in these projects.

The Town Council has adopted a policy in the Comprehensive Plan to pursue the construction of bicycle lanes on arterial and collector streets within the community. This policy is intended to accommodate existing bicyclists and to encourage more individuals to use bicycles on a regular basis, particularly for commuting to work or school. The Comprehensive Plan includes an Action Plan that identifies the goal to "adopt roadway standards for on-street bike lanes and begin applying to resurfacing/reconstruction projects" with 0-2 years of the adoption of the Plan. The Plan suggests a deadline of December 31, 2001 for development and adoption of these guidelines.

We suggest the following specific standards to implement the Comprehensive Plan's goal.

- Bicycle lanes should be provided on arterial and collector streets within Chapel Hill. In cases where specific conditions would not support bicycle lanes and in situations where the Council wishes to minimize the impact of roadway widenings on adjacent properties wide outside lanes should be included in these projects.

- Bicycle lanes should be provided on collector streets with higher speeds or traffic volumes. Collector streets that have low speed limits and traffic volumes should be provided with wide outside lanes.

- Wide outside lanes should be provided on local and those collector streets that are identified as part of the Town's bicycle network.

The Comprehensive Plan also recognizes the need to develop a detailed Bicycle and Pedestrian Plan. This Plan could provide the means for implementing the Town's Bicycle policies by identifying a bicycle network that would include arterial, collector and local streets. Appropriate facility designs could then be implemented along specific corridors identified in the Plan.

ADVISORY BOARDS AND MANAGER'S RECOMMENDATION

Transportation Board Recommendation: The Board met on May 1, 2001 and voted 7-0 to recommend that the Council approve the preliminary policy proposed by staff and that (Attachment 3):

- The specific standards identified on page 6 of the April 24, 2001 Planning Staff Report be incorporated into the recommendation; and
- That bikelanes be considered for collector streets where appropriate rather than implemented on all collector facilities.

Bicycle and Pedestrian Advisory Board: The Board met on May 22, 2001 and voted 5-1 to recommend that the Council consider the comments and recommendations contained in the May 22, 2001 Board memorandum. (Attachment 4)

This memorandum proposed the following criteria for implementation of bicycle lanes:

- Roads with 35 mph and 45 mph speed limits
- Intersections are minimal, with limited cross traffic
- Few driveway cuts
- Limited turning movements
- Descents with high speeds (>25 mph) are not an issue
- Commitment to keep bicycle lanes free of debris

Manager's Recommendation: That the Council adopt Resolution A, setting a policy to pursue the construction of bicycle lanes on arterial and collector roads in Chapel Hill. Resolution A incorporates the recommendations of the Transportation Board.

Resolution B would approve a policy for bicycle lane construction that incorporates the criteria defined by the Bicycle and Pedestrian Advisory Board.

ATTACHMENTS

1. April 24, 2001 Memorandum, Comparison of Wide Outside Lanes and Bicycle Lanes (p. 10).
2. Transportation Board Recommendation (p.27).
3. Bicycle and Pedestrian Advisory Board Recommendation (p.28).
4. "The Effect of Bikeways on Traffic", Bicycle Transportation, John Forester, 1994 (p. 33).

RESOLUTION A
(Transportation Board and Manager's Recommendation)

A RESOLUTION ADOPTING A POLICY FOR THE CONSTRUCTION OF BICYCLE FACILITIES WITHIN THE TOWN (2001-06-11/R-16a)

WHEREAS, it is the goal of the Town of Chapel Hill to accommodate the needs of existing bicyclists; and

WHEREAS, is the goal of the Town of Chapel Hill to encourage greater use of bicycles as an alternative mode of transportation; and

WHEREAS, research indicates that the provision of bicycle lanes and paths would encourage greater use of bicycles by casual and new bicyclists; and

WHEREAS, the Chapel Hill 2000 Comprehensive Plan includes the objective "develop and maintain a system of safe and efficient bikeways (on-street bike lanes and off-street paths within greenways) designed to contribute to Town-wide mobility, connecting neighborhoods with activity centers, schools, parks, and other neighborhoods"; and

WHEREAS, the Comprehensive Plan recommends the Town "adopt revised roadway standards incorporating on-street bikelanes, including a commitment to install bike lanes in roadway resurfacing projects where feasible";

NOW, THEREFORE, BE IT RESOLVED by the Council of the Town of Chapel Hill that the Council adopts the following policy:

- Bicycle lanes should be provided on arterial and collector streets within Chapel Hill. In cases where specific conditions would not support bicycle lanes and in situations where the Council wishes to minimize the impact of roadway widenings on adjacent properties wide outside lanes should be included in these projects.

- Bicycle lanes should be provided on collector streets with higher speeds or traffic volumes. Collector streets that have low speed limits and traffic volumes should be provided with wide outside lanes.

- Wide outside lanes should be provided on local and those collector streets that are identified as part of the Town's bicycle network.

BE IT FURTHER RESOLVED that the Council directs the Manager to incorporate this policy in all design guidelines used by the Town to construct or improve roadways.

This the 11th day of June, 2001.

RESOLUTION B
(Bicycle and Pedestrian Advisory Board Recommendation)

A RESOLUTION ADOPTING A POLICY FOR THE CONSTRUCTION OF BICYCLE FACILITIES WITHIN THE TOWN (2001-06-11/R-16b)

WHEREAS, it is the goal of the Town of Chapel Hill to accommodate the needs of existing bicyclists; and

WHEREAS, is the goal of the Town of Chapel Hill to encourage greater use of bicycles as an alternative mode of transportation; and

WHEREAS, the Chapel Hill 2000 Comprehensive Plan includes the objective "develop and maintain a system of safe and efficient bikeways (on-street bike lanes and off-street paths within greenways) designed to contribute to Town-wide mobility, connecting neighborhoods with activity centers, schools, parks, and other neighborhoods"; and

WHEREAS, the Comprehensive Plan recommends the Town "adopt revised roadway standards incorporating on-street bikelanes, including a commitment to install bike lanes in roadway resurfacing projects where feasible";

NOW, THEREFORE, BE IT RESOLVED by the Council of the Town of Chapel Hill that the Council adopts the following policy:

- Bicycle lanes should be provided on arterial and collector streets within Chapel Hill that meet all conditions of the following criteria:

    - Roads with 35 mph and 45 mph speed limits
    - Intersections are minimal, with limited cross traffic
    - Few driveway cuts
    - Limited turning movements
    - Descents with high speeds (>25 mph) are not an issue
    - Commitment to keep bicycle lanes free of debris

BE IT FURTHER RESOLVED, that the Council directs the Manager to incorporate this policy in all design guidelines used by the Town to construct or improve roadways.

This the 11th day of June, 2001.

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MEMORANDUM

TO: Transportation Board
Bicycle and Pedestrian Advisory Board

FROM: Roger Waldon, Planning Director

SUBJECT: Comparison of Bikelanes and Wide-outside Lanes

DATE: April 24, 2001
May 1, 2001

BACKGROUND

At the December 11, 2000 Council review of the draft 2002-2008 Draft Metropolitan Transportation Improvement Program, there was some discussion of the issue of whether bikelanes or wide outside lanes should be included as part of roadway projects. The Council requested staff to prepare a review of the issues and to request recommendations from the Transportation Board and Bicycle and Pedestrian Advisory Board. We anticipate taking the staff report and advisory board recommendations to the Council on May 7, 2001. We have listed below the documents reviewed in the preparation of this staff report. If Advisory Board members would like copies of these reports we can make them available. A copy of all these reports is available for review in the Planning Department.

REVIEW OF STUDIES

For purposes of this discussion bicycle lanes are defined as lanes at least 4 feet wide located on the outside of general automobile travel lanes. These bicycle lanes are usually provided on roadways with curb and gutter and are delineated by a solid strip and signed appropriately. Bike lanes can also take the form of 4 foot shoulder sections on roadways without curb and gutter. These bicycle facilities are usually not signed as a bikelane. Bikelanes provide a defined separation between motor vehicles and bicyclists. Implementation on existing roadways require additional pavement. They also require special treatments at intersections.

Wide outside lanes include the provision of 2 feet of extra pavement in each lane on a two lane facility or the outside lanes on multilane facilities, creating a 14 foot lane which is shared by bicycles and automobiles. Wide outside lanes can be provided on roadways with or without curb and gutter. Wide outside lanes integrate bicyclists with motor vehicle traffic and can be retrofitted through narrowing the existing motor vehicle lanes or by adding additional pavement during resurfacing of streets without curb and gutter.

In considering the issue of bicycle facility design we have reviewed several local, state and federal documents. We have listed below the documents reviewed.

- Planning For Chapel Hill's Future: The Comprehensive Plan, May 8, 2000
- Durham-Chapel Hill-Carrboro Urban Area Bicycle Plan, 1992
- City of Davis, Public Works Department, Bicycle Plan, May, 1993
- A Report on the NCDOT Pedestrian and Bicycling Safety Summit 2000, North Carolina Department of Transportation, 2000
- Incorporating Bicycle and Pedestrian Elements into Transportation Planning, NCDOT Statewide Planning Branch, Small Urban Unit.
- National Bicycling and Walking Study, Case Study Number One, Reasons Why Bicycling and Walking Are Not Being Used More Extensively as Travel Modes, US Department of Transportation, Federal Highway Administration, 1992.
- Selecting Roadway Design Treatments to Accommodate Bicycles, US Department of Transportation, Federal Highway Administration, January, 1994
- Bicycle Lanes Versus Wide Curb Lanes: Operational and Safety Findings and Countermeasure Recommendations, US Department of Transportation, Federal Highway Administration, October, 1999

Chapel Hill 2000 Comprehensive Plan

We have attached pages 92-98 of the 2000 Chapel Hill Comprehensive Plan, which deal directly with bicycle and pedestrian issues.

Chapel Hill has adopted a goal to "develop a balanced, multi-modal transportation system that will enhance mobility for all citizens, reduce automobile dependence, and preserve/enhance the character of Chapel Hill". To meet that goal the Town adopted the general objective to:

"increase emphasis on transit, bicycle, and pedestrian mobility town-wide. Achieve an increase in the percentage of total trips within Chapel Hill by alternative transportation modes and a corresponding reduction in the percentage of trips by automobile".

The 2000 Chapel Hill Comprehensive Plan also includes the specific objective to "develop and maintain a system of safe and efficient bikeways (on-street bike lanes and off-street paths within greenways) designed to contribute to Town-wide mobility, connecting neighborhoods with activity centers, schools, parks, and other neighborhoods."

The Plan recommends the Town "adopt revised roadway standards incorporating on-street bikelanes, including a commitment to install bike lanes in roadway resurfacing projects where feasible".

Chapel Hill's bicycle facility policy reflects the findings and conclusions of various federal studies. The goal of both federal transportation policy and the Town's policy is to promote the greater use of bicycles. Several federal studies have segmented the bicycling community into several categories based on their experience and preferences.

Selecting Roadway Design Treatments to Accommodate Bicycles

In 1994 the Federal Highway Administration completed the Report Selecting Roadway Design Treatments to Accommodate Bicycles. The Report points out that the federal policy goal for bicycling is to accommodate current use and to encourage increased use, while enhancing safety. The Report segmented the bicycling population into three categories:

- Group A, advanced bicyclists who can operate under most traffic conditions. Estimated to represent 5% of the bicycling population. They are best served by direct access to destinations usually via the existing street system and the opportunity to operate at maximum speeds with minimum delay. Sufficient operating space on the roadways or shoulder is required by this group.
- Group B, casual or new adult and teenage riders who are less confident of their ability to operate in traffic without special provisions for bicycles. They are best served by comfortable access to destinations using either low-speed, low volume streets or designated bicycle facilities. These include well defined separation of bicycles or motor vehicles on arterial and collector streets through the provision of bikelanes, shoulders or separate bike paths.
- Group C, pre-teen children whose roadway use is initially monitored by their parents.These riders prefer accesses to key destinations including schools, recreational facilities, shopping and other residential areas. They prefer residential streets with low volumes and speeds and well defined separation of bicycles and motor vehicles on arterial and collector streets or separate bike paths.

The Report also identified the major factors that influenced the adequacy of specific routes to accommodate bicyclists.

- Traffic volumes: higher motor traffic volumes represent greater potential risk for bicyclists and the more frequent overtaking situations are less comfortable for group B/C bicyclists unless special design treatments are provided.
- Average motor traffic speeds: The average operating speed is more important than the posted speed limit.
- Traffic mix: the regular presence of trucks, buses and recreational vehicles can increase the risk and have a negative impact on the comfort of bicyclists.
- On-street parking: the presence of on-street parking increases the width needed in the adjacent travel lane or bike lane to accommodate bicyclists.
- Sight distance: inadequate sight distances occurs when motorists are overtaking bicyclists and there is insufficient time for the motorist to change lanes or slow to the bicyclist speed.

- Number of intersections: Intersections pose special challenges to bicyclists and motor vehicles.

