NC 86/Airport Road Pedestrian and Bicycle Safety and Mobility Study: Chapel Hill Community Mobility and Health Initiative

Final Report
prepared for the
Town of Chapel Hill, North Carolina

August, 2004

Libby Thomas
Charles Zegeer
William Hunter

The Highway Safety Research Center
Of the University of North Carolina
Chapel Hill, North Carolina

EXECUTIVE SUMMARY

In the fall of 2003, the Town of Chapel Hill was one of 25 communities across the nation to be awarded an Active Living by Design grant from the Robert Wood Johnson Foundation. The goal of the Active Living program is to help communities create environments that will encourage more daily physical activity and hence improve public health. The NC 86/Airport Road Pedestrian and Bicycle Safety and Mobility Study, as described in this report, is one element of Chapel Hill's Active Living by Design program. A key aspect of the overall Active Living program goal to increase physical activity in the community is to create an environment that is conducive to walking and bicycling to complete many regular daily trips, such as commuting to work, completing shopping trips or errands, and other day-to-day activities. The intent of this study, therefore, was to assess safety barriers and other factors that may limit walking and bicycling along a key town corridor, Airport Road, and suggest possible remedies. The process and findings from this initial assessment might also guide efforts to improve other Town corridors. Significant future development, particularly of the Carolina North campus, is also pending along the corridor. The recommendations from this report, though based primarily on current conditions, may also help in the planning and development of these adjacent areas to create an inviting pedestrian and bicycle-friendly sector of town and campus.

This report includes a preliminary assessment of existing pedestrian, bicycle, and transit patterns, identification of critical safety and access problems, and the development of potential countermeasures (treatments) for improving pedestrian and bicycle safety and access and encouraging more walking and bicycling along the corridor. The study report will be submitted to the Chapel Hill Town Council for further review of the suggested treatments.

Study Area and Current Conditions

The study area includes the approximately 4-mile Airport Road corridor in Chapel Hill, NC, from Interstate 40 (I-40) in the north to the terminus at the North Street intersection in the south. Airport Road is basically a five-lane arterial roadway, two-way, with center two-way left turn lane, for most of its length. Airport Road serves as a major arterial carrying between 20,000 and 32,500 vehicles per day traveling at average speeds of more than 42 mph. Airport Road provides the main throughway for all travel modes, including transit, for the northern area of town toward the town center and the University of North Carolina campus. Development in areas adjacent to the roadway is about 40% residential, with half that being high-density residential. There is a mix of other uses, primarily institutional and office, with approximately 7% commercial development.

Twelve-hour weekday counts noted 2,814 pedestrians walking near 10 observation locations along the corridor, and 557 bicyclists riding near the same 10 locations. Also, 125 bicyclists and 519 pedestrians were observed on Airport Road near the entrance to the Bolin Creek Trail during a 12-hour Saturday count. During the weekday counts, higher pedestrian and bicycle activity was observed closest to the town center and UNC campus, near the Bolin Creek greenway, and near some transit stops that are close to

dense residential developments. Daily bus use for the six routes that stop along Airport road was around 1000 persons. Much of the use is concentrated at stops hear high-density residential areas. Most bus boardings are southbound (toward the University and town center) and most alightings are northbound.

Safety and Access Issues

In order to create a more pedestrian- and bicycle-friendly environment along Airport Road, a number of key issues will need to be addressed. The following are the key issues or challenges identified that affect pedestrian and bicyclist safety and access along Airport Road:

- Airport Road is an arterial, high volume roadway with no alternative routes to town / campus.
- High speeds of motor vehicles contribute to making walking and bicycling in the corridor unsafe.
- It is difficult for bicyclists and pedestrians to access or cross Airport Road from non-signalized side streets and mid-block locations; traffic signals are widely spaced.
- There are currently incomplete and inadequate sidewalks and a lack of buffers between sidewalks and travel lanes.
- There are shifting and discontinuous bicycle facilities.
- Numerous driveways and side streets, along with the two-way, left turn lane design, create numerous conflict points for pedestrians and bicyclists with turning motor vehicles.
- There is poor sight distance at numerous driveways and intersections.
- There is a high crash area around the Hillsborough Road / Umstead Drive intersection with Airport Road.
- Wrong-way and sidewalk bicycling have contributed to bicyclist crashes with motor vehicles in the corridor.
- Wide, multi-lane intersections are unpleasant and difficult for pedestrians and bicyclists to negotiate.
- Wide curb radii / cross sections at some connecting streets and driveways increase pedestrian and bicyclist exposure to traffic.
- Trail access issues may discourage bicycling and walking or contribute to wrong-way bicycling along the corridor.
- Bus stop issues may discourage bicycling and walking as part of transit trips.

Finally, a primary goal of the Active Living program is to increase bicycling and walking in the community, so an objective of this assessment was to identify treatments that would encourage greater walking and bicycling along the Airport Road corridor.

Potential Treatments

A number of treatments are available that should improve walking and bicycling conditions along Airport Road. Below we identify some of the key treatments that we think have the greatest chance of successfully improving conditions for bicyclists and pedestrians along this corridor. All of these potential treatments are suggested for further consideration and evaluation by the Town and NCDOT. More detailed lists, including

other options and supporting information, are provided in the body of this report. When re-designing an existing roadway, flexibility and compromise may be required. Additionally, a thorough public process is important to successful implementation of some treatments.

With the above considerations in mind, the following measures are suggested as potential treatments along Airport Road.

Provide median refuge

To assist pedestrians (and bicyclists) in crossing this busy, multi-lane corridor:

- *Replace the two-way, left turn lane with a raised median. Providing median pockets (curb cuts) at high mid-block crossing locations would improve access for all pedestrians and bicyclists.*

This treatment should help with a number of the problems noted above. Raised medians provide a refuge for pedestrians crossing at mid-block locations. They also reduce the number of conflict points by restricting left turn access to designated locations. A raised median should also improve motor-vehicle safety.

Complete pedestrian facilities

To provide a complete network of accessible pedestrian facilities in the Airport Road corridor, the following treatments are suggested:

- *Close the gaps in the walkways with wide, well-designed sidewalks.*
- *Provide appropriate access through proper curb cuts at all crosswalk areas and high midblock crossing locations such as transit stops.*
- *Provide crosswalks and pedestrian signal heads at all sides of signalized intersections.*
- *Maintain sidewalks in passable condition throughout the year.*

Enhance pedestrian safety and the aesthetic environment

The goals of enhancing the pedestrian environment should include adding as much width to the buffer between pedestrians and traffic lanes as possible. Ideally, a vertical buffer (*i.e.*, tall shade trees) will also be added throughout the corridor to increase separation between pedestrians and the traffic lanes, provide visual narrowing of the roadway, and enhance the comfort of the walking environment, particularly in the warmer months. The following treatments would help to improve the safety and comfort of the pedestrian environment:

- *Add / increase buffer strip between walkway and motor vehicle lanes. Five-foot buffers are recommended for arterial streets.*
- *Plant street trees (shade trees), preferably in buffer strips and/or medians. Alternatively, create a continuous canopy by planting, or encouraging property owners to plant, on the outer side of the sidewalk when necessary.*

Provide consistent space for bicyclists

Providing a consistent space for bicyclists on the roadway, particularly bike lanes, would enhance the appeal of the corridor for bicyclists. Connecting these facilities with other

bicycle routes / facilities along other corridors will enable bicyclists to travel to desired destinations. Bicyclists are particularly vulnerable to poor pavement, debris, and poorly-placed pavement seams, utility covers and drainage grates; thus adequate sweeping and maintenance plans of bicycle facilities should be in place, as well as proper placement of utilities and seams when re-paving or repairs are completed. To improve safety and encourage more bicycling in the corridor, the following treatments are identified:

- *Add bike lanes to entire corridor through re-striping and/or curb or median realignment. (Special paving treatments may add additional emphasis and help visually narrow the roadway.)*
- *Repair / replace hazardous drainage grates with bicycle-compatible design.*
- *Develop and implement a hazard-identification and regular sweeping and maintenance plan to keep facilities safe for bicyclists.*
- *Provide bicyclist access from each side of Airport Road to Bolin Creek Trail.*
- *Connect Airport Road bike facilities with other bike routes / paths linking to key destinations.*

Improve intersection safety

The major intersections along the corridor are challenging for both pedestrians and bicyclists. Slowing speeds and improving traffic signal compliance would improve safety for bicyclists and pedestrians. Other treatments that could improve intersection safety by reducing exposure, improving sight distance, and reducing conflicts between pedestrians and bicyclists with turning vehicles include the following:

- *Narrow turn radii at intersections and driveways to reduce crossing distance and turn speed of vehicles.*
- *Add proper curb cuts to all pedestrian crossing locations - two curb cuts per corner at intersections.*
- *Provide crosswalks and pedestrian signal heads at all sides of signalized intersections. Special coloring or paving treatments may add emphasis.*
- *Add median refuge / extension with curb cuts to crossing areas along with center pedestrian activator button at signalized locations (may also help reduce turning speeds and 'cutting corners').*
- *Consider restricting right-turn-on-red maneuvers. A partial restriction could indicate "No RTOR when pedestrians present."*
- *Address sight distance problems at intersections.*

Lower motor vehicle speeds

Reducing motor vehicle speeds is a challenge. To consistently lower motor vehicle speeds through traditional enforcement requires frequent and random effort and significant penalties. Altering the roadway may have a more sustainable effect on motor vehicle speeds, thus the following treatment is suggested for serious consideration:

- *Narrow the travel lanes to 11 feet or less through re-striping, or, through curb or median re-alignment. Lane narrowing could help to slow motor vehicle speeds as well as reduce the exposure of crossing pedestrians and bicyclists to traffic.*

An added benefit of designating bicycle lanes is that space could be reallocated from existing motor vehicle lanes to the bike lanes. The addition of a raised median, and the

use of other visual narrowing techniques, such as completing sidewalks and buffer strips and planting street trees, could further slow the traffic speeds on the roadway. Curb or median realignment may also be useful in adding width to the buffer strip and sidewalk.

Improve sight distance at connectors

Developing a long-term plan to deal with the large number of driveways and intersecting streets with sight distance problems along Airport Road is an important component of creating a safe and encouraging environment for pedestrians and bicyclists. The following treatments are suggested:

- *Keep foliage trimmed; remove/relocate shrubbery immediately adjacent to the walkway.*
- *Develop landscape planting and maintenance guidelines for the entire corridor.*
- *Continue raised sidewalk across all driveways to encourage motorists turning into or out of Airport Road to yield to pedestrians and bicyclists.*
- *Evaluate right-of-way options and develop plan for improving sight distance at driveways and intersections, as well as sidewalk clearance.*

Enhance transit stop access and appeal

Improving access and ease of use of the bus system along the corridor complements the goal of increasing walking and bicycling. Providing safe locations, proper access for pedestrians and bicyclists at transit stops, and sheltered waiting platforms away from the roadway, as well as excellent route service, enhances the appeal of transit and should help to increase combined trips. To improve access and appeal of transit, the following treatments are suggested:

- *Add curb cuts at mid-block transit stops and trail access points (when trail improvements are completed).*
- *Add waiting platforms adjacent to the sidewalk at bus stops.*
- *Add bus shelters and seating to those stops without them.*
- *Add bicycle parking to park and ride locations, commercial areas, and other destinations. Consider covered parking for bicycles at park and ride locations. (Evaluate need for bicycle parking at transit stops.)*
- *Evaluate location and design of transit stops in terms of safety, bicyclist and ADA (Americans with Disabilities Act) access, as well as convenience or proximity to origins and destinations.*

Encouraging more walking and bicycling

Airport Road is the only feasible through route for all modes of travel from the northern neighborhoods of Chapel Hill to the town center and the University of North Carolina campus. Under current conditions, most walking and bicycling seems to be utilitarian – commuting to work or school. There is considerable potential for creating a vibrant corridor for walking and bicycling since the area is still undergoing development. Safety and access improvements, such as providing connected bicycle and pedestrian facilities and crossing enhancements, such as a raised center median, along with treatments intended to slow motor vehicle speeds, should help to make bicycling and walking along the corridor possible for more of the population. Additional improvements in landscaping, lighting, paving treatments, transit stop treatments, and aesthetics should

help to make walking and bicycling along Airport Road appealing to more of the population, particularly as more areas are developed with a mix of uses and destinations. Providing appealing choices for active modes of transportation will enable residents to pursue healthier, less car-dependent lifestyles that will in turn have multiple benefits for the community including less traffic congestion and less air pollution.