The Report proposes that a two-tiered approach be taken to bicycle facility design. It suggests that Group A riders will be best served by making every street bicycle friendly. This approach may be accomplished by adopting highway design standards that include wide curb lanes and paved shoulders to accommodate shared use.

Group B/C riders are best served by identifying key travel corridors, typically served by arterial and collector streets, and by providing designated bicycle facilities on selected routes through these corridors. The Report proposes that "given the stated policy goal, a supply driven approach to providing designated bicycle facilities to encourage increased use by group B/C riders (i.e., "if you build it they will come") is warranted".

<u>National Bicycling and Walking Study, Case Study Number One, Reasons Why Bicycling and Walking Are Not Being Used More Extensively As Travel Modes</u>

<u>The National Bicycling and Walking Study, Case Study Number One, Reasons Why Bicycling and Walking Are Not Being Used More Extensively As Travel Modes</u>, found that "numerous studies in the past twenty years have asserted that the inclusion of bicycle-friendly features on or along major through streets is of extreme importance in creating functional bicycling routes for utilitarian trips." A Key Finding of the Study was that "considerably more important is the ratio of bikeways to road mileage. Even when university towns are excluded from consideration, cities with higher levels of bicycle commuting have on average 70% more bikeways per roadway mile and six times more bike lanes per arterial mile. Given the considerable difference in the levels of bicycle commuting between the two groups (university and non university cities) the presence of on-road facilities looms large".

The Study used a 1991 Harris survey of active bicycle riders, defined as those who had ridden a bicycle in the last year, but not commuted during the previous month, which found that 49% would consider using a bicycle to travel to work if "safe bike lanes" were available.

<u>Incorporating Bicycle and Pedestrian Elements into Transportation Planning</u>, NCDOT

This Report includes a brief discussion of both wide outside lanes and bicycle lanes. The Report suggests that a wide outside lane "is an effective way to accommodate bicyclists riding in the same lane with motor vehicles". The Report recommends that motor vehicle traffic should not be more than 60% of the routes Level of Service C capacity and truck traffic not exceed 5% of total vehicle volume.

The Report suggests that bikelanes work most effectively in mid-block situations by separating bicyclists from overtaking motor vehicles and that under certain conditions they can be effective as a safety treatment, especially for less-experienced bicyclists.

Report on the NCDOT Pedestrian and Bicycling Safety Summit 2000

The State of North Carolina has adopted action priorities for walking and bicycling in the recently released Report on the NCDOT Pedestrian and Bicycling Safety Summit 2000. The Report recommends that the State "give priority to the construction of bicycle improvements (primarily paved shoulders in rural areas and wide outside lanes and bike lanes in urban areas) along the state's 4,000 miles of Bicycling Highways". The Report also includes a recommendation that on University/College campuses the priority for bicyclists should be to "build dedicated bicycle paths and lanes".

City of Davis, Bikeways Plan, May 26, 1993

The City of Davis, California has been cited as an example of a community that has successfully encouraged increased use of bicycles. The Davis Bikeways Plan recognizes the segmentation of bicyclists into groups based on their experience and needs. The Plan suggests that the avid bike enthusiast makes up a small segment of the population, while the regular and young bicycle riders compose bulk of the population.

The Davis Plan states the "bike lanes provide a significant benefit to safe and efficient bicycle circulation. Conflicts between bikes and autos are dramatically reduced when on-street lanes are installed. Having separate identifiable areas on the street for bikes and autos places the travelers in predictable locations." The Davis Plan proposes providing bicycle lanes and/or paths along all collector and arterial streets. The Plan does not propose the construction of wide outside lanes.

Bicycle Lanes Versus Wide Curb Lanes: Operational and Safety Findings and Countermeasure Recommendations

In response to the continuing debate over the appropriate application of bikelanes and wide outside lanes in 1999 the US Department of Transportation released a study that reviewed operational and safety findings from a comparative analysis of bicycle lanes versus wide curb lanes. The study, Bicycle Lanes Versus Wide Curb Lanes: Operational and Safety Findings and Countermeasure Recommendations, concluded that "both BL (bikelanes) and WCL (wide curb lanes) facilities can and should be used to improve riding conditions for bicyclists".

The Study determined that "significant differences in operational behavior and conflicts were found between bike lanes and wide curb lanes but varied depending on the behavior being analyzed. Wrong way riding and sidewalk riding were much more prevalent at WCL sites compared to BL sites. Significantly more motor vehicles passing bicycles on the left encroached into the adjacent traffic lane from WCL situations compared with BL situations. Proportionally more bicyclists obeyed stop signs at BL site; however, when a stop sign was disobeyed, the proportion of bicyclists with both "somewhat unsafe" and "definitely unsafe" movements was higher at BL sites. The vast majority of observed bicycle-motor vehicle conflicts were minor and there were no differences in the conflict severity by type of bicycle facility".

The Study went on to conclude that "given the stated preferences of bicyclists for BLs in prior surveys (e.g., Rodale Press, 1992) along with increased comfort level on BLs found in developing the Bicycle Compatibility Index (Harkey, et al., 1998), use of this facility is recommended where there is adequate width, in that BLs are more likely to increase the amount of bicycling than WCLs".

DISCUSSION

In the various studies reviewed there is considerable evidence that the bulk of individuals who ride a bicycle occasionally, referred to as B/C group bicyclists, prefer bikelanes to wide-outside lanes. While a variety of factors, including traffic speed and volumes have a significant influence on the perception of safety along roadways, the evidence also suggests that these bicyclists might be encouraged to ride a bicycle more often if provided with bikelanes. Given the goal of the Town to encourage greater use of bicycles as an alternative mode of transportation the provision of bikelanes or separate bicycle facilities should be pursued where feasible.

The Town Council has adopted a policy in the Comprehensive Plan to pursue the construction of bikelanes on arterial and collector streets within the community. This policy is intended to accommodate existing bicyclists and to encourage more individuals to use bicycles on a regular basis, particularly for commuting to work or school. The Comprehensive Plan includes an Action Plan that identifies the goal to "adopt roadway standards for on-street bike lanes and begin applying to resurfacing/reconstruction projects" with 0-2 years of the adoption of the Plan.

We suggest the following specific standards to implement the Comprehensive Plan's goal.

- Bikelanes should be provided on all arterial and collector streets within Chapel Hill. In cases where the Council wished to minimize the impact of roadway widenings on adjacent properties wide outside lanes could be included in these projects.

- Bikelanes should be provided on collector streets with higher speeds or traffic volumes. Collector streets that have low speed limits and traffic volumes should be provided with wide outside lanes.

- Wide outside lanes should be provided on local and those collector streets that are identified as part of the Town's bicycle network.

The Comprehensive Plan also recognizes the need to develop a detailed Bicycle and Pedestrian Plan. This Plan could provide the means for implementing the Town's Bicycle policies by identifying a bicycle network that would include arterial, collector and local streets. Appropriate facility designs could then be implemented along specific corridors identified in the Plan.

RECOMMENDATION

We believe that the policy to pursue the construction of bikelanes on arterial and collector roads in Chapel Hill is appropriate. We suggest that specific roadway design guidelines be developed and adopted by 12/31/2001 as specified in the Chapel Hill Comprehensive Plan.

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Raleigh. Phase I of the Study has been completed and Phase II was expected to begin in April 2000.

Triangle J Council of Governments Regional Development and Mobility Principles Study: This study will evaluate various land use scenarios for the Triangle Region and assess their impacts on transportation and other factors (e.g., water quality and air pollution).

10.2 GOALS, OBJECTIVES, AND STRATEGIES

GOALS AND OBJECTIVES

Goal

Develop a balanced, multi-modal transportation system that will enhance mobility for all citizens, reduce automobile dependence, and preserve/enhance the character of Chapel Hill.

Objectives

General:

Increase emphasis on transit, bicycle, and pedestrian mobility town-wide. Achieve an increase in the percentage of total trips within Chapel Hill by alternative transportation modes and a corresponding reduction in the percentage of trips by automobiles.

Emphasize transit and pedestrian/bicycle mobility in the vicinity of the downtown and the University of North Carolina at Chapel Hill (UNC) campus.

Minimize roadway improvements that increase automobile capacity. Proposed automobile capacity improvements should not negatively impact any alternative mode level of service.

Integrate all transportation modes within existing and future developments with appropriate land uses, design standards, and infrastructure. A priority should be to connect residential areas to nearby commercial centers, schools, parks, and other neighborhoods with sidewalks and bike lanes and/or paths.

Develop strategic transportation linkages between neighborhoods, transit stops, and activity areas.

Multi-Modal Streets and Highway System: Develop and maintain a comprehensive network of streets and highways that support safe automobile, transit, bicycle, and pedestrian mob within Town.

Public Transportation: Maintain a public transportation syst that enhances the mobility and safety of Town residen employees, and students. Increase per capita ridership wi provision of increased service to an expanded park-n-ride system that complements regional transit.

Bikeways: Develop and maintain a system of safe and efficie bikeways (on-street bike lanes and off-street bike paths with greenways) designed to contribute to Town-wide mobilit connecting neighborhoods with activity centers, schools, park and other neighborhoods.

Pedestrians: Develop and maintain a pedestrian circulatio system, including sidewalks and greenway trails, that provide direct, continuous, and safe movement within and betwee districts of Town. Link neighborhoods to activity centers, transi stops, schools, parks, and other neighborhoods.

Transportation Demand Management: Develop and implement programs that reduce the percentage of trips made by single occupancy vehicles, and encourage transportation by altern modes.

Parking: Develop a parking system within downtown that recognizes the need for adequate short-term parking while encouraging policies and practices that minimize the long-term parking supply.

STRATEGIES AND ACTIONS

10A. Multi-Modal Street and Highway System

Developing and maintaining a comprehensive network of streets and highways that support safe automobile, transit, bicycle lanes, and sidewalks is critical to improving mobility within the Town of Chapel Hill. Of particular concern is the development of performance standards for pedestrian and bicycle mobility that can be used in combination with vehicular performance to evaluate and develop Chapel Hill's transportation infrastructure. These standards should be coupled with an aggressive program of constructing bicycle lanes and sidewalks, with connections to a town-wide greenway network, in order to create a truly multi-modal street and highway system.

The basis for the multi-modal street and highway system is the Arterial Street Plan presented in Figure 15. This plan depicts the primary arterial and collector transportation system that provides mobility within and through the Town of Chapel Hill.

10A-1. Develop a method for evaluating operating performance for pedestrians and bicycles.

Similar to most communities within the United States, the Town of Chapel Hill currently defines the optimal operating performance for automobiles using a traffic engineering concept referred to as level of service. Levels of service are simply performance measurements from A to F, where A is excellent (free traffic flow with little restriction on maneuverability caused by other vehicles) and F is failure (subject to severe congestion and extreme delays). The measurement is based on average vehicular waiting time for intersections and average travel speed for arterial streets.

Because Chapel Hill does not have a similar method of evaluating the pedestrian and bicycle network, the following measures for assessing pedestrian and bicycle performance are proposed.

Pedestrian Levels of Service Performance Measures

National examples of pedestrian network performance are very limited. One such example, however, was developed as part of the City of Fort Collins, CO Pedestrian Plan. As this plan was being developed, it was recognized that a procedure for measuring pedestrian performance did not exist elsewhere in the United States. The procedure developed for the Fort Collins plan was adapted from pedestrian performance methodologies developed in Europe and includes the following five performance measures:

Directness: Measurement of the walking trip length.

Continuity: Measurement of the completeness of the sidewalk system.

Street Crossings: Measurement of the pedestrian safety in crossing a street.

Visual Interest and Amenity: Measurement of the pedestrian system's attractiveness and features.

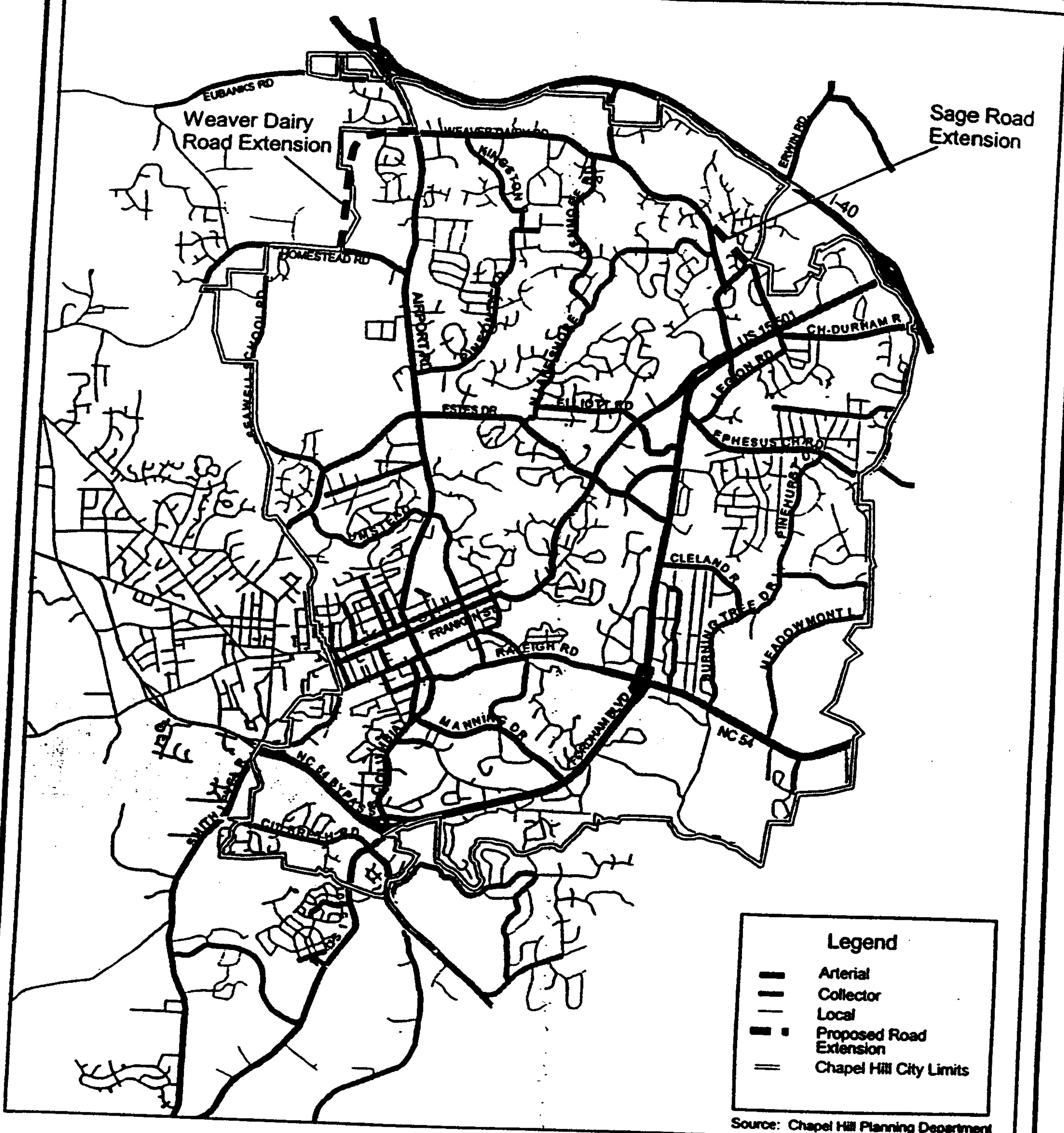
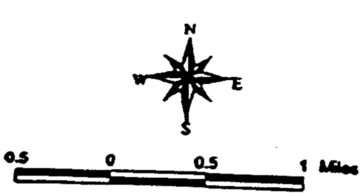


Figure 15



Arterial Street Plan

Comprehensive Plan

Chapel Hill, North Carolina

May 8, 2000

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Security: Measurement of the pedestrian's sense of security.

Although these measures can be applied throughout Chapel Hill, the acceptable performance thresholds will vary by type of activity area. As an example, a high pedestrian performance level will be of greater importance in the downtown than in outlying, lower density subdivisions with light vehicular and pedestrian traffic. The following activity areas to which differential performance standards would be applied are proposed:

- Downtown and UNC: This area reflects the most pedestrian-oriented environment where all performance measures should be high.

Activity Corridors and Centers: This area is defined by the primary commercial and employment centers outside of Chapel Hill's downtown. Providing direct linkages within a minimum of one-quarter mile (and preferably one-half mile) radius of these centers will increase local pedestrian travel.

School/Recreation Walking Areas: These include all routes within one-quarter to one-half mile of all schools and recreation areas. The distance for schools may need to be greater based upon the school district's policy regarding the distance students must live from a school to be eligible for busing.

Transit Corridors: These include areas within one-quarter to one-half mile of existing transit and routes identified in the transit plan.

Other: This category includes all locations not falling within one of the four previous areas.

Figure 16 illustrates existing sidewalks and potential pedestrian zones corresponding to the above descriptions.

Bicycle Level of Service Performance Measures

Intuitively the Town of Chapel Hill has all the makings for a community with high bicycle mobility: a University population, high trip density with relatively short trips, and good climate. The completeness of the bicycle network to provide safe and direct connections, however, is lacking.

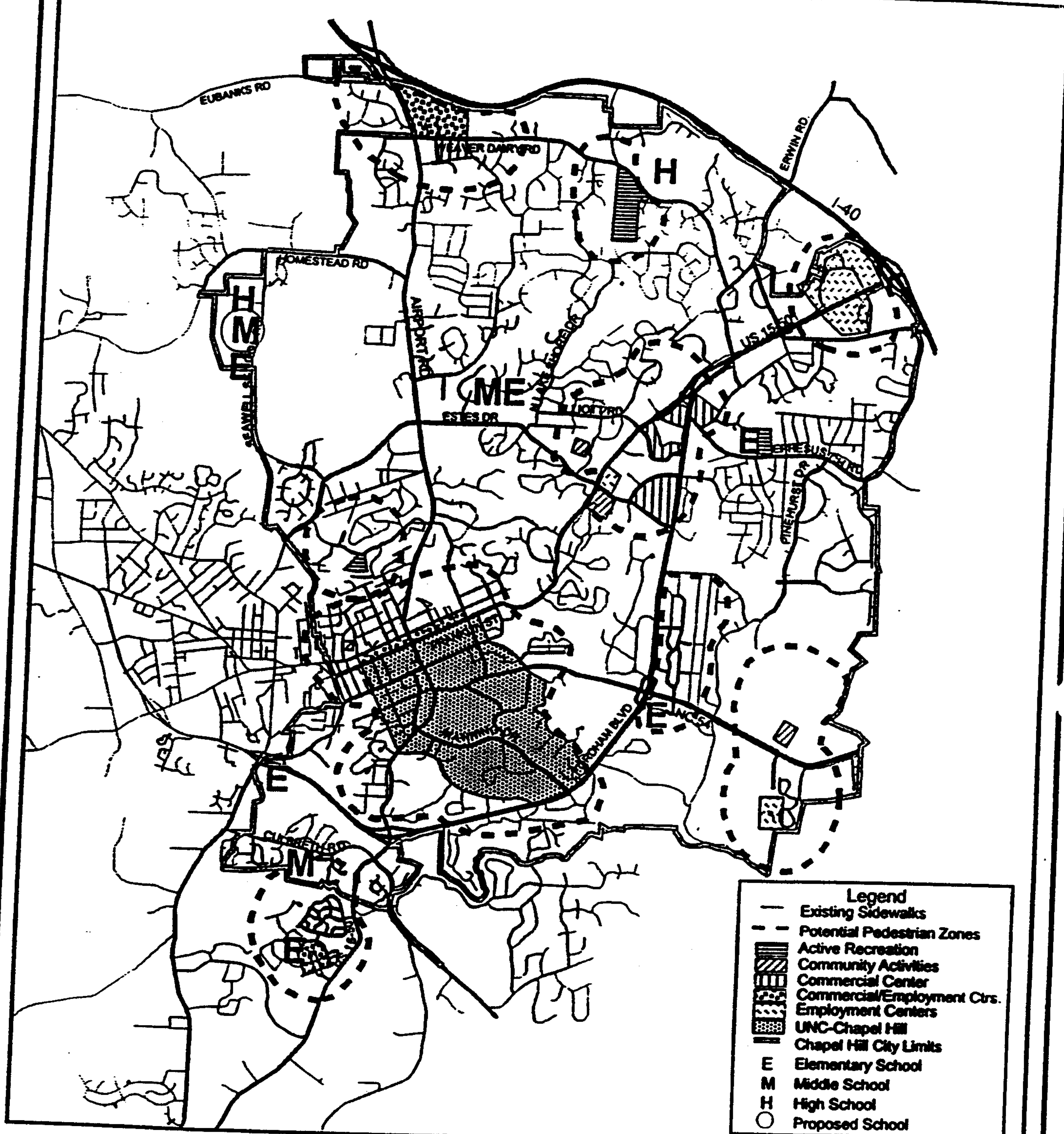
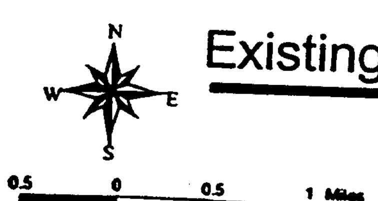


Figure 16



Existing Sidewalks and Potential Pedestrian Zones

Comprehensive Plan

Chapel Hill, North Carolina

May 8, 2000

Source: Chapel Hill Planning Department

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Further complicating matters, there is no methodology widely accepted by engineers, planners, or bicycle coordinators that will allow the ability of a roadway to allow efficient operation of both bicycles and motor vehicles to be determined. Determining how existing traffic operations and geometric conditions impact a bicyclist's decision to use or not use a specific roadway is the first step in defining the bicycle compatibility or performance of the roadway.

In December of 1998, the U.S. Department of Transportation in association with the UNC Highway Safety Research Center developed a Bicycle Compatibility Index (BCI) to evaluate existing facilities. This index also assists in determining what geometric improvements may be required for new facilities to achieve the desired level of service performance for bicycles. The BCI Compatibility Index can be applied to the Town of Chapel Hill in the following three ways:

1. Evaluating all existing and planned bicycle routes using the BCI index will provide for an accurate assessment of the bicycle network, not just a map showing where bicycle lanes may or may not happen to be.

2. The BCI index is the first of its kind to provide a direct correlation of facilities to performance, which allow bicycle plan designers to examine the field variables to improve bicycle lane performance. Weak links in the existing and planned network can be determined, and sites needing improvements can be prioritized based on index values.

3. The BCI index provides for performance measures that can be used in combination with traffic engineering standards to balance a street or corridor's level of service. As an example, one could argue that widening a roadway to improve automobile level of service must be done in balance with the bicycle level of service. Hence new roadways or roadways that are being redesigned or retrofitted can be assessed to determine if they are bicycle compatible. If the roadway does not meet the desired level of performance, the model can be used to evaluate changes in the design necessary to improve performance for bicycles.

Actions: Pedestrian/Bicycle Operating Performance

- Develop and adopt procedures for evaluating the operating performance of pedestrian and bicycle facilities (Town staff, Town Council, Walks and Bikeways Commission)
- Use the adopted procedures to evaluate existing and planned pedestrian and bicycle facilities (Town staff)
- Hold a Town/NCDOT summit on bicycle compatible highway design and develop roadway design standards that incorporate bicycle lanes (Citizens, Town staff, NC DOT)
- Incorporate schedule to implement bicycle lane design standards into the Bicycle Improvement Action Plan developed per Strategy 10A-2 (Walks and Bikeways Commission, Town staff, Town Council)

Measure of Progress: Pedestrian/Bicycle Operating Performance

- Adopt pedestrian/bicycle operating performance measures no later than 12/31/2001

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Actions: Pedestrian and Bicycle Networks

- Develop and adopt Pedestrian and Bicycle Improvement Action Plans to achieve target performance measures (Walks and Bikeway Commission, Town staff, Town Council UNC Planning Committee)
- Develop a funding and implementation program to construct priority pedestrian and bicycle improvements identified by the plans (Town staff, Town Council)
- Adopt revised roadway standards incorporating on-street bike lanes, including a commitment to install bike lanes in roadway resurfacing projects where feasible (Town staff, Town Council)

Measures of Progress: Pedestrian and Bicycle Networks

- Adopt a committed funding source and schedule to implement the pedestrian and bicycle networks no later than 12/31/2001
- Adopt revised roadway standards incorporating on-street bike lanes no later than 12/31/2001
- Improve the pedestrian network to acceptable performance levels within the downtown, UNC, and other pedestrian priority zones identified by the Pedestrian Improvement Action Plan no later than 12/31/2004
- Provide continuous bicycle lanes along Airport Road, U.S. 15-501, and Franklin Street from the northern Town boundary to the UNC campus when these roadways are next resurfaced and no later than 12/31/2004

10A-2. Develop a comprehensive pedestrian and bicycle network.

The performance measures described in Strategy 10A-1 will be of little utility unless coupled with concerted action by the Town to develop a comprehensive network of pedestrian and bicycle facilities. This network should be designed to provide direct connections between neighborhoods and from neighborhoods to activity centers. It should include sidewalks and bike lanes along streets and highways (the focus of this strategy) and off-street bicycle/pedestrian paths developed as part of the greenway network (see Chapter 9.0).

A multi-faceted approach to developing the comprehensive pedestrian and bicycle network should be pursued. For example, roadway resurfacing or reconstruction projects should incorporate re-striping to accommodate bicycle lanes wherever feasible. Traffic signals or other devices should be provided at intersections to accommodate pedestrians and bicyclists needing to cross major roadways. Consideration should be given to use of utility rights-of-way for bikeways/greenways where feasible. Development of the pedestrian/bicycle network should be coordinated with Carrboro, Orange County, Hillsborough, and the City and County of Durham to encourage regional connections.