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Background of the Study

In the fall of 2003, the Town of Chapel Hill was awarded an Active Living by Design grant from the Robert Wood Johnson Foundation through the Active Living by Design program. The Foundation provided the grants to 25 communities across the nation with the goal of encouraging Americans to improve their health by incorporating physical activity into their daily routines. An important step towards achieving such behavioral change in the community is to create a physical environment that encourages citizens to be more active. The NC 86/Airport Road Pedestrian and Bicycle Safety and Mobility Study as described in this report, is one element of Chapel Hill's Active Living by Design program. This study, conducted by the Highway Safety Research Center of the University of North Carolina (HSRC), will guide the Town's efforts to improve the walking and bicycling environment along Airport Road. This preliminary analysis includes an assessment of existing pedestrian and bicycle patterns, identification of critical safety problems and the development of options for improving pedestrian and bicycle safety and access and encouraging more walking and bicycling along the corridor. The study report will be submitted to the Chapel Hill Town Council for further review of the suggested treatments.

In recent years, traffic engineers and planners have designed and built streets primarily based on safe and efficient movement of the automobile. Providing a well-balanced transportation system also requires including basic facilities that encourage safe bicycling and walking. In the report that follows, we have identified a number of treatments that, if implemented, should significantly improve pedestrian and bicyclist safety and access along the Airport Road corridor and result in increased walking and bicycling.

There are a number of important factors outside of the typical purview of transportation planners and engineers that also have a significant bearing on whether people will walk or bicycle more in the future. People choose to walk or bike for a variety of purposes, including for recreation and fitness, commuting or connecting with transit, completing errands, and making social visits or meeting in public places. Walking trips to complete errands, dine out, visit neighbors, or travel to work or school are as (and perhaps more) important in the overall goal to increase daily activity levels as walks explicitly intended for fitness. Some of the other factors that may have a bearing on the amount of walking and bicycling that will occur, particularly for these other purposes, include: the close alignment of buildings near the street, complexity (diversity and density) of land uses, and appealing open spaces (Jaskiewicz, 1999 after Rapoport, 1990 and Jacobs, 1993). Many community attributes therefore, inter-related with transportation infrastructure and design, affect the willingness of people to walk or bike. We will touch on some of these issues in this report, particularly in the section on encouraging bicycling and walking, but hopefully, these important factors are currently being addressed through land-use and infrastructure planning, and policy-making decisions.

There are a number of changes already in motion that will bear on the success of improving the pedestrian and bicycling appeal of the Airport Road corridor and of Chapel Hill as a whole. A key consideration is the development of the Carolina North campus of the University of North Carolina along the west side of a portion of the Airport Road corridor.

The development of this large parcel will have a significant bearing on transportation demand (all modes) by the generation of new users and additional traffic to and between campuses. Other key impacts on the attractiveness of the Airport Road area for walking and bicycling will result from the design and implementation of the overall development – pedestrian and bicycle facilities connecting to the Airport Road corridor, the uses and density of the development, location and accessibility of new businesses and services to Airport Road, and others. The provision of appealing bicycling and walking facilities could offset some of the expected increases in motorized traffic. And the addition of new and interesting destinations along Airport Road could produce a lively environment for walking, bicycling, working, and social interaction.

There is also currently a bicycle and pedestrian master plan under development by the town. According to a draft, the purpose of the plan is: "to increase bicycle and pedestrian use, to identify a potential network of bicycle and pedestrian facilities, and to identify methods of creating it." (Town of Chapel Hill Bicycle and Pedestrian Action Plan, 2004 draft plan). Additionally, a number of bicycle and pedestrian improvements for streets and greenways connecting with Airport Road are identified in the State Transportation Improvement Program. There are plans for greenway extensions as well as improvements in access and connectivity to existing greenways. Hopefully, some of the recommendations given in this report will prove useful in conjunction with these other plans and overall goals for improving bicycling and walking opportunities in Chapel Hill.

In completing this initial assessment of the Airport Road corridor, our primary directive was to evaluate existing safety and accessibility conditions along the corridor and to suggest possible improvements for bicyclists and pedestrians. The following sections include:

- a description of the study area,
- a summary of the methods used in this study,
- a summary of existing conditions and transportation mode use,
- a summary of public input,
- problem and solution identification,
- key recommendations and conclusions.

Study Area Description

The study area includes the approximately 4-mile Airport Road corridor in Chapel Hill, NC, from Interstate 40 (I-40) in the north to the terminus at the North Street intersection in the south (fig.1). Airport Road is basically a five-lane arterial roadway for most of its length. This arterial roadway is a main thoroughfare that links I-40 and rural areas of the county with the Chapel Hill downtown area and the University of North Carolina campus. Airport Road also provides access for a number of residential neighborhoods in town.

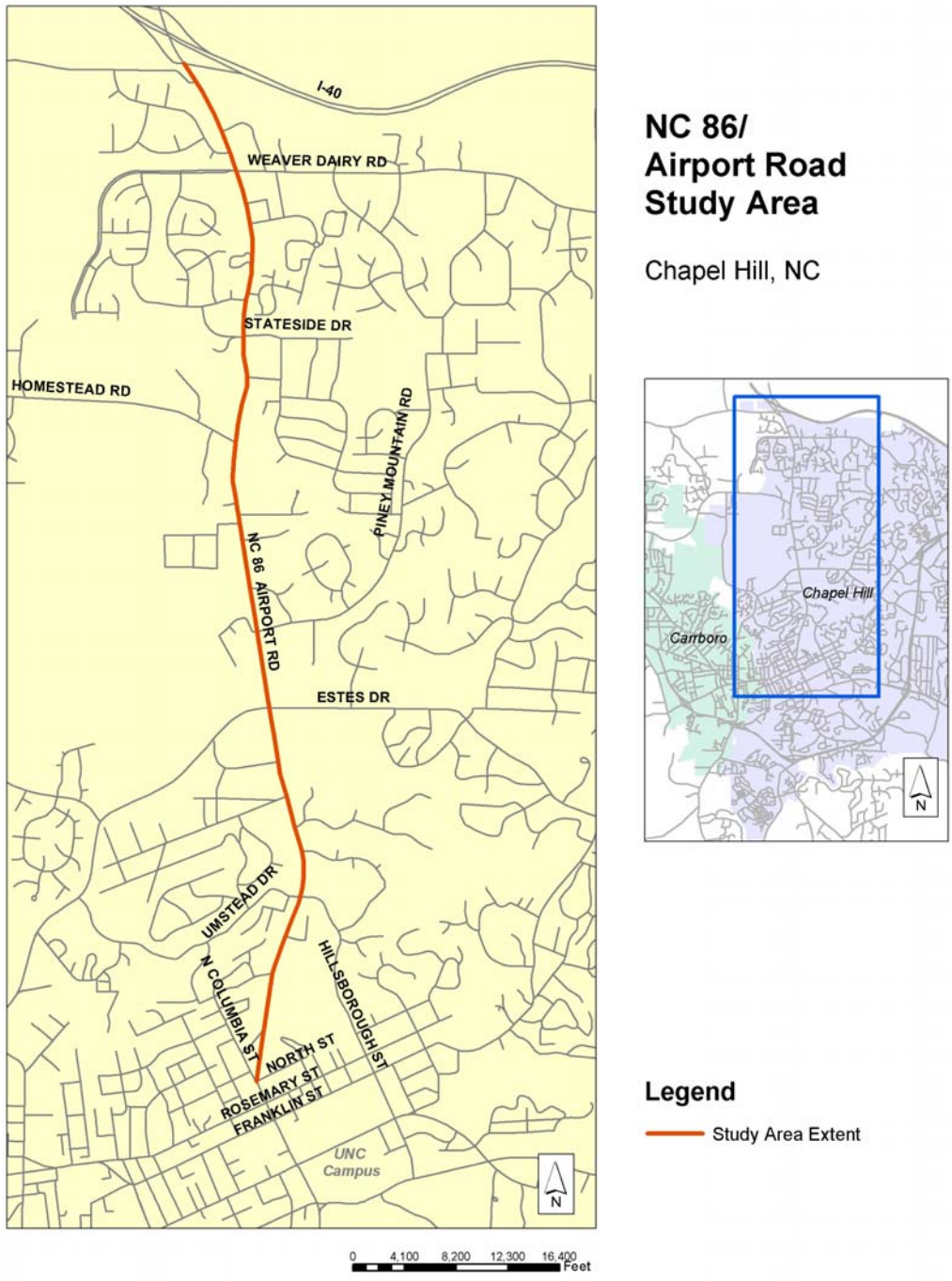


Figure 1. NC 86 / Airport Road pedestrian and bicycle assessment study area.

Development along the corridor is on-going. (Appendix A contains a study area land use map and aerial images of the present-day corridor). According to information provided by the Town, land uses abutting Airport Road consist approximately of:

Commercial	7%
Institutional	25%
Mixed use	6%
Office	10%
Low residential	16%
Medium residential	2%
High Residential	19%
Parks / open space	7%
Undeveloped land	7%

The posted speed limit in the northern-most segment near I-40 is 45 mph. The speed limit is reduced to 35 mph north of Weaver Dairy Road and is 35 mph through the rest of the corridor.

The roadway itself has three major cross-sectional areas (shown in fig. 2):

Airport Road section with center, raised median

– From I – 40 south to Homestead Road, Airport Road is a raised-median divided four-lane, consisting of two through lanes in each direction, with bike lanes on each side. There are curbs, approximately 4' grass-only buffer strips, and sidewalks on both sides, with dedicated turn lanes added at intersections.

– From near Homestead Road (this configuration begins and ends at different locations on the east and west sides) south to Estes Road, the roadway takes on a rural-type cross-section with 5 lanes, including a center, two-way left-turn lane (TWLTL) and paved shoulders (no curb or sidewalk for most of the west side and about half of the east side of this sector). Curb, gutter, and sidewalks begin north of Piney Mountain Road on the east side of the roadway and continue south and are sporadic in other areas.

Airport Road area with paved shoulders, TWLTL

– Estes Road south to North Street continues the 5 lanes with TWLTL, but with wide outside lanes instead of paved

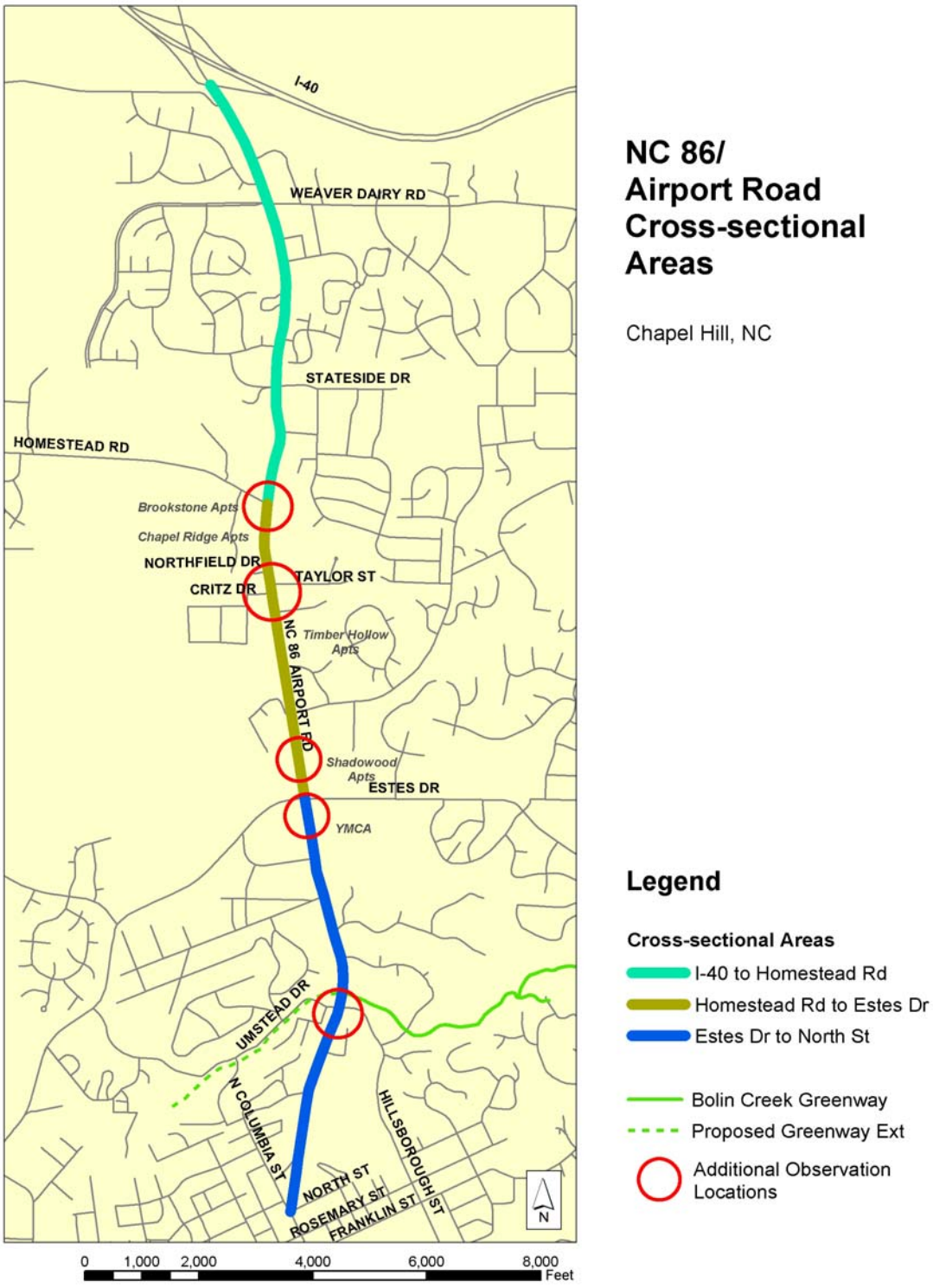


Figure 2. NC 86 /Airport Road cross-sectional profile segments and observation locations.

shoulders. This segment is bounded by curb, sidewalks for most of the length (except on the west side north of Airport Drive), and narrow, grassy, or nonexistent sidewalk buffers.

Motor vehicle speeds, traffic volumes, and other conditions along the corridor are further detailed below.

Segment of Airport Road with wide outside lanes, TWLTL

Study Methods

This study included an informal assessment of the Airport Road existing facilities; assessment of current traffic conditions and mode use along the corridor; observations of interactions of pedestrians, bicyclists, motorists, and transit; and input from the public on perceived barriers to walking and bicycling in the corridor. In order to assess existing transportation mode use and traffic conditions along Airport Road, HSRC analyzed traffic volume and speed data, pedestrian and bicyclist counts, transit use, and other information provided by the Town of Chapel Hill. The Town also requested and provided an NCDOT "strip-analysis" on all reported motor vehicle crashes for the five-year period from 7/1/1998 to 6/30/2003. HSRC also identified and analyzed police-reported bicycle and pedestrian crashes with motor vehicles over a five-year span (1998 – 2002) by type of crash, location, and contributing factors.

With the Town's input, five locations were identified to make additional field observations of existing conditions (circles shown in figure 2). These areas were as follows:

- Hillsborough Street area – from near the #725 Airport Road (west side) bus stop #3448, going north to the Bolin Creek Greenway entrance. This segment spans the Hillsborough / Umstead Road intersection with Airport Road.
- YMCA area to Estes Drive – from bus stops near the YMCA, #3053 on east side, and #3445 on west side, north to Estes Drive.
- Shadowood Apartments area – includes bus stops #3479 on the east side and #3327, west side.
- Northfield Drive area – from bus stop #3334 near Ashley Forest Drive north to bus stop #3335 north of Taylor St (both on the east side) and including west side stop #3420 near Critz Drive.
- Homestead Road / Brookstone Apartments area – from the bus stop #3332 south of Homestead Road on the west side north to bus stop #3333, northeast side of Homestead Road intersection with Airport Road.

The HSRC study team visited these locations several times and made observations of the existing geometric configuration and facilities, and of pedestrian and bicyclist movements and interactions with motorists, including videotaped observations. Additionally, field investigations included driving and walking the corridor on several occasions to make additional observations regarding bicycle and pedestrian problems or potential improvements.

With the Town's assistance, a forum was held with project team members, in which the public was invited to provide input into problems and perceived barriers to walking and bicycling along Airport Road. Written pedestrian and bicyclist survey forms were provided along with enlarged maps of the entire corridor for notating problem areas or needs. (Copies of survey forms with results are included in appendices.) During the forum, we also provided images of different types of walkways and midblock crossing facilities and solicited opinion on preferred types of facilities. Project staff also met on several occasions with Town staff from planning, engineering, parks and recreation, and the police department for briefings and to exchange ideas on how to make the corridor more bike and pedestrian-friendly.

Existing Bicycling and Walking Conditions and Transportation Mode Use

Below, we summarize the results of our analyses. Information obtained from observations and videotaping is included where appropriate. This information helped to form our assessments in the problem identification section that follows.

Motor vehicle volume

The volume of motorized traffic along the corridor varies from a low of about 21,000 vehicles per day in the southern-most reaches to nearly 36,000 vehicles north of Homestead Road in the north (Table 1).

Table 1. Average daily traffic (ADT) at five locations along airport road (count from 9/16/2003).

Segment of Airport Road	Total Volume (ADT)	Southbound Volume (ADT)	Northbound Volume (ADT)
N of Chapel Hill North	29,479	14,484	14,995
N of Homestead Road	35,851	19,386	16,465
N of Estes Drive	32,588	15,675	16,913
S of Estes Drive	26,156	15,164	10,992
N of North Street	20,664	10,493	10,171

The peak volumes tend to reflect movements into town in the morning and out in the evening. There are, however, also somewhat lower traffic peaks in the opposing directions

during both periods. There are also generally high volumes of traffic in both directions all day – from 600 vehicles per hour near North Street to around 1000 vehicles per hour north of Estes. The highest one-hour daily peaks for the southbound lanes occurred during morning hours, beginning around 7:30 am (fig. 3).

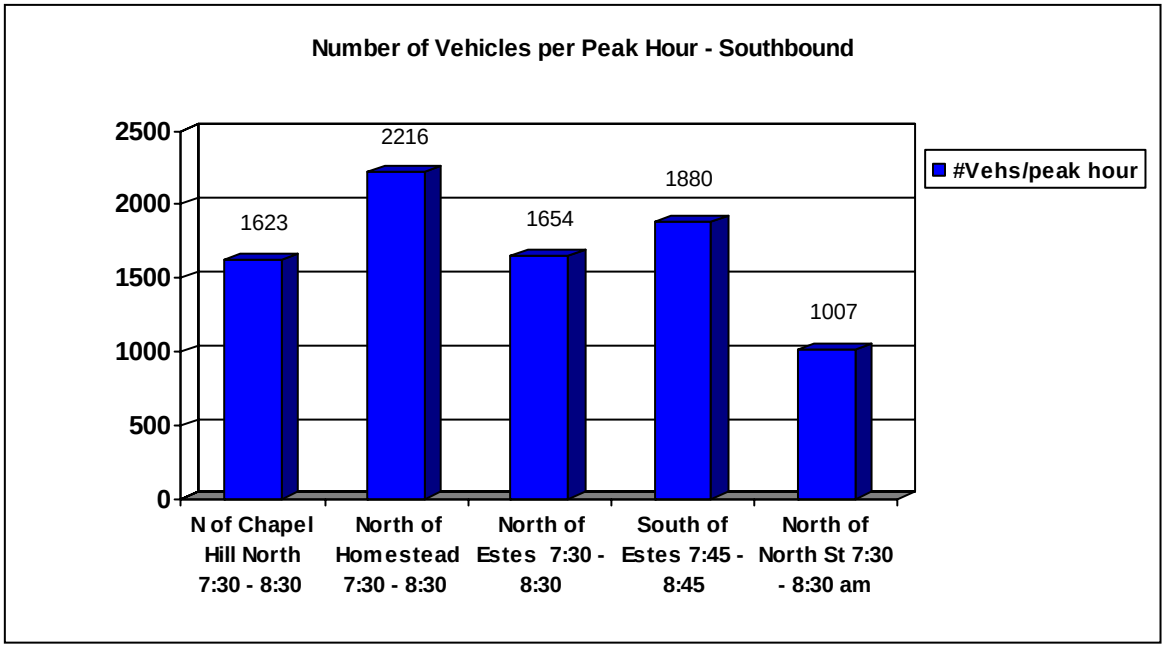


Figure 3. Southbound peak hour motor vehicle volumes from Average Daily Traffic estimates at five locations along Airport Road (date collected, 9/16/2003).

In the northbound lanes, hourly peak totals occurred in the evening hours, beginning around 4:45 pm as illustrated in fig. 4.

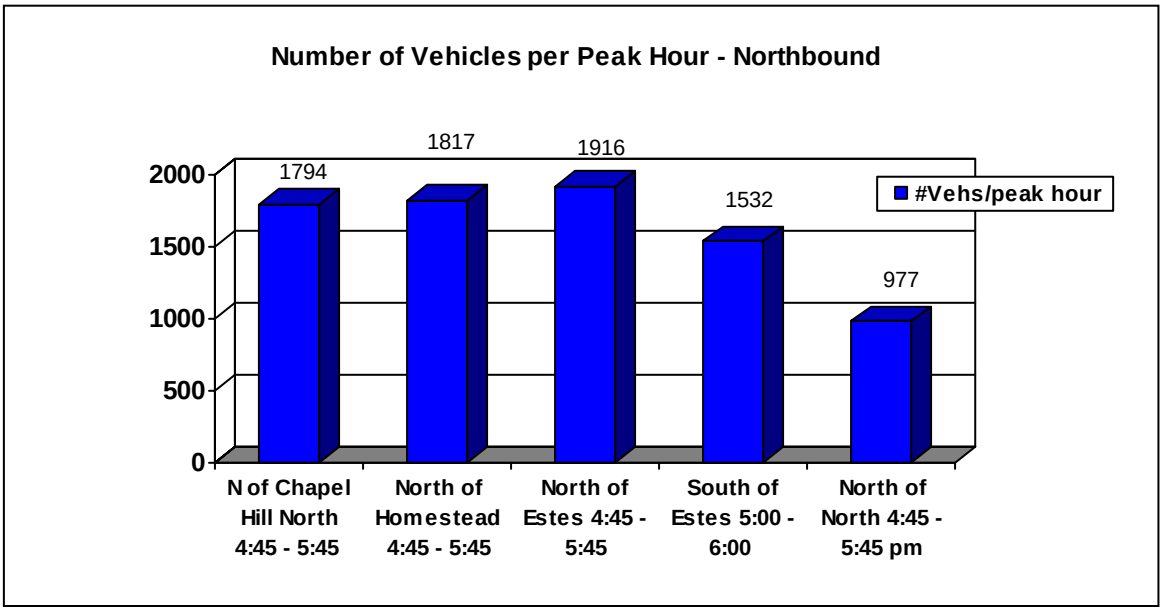


Figure 4. Northbound peak hour motor vehicle volumes from Average Daily Traffic estimates at five locations along Airport Road (collected 9/16/2003).

Motor vehicle speed

Speed data were collected from northbound and southbound lanes of Airport Road between Homestead and Westminster Roads, for eight full 24-hour periods (southbound - from 1:30 pm, April 6 to 4:45 pm, April 15, 2004). The first and last partial days were excluded from the analysis. The posted speed limit in this area is 35 mph. The northbound data from the automatic counter appeared to be unreliable, so results are from only one direction and one count location. The southbound results indicate the following:

- Average daily mean speed of 42 mph (Table 2)
- Average daily 15th percentile speed (15% of motor vehicles are traveling at or below that speed) of 35 mph
- Daily 50th percentile speed was 43 mph (very consistent)
- Average daily 85th percentile speed of > 48 mph

Table 2. Daily motor vehicle speeds for one southbound location on Airport Road.