Town-wide bicycle and pedestrian plan recommendations have been developed in draft form but have not yet been adopted. A map of existing and proposed Chapel Hill bicycle facilities based upon the draft Bicycle Plan is presented in Figure 17. The plans should be re-evaluated in the context of the proposed performance measures and a schedule developed for their implementation.

Securing adequate funding will be key to successful implementation of the bicycle and pedestrian plans. Filling in gaps in the existing system should be a major priority in programming new improvements. In addition to the financing required for facility development, adequate funding should be committed in the Town's annual budget for sidewalk, bikeway, and greenway maintenance needs.

Bicycle facility development and maintenance should be coupled with other measures to promote bicycle usage in Chapel Hill, such as a public information and education program. The Town could "lead by example" by integrating bicycle usage into the day-to-day activities of the Police and other departments.

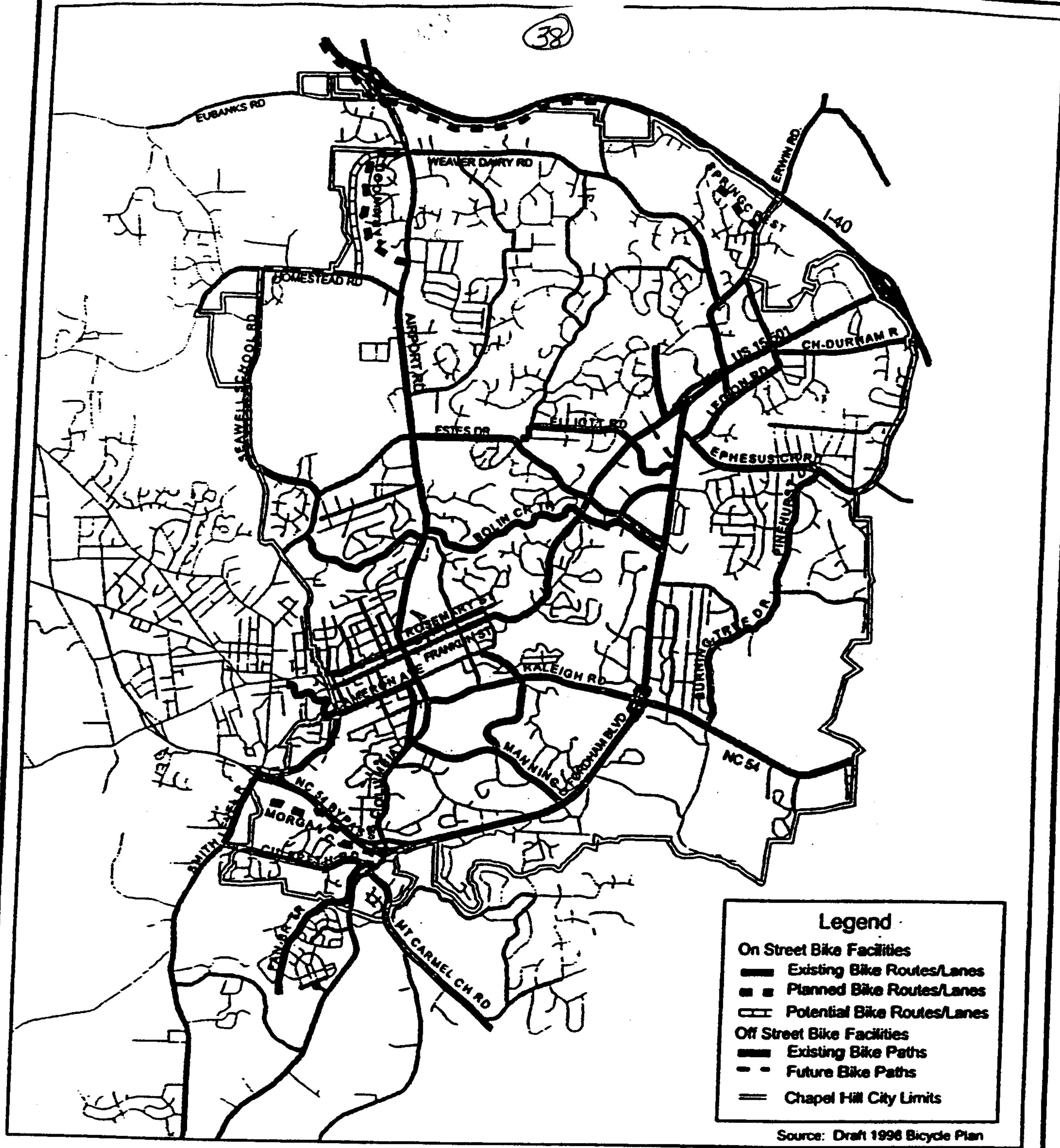

Figure 17

Existing and Planned Bike Network

Comprehensive Plan

Chapel Hill, North Carolina

May 8, 2000

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Consideration should be given to adopting standards in the Development Ordinance regarding the provision of bicycle parking/ storage facilities in parking lots and at workplaces. Covered, secure bike parking should also be provided at park-and-ride lots.

10B. Traffic Management

Traffic management is the process of improving the overall traffic flow of the street system without making major roadway improvements. Traffic management also includes changes in traffic control devices and the implementation of traffic calming techniques to control traffic in residential areas and locations with pedestrian and bicycle activity.

10B-1. Develop a process to address residential area traffic impacts.

As Chapel Hill grows and traffic volumes increase, there is increased propensity for automobile drivers to seek alternative routes to avoid congested arterials. Often these routes are within Chapel Hill's residential areas, where the roads were not designed to accommodate the higher volumes and traffic speeds.

The concept of traffic calming has evolved over the past two decades as a way to lessen the desirability of neighborhood streets for non-local traffic and to reduce traffic speeds. Often neighborhood residents request devices such as speed humps, chokers or barricades to address their problems. These mitigations, however, often cause safety problems or divert the problem to other locations.

A phased, non-capital improvement planning process should be undertaken to address the potential impacts on neighborhoods of drivers seeking alternate routes. This process might include:

Neighborhood education and awareness program

Enforcement (i.e., increased patrols, smart trailers that instantaneously report the speed of the passing vehicle and radar speed cameras from which speeding tickets are issued; this may require a statutory change)

A legal change to give pedestrians the right-of-way (would need to be done at the state level)

Engineering changes (signing, pavement markings)

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SUMMARY OF TRANSPORTATION BOARD ACTION

Subject: Comparison of Bikelanes and Wide-outside Lanes

Meeting Date: May 1, 2001

Recommendation: That the Council approve the recommendation included in the Planning Staff Report dated May 1, 2001 subject to the following changes and/or stipulations.

- That the specific standards identified on page 6 of the Planning Staff report be incorporated into the recommendation; and
- That bikelanes be considered for collector streets where appropriate rather than be implemented on all collector facilities.

Vote: 7 - 0

Aye: Cianciolo, Fulton, Hintz, Hampton, Howe, Sayle, Schroeder,

Prepared by: Loren Hintz, Chair, Chapel Hill Transportation Board
David Bonk, Senior Transportation Planner, Staff

ATTACHMENT 3

(41)

SUMMARY OF BICYCLE AND PEDESTRIAN ADVISORY BOARD ACTION

Subject: Comparison of Wide Outside Lanes and Bicycle Lanes

Meeting Date: May 22, 2001

Recommendation: The Bicycle and Pedestrian Advisory Board reviewed the staff memorandum dated April 24, 2001 and voted to recommend that the Council consider the comments and recommendations contained in the attached Board memorandum dated May 22, 2001.

Vote: 5 – 1

Aye: Dorothy Verkerk, Ray Magyar, Eva Metzger, Wayne Pein, Doug Venema

Nay: Evelyn Gordon

Prepared by: Dorothy Verkerk, Chair, Bicycle and Pedestrian Advisory Board DV Cby TK
Than Austin, Long Range Planner

(42)

MEMORANDUM

TO: Mayor and Town Council

FROM: Bicycle and Pedestrian Advisory Board
Dorothy Verkerk, Chair DV (by TA)

SUBJECT: Comparison of Wide Outside Lanes and Bicycle Lanes

DATE: May 22, 2001

The following is a response to the 24 April 2001 memorandum drafted by the town staff and submitted to the Board.

Review of Studies

The Comprehensive Plan was drafted before the Board was functioning, so the Board members were not able to lend their expertise and advice on the matter of bicycle lanes (hereafter BL). We do not believe the members who wrote the Comprehensive Plan were fully apprised of the issues involved in cycling in Chapel Hill. Also, the studies cited in the memorandum reflect only one position--bicycle lanes--without a discussion of the body of literature that supports wide outside lanes (hereafter WOL), an omission that flaws the report. Much of the support for bike lanes is based on the **perception** of safety rather than on hard data and on experience gained from cycling in town. The report also makes the error of stating that WOL are 14 feet wide. They can be as much as 16 feet.

These are some of the studies not considered by the staff and which inform much of our position:

J. Forester, *Effective Cycling*, (1976; 6th ed., MIT Press/Cambridge, MA & London, 1993).

Review of the 1986 edition by G. Kovaciny, *Bicycle USA*, March/April 1986.

In response to other studies cited in the staff report:

1. Selecting Roadway Design Treatments to Accommodate Bicycles (page 3)

This report was produced for the FHWA by the Bicycle Federation of America, an advocacy firm consisting of no more than a half dozen employees. Bill Wilkinson, the director, wrote the report. The classification of bicyclists into groups is misleading, and is not based on scientific research. No attempt is made to classify motorists and place them in different facilities.

2. Report of the NCDOT Pedestrian and Bicycling Safety Summit 2000 (page 5)

Bicyclists were not a part of this Summit.

3. Bicycle Lanes Versus Wide Curb Lanes: Operational and Safety Findings and Countermeasure Recommendations.

One board member worked on the study cited in the town staff report and it is flawed. Roads with BL were compared to roads with WOL, but this is not a sound research methodology. In order to compare these facilities, the same road would have to be a BL and a WOL. Furthermore, the finding that more wrong way riding takes places in WOL is a misrepresentation of the data (the data reduction was in error) and is also a result of the faulty research design. Wrong way riding is situational. For example, bicyclists on Airport Rd ride the wrong way on the east sidewalk because they don't want to cross Airport Rd twice in order to get to campus. It is possible that in the study the WOL data collection sites were more amenable to wrong way riding based on bicyclist origin and destination desire lines.

Essentially, the board takes exception to the statement that "Bikelanes should be provided on **all** arterial and collector streets..." (emphasis added, page 6). The board's position is that BL or WOL should be situational, based on opportunity and on the individual necessities of each road, since no two roads are alike in Chapel Hill. It goes without saying that we fully support the goal of encouraging more cycling in town, but we emphasize that correct cycling be enabled through a well implemented plan that considers all options, problems, and situations.

Funding

BL are constructed from a very limited allocation of funds, which in reality means that they often are not funded. WOL, on the other hand, are funded from NCDOT road construction monies, which means that they are much more easily funded and built. Moreover, funding for bike lanes requires a local match. The board urges the Council to consider this important benefit of WOL since a wide lane is preferable to no bike lane or accommodation for cyclists; the Estes Drive extension is a case in point. Also, WOL are a better means of establishing a regional bicycling network, linking towns and rural communities. The board, for example, does not envision NCDOT building bike lanes on 15-501 from Chapel Hill to Pittsboro, but it does envision the construction of WOL.

In addition, BL require greater rights-of-way, which increase the cost and therefore lessen the potential for actual construction. Greater ROW requirements and costs for a standard 12' lane with standard 4' BL (16' total feet) as compared to a 14' or 15' WOL. Less total width of a WOL means less impermeable surface to contribute to downstream flooding. The bike lanes north of Homestead on Airport road are about 6000 feet long and 5 feet wide, 1 foot wider than is required (17' of total width including the adjacent lane). Here, 15' WOL would have saved 24,000 (2 x 6000 x 2) square feet of impermeable surface, and considerable money in ROW acquisition and roadway construction costs. Furthermore, the excessively wide BL have predictably become riddled with debris.

Restriction of bike lanes for the cyclist

Bike lanes confine the cyclist to the lane, so that whenever the bicyclist leaves the lane to make a left turn or to avoid debris the bicyclist has then encroached on lanes dedicated solely to cars. When all vehicles share all the lanes, bicyclists and cars bear equal responsibility.

§20-4.01 (49) of the NC traffic code says: "...for the purposes of this Chapter bicycles shall be deemed vehicles and every rider of a bicycle upon a highway shall be subject to the provisions of this Chapter applicable to the driver of a vehicle except those which by their nature can have no application." Thus, bicycle riders have equal rights to the road as do other vehicle operators. BL have the effect of sending the message to motorists that bicyclists have less right to be out of the BL. BL create the expectation in motorists that bicyclists will and must stay "where they belong." Some motorists make the incorrect assumption that bicyclists should be on the sidewalk. This misperception can manifest itself as "Get on the sidewalk!" yells, honking, or even physical harassment: several incidences of this have been reported to the board. When on-road space is specifically outlined for BL, that assumption is even stronger: "Get in the Bicycle Lane!" Some communities have made laws requiring bicyclists to be in BL unless there is justification to be out of them. The board does not support this kind of restrictive legislation.

The board notes that the BL in Chapel Hill and Carrboro often simply stop and leave the bicyclist without a lane, particularly at intersections. The staff memorandum points out that they "require special treatments at intersections" and that "Intersections pose special challenges" (pages 1, 4); however, this problem has not been successfully addressed in Chapel Hill, nor is there any indication in the staff report how these challenges would be overcome. BL add to complexities at intersections and roads in general. A 5-lane road becomes a 7-lane road when BL are added. Motorists turning right must turn across the BL. BL encourage bicyclists to overtake motorists on the right side and to go to the front of the queue. Passing on the right is very risky and leads to many Right Hook collisions.

The board advocates sharing the road, education of rights and responsibilities, and courtesy.

"They that can give up essential liberty to obtain a little temporary safety deserve neither liberty nor safety." *Benjamin Franklin, Historical Review of Pennsylvania, 1759.*

The perception of safety

BL are typically advertised as increasing bicyclist safety. BL, and WOL for that matter, have never been shown to actually increase safety as defined by reduced collisions. Two separate bicycle-motor vehicle crash analyses, (Bicycle-Motor Vehicle Crashes in Chapel Hill, 1993-1995 and 1996-1999) spanning 7 years, have shown the most prevalent collisions in Chapel Hill occur at driveway or roadway intersections. These crashes are partly a result of bicyclists being too close to the edge of the road. BL tend to aggravate this problem because of the physical, operational, and visual separation that a bike lane produces, and the constraining nature of the stripe. The educational countermeasure for these types of collisions is Use More Lane or Take The Lane. BL thwart this message because they restrict bicyclists.

BL are touted as drawing new bicyclists because they "feel" safer. Is it proper to attract novice riders to potentially dangerous situations because of the perception of safety? Novice bicyclists fear getting hit from behind, an unlikely type of collision, and so request BL, the only on-road accommodation they may know to exist. The board strongly encourages an educational campaign to make novice riders aware of safe riding practices. The board does not advocate luring young riders into BL on higher speed roads due simply to a heightened perception of safety.

Chapel Hill realities

Due to the town's hilly topography that allows cyclists to achieve speeds of up to 40 MPH, BL are not designed for these greater speeds, whereas WOL allow the cyclist to use more of the existing lane. These high speeds require the cyclist to make advance preparation for turning left that are not accommodated by BL.

Existing BL are currently filled with impediments--rocks, gravel, sunken grates, glass, leaves--that require the cyclist to leave the lane. Due to the sweeping action of cars, WOL are less hazardous and allow the cyclist the option of taking more lane.

The staff memorandum does not address one-way streets in Chapel Hill, indicating that the issue has not been fully examined for all situations in town.

The town is encouraging the use of public transit, which the board strongly supports but also recognizes that this poses a special problem for cyclists. Bus stops and routes frequently impinge on BL, which again requires the cyclist to leave BL. WOL would not solve this problem, but would allow the cyclist to use all of the existing lane to maneuver around the busses.

Bike Lanes

The board might consider a bike lane if ALL of the following criteria are met:

1. Roads with 35 MPH and 45 MPH speed limits
2. Intersections are minimal, with limited cross traffic
3. Few driveway cuts
4. Limited turning movements
5. Descents with high speeds (>25 MPH) are not an issue
6. Commitment to keep bicycle lanes free of debris

Summary

Funding has the highest priority for implementing WOL as the default position rather than BL. The *perception* of BL safety is not a compelling reason for bicyclists to give up the road since WOL are a feasible and simple alternative.

* This report is based on the board's lengthy discussion over a two-year period about WOL and BL and excerpts from the study by Wayne Pein, *Bicycle Lanes vs. Wide Outside Lanes*, 1999.

9 The Effect of Bikeways on Traffic

Why We Need to Study the Effects of Bikeways

Two arguments have been used to promote bikeways: they would make cycling much safer and, therefore, the amount of cycling transportation would increase. Because the second argument supposedly was the natural result of the first they were practically only one argument. However, bikeways may not produce either of those effects and they certainly have many more that traditionally have not been considered. We need to understand the effects that bikeways have on traffic before we can evaluate the value of bikeways. So far as accident reduction is concerned, the study of accidents in the absence of bikeways demonstrates the limits of the improvement that is possible. It is a logical truth that it is not possible to eliminate in the future, or even to reduce, accidents that have not been occurring in the past. Only those that have been occurring in the past can be eliminated in the future. However, there is the possibility that bikeways increase accidents, either by increasing the number of some types that have been occurring, or by creating entirely new types. That possibility can be examined only by studying the effect of bikeways on traffic operations.

Studying the relationship between cyclists and motorists during traffic maneuvers was unnecessary so long as we assumed that cyclists should act like motorists. Traffic engineers understood without formal study how drivers operate upon the road, and they designed accordingly. So long as no attention was paid to cyclists, or they were assumed to act like motorists, nothing different was needed. Since traffic engineers already understood, as drivers, what happens during traffic maneuvers, there was no need to include in traffic-engineering textbooks analyses of motorists' behavior during maneuvers.

Because of this lack of training, traffic engineers (both professional and amateur) failed to realize the consequences of proposals to separate bicycle traffic from motor traffic. Every system of separation changes the relationship between cyclists and motorists during traffic maneuvers. There was an implicit assumption that the effect of the change was insignificant in comparison with the enormous reduction in collisions that they believed would be produced by separation. This belief had been produced by the traffic engineers' belief that the only trouble with cyclists was that they got in the way of motorists, either delaying the motorists or getting smashed in the process. It was convenient for them to believe this superstition because they served motorists. Human though this tendency may be, it is professionally inexcusable. Therefore, cyclists had to establish the discipline of cycling traffic engineering to resist the physical dangers and restricted rights produced by the effort to separate bicycle traffic from motor traffic.

The first demonstration that the assumption was likely to be false came from accident statistics. Car-bike collisions are not produced by the failure of separation, but by relationships during traffic maneuvers that cannot be eliminated by building grade-level bikeways. Crossing and turning relationships during traffic maneuvers are involved in over 95% of car-bike collisions, while failure of such separation as can be achieved is the cause of less than 5% of car-bike collisions. Bikeways, in other words, are aimed at a problem that is insignificantly small while they fail to address the great majority of car-bike collisions. Some promoters of bikeways accept this logic and say that it does not matter how few cyclist casualties bikeways would prevent, because bikeways are justified by the feeling of "perceived safety" that will persuade noncyclists to start cycling.

The phrase "perceived safety" is used in the strictly propaganda sense of claiming that greater safety exists in a form that appears obvious to new cyclists, without bothering to test whether the opinions of these new cyclists accurately reflect the true safety situation. In actual fact, of

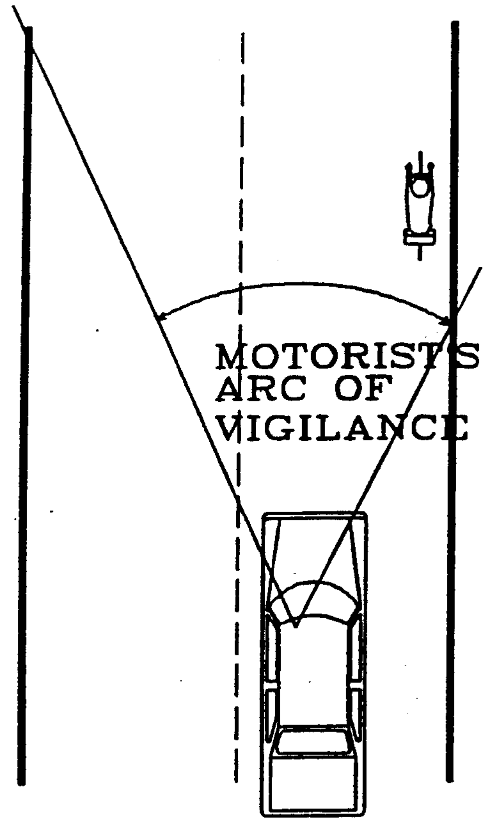

Fig. 9-1 Car Overtaking Cyclist, Two-Lane Road

course, the so-called perception of safety is, for nearly all the persons concerned, merely the natural outward show of the cyclist inferiority superstition. In order to assess the accuracy of these opinions it is necessary to carefully compare the actual traffic maneuvers made under bikeway and roadway conditions.

Other bikeway advocates say that, since there is insufficient information to determine whether roadways are better or safer than bikeways, we should continue to build bikeways unless we find sufficient evidence to stop. Again we see the implicit assumption that bikeways are better or safer than roadways, coupled with the also implicit, and false, assumption that bikeway cycling is the status quo while roadway cycling is the radical proposed alternate. Logically, of course, one who truly believes that the questions of bikeway safety and efficiency are undecided should advocate roadway cycling while investigating the bikeway question, which naturally must include comparison of roadway and bikeway traffic maneuvers. For these reasons, it is vital to compare the relationships between cyclists and motorists under normal conditions with those under bikeway conditions to determine whether the change to bikeway conditions involves an unacceptable increase in the hazard of car-bike collisions for equal speeds and efficiencies of operation.

For this discussion, the term "bikeway" is restricted to bicycle-only facilities parallel and adjacent to normal roadways. Bikeways that follow routes away from all highways almost by definition involve no hazard of car-bike collision. The hazards involved when such bikeways cross roadways will be discussed later, and are no different from those of pedestrian crossings. Bikeways in the sense used in this section are either bike lanes that are part of the roadway or bicycle sidewalks or side paths. So far as the car-bicycle relationships are concerned, the difference between lanes and side paths is one of degree, not of kind.

In the following drawings, please remember that they depict moving vehicles that will continue forward, even into collisions.

Car Overtaking Bike

Motorists overtake cyclists on the left in nearly all cases. There are two situations: narrow lane and wide lane. In a narrow lane the motorist has to use some or all of the adjacent lane to overtake, so he must wait until that lane is clear. In a wide lane he has sufficient room to overtake within that lane, so he need not wait. Whether the wide lane has no separation between motorist and cyclist or whether it has a stripe, berm, or curb separating them does not change the relationship between them. Although a berm or curb prevents the cyclist from turning left in front of the overtaking car, this has no significance in the practical case because wherever cyclists turn left the berm or curb is cut to allow this. On a two-lane road the analysis is easy. The motorist is looking ahead and steering his car. He sees the cyclist and steers his car to the cyclist's left, provided that the rest of the road ahead is clear, as shown in Fig. 9-1, Car Overtaking Cyclist, Two-Lane Road.

On a multilane road with narrow lanes the analysis is more difficult. The motorist must look to his left rear to see whether the adjacent lane is clear of overtaking traffic. He looks first in his left-hand mirror, and if that shows no traffic he turns his head leftward to verify that no traffic is present. His arc of vigilance extends from left rear the right front, so he can see both the nearby over-

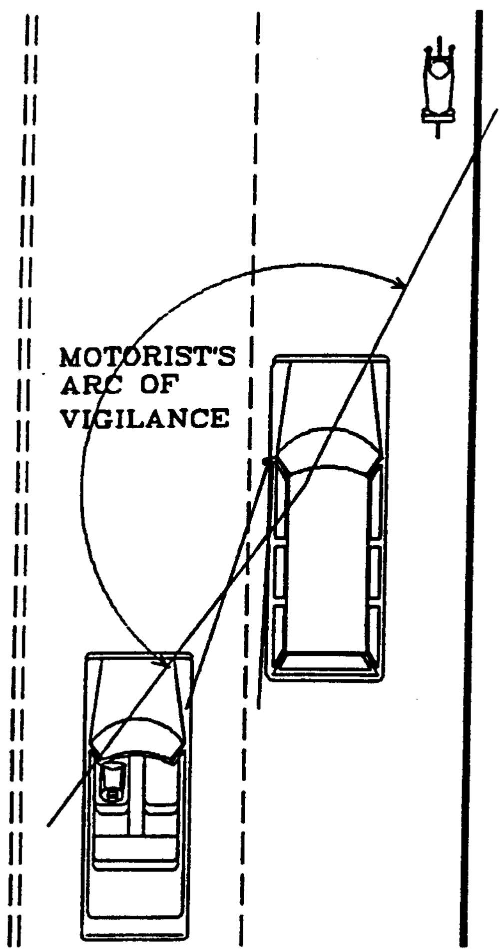

Fig. 9-2 Car Overtaking Cyclist, Multilane Road

taking traffic and the cyclist by merely moving his eyes as shown in Fig. 9-2, Car Overtaking Cyclist, Multilane Road.

In both cases the cyclist pays the motorist no attention—he continues to travel straight ahead at steady speed. Bikeway systems are therefore equal to normal roadways of equal total width when a motorist overtakes a cyclist.