Between Westminster and Homestead - Southbound						
date	Mean speed	15th percentile	50th percentile	85th percentile	# vehicles included in estimates	total vehicles
4/7/2004	42.4	34.6	43.1	48.6	12,227	12,678
4/8/2004	42.2	34.5	42.9	48.3	12,420	12,816
4/9/2004	42.2	34.8	43.1	48.2	10,986	11,173
4/10/2004	41.9	34.5	42.8	48.1	8,469	8,620
4/11/2004	42.6	35.3	43.4	48.5	8,276	8,542
4/12/2004	41.9	34.4	42.7	48.0	10,423	10,545
4/13/2004	42.3	35.1	43.1	48.1	10,780	10,987
4/14/2004	42.2	35.0	43.1	48.2	10,998	11,173

Sixty-one to 68% of all southbound vehicles were traveling between 40 and 50 mph and the 15th percentile speed of nearly 35 mph indicates that about 85% of vehicles are traveling above the speed limit. Less than one-third of vehicles traveled at or below 40 mph. (See fig. 5 for average daily percentages of vehicles traveling at each 10 mph speed interval.)

During peak morning hours, an even greater proportion of in-bound vehicles (72%, data not shown) traveled between 40 and 50 mph. Perhaps most alarmingly, above 5% of vehicles were traveling between 50 and 60 mph on some days (3% being the average daily percent). There seemed to be no clear pattern by day of the week, nor differences from weekday to weekend. The highest mean speed occurred on Sunday, but the lowest occurred on Saturday. Although we did not perform extensive analyses by time of day, these results suggest that congestion is not significantly limiting speeds at this time, or if so, only for very limited periods. (A more thorough speed study would be helpful to validate these data and findings, including the hopefully anomalous readings indicating that 2% of vehicles were traveling above 90 mph. A thorough speed study could also prove useful in targeting enforcement efforts.)

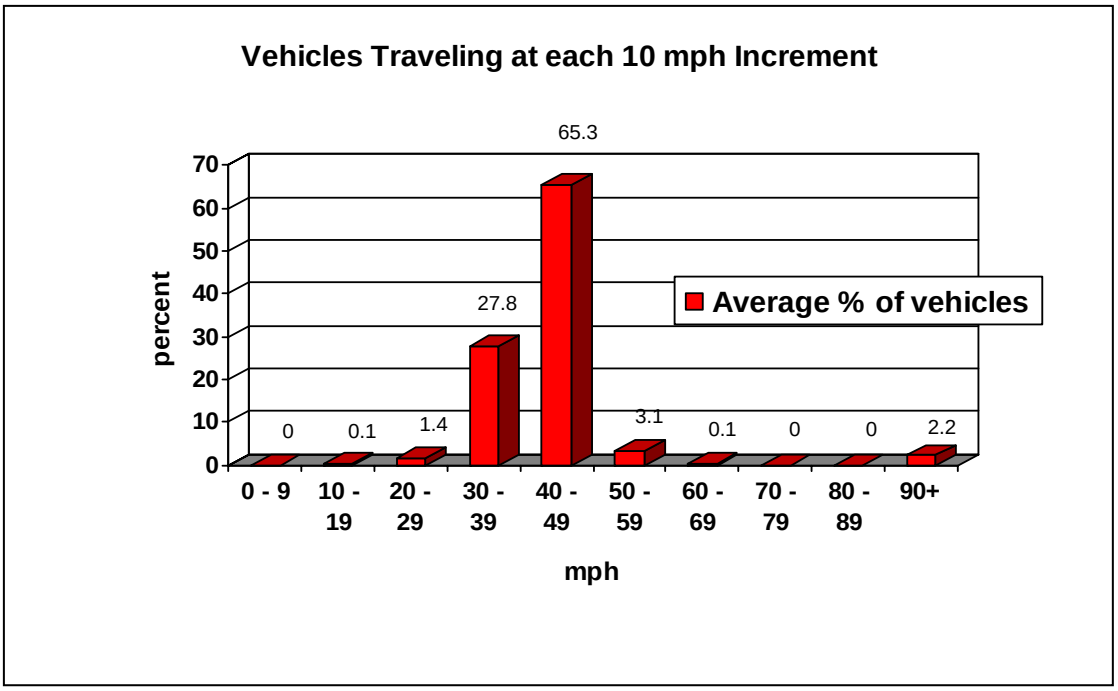


Figure 5. Average percent of inbound vehicles traveling at each 10 mph increment over an eight-day period, April 7 – 14, 2004.

Pedestrian counts

Twelve-hour pedestrian counts were conducted on weekdays at ten locations along Airport Road between September 17, and November 18, 2003. A second count was conducted at the Bolin Creek trail location on a Saturday. A total of 3333 pedestrians were observed, 2814 during the ten weekday observations. Approximately 40%, or 1364 pedestrians, were observed crossing the roadway and 60%, or 1969 pedestrians were observed walking along the roadway at all locations and times. It is likely that many of the same individuals were observed both 'coming' and 'going' to work, school, or other activity.

As might be expected, the highest counts of pedestrians both crossing the street and walking along Airport Road are from the southern-most count locations close to town and campus – near Stephens Street, Hillsborough Street, and the Bolin Creek area (Table 3). There were more pedestrians counted near the Bolin Creek Trail on Saturday (519) than on the weekday (405). More than four times the number of pedestrians were observed walking along the roadway near the Stephens Street and Hillsborough Street locations than at any (except one) of the other locations.

Other high pedestrian counts, especially of pedestrians crossing Airport Road, tended to come from locations near bus stops with high transit use where many riders must cross Airport Road for either the originating or return trip. There were large numbers of pedestrians crossing Airport Road near Shadow drive (Shadowood Apartments), and the Northfield Drive / Taylor Street / Critz area. Both of these locations are near large multi-family housing

complexes opposite transit stops. Substantial numbers of pedestrians were also observed walking along the roadway near Northfield Drive, even though this area lacks connected sidewalk facilities. (There are several gas stations / markets that may attract pedestrians in the area.) There were very few pedestrians walking along the roadway at other locations where there is no sidewalk. (Note the west side counts for YMCA and Shadowood sites.)

Table 3. Twelve- hour pedestrian counts from ten Airport Road locations (data collected 9/17 – 11/18/2003).

Location	Crossing E to W	Crossing W to E	Walking along – East side	Walking along - West side	Total
Stephens St.	0	33	259	171	463
Hillsborough St	160	119	260	198	737
Bolin Creek	134	64	189	18	405
Bolin Creek (Sat.)	212	82	213	12	519
YMCA	30	0	93	6	129
Shadow Dr.	127	127	56	9	319
Northfield Dr.	69	51	102	130	352
Stateside Dr.	30	9	43	39	121
Westminster	40	5	51	16	112
Weaver Dairy Rd	20	18	36	25	99
Chapel Hill North	21	13	24	19	77
Total	843	521	1326	643	3333

The analysis of individual locations (see Appendix B) indicates that peak activity, based on these 12-hour counts, generally occurred during morning hours from about 7 to 9 am and late afternoon hours from about 4 to 6 pm, with mid-day peaks as well. These peak hours coincide with peak motor vehicle volumes, and suggest that much of the activity is related to commuting to school and work. There is, however, significant activity spread throughout the day as might be expected in a university town. It is unclear why the two northernmost sites (Weaver Dairy Road and Chapel Hill North) tended to have greater activity from late morning through the afternoon, although both of these sites, along with Westminster, the third northern-most location, had the fewest pedestrians at around 100 per location. Perhaps these afternoon peaks were related to taking walking trips for purposes other than commuting, such as for errands and recreation. The northern-most count locations tend to be near single-family housing rather than near large multi-family units as with some of the higher-count locations.

Bicyclist counts

A total of 682 bicyclists were observed during 12-hour counts, conducted simultaneously with the pedestrian counts, at 10 locations along the corridor; 557 of these were observed during weekdays. As with pedestrians, more bicyclists were observed at the three count locations closer to Town and the University, Stephens Street, Hillsborough, and Bolin Creek (Table 4). There were significantly more bicyclists observed near the Bolin Creek Trail on

Saturday (125) than on the weekday (79). Of 559 bikes observed traveling along Airport Road, 171, or 31%, were riding against traffic, predominantly on the east side of the roadway. On the east side of the corridor, the sidewalk network is more continuous in most areas, and there is also less undeveloped property and more office / business / commercial areas. We do not have data about whether cyclists were traveling on the sidewalk, but from our observations, we suspect that most wrong-way riding does occur on the sidewalk.

Table 4. Twelve-hour bicycle counts from ten Airport Road locations (data collected 9/17 – 11/18/2003).

		Traveling North to South		Traveling South to North		
Location	Crossing	East side	West side	East side	West side	Total
Stephens St.	1	45	20	46	18	130
Hillsborough	5	26	41	34	2	108
Bolin Creek	26	8	14	28	3	79
Bolin Creek (Sat.)	57	18	12	38	0	125
YMCA	6	11	14	40	0	71
Shadow Dr.	1	11	12	12	4	40
Northfield Dr.	6	2	11	18	0	37
Stateside	12	2	14	7	0	35
Westminster Dr.	4	1	1	6	1	13
Weaver Dairy Rd.	2	7	4	7	3	23
Chapel Hill North	3	6	3	6	3	21
Total	123	137	146	242	34	682
		Wrong way			Wrong way	

Transit use

Six transit routes cover all or portions of Airport Road – the A, G, HS, NS, NU, and T routes. Our observations reveal that a number of the bus stops are located near multi-family housing areas that appear to generate mostly student bus riders (figures 6 and 7). The most heavily-used transit stops, for one full day of service by all routes, were as follows:

- Near Shadowood Apartments, east and west side stops – crossing Airport Road is required for apartment residents to access the west side stop for southbound travel.
- Airport Rd at #725, west side (formerly UNC Human Resources) and at Foster's Market, east side.
- At Critz Drive, west side, and at Taylor Street, east side – crossing is required from the east side, northbound stop (Taylor Street stop) for those returning to apartments on the west side. Ashley Forest, east side, nearby, also receives heavy use.
- Brookstone Apartments, west side, and Homestead Road, east side – crossing is required for northbound travel to return to apartments on west side.
- Timber Hollow, east side also had above 50 riders per day /mostly alighting northbound.

Judging from the boarding and alighting data, most use seems to be toward campus and back (southbound boardings and northbound alightings) as would be expected. (Complete transit use data by stop is included in Appendix C.)