The success of this maneuver is amply demonstrated. It is the most frequent interaction between cyclists and motorists, and its failure is only an infrequent cause of collisions. In terms of success rate it must be the most successful of all cyclist-motorist maneuvers.

Bike Overtaking Car

If the cyclist overtakes the motorist on the left, the situation is identical to that for the motorist overtaking the cyclist, except that the cyclist must more frequently use the adjacent lane because the motorist is much less likely than the cyclist to leave sufficient room on his left for overtaking within the same lane. The rules of the road forbid overtaking on the left at intersections where the motorist may turn left, and they require the turning motorist to be at the centerline and to display a left turn signal. These rules effectively prevent collisions between overtaking cyclists and left-turning motorists.

If the cyclist overtakes a moving motorist on the right, between car and curb, the situation is different. The motorist believes that his is the rightmost vehicle on the road and therefore feels free to turn right at any time. The biggest physical blind spot of most motor vehicles is to the right rear, the location where any cyclist who would be endangered must be. This converts the bike-overtaking-car maneuver into a motorist-right-turn car-bike collision, as shown in Fig. 9-4, Motorist Turning Right, Bikeway Style.

The cyclist is well advised never to overtake a motorist on the motorist's right unless the motorist is stopped by motorists ahead of him who prevent him from turning right suddenly, or has no place to turn into. The bikeway system compels the cyclist to overtake on the right, but provides no protection against the hazards of right-turning motorists; everywhere that motorists desire to turn right they are permitted to do so, and if there is a physical separation, it is cut at those locations. Two arguments are made against this analysis. The first is that the presence of a bike-lane stripe to the motorist's right requires him to yield to through cycle traffic before turning right. Observation shows that motorists usually do not. In Davis, California, the bike-lane city, 20 right-turning motorists in a row were observed to turn right without first merging into the bike lane, against the law and directly across the street from the police station. Whether this is because the motorist does not see the cycle traffic approaching from his right rear or because he does not look for it is immaterial. No cyclist should risk his life attempting to overtake between motorist and curb. The second argument is that the cyclist is not required to overtake between motorist and curb, but is allowed to leave the bike lane to overtake. The law may be so worded, but the law has little effect on feelings and behavior and none on physical fact. Motorists don't like cyclists to leave the bike lane, cyclists don't want to do so, and the fact that the bike lane has preempted the space on the right means that there is even less room on the

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motorist's left for overtaking.

Bikeway systems are therefore more dangerous to cyclists than the normal roadway system whenever cyclists overtake motorists.

Car and Bike on Intersecting Courses at Uncontrolled Intersection

At an uncontrolled intersection the first vehicle to arrive has the right of way, and bikeways provide no protection against the collisions resulting from error in observing the relative time of arrival. However, bikeways encourage the commission of errors by blurring the boundary of the intersection. Is the intersection boundary where the motor-traffic lanes intersect, or where the bikeway lanes intersect? The legal definition of the curb lines extended is ambiguous in this case. A simple definition, whatever it is, will not solve the problem because it is a psychological problem. Motorists feel that the intersection is where the crossing motor traffic moves. They do not stop at a crosswalk unless it is already occupied by a pedestrian. The more distant the bikeway is from the roadway it parallels, the more it looks like a sidewalk, so the less it will be respected by crossing motorists. This effect has been amply demonstrated at stop signs, where motorists' behavior reflects their thoughts. Presumably the same feeling exist when motorists approach uncontrolled intersections, even though their behavior can rarely be used to evaluate their feelings.

No data have been published on this situation, probably because few car-bike collisions occur at uncontrolled intersections and few bikeways cross uncontrolled intersections. However, the effect described above is well recognized at stop-signed intersections, and in any case the effect can only be against bikeways. Therefore, bikeways are more dangerous than the normal roadway system at uncontrolled intersections.

Car and Wrong-Way Bike on Intersecting Courses

Some bikeway systems introduce a new major cause of collisions. Those systems in which cyclists travel on the wrong side of the roadway, be they on two-way bike lanes or on two-way sidepaths, inject cyclists into the intersection from the direction that motorists do not scan for oncoming traffic. Dutch data for a two-way sidepath intersection show that 92% of car-bike collisions occurred with wrong-way cyclists and only 8% with right-way cyclists, despite no obvious directional imbalance in the traffic.

Car and Bike on Intersecting Courses at Stop-Signed Intersection

If a cyclist is stopped by an arterial stop sign, the situation is identical to that for a motorist, whether the cyclist is on a bikeway or not. The situation is well understood, and no differential analysis is required.

If the cyclist is on or parallel to an arterial road and a motorist faces a stop sign, the situation is different. In 20% of collisions due to this situation in the normal system, the motorist acted as if the stop sign were absent. Quite obviously, the presence or absence of a bikeway has no effect on these situations. If the motorist is prepared to not stop despite the expectation of motor traffic, he is not going to stop on the expectation of bicycle traffic. In the other 80% of the collisions between motorists at stop signs and cyclists on arterials under the normal road system, the motorist first stopped (or effectively stopped), then restarted and hit the cyclist. The mechanism is simple to understand. The motorist moved from the stop sign to the edge of the motor traffic without expecting any traffic traveling at road speed between the stop line and the line of motor traffic. Not expecting any, he didn't scan for any, so he didn't see the cyclist and therefore hit him. The proper prevention technique is for the cyclist to ride as close to the motor-traffic line as he can, and to move further to the left if he observes a motorist restarting. The greater the separation produced by a bikeway, the more dangerous the location it compels the cyclist to ride in. Bike lanes put the cyclist nearer the curb and make it more dangerous for him to move left into traffic to avoid a collision.

Sidepaths with Stop Signs

Sidepaths or bermed bike lanes put the cyclist in an area where motorists habitually slow but do not stop, and they trap the cyclist so that he is unable to escape. By actual measurement, during commuting traffic hours, sidepath bikeways with most of their intersections protected by stop sign

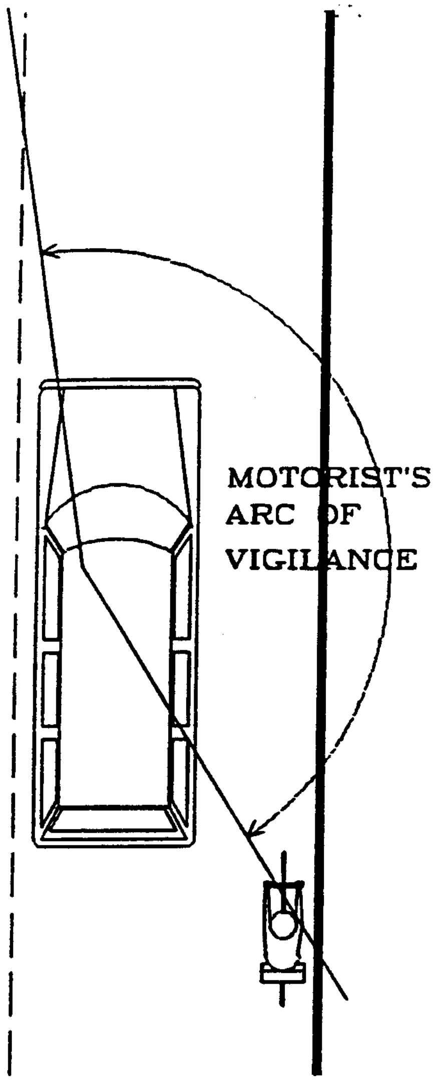

Fig. 9-3 Motorist Merging in Front of Cyclist

produced 1,000 times more serious car-bike conflicts than normal cycling on the same roadways at the same time of day.[1] The test was so extremely hazardous that nobody has dared to repeat it.

Therefore, bikeways are more dangerous at stop-signed intersections than is normal cycling on the roadway.

Merging

In merging situations, it doesn't matter whether the motorist is merging or the cyclist is merging; the characteristics of the maneuver are identical for each. Merging behind the nearest vehicle presents little problem—the merging driver has the other in full view before him, so all he has to do before moving over is to adjust his speed until there is a safe distance between them. In case of error, the passive driver sees nothing and takes no action, but continues to drive straight ahead at steady speed unless knocked off course by the collision.

Merging in front of another vehicle is different in two ways. First, the passive vehicle is behind the merging driver's normal field of view. Second, the merging vehicle is within the passive driver's field of view and the passive driver has an effective collision-avoidance maneuver available to him. As Fig. 9-3, Motorist Merging in Front of Cyclist shows, the merging driver has to turn his head so he can observe from straight ahead, where he is going, to the rear quarter, where the other vehicle is or may be. This is safe and possible only if there is no chance of traffic conflict from the other side of the merging driver's path. If there is the possibility of such conflict, such as from an intersection, the merging driver will look forward toward it rather than backward at the driver behind. The passive driver in this case is watching the maneuver. The possible error is that the merging driver leaves little or no space between the two vehicles. The passive driver looks at the motion of the merging driver, and if he believes that there will be insufficient clearance he slows down to produce more clearance. All vehicles possess far greater deceleration ability than acceleration ability, so the avoidance is generally successful. The merging driver could, if he chose, defeat this avoidance maneuver and cause a collision by applying his brakes as he moved over, but naturally this conscious maneuver is not performed since he merely wishes to move over. (However, this effect occurs during the motorist right-turn maneuver.) It is obvious that, under the common conditions of highway operation with automobiles or smaller vehicles, merging at places removed from other conflicting traffic is remark-

1. I rode at the same speeds I used on the road at the same time of day, and I counted the incipient car-bike collisions that required all my bike-handling and traffic skill to avoid. They averaged two per mile, on a road on which I had previously cycled at least 500 miles without any problems. The eighth near collision nearly killed me; it was just chance that I was not hit headon. Therefore, I terminated the test at 4 miles.

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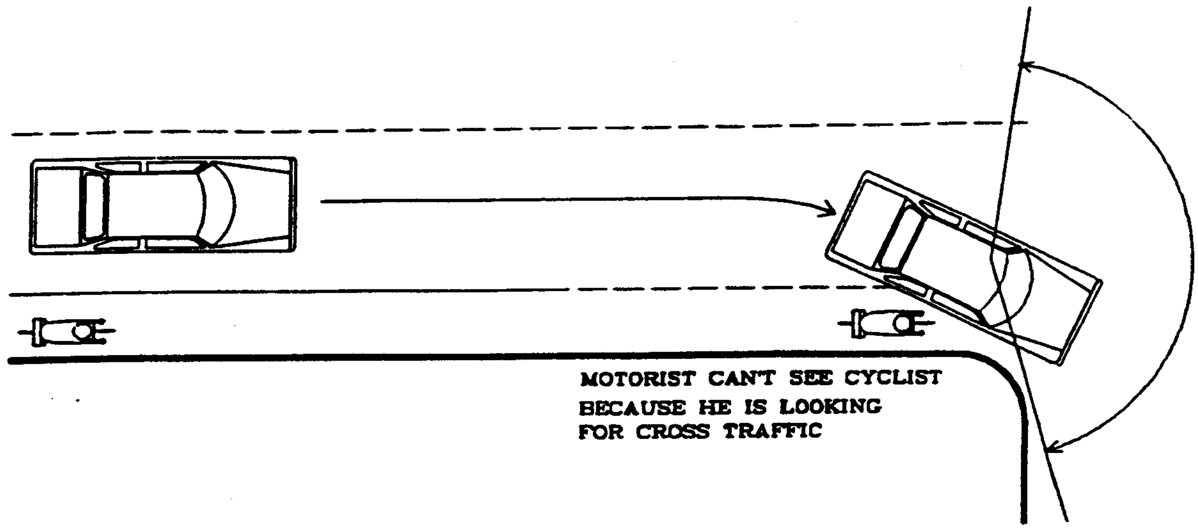

Fig. 9-4 Motorist Turning Right, Bikeway Style

ably safe and causes a collision only through a significant mistake by the merging driver and inattention by the passive driver. The most frequent mistake that motorists make about cyclists is to underestimate a cyclist's speed. This is a frequent cause of motorist errors in the merging situation, but it is an infrequent cause of car-bike collisions because so long as the motorist continues in forward motion the cyclist has only to ease up his pedaling in order to fall far enough back to avoid collision. Long trucks and buses are too long for this simple collision-avoidance maneuver to work, but professional drivers estimate cyclists' speeds much more accurately, so the problem arises much less frequently.

Motorist Turning Right

Under the normal system, the motorist right turn, when properly conducted, starts with a rightward merge, either into a position on the cyclist's normal path of travel or across it into a right-turn-only lane. In the latter case, the interaction is completed; the right-turning motorist turns from his lane away from the cyclist. If there is no right-turn-only lane and the motorist merges into the cyclist's path there is further interaction if, as is usual, the motorist slows for the turn. The cyclist slows down also, or, if he prefers and if the way is clear, he merges left and overtakes the motorist. This interaction is safe because the cyclist sees the motorist, slows down a safe distance behind him, and can always stop if necessary.

Under the bikeway system the motorist right turn is not preceded by a merge. The motorist turns from his traffic lane across the bike lane or sidepath. As Fig. 9-4, Motorist Turning Right, Bikeway Style shows, the motorist must combine the merge and the turn. This requires the motorist to do more than is humanly possible. He must look left and ahead to make sure that no traffic is coming from the cross street, and he must look to his right rear to see if any cyclists are coming. He cannot do both at once, because his eyes cannot swivel in such a wide arc without a movement of the head. Given this choice, naturally the motorist often continues to look for the traffic ahead, which threatens him, rather than for cycle traffic, which is not dangerous to him and which is in any case infrequent. The cyclist, moreover, has no chance of avoiding the motorist once the motorist has started to turn. This is not the merging situation, in which a mere slowing down of the passive driver permits the driver making the error to complete his move in safety. The turning motorist exchanges forward motion for sideward motion, cutting into the cyclist's path and slowing down simultaneously. In many cases the cyclist cannot, after realizing what's happening, apply sufficient deceleration to prevent himself from running into the side of the car as it turns. Whether the cyclist is in a bike lane or on a sidepath is immaterial. Although the conditions are different in small details, in neither case has the cyclist much chance to escape, and in order to avail himself of that small chance he must exercise very careful vigilance, have great understanding of traffic behavior to predict what is happening, and be able to maneuver his bike like a racing cyclist. The cures that are possible while maintaining the bikeway system are much worse than the normal system. Either the motorist must stop before right turns, holding up motor traffic and those cyclists who will not brave the hazard, or the cyclist must stop, delaying himself at every intersection for a much greater total delay than that produced by the most cautious possible behavior under the normal system. If the motorist is required to stop, the cyclist is still not fully protected. At some time the motorist is going to make his right turn. The cyclist approaching from behind does not know, and has no way of knowing, whether the stopped motorist has stopped to let him pass, or whether he has stopped for other cyclists (or for the possibility of cyclists), and may restart his turn just as the cyclist arrives. With visibility from the car as poor as it is in that direction, the cyclist dare not take the chance. So in effect both motorist and cyclist have to stop, and there is an Alphonse and Gaston exchange while both try to decide who will go first. Not only does this take time, but on occasion both start simultaneously and there is a collision, although each knew of the other's presence and desire.

Quite obviously bikeways are far more dangerous to cyclists in the motorist-right-turn situation than is normal roadway cycling. Even under normal conditions, car-bike collisions in which the car is turning right are 11% of the total, so under bikeway conditions it is quite reasonable to predict a significant increase in car-bike collisions.

Motorist Turning Left

Car-bike collisions in which the car is turning left typically occur after the car is halfway through its turn. These account for 13% of car-bike collisions in nonbikeway systems. Left turns are of course a factor in a large proportion of car-car collisions, and the mechanism is probably the same for each type. Bikeways offer no protection against this type of collision. Rather, they aggravate the causes of such collisions by putting the cyclist where he is less likely to be seen by the left-turning motorist and where his habits are less likely to protect him, and by limiting or preventing the cyclist's avoidance maneuver. The lack of protection is obvious. Presumably this type of collision occurs because the motorist either does not see the approaching cyclist or underestimates his speed. The best preventive is for the cyclist to ride where he can best be seen, which is as close as possible to the traffic lane and not over to the side of the road or on the

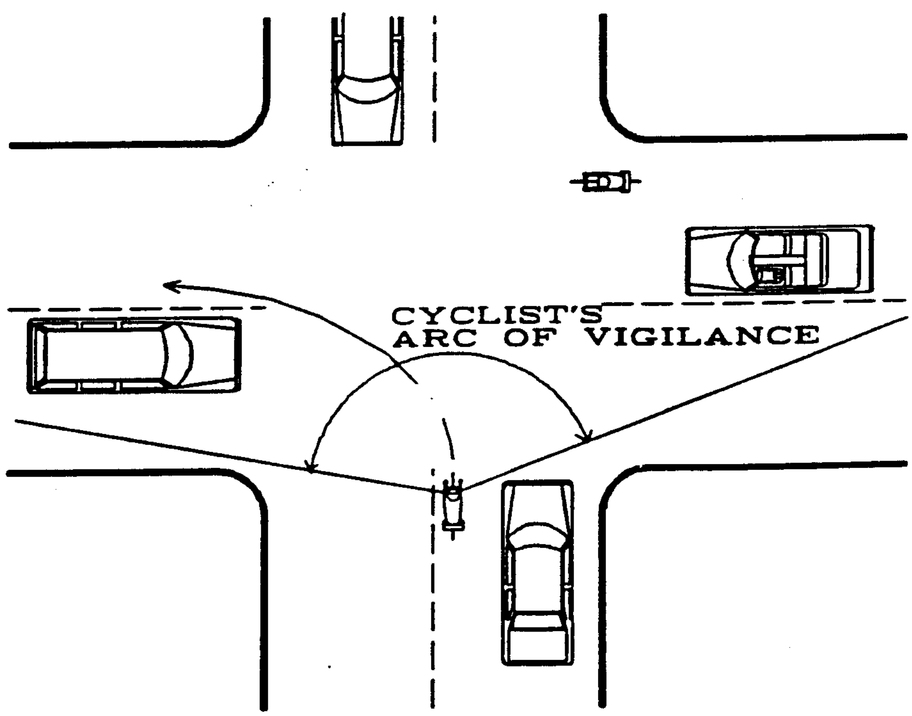

Fig. 9-5 Cyclist's Left Turn, Vehicular Style

sidewalk. This position also gives the cyclist more room for his avoidance maneuver, which is an instant right turn to get away. Bike lanes near the curb give the cyclist less room to turn in, and side-paths remove all chance of turning at road speed.

Therefore, bikeways increase the hazards from left-turning motorists, which in normal systems are involved in the most frequent form of motorist-caused car-bike collision. Significant increases in such collisions must be expected if bikeways are constructed.

Cyclist Turning Left

The cyclist's left turn in the normal system is a series of left merges to the center line or the left turn lane, followed by a left turn when traffic permits as shown in Fig. 9-5, Cyclist's Left Turn, Vehicular Style. At an uncontrolled intersection, the cyclist safely waits next to the center line at the intersection boundary. He interferes with nobody and can see all the traffic to which he must yield. At a controlled intersection at which the cyclist has the right of way over crossing traffic, he waits nearer the center of the intersection because he does not have to yield to crossing traffic. Particularly with a signal, this gives him priority to proceed once oncoming traffic has cleared. Again, he interferes with nobody and is safe. In both cases, traffic from his rear overtakes on his right side, knowing that the only reason that he would be waiting there is to make a left turn.

The cyclist on a bikeway is in a different situation. He must cross the intersection on his original course and turn left at the far side of the intersecting street. Somewhere along that course he reaches a position at which he must decide whether or not to turn. To reach that decision he must observe traffic from his right, from in front, and from behind, and he has just ceased worrying about traffic from his left. As Fig. 9-6, Cyclist's Left Turn, Bikeway Style shows, it is beyond human capability to observe all this traffic simultaneously. He will make a mistake. He wants to reach a destination somewhere on his left. The system tells him to turn here. The most probable mistake is to turn left and get hit. The cyclist in this situation has only two safe choices. The first is to go straight on. The system really allows no left-turn movement at all because the only one that it offers is too dangerous to use. The second choice is to turn toward the corner of the sidewalk and stop. Once stopped the cyclist car turn his bike around in place and wait until he is sure the traffic

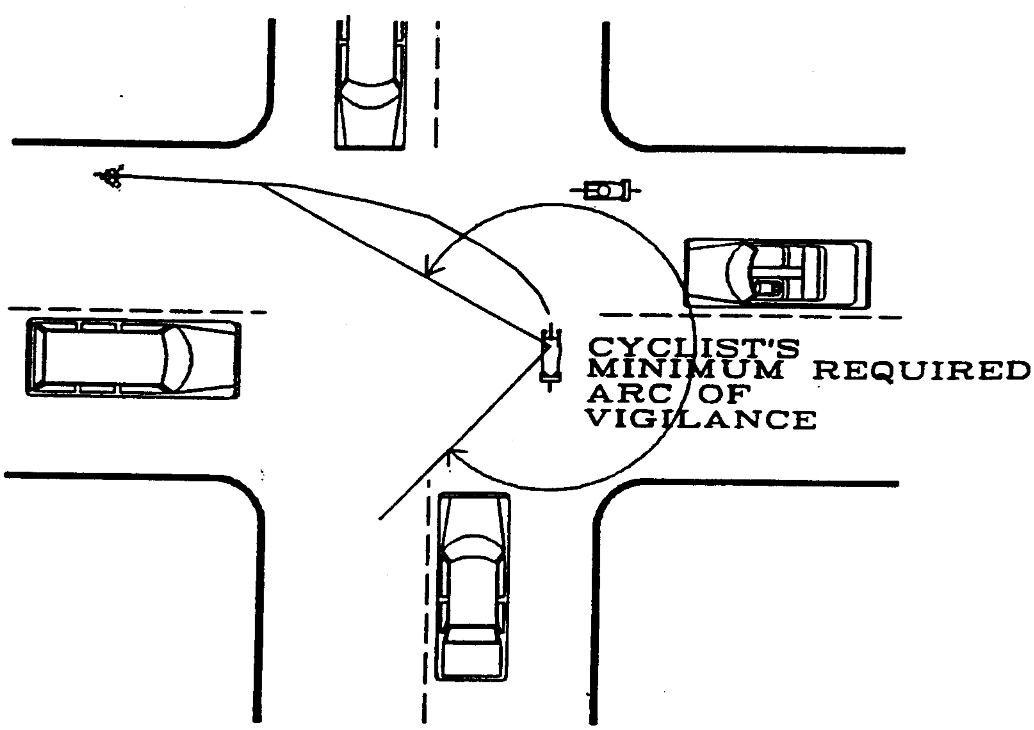

Fig. 9-6 Cyclist's Left Turn, Bikeway Style

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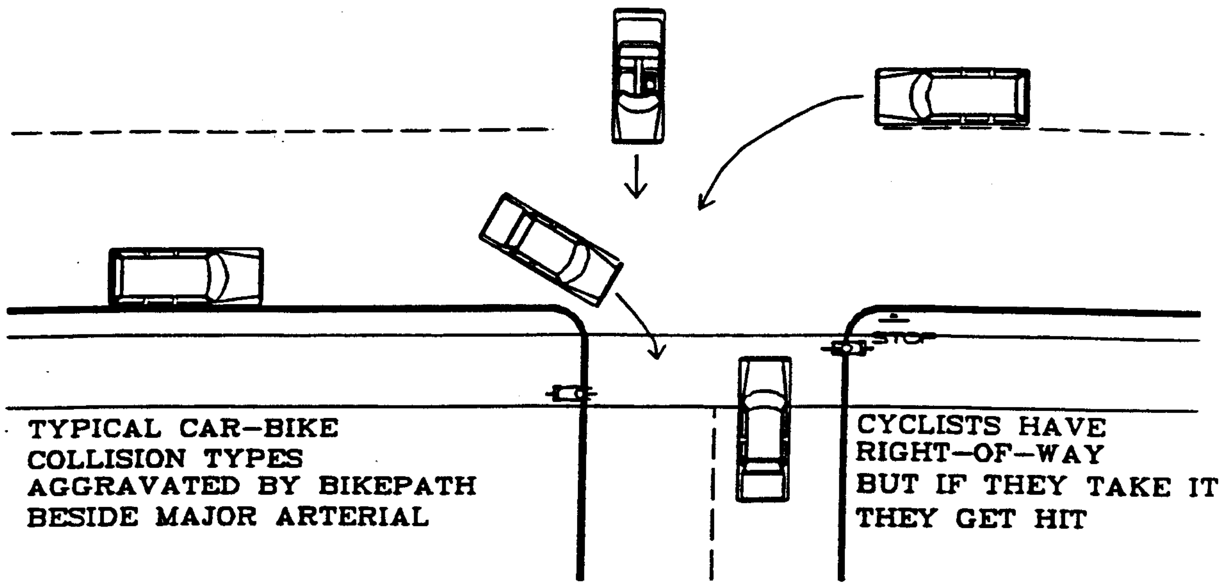

Fig. 9-7 Typical Side-Path Hazards

has cleared before moving on in the new direction. Without that safe stop out of traffic the cyclist cannot make up his mind safely whether or not it is safe to go.

Quite obviously, the bikeway left-turn maneuver is extremely hazardous. The only time I have ever tried one in traffic was from a sidepath. I have never been so nearly dead in my life; escaping from that situation was about as dangerous and required as much skill as aerial dogfighting. That's another reason why I refuse to test these systems further.