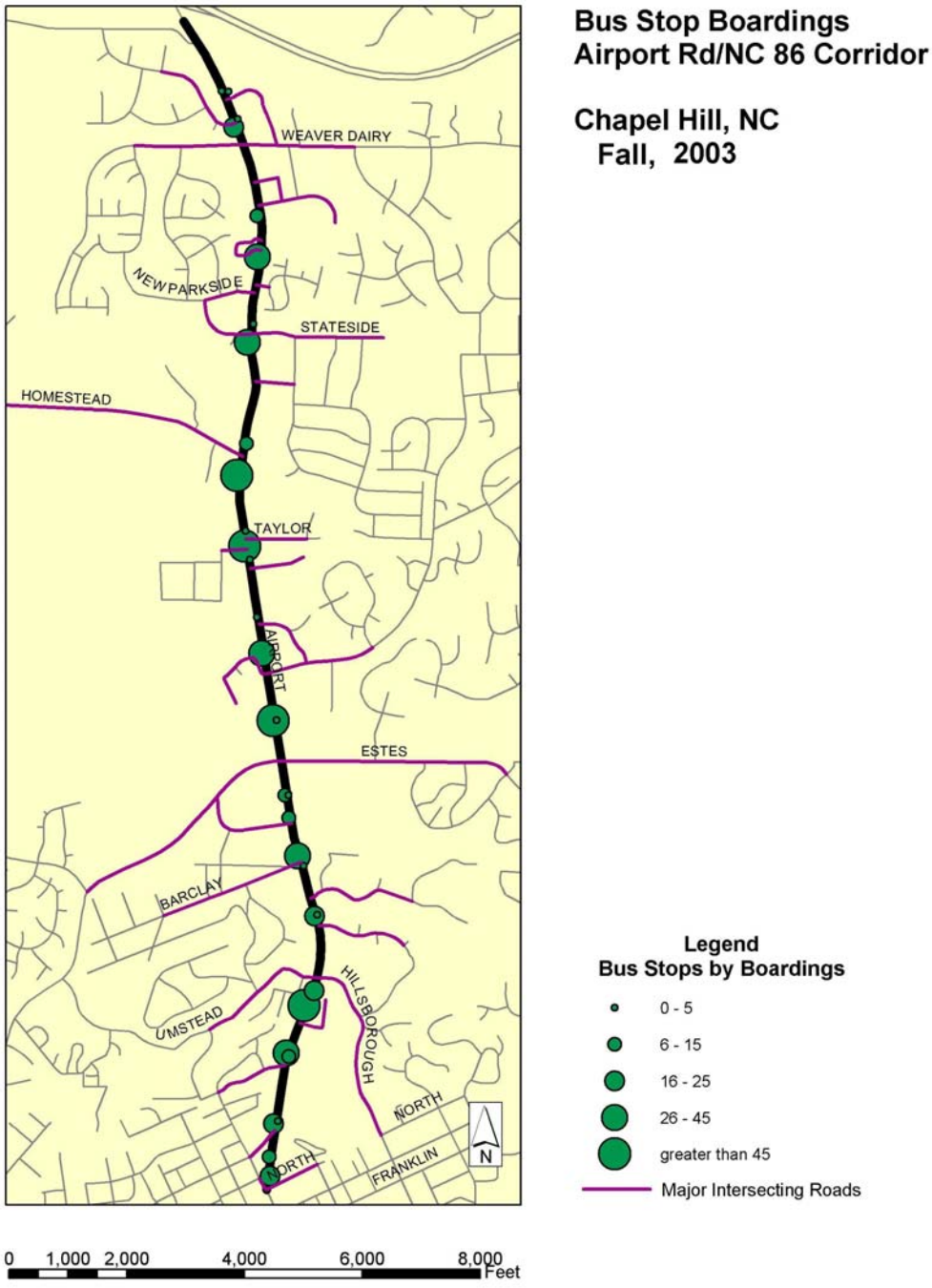


Figure 6. One day of transit use at stops along Airport Road as of November, 2003 (N = 913 boardings during one complete day of service by all routes).

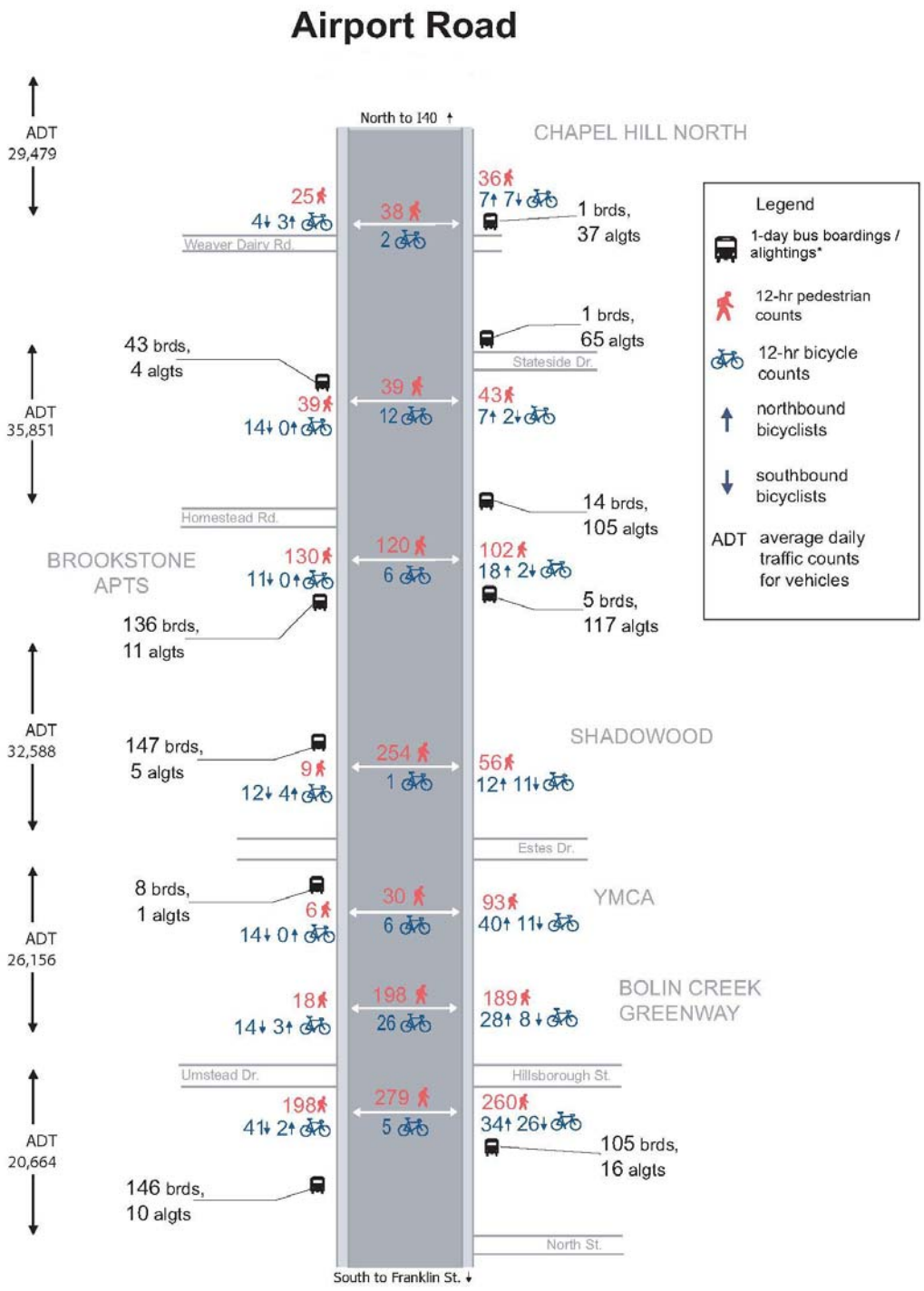


Figure 7. Schematic diagram of corridor (not to scale) with recent counts of motor vehicle volumes (ADT), transit use, and pedestrian and bicycle activity. (Select data are shown. All counts from fall, 2003.)

*Transit counts include boardings and alightings for all routes using the stop. (Each count by route may have been conducted over portions of multiple days, but totals use for one complete daily schedule for all routes.)

Many of the bus stops are located too distant from signalized intersections where a signal-protected crossing phase might assist with crossing this busy, multi-lane corridor. Our observations and videotaping during peak periods revealed that in many cases, pedestrians are having to wait a significant amount of time for a gap in traffic, cross one direction of travel lanes, wait in the unprotected center turn lane (with heavy, fast-moving traffic passing by in both directions) and cross the remaining lanes when another gap in traffic is available.

Crossing Airport Road with center TWLTL

This scenario occurs throughout the southern section of Airport Road, from Rosemary Street to Homestead Road, where there is no center raised median and long intervals with no available crossings.

Some of the busiest transit stops also lack sidewalk access leading to the stop (including the west side at Shadowood, Taylor Street, and the YMCA west side). Some of these midblock stops have curbs even though no sidewalks lead to the stop. Since most pedestrians (and perhaps some bicyclists) are accessing these stops by crossing the street midblock, the lack of curb cuts at the stops may affect access as well. Additionally some transit stops are located between commercial driveways (*e.g.*, Fosters) where pedestrians exit behind the bus and may then encounter vehicles turning into and out of busy driveways. Finally, there are few amenities associated with the transit stops. Only about six stops have waiting platforms or a shelter to encourage use and many lack seating.

Figure 7 illustrates various mode uses throughout the corridor, with the greater pedestrian and bicycle activity in the southern areas, high transit use around high density housing, and greatest motorized traffic volume in the northern sectors.

Motor vehicle crashes

According to the NCDOT strip analysis, there were 484 total reported motor vehicle crashes on the 4 mile strip from Rosemary Street to I-40 during the five-year period of 7/1/1998 to 6/30/2003.

The numbers of crashes with various reported injury levels were as follows:

- 0 with fatal injuries
- 9 with A-type injuries (disabling)
- 54 with B-type injuries (evident)
- 147 with C-type injuries (possible)
- 274 Property Damage Only (no injuries)

October, followed by August, were the heaviest crash months in the corridor over the five years with 11% and 10%, respectively, of reported crashes occurring during those months. More crashes occurred on Wednesdays (18%) than the next highest days (Monday, Thursday, and Friday, all with 16% each). Sunday had the lowest proportion of crashes at 8%, followed by Saturday with 12%, and Tuesday with 15%.

The most frequent type of crash, by far, accounting for nearly 50% of crashes, was the "Rear end, failure to slow or stop," a crash type often associated with excessive speed and/or congested conditions (Table 5). Left turn crashes account for another 19%, including those striking vehicles on the same roadway and on different roadways. Angle crashes, typically associated with intersections or driveways, accounted for approximately 9% of crashes. And crashes between motor vehicles and bicyclists were in the top seven types of crashes with 18 collisions over this five-year period. According to the strip analysis, there were also five crashes involving pedestrians over this time period. (Although the strip analysis identified only 18 bicycle collisions and 5 pedestrian collisions, almost all of which involved only a single individual, the report also indicated that 37 bicyclists were struck and 11 pedestrians were struck. Unfortunately, it is sometimes difficult to correctly identify all pedestrian and bicyclist crashes through the state electronic crash database. HSRC identified 27 reported bicyclist – motor vehicle crashes and eight reports of pedestrian crashes involving 9 pedestrians for this corridor over a five-year period, described in more detail below.) All other crash types accounted for less than 1% each of crashes, for a total of 3.5%.

Table 5. The predominant types of motor vehicle crashes in Airport corridor study area for five year period, 7/1/1998 to 6/30/2003 (in rank order).

Crash description	# of Crashes	% of Crashes
Rear end, failure to slow or stop	223	46.1
Left turn, same roadway	53	11.0
Angle Crashes	42	8.7
Left turn, different roadway	39	8.1
Sideswipe, same direction	29	6.0
Animal	18	3.7
Bicyclist	18	3.7
Run-off road (left, right and straight)	14	2.9
Right turn, different roadways	8	1.7
Head-on	6	1.2
Rear-end, turn	6	1.2
Sideswipe, opposite direction	6	1.2
Pedestrian	5	1.0
All others	17	3.5

Pedestrian Crashes

The pedestrian and bicyclist crashes identified by HSRC were analyzed individually to assess the circumstances and contributing factors involved in the crashes. Eight pedestrian crashes occurred over a five year period (from January 1, 1998 – December 31, 2002 – a slightly different time period than the strip analysis). (See Appendix D for individual descriptions of motor vehicle - pedestrian and motor vehicle - bicyclist crashes.)