Remedies for Bikeways

Naturally there have been efforts to remove these dangerous deficiencies of bikeways. Nothing can be done for sidepath bikeways except to require cyclists to yield all right of way to all traffic either all the time or through a system of traffic signals that will stop all motorists part of the time and all cyclists the rest of the time. Requiring all motorists to yield at all times is not even a theoretical possibility both for social reasons and because the motorist is not at risk and is not able to observe the potential conflict from his position on the roadway. These deficiencies occur not only at formal intersections of streets but also at every driveway. In the one United States comparison of the change in the rate of car-bike collisions (when sidepaths were designated on sidewalks in Palo Alto) the bikeway car-bike-collision rate per bike-mile was 154% of the no-bikeway rate.[2] See Fig. 9-7, Typical Side-Path Hazards. Recognition of these insoluble hazards of bicycle sidepaths lead to declarations that they were no longer recommended (California 1978; American Association of State Highway and Transportation Officials 1981, 1991). The AASHTO *Guide for Development of New Bicycle Facilities* (1981) stated that "sidewalks are generally not acceptable for bicycling [except] in a few limited situations such as on long and narrow bridges." It further circumscribes the feasibility of urban bicycle paths by stating: "It is preferable that the crossing of a bicycle path and a highway be at a location away from the influence of intersections with other highways.... Where physical constraints prohibit such independent intersections the crossings may be at or adjacent to the pedestrian crossing. Rights of way should be assigned and sight distance should be provided so as to minimize the potential for conflict resulting from unconventional turning movements." AASHTO does not, however, describe any method of assigning rights of way to prevent these unconventional-turning-movement conflicts. The only method known is to install traffic signals with completely different green phases for motorists and for cyclists, a measure that imposes considerable delays on motorists and very severe delays on cyclists. This system is used in Holland, which explains the New Scientist report[3] of Dutch

2. Palo Alto Staff Report, 17 Jan 74.

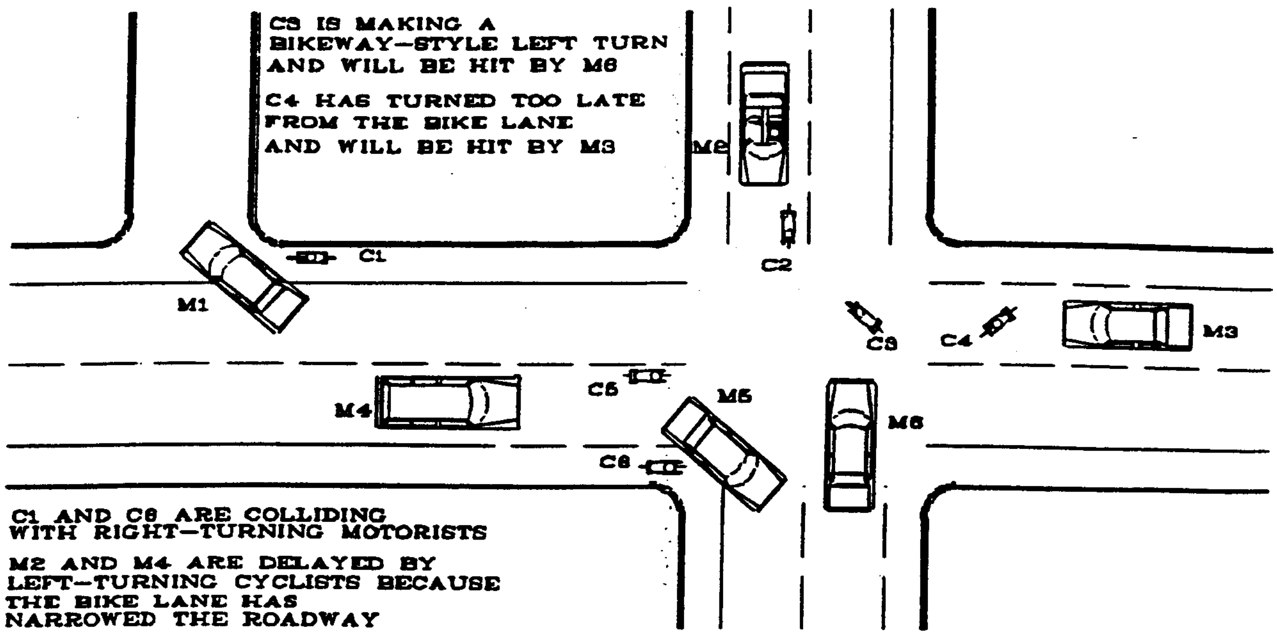

Fig. 9-8 Typical Bike-Lane Hazards

cyclists avoiding bikeway streets.

The 1991 version of the AASHTO Guide contains one page of cautions, euphemistically called operational problems, against using bike paths adjacent to roadways. However, the authors of the new version carefully edited out any mention of the greatest operational problem: bicycle sidepaths are very dangerous because they cause large numbers of car-bike collisions. Even with this editing, the logic remains. Operational problem #6 says: "Bicyclists using the bicycle path generally are required to stop or yield at all cross streets and driveways, while bicyclists using the roadway usually have priority over cross traffic, because they have the same right of way as motorists." Why are the cyclists on the bike path required to stop or yield at every cross street or driveway? That's easy: if they don't they get smashed. If the traffic engineer installs stop or yield signs at all those places, it shows the public that he knows that the design is dangerous. If he doesn't, the public may be more likely to use the facility but he places his employer in legal jeopardy.

With urban bicycle sidepaths recognized as hazardous, bike lanes were the only remaining type of practical urban bikeways. Therefore, engineering-minded bikeway advocates in the San Francisco Bay area concentrated their efforts on reducing the hazards created by bike lanes. Their solution, which after several levels of persuasion became the *Manual for Uniform Traffic Control Devices* bike-lane standards and the AASHTO *Guides for the Development of [New] Bicycle Facilities* (1981, 1991), is to delete the bike-lane stripe immediately before intersections on the assumption that this allows or encourages left-turning cyclists to first merge left and right-turning motorists to first merge right. However, traffic does not follow this assumption either at intersections or at driveways, presumably because both cyclists and motorists fail to understand the principles of traffic engineering, believing only that the bike-lane stripe reinforces and exemplifies the rule that cars keep left and bicycles keep right. Furthermore, this line deletion does not occur before driveways where the problems are identical and the turning volume may be very high (as at shopping-center driveways). Deletion before driveways was rejected for the very simple reason that if the stripe were deleted for an adequate distance before every driveway, no stripe would remain on most streets. For much the same reason, the stripe deletion distance is typically only 92 feet, which is completely insufficient for a one-lane merge on a 25-mph street. By the normal traffic-engineering rule, such a merge requires 300 feet.

The above criticisms apply to plain streets without special features. At those locations where there are special features, bike lanes create even

3. *New Scientist*, 4 June 1981.

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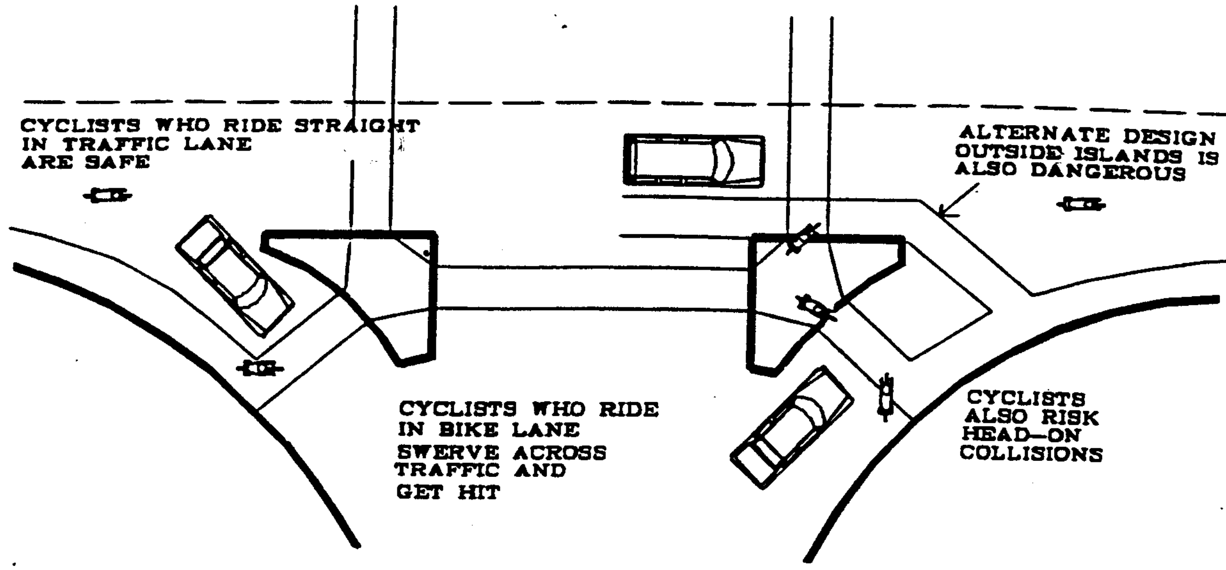

Fig. 9-9 Bike-Lane Hazards at Free-Running Rights

more hazards. At free-running right-turn-only lanes the bike-lane designer has the problem of deciding whether to follow the curve of the curb or follow the straight-through traffic lane. Of course, he should follow the straight-through lane, because that is where cyclists (those not turning right) ought to be riding. However, few designers do, and if they do they have to justify this to the public. The problems posed by trying to design bike lanes into the on and off ramps at freeway overcrossings are impossible to solve. I have attended several conferences at which the problems of particular overcrossings were discussed, and in each case designing a bike lane into the overcrossing made the problems worse and even the bike-lane advocates reluctantly concluded that the no-bike-lane solution was the best. No matter what solution is chosen, it will prove more hazardous for at least some of the users while not making any users safer. Typical hazards are shown in Fig. 9-9, Bike-Lane Hazards at Free-Running Rights and in Fig. 9-10, Bike-Lane Hazards at Freeway Overcrossings.

Summary

The design principles accepted by bike-lane advocates largely deny that bike lanes should exist in urban areas. The AASHTO Guide states flatly: "Bicycle lanes tend to complicate both bicycle and motor vehicle turning movements at intersections. Because they encourage bicyclists to keep to the right and motorists to keep to the left, both operators are somewhat discouraged from merging in advance of turns. Thus some bicyclists will begin left turns from the right-side bicycle lane and some motorists will begin right turns from the lane to the left of the bicycle lane. Both maneuvers are contrary to established Rules of the Road and result in conflicts."

Quite clearly, even the documents produced by modern bikeway advocates as the supposed basis for their activities conclude that practical conventional urban bikeways increase the traffic conflicts that according to accepted accident statistics cause about 30% of car-bike collisions. In contrast to these flatly stated conclusions, these documents make no specific claim that bikeways reduce the accident rate, increase cyclists' speeds, or reduce the required level of cycling skill. The only specific, objective advantage of bikeways stated in the AASHTO Guide is that bike lanes can increase the total capacity of a highway that carries mixed bicycle and motor traffic. This effect will occur only if a highway with narrow lanes is widened by the construction of a new bike-lane surface—and of course it is the widening that increases the capacity, not the stripe that makes a

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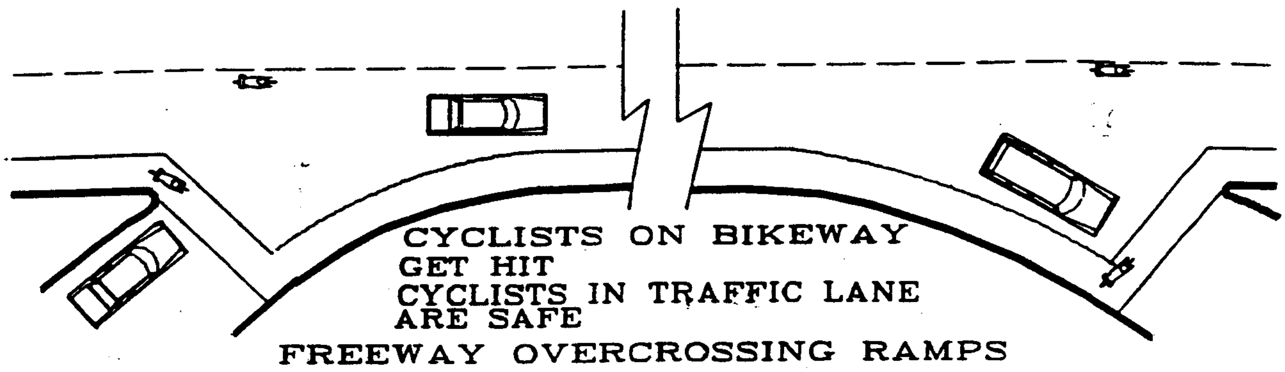

Fig. 9-10 Bike-Lane Hazards at Freeway Overcrossings

bike lane of the new surface. Since these are the accepted facts on both sides of the bikeway controversy, the motivation for bikeway advocacy must be sought elsewhere than in the traditional transportation criteria of the safety and convenience of the traveling public. Furthermore, the safety and convenience of the cycling public can be improved only by programs other than bikeways.