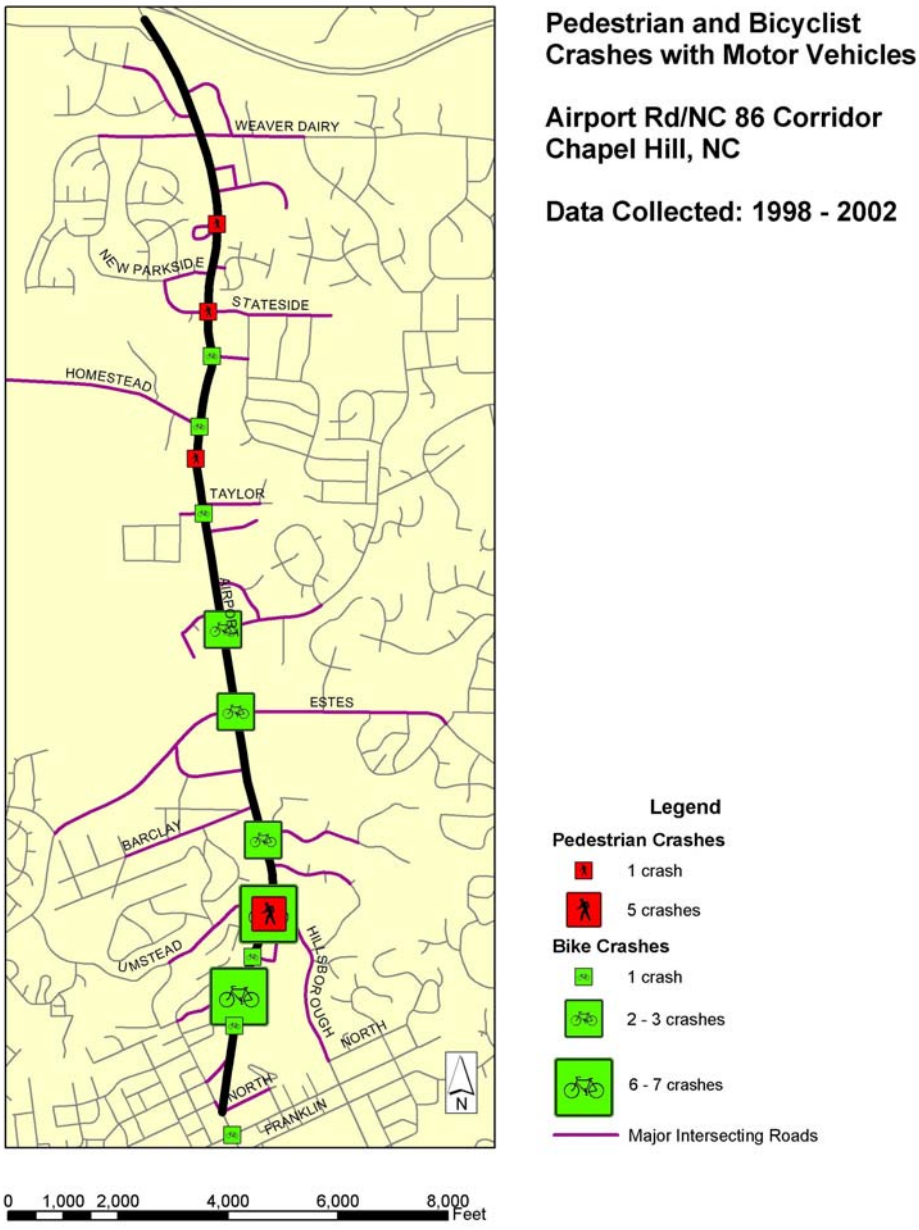


Figure 8. Approximate locations of pedestrian and bicyclist crashes with motor vehicles on Airport Road over a five year period, 1998 – 2002 (N = 8 pedestrian, 27 bicyclist crashes).

- 5 of the 8 crashes occurred in the vicinity of the Airport Road intersection with Hillsborough Road and Umstead Drive (see fig. 8 for locations of pedestrian and bicyclist crashes).
  - 4 of the Hillsborough area crashes involved pedestrians crossing Airport Road and apparently failing to yield to motor vehicle traffic, including 1 'dash' type
    - 3 occurred outside of the crosswalk areas, 2 north (where there is at present no crosswalk or pedestrian signal head) and 1 south of the intersection.
    - 1 occurred in the south leg crosswalk.
  - The 5th crash in this area occurred at the northern driveway of the PVA (public vehicular area) northeast of the intersection, in which the motorist failed to yield to a pedestrian on the sidewalk before pulling out
  - 3 of these crashes occurred at dusk or night.
- The other 3 crashes included: another driveway exit crash with pedestrian crossing the driveway, a worker in the median being struck by a weaving motorist, and an unusual crash with a motorist clinging to a vehicle that began moving in a driveway.

Bicyclist Crashes

Twenty-seven crashes between motor vehicles and bicyclists on Airport Road were identified for the five-year (1998 – 2002) time period.

- 11 crashes involved motorists pulling out at intersections or driveways into the path of a bicyclist.
  - 7 of the 10 crashes where motorists pulled out, involved cyclists riding against the direction of traffic on the sidewalk.
  - 2 of 3 crashes, when the bicyclist was not clearly on the sidewalk, occurred at night.
  - One involved sidewalk riding, but not wrong-direction riding.
  - 5 of the 10 "pull-out" crashes occurred when motorists drove out at stop signs along the corridor; 3 occurred at driveways, 3 occurred at signalized intersections with 2 being right-turn-on-red maneuvers.
  - Another crash that included sidewalk riding, involved a motorist pulling into an apartment complex driveway from a street across Airport Road.
- 8 crashes involved motorists turning left in front of an on-coming bicyclist; three of these occurred in the vicinity of Hillsborough and Umstead at commercial driveways (PVAs). Two of these crashes involved bicyclists traveling on the sidewalk; one occurred at night.
- 2 'right-hook' crashes involved motorists passing and then turning right across the path of a bicyclist traveling straight; in one case the bicyclist was traveling on the sidewalk.
- 2 crashes were apparently related to bicyclists' attempts to change lanes/merge left to make left turns. The high speed and large volume of traffic in the corridor may increase the difficulty for bicyclists to make left turns.
- Another crash involved a cylist turning left from a crosswalk area across the path of a motor vehicle traveling straight.
- In 2 crashes, bicyclists rode through a red light. In one case the bicyclist was traveling eastbound crossing Airport toward Piney Mtn. Road. In the second, the bicyclist was on Airport and failed to clear as the signal changed at Hillsborough.

Six crashes took place during conditions of dusk, or darkness with lighted roadway, factors that may have contributed to the crashes. There were also a number of locations with multiple crashes over this time period, including the area around Mill Creek Apartments (two crashes) and Longwood Drive (four crashes) (fig. 8). There were seven crashes at or near the intersection with Hillsborough and Umstead, two at or near Mt. Bolus, three at Estes, and two at Piney Mountain. No bicycle-motor vehicle crashes had been reported during this five-year interval for the area north of Homestead Road where there have been bicycle lanes since the reconstruction project was completed in the late 1990s. This result may be partly due to the fact that there is less riding in this area, but it may be partially that the raised median results in fewer conflict points. In any case, we have identified no reported crashes between motorists and bicyclists during the five-year study period on the section of Airport Road with bicycle lanes.

Focus areas observations and conditions

Among the five areas where on-site observations were conducted, the Shadowood, Northfield / Taylor / Critz, and Homestead Road areas are all located near large multi-family housing complexes that generate substantial numbers of transit users. The transit stops at both Shadowood and Northfield areas are midblock in the area with TWLTL and lack any pedestrian crossing facilities. Both locations also lack sidewalks or have gaps leading to one or more of the transit stops. Only the west side stop at Shadowood has a bus shelter. At both of these locations, we observed pedestrians having difficulty crossing the roadway. Pedestrians typically waited for a gap in the first two lanes, crossed to the TWLTL, then waited significant amounts of time before being able to cross the remaining two lanes. Sometimes motorists would stop in the next lane beyond the TWLTL and wave the pedestrians across, setting up a "multiple threat" situation, whereby pedestrians may be struck by motorists in adjacent lanes whose view of them is blocked by the stopped vehicle.

Shadowood bus stop on the west side of Airport Road

Bus stop near Taylor Street, east side of Airport Road, opposite Northfield Drive

The Homestead Road area transit stops are located near the signalized intersection with Airport Road. North of the intersection is a raised median while there is TWLTL south of the intersection. While a number of pedestrians appeared to cross with the signal, we also observed pedestrians walking along the roadway and then crossing outside of the crosswalk area. Some pedestrians may feel more comfortable crossing midblock rather than rely on the signal to stop heavy, speeding traffic or on turning motorists to yield at this wide, multi-lane intersection. We observed a number of motorists making right turns on red from Homestead Road onto Airport Road without stopping or looking to the right before proceeding. With the wide turn radius and landscaping planted on the northwest corner, the problem is exacerbated since even motorists who plan to stop, must pull across the crosswalk before they have sufficient sight distance to make a right turn on red at this location.

Wide curb radius and right-turn-on-red at Homestead Road

Problems at the YMCA and Estes Road area include a lack of sidewalks on the west side of Airport road throughout this area, as well as on the west side approach of Estes Drive. There are no bus shelters at the transit stops, missing crosswalks and pedestrian signal heads on three legs of the intersection, and poor curb and pedestrian ramp design on the southeast side. The crosswalk is misaligned with the single corner curb cut. There are sight distance issues on all four corners of the Airport Road and Estes Drive intersection that may increase crash risk for both pedestrians and bicyclists, particularly from right-turn-on-red maneuvers. The bike facilities undergo transition at this difficult intersection as well. The paved shoulder on the southbound approach to the Estes Drive intersection ends where a left turn lane is added near the intersection forcing bicyclists to merge with traffic near the intersection. There is also a hazardous drainage grate near the end of the paved shoulder. On the south side of the intersection, southbound, a wide outside lane

No sidewalk access on west side of Airport Road leading to YMCA stop

replaces the regular travel lane plus paved shoulder. The paved shoulder, though with rough pavement in some areas, may provide a more appealing bicycle facility to some users, since the space is clearly delineated with a stripe. Northbound, the curb and wide outside lanes continue until beyond Piney Mountain Road. At least three bicyclist crashes, previously discussed, have been reported for the Estes intersection over the five-year study period.

Hillsborough Road area

The Hillsborough street area accounted for 63% of the pedestrian crashes and 26% of the bicyclist crashes with motor vehicles along the Airport Road corridor during the five-year study interval. This segment is in the area with the four lanes plus TWLTL cross-section. There are wide outside lanes marked by hazardous drainage grates to accommodate bicyclists, and sidewalks on both sides through this area, but only a narrow grass strip buffer. This area appears to be one of the busiest locations with regard to pedestrian and bicycle activity.

The primary difficulties include: 1) the steep grades approaching the intersection from both Airport Road directions, 2) curves on all approaches and other sight distance issues, and 3) the complexity of the area that includes the Bolin Creek trailhead northeast of the intersection, two commercial driveways northeast of the intersection, a series of two commercial plus one office driveway southeast of the intersection, southeast side transit stop located between the two commercial driveways, and a west side transit stop located several hundred feet south of the intersection. There is no crosswalk or pedestrian signal on the north side of the intersection. The crashes and problems, particularly with left-turning vehicles, were discussed in some detail in the crashes section. The transit stops are distant enough from the intersection that most users cross midblock. As in other locations with TWLTL, pedestrians typically must wait unprotected in the TWLTL to complete their crossing and frequently conflict with motorists turning into and out of the driveways. There is a shelter (although in poor condition) and seating at the west side bus stop, but no shelter on the east side.

Public Input

At least 18 persons interested in pedestrian and bicycling safety and access along the corridor attended the public input workshop. Citizens responded to bicycle and pedestrian surveys (according to their interest), ranked the most appealing walkway and midblock crossing treatments, noted problem areas and issues on maps of the corridor provided by the Town, and discussed issues with HSRC personnel and Town staff. Pedestrian and bicyclist survey

results and a complete summary of the notations on the maps are provided in Appendix E. Below is an annotated summary of results from the public input forum.

Most preferred walkway featured a wide buffer and street trees. (photo by D. Burden)

– The unanimously ***preferred walkway design*** incorporated a wide buffer strip with large, uniformly planted shade trees. The least preferred design pictured the existing Airport sidewalk, with no buffer, and no street trees, as on the east side of Airport Road north of Hillsborough Street. The request for completing the sidewalks, adding buffer strips and trees, was repeated numerous times. Common requests were for completing sidewalks/closing gaps, completing sidewalks to bus stops, wider sidewalks, and buffers with trees to separate walkways from traffic. (A number of particular gaps in sidewalks were mentioned, which may be reviewed in the appendices.)

– The most widely ***preferred midblock crossing treatment*** included a traffic signal, a raised median with cut-through and a colored crosswalk. The second-most preferred treatment also incorporated a raised median, with a cut through and a z-style marked crosswalk. The request for raised, planted medians throughout the corridor was echoed a number of times, both on the maps as well as the written surveys. Pedestrian refuge islands at particular locations (such as the 725 Airport Road transit stop) were also mentioned as a possibility.

Most-preferred crossing featured a median refuge and signal, and colored, textured crosswalk. (D. Burden)

Second choice crossing also featured a median with an offset, zebra-style crosswalk. (photo, D. Burden)

– There were a number of concerns about transit stops and other areas (Chapel Hill North, Stateside Road areas) where people need to cross, but there are at present no signals or other improvements. A traffic signal was requested for the Stateside Drive intersection. (Respondent also indicated "As a motorist, it is also impossible to turn left from Stateside onto Airport Road.")

– In some cases, there were requests to move bus stops to intersections, presumably for better access. Again, treatments such as raised medians and traffic signals with crossings were desired at these locations.

– The width and number of lanes to cross were concerns at larger intersections such as Homestead Road. Marked crosswalks were requested for the north side of the Hillsborough/Umstead intersection, and at all sides for Estes Drive and Weaver Dairy Road intersections.

– Bike lanes throughout the corridor were requested as well as bike-friendly drain grates. There were also requests for bike parking at shopping centers and the park and ride lot.

– There was much concern to "slow down traffic!," "slow speeds," and make the northern segment of the corridor "look less like a highway." It was also suggested that signals coming into town and going out be synchronized for 35 mph driving.

Identified Problems and Potential Solutions

Some of the key conditions and problems affecting bicyclists and pedestrians in the Airport Road corridor are described in the following sections. This list is not a complete, detailed list of all problems that might be identified, but includes factors we deem to be among the most important of those affecting bicyclist and pedestrian safety and access as well as the desire to walk or bicycle along the corridor. In this preliminary assessment, a number of potential solutions are identified. We have, however, restricted the solutions identified to those that were considered appropriate for this corridor. Even so, not all are considered by the project team to be equally effective, but are presented as alternatives for consideration by the Town. We have noted research and other information regarding the relative efficacy of various treatments as implemented and tested in other locations, but any measures should be fully evaluated by the town (and/or NCDOT) for the specific locations or conditions under consideration before implementation.

In addition to the sources particularly cited, many of our recommendations are discussed in *Pedestrian Facilities Users Guide: Providing Safety and Mobility* (Zegeer, *et al*., 2002), which may be referred to for additional information. We have also included case studies with examples of treatments that have been implemented in other communities (Appendix F). These case studies are from the soon to be released *PedSafe: Pedestrian Safety Guide and Countermeasure Selection System* (a project for the Federal Highway Administration).

Problem 1 – Arterial high volume roadway with no alternative routes to town / campus
Airport Road serves as an arterial carrying between 20,000 and 32,500 vehicles per day at present, depending on location. (This volume is anticipated to increase with added development, particularly Carolina North.) The only other route from the north side of Chapel Hill to Town or the University of North Carolina campus is the 15/501, Franklin Street corridor which serves the northeast area of Town. There are no nearby through routes and few alternatives into the town or campus (with the exception of Hillsborough Street, in the southern quarter of the corridor which runs from Airport Road to campus).

The high volume of motor vehicles makes it difficult for pedestrians to find sufficient gaps in traffic to cross multiple lanes in both directions, particularly at non-signalized locations (such as transit stops and others). The high volume also makes it difficult for bicyclists to enter the traffic stream, change lanes, and complete turns and other maneuvers.

There are also no alternatives for bicyclists traveling from neighborhoods and apartment communities along the corridor to the town center due to a lack of connectivity of neighborhood streets as well as a lack of bike paths or multi-use trails connecting destinations. In many communities, bicyclists may use collectors or less busy local streets to travel to destinations, but in this and many areas of Chapel Hill, there are no feasible alternatives to major arterials for those wanting to travel to the town center, campus, or across town. There are slightly more options for pedestrians, but the Airport Road corridor still provides the main throughway for all modes, including transit, for the northwest area of town.

Potential short term solutions

- *Promotional efforts to encourage use of transit, multi-modal trips, bicycling and walking trips to replace single-vehicle auto trips. A number of cities/communities have Bike to Work weeks, Commuter Coach (whereby a riding coach at the workplace encourages cycling), work-sponsored incentive programs and other programs to increase bicycling, walking, etc.*
- *Add / improve transit service to increase ridership.*
- *Encourage greater use of Park & Ride.*

Potential long term solutions

- *Evaluate need for additional Park and Ride space / service.*
- *Evaluate / implement additional long-range transit improvements.*

Improvements in existing bus service frequency and routes, along with promotional efforts, may help to increase use of transit in the nearer term. Safety improvements and other enhancements to the Airport Road corridor, as well as promotional efforts, may help to increase the number of trips made by walking and biking, and of multi-modal trips. Long-range transit enhancements for the corridor are already in the planning stages according to town staff. The adopted 2025 Durham-Chapel Hill-Carrboro Regional Transportation Plan includes the proposed implementation of a high capacity transit corridor using NC86/Airport Road, from I-40 in the north to Southern Village along US 15-501 in the South. The transit technology could be either streetcar or high capacity bus-way. Such service may provide an

appealing alternative to private vehicle use. Additionally, implementing other improvements (suggestions following) which help other travel modes may help to reduce the number of motorized trips.

It will be more difficult to have an effect on out-of-town commuters, but improving park and ride and regional transit service could help to offset expected increases in the volume of vehicles on Airport Road.

Problem 2 - High speeds of motor vehicles make walking and bicycling in the corridor unsafe and unpleasant

A majority of the vehicles on Airport Road are, unfortunately, exceeding the speed limit, with average speeds of more than 42 mph and 85th percentile speeds of 48 mph (according to the available data). Most of the corridor has designated limits of 35 mph, except the segment north of the town limits near I-40 which is currently signed for 45 mph. The high speeds of motor vehicles make it especially difficult and dangerous for pedestrians crossing at unprotected locations, as well as for bicyclists attempting to cross the roadway, merge with traffic, or make lane changes in anticipation of turns. In addition to increasing the risk of a crash, higher speeds increase the probability of a pedestrian being killed when struck by a vehicle. The likelihood of a pedestrian dying when struck by a vehicle traveling at 20 mph is around 5%; at 30 mph the chance increases to 45%, while the chance of death increases to 85% if struck by a vehicle traveling at 40 mph (U.K. Department of Transportation, 1987). The high motor vehicle speeds also make it difficult for some bicyclists to feel comfortable sharing the roadway (according to public comments).

Potential short term solutions

Effective short-term treatments to reduce speed on arterials are limited.

- *Enforcement - Traditional speed and traffic enforcement is labor intensive and difficult. Enforcement may be effective as a deterrent, but typically only if officers are frequently and randomly enforcing, and penalties are costly to the drivers (*i.e.*, upheld by the courts).*
- *Signs - Some communities have increased the size of speed limit signs, which combined with enforcement, may bring about some reduction in speeding. Share the road signs, pedestrian warning signs and others might also be used at select locations such as high pedestrian crossing locations, but care should be taken not to over-use signs, which may add to visual clutter or reduce the impact. Any benefit of signs is usually also short-term.*
- *Speed trailers – Motorists may slow, at least for some distance, in response to speed trailers that indicate motorists' travel speeds. The effect is, however, also likely to be short-term, while trailers are in use.*
- *Reduce speed limit of northern-most segment of Airport Road, at least in southbound lanes, to 35 mph – While reducing speed limits is not generally effective at reducing speeds, there may be some benefit in reducing the speed limit from 45 mph to 35 mph for the in-bound traffic from I-40 to send the message that vehicles are entering an urban area.*
- *Lane narrowing through re-striping – In the southern portion (south of Homestead Road) the cross-section could be re-configured to narrow travel lanes to 11 feet or*

less and provide a bicycle lane. In the northern area, the 12' lane widths could also be reduced to 11' and space added to the bike lanes. (See Appendix G for current cross-section designs of various Airport Road segments.)

Potential long term solutions

- *Roadway / lane width reductions – Lanes could be narrowed to 11' and the space allocated to other uses such as buffer or wider sidewalks through curb and/or median re-alignment. Narrowing the roadway would not only slow vehicle speeds, but would also reduce the exposure of crossing pedestrians and cyclists to traffic.*
- *Replace two-way left turn lane with raised, planted median and left-turn pockets for motor vehicles (discussed in more detail in next section).*
- *Visual narrowing - complete curb and gutter, sidewalks and bike lanes; plant shade trees in buffer strips and/or median; landscape / street furniture, transit stop treatments.*

Treatments that alter the design speed of the roadway and the perception that it is a high-speed roadway may have a more sustainable impact on speeds than the use of traditional enforcement and/or signs. Roadway narrowing and visual-narrowing techniques, such as adding raised medians and planting trees, are often-used treatments for reducing vehicle speeds on high-volume arterials.

Problem 3 - Long intervals with no traffic signals or crossings makes it difficult for bicyclists and pedestrians to access or cross Airport Road at many locations.

Long stretches of Airport Road with no signals or crossing enhancements make it exceedingly difficult for pedestrians and bicyclists to cross Airport Road or for bicyclists to enter the fast-moving traffic on this multi-lane, busy roadway. There are only eight traffic signals in the 4 mile segment from I 40 to North Street, so pedestrians must cross unassisted or face potentially long detours to cross at signalized intersections. Bicyclists or pedestrians attempting to access the roadway from numerous non-signalized side streets or driveways face an even greater challenge since turning vehicles may be added to the mix of high volumes of through traffic.

A 'crowd' crossing from bus stop to Northfield area

Transit stops are located near sites generating high-volumes of transit users, but these sites provide no accommodation at present for helping pedestrians to safely cross the road. Our

observations during peak periods show large numbers of pedestrians forced to cross one direction of traffic at a time, often waiting for extended periods in an unprotected two-way center turn lane, or else threading their way among cars. The Taylor Street / Critz / Northfield area and Shadowood area have particularly high volumes of transit users crossing the roadway. (The intersection at Estes Drive may provide gap assistance to pedestrians crossing the northbound lanes at Shadowood, but the Northfield Street area is even more distant from the nearest signals at Piney Mountain and Homestead Roads, and gaps seem to be very infrequent in both travel directions during peak periods. Even when pedestrians are able to cross the first two lanes, they must often wait considerable time in the TWLTL to cross the remaining lanes.)

Potential short term solutions

- *Evaluate the possibility of relocating some bus stops to nearby signalized intersections. Locating bus stops on the far leg of intersections improves safety by reducing the likelihood of pedestrians stepping out into traffic from in front of the bus.*

Potential long term solutions

- *Replace the two-way left-turn lane (TWLTL) with a raised median and vehicle left-turn pockets, with curb cuts (median pockets / refuges) for pedestrians and bicyclists at high crossing locations. Four-foot minimum width raised medians are required for pedestrian safety, although widths of 6 to 8 feet are desirable. Tall-growing shade trees could be planted in the median to enhance the walking environment as well as provide additional visual narrowing (discussed further below). Median trees may be especially desirable where rights-of-way limitations may prevent tree-planting in a sidewalk buffer strip. Median planting of low growing herbs, evergreens, or shrubs and small trees is not recommended for most locations, since the median should provide a crossing amenity for pedestrians. Low-growing herbs, shrubs and trees will both hinder pedestrians and may block their view by motorists. Pedestrians must cross midblock in this corridor since traffic signals are spaced too far apart for pedestrians all along the corridor to cross only at signals.*

Median with accessible pedestrian refuge pocket. (Note: crosswalks should not be striped midblock unless signals are present) (ITE Pedestrian Bicycle Council)

- *Continue to monitor the need for midblock traffic signals. If traffic signals are installed in the future, add crosswalks. Adding crosswalks on multi-lane roadways at midblock, non-signalized locations is* ***not*** *recommended and may actually increase crashes (Zegeer, et al., 2002).*
- *Monitor the need for traffic-signals at intersections. To assist pedestrians and bicyclists in crossing or accessing the corridor, provide pedestrian and bicycle push buttons or other bicycle detectors (loop, camera, etc.) at lower-volume intersections.*

Studies in Georgia, New Jersey, and other locations, have found that raised medians (along with redesigned intersections curbs and sidewalks) reduced exposure for pedestrians by as much as 28%, reduced vehicle speeds by about 2 mph, (Parsonson, Waters, and Fincher, 2000) and reduced pedestrian fatalities per 100 miles of roadway by 78% compared with TWLTL (King, Carnegie, and Ewing, 2003). A 2002 study by Zegeer, *et al.* al. for the Federal Highway Administration (FHWA) found that raised medians and median islands were associated with a significant reduction in pedestrian crash rates for multi-lane roads.

Planted median with left turn pockets (photo by D. Burden)

In conclusion, the addition of a raised median throughout the corridor with appropriately-placed left-turn pockets, and median curb cuts for pedestrian and bicyclist access, should improve crossing safety and access for pedestrians. This treatment should also improve motor-vehicle safety, since research has shown that divided, multi-lane roads (i.e. those with raised medians separating opposing directions of travel have significantly lower rates of total crashes, compared to undivided roads (Zegeer, et. al. 1997).

Problem 4 - Incomplete and inadequate sidewalks

One of the most obvious problems for pedestrians along the Airport Road corridor is the lack of continuous sidewalks. Numerous gaps in the sidewalk, particularly along the western side, create problems for those wishing to walk or bike to destinations along the corridor, as well as connect to neighborhoods. In addition to posing accessibility problems for people in wheelchairs, parents pushing strollers, bicyclists using the sidewalk as a bikeway, and others, the lack of sidewalks may contribute to a type of crash where pedestrians walking along the roadway are struck by passing motorists. (In general, many 'walking along roadway' crashes occur at night.)

No sidewalk leading to bus stop between Northwoods Drive and Weaver Dairy Road

Where there are walkways, they are either immediately adjacent to traffic lanes or have only a narrow (4' or less) grass strip with no vertical buffer between the walkway and travel lanes. These conditions create a very uncomfortable environment for pedestrians and discourage walking.

Side-street and Airport Road curb cuts are also often combined into one corner cut rather than occurring in line with the sidewalk and crosswalk, potentially directing pedestrians into the travel lane, especially risky for pedestrians using wheelchairs.

Potential short term solutions

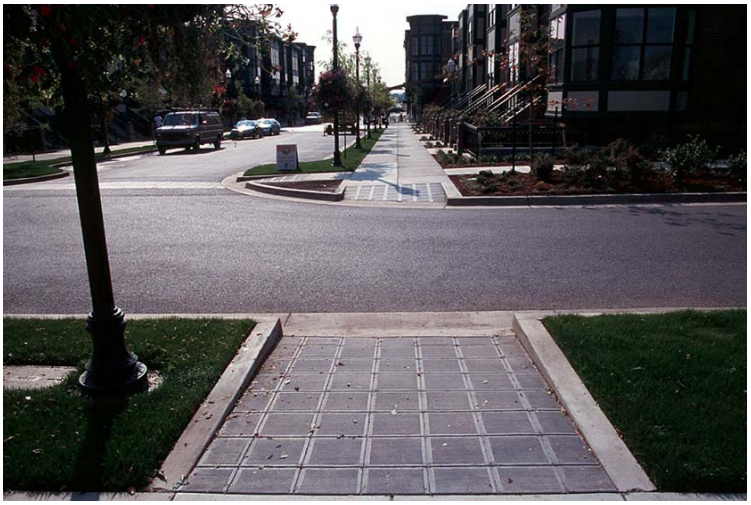
- *Repair / replace sidewalk sections where missing or broken.*
- *Maintain sidewalks in passable condition throughout the year.*

Potential long term solutions

- *Complete sidewalks throughout corridor. Unobstructed sidewalk widths of 6 to 8 feet are recommended for arterial streets. (Occasional point obstructions may be acceptable, as long as there is at least 36 inches for wheelchair maneuvering.)*
- *Add / increase buffer strip between walkway and motor vehicle lanes. Recommended minimum buffer widths for arterial streets are 5 to 6 feet. (Flexible design may be required in areas with insufficient right-of-way to provide the recommended sidewalk and buffer widths. Bicycle lanes also increase the buffer between pedestrians and motorized traffic).*
- *Plant street trees (shade trees) in buffer strips.*

Single corner curb cut is misaligned with crosswalk at Estes Drive.

- *Add proper curb cuts to all pedestrian crossing locations - two curb cuts per corner, aligned with crosswalks / crossing areas.*
- *Add curb cuts and median pockets where needed, including at midblock transit stops.*



Well-designed curb cuts in line with sidewalk and crossing and recently-planted street trees, Hillsboro, OR (D. Burden)

In addition to providing better access, sidewalks are associated with improved safety. Recent research in Wake County, NC by HSRC, has found that the presence of sidewalks or walkways on both sides of the road are associated with an 88% reduction in "walking along roadway" pedestrian crashes (compared with having no sidewalks) (McMahon, 2002).

Problem 5 – Shifting and discontinuous bicycle facilities

The bicycle facilities begin in the north with 4 to 5' bike lanes. A rural-type cross-section with paved shoulders as a bicycle facility begins approximately at Homestead Road and continues, on the west side, to Estes Drive. The southbound paved shoulder abruptly ends near the Estes Drive intersection, forcing bicycles to merge with traffic near the intersection. Wide curb lanes begin south of Estes and continue to North Street. In the areas with curb and gutter, the wide outside lanes are marked by bike-incompatible, below-grade drain grates and the beginning of seam reappearance where the roadway was previously paved over the gutter pan seam. This space is pre-empted for other uses at North Street and southward, replaced by turn lanes, on-street parking and bus-stops. It requires savvy bicyclists to navigate this puzzle of facilities.

Estes Drive intersection with Airport Road is a hazardous one for bicyclists.

Bicyclists are allowed to use the walkways, but as noted in the discussion on crashes, cycling on walkways poses its own hazards, discussed further below. Furthermore, the walkways themselves are inadequate for bicycling, particularly on the west side where there are many gaps and walkways are too narrow to accommodate bicyclists passing pedestrians.

The lack of continuous bicycle facilities or space on the roadway for bicyclists – particularly bicycle lanes in most areas of the corridor – encourages many cyclists to use the sidewalk facilities, where they exist, while others may choose not to attempt to ride along this corridor. (Appendix H contains additional observations of bicyclist needs along the corridor.)

Potential short-term solutions

- *Repair below-grade, hazardous to bikes, drain grates.*
- *Re-stripe bicycle lanes to the left of all right-turn only lanes where they have been striped to the right of such lanes or on any future installations.*
- *Implement a regular sweeping and maintenance plan to reduce hazards for bicyclists.*
- *Develop and implement a hazard-identification plan.*

Different paving treatments such as this concrete bike lane may enhance conspicuity of bicyclists and visually narrow the roadway. (Photo, D. Burden)

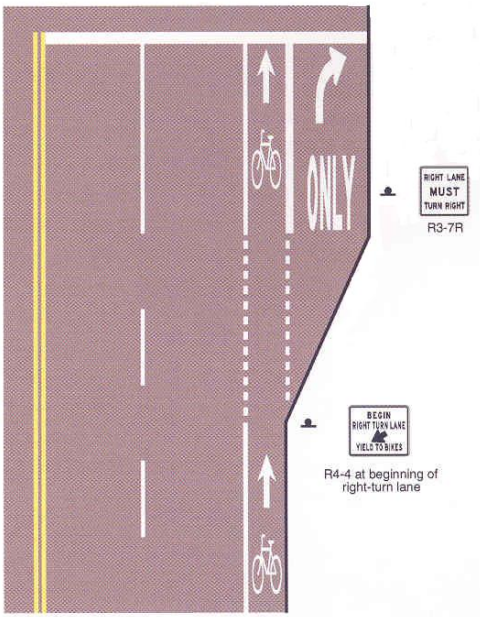
Potential long-term solutions

- *Add bike lanes to entire corridor* (different paving treatments may be used for additional emphasis).
- *Replace hazardous drainage grates with a bicycle-compatible design.*
- *Connect Airport Road bike facilities with other bike routes / facilities that lead to key destinations.*
- *Add curb cuts and ramps for bicyclists where needed, including at midblock transit stops.*

The Airport Road corridor could benefit from a consistent bicycle facility profile. When bicyclists are surveyed, bike lanes are consistently preferred as the facility of choice. The Bicycle Compatibility Index (Harkey, *et al.,* 1998), a tool for examining the comfort level of streets, shows bicyclist level of service is enhanced by the use of bike lanes. Bike lanes are easily identifiable as a place for bicyclists to ride, as opposed to wide outside lanes. Bicyclists also seem to feel safer operating in their defined space. Wide outside lanes are certainly an acceptable bicycle facility (Hunter, *et al.,* 1999), but a unified corridor with bike lanes would give a more bicycle-friendly appearance. There appears to be space to accommodate bike lanes throughout the corridor by: (1) varying the cross-section with paved shoulders between Homestead Road and Estes Drive, and (2) converting the wide outside lanes to bike lanes between Estes and North Street and reallocating space from other lanes to the bike lane (Appendix G). A recent study completed for the Florida DOT shows that even the conversion of wide outside lanes to a three-foot undesignated lane (in essence a

substandard bike lane) had considerable benefits for bicyclists (Hunter and Feaganes, 2004), although 5' or wider bike lanes would be preferred.

The hazardous drain grates in the section with wide outside lanes should also be improved. If this proves to be too expensive in the short term, then use of bike lanes should give bicyclists more space to avoid the drain grates than at present. Curb cuts at transit stops and other potential bike crossing locations, both in newly created center, raised medians and at the edge of the roadway, would also enhance bike friendliness.



Bike lane treatment at right-turn-only lanes (AASHTO, 1999)

Problem 6 – Numerous driveways and side streets

The numerous intersecting driveways and side streets create many conflict points for motorists with pedestrians and bicyclists, as well as with other motorists, particularly in the segments with TWLTL. Two of the 8 pedestrian crashes involved motorists exiting from driveways. Sixteen of 28 bicyclist crashes involved motorists turning into or pulling out of driveways or non-signalized side streets. In the segments of Airport Road with no median, numerous turning locations result in conflicts between turning motorists and pedestrians and bicyclists attempting to cross, as well as those traveling along, the roadway. Left turns appear to be a particular hazard to bicycling along the corridor. Eight bicyclist crashes involved motorists turning left in front of on-coming bicyclists. During our observations, we also noted conflicts between pedestrians crossing Airport Road and motorists entering or exiting Airport Road in the section with TWLTL.

The two most complex segments of the corridor at present appear to be from North Street to Hillsborough Street and the segment between Estes Drive and Homestead Road. There are approximately 17 east side, and 16 west side, driveway and roadway connections between North Street and Hillsborough Street, and 15 east side, and 16 west side connections from Estes Drive to Homestead Road.

Diverter intended to restrict left turns at this driveway lacks curb cuts and creates an obstacle for pedestrians.

Potential short-term solution

- *Evaluate commercial driveway access and traffic patterns for possible improvements.*

Potential long-term solutions

- *Add on-going center, raised median that will provide a crossing refuge as well as restrict left-turn access resulting in fewer conflict points.*
- *Restrict left turns in other ways (regulatory signs, diverters / median refuges at driveway exits, etc.).*
- *Develop access management plan for future and re-development.*

Again, the use of a raised median may improve Airport Road pedestrian and bicyclist safety by restricting left turn movements to fewer locations as well as providing a refuge for crossing pedestrians and bicyclists. There will also be fewer conflict areas for motor vehicles, and, as noted previously, overall traffic safety may be improved. The tradeoffs involve typically only slight increases in travel time for some left-turning motorists and a perception by property owners of decreased access for motorists.

Problem 7 – Poor sight distance at numerous driveways and intersections

One especially problematic section for sight distance issues extends from North Street to the Bolin Creek trail intersection on both sides of the roadway. Shrubbery planted immediately adjacent to the walkway, as well as the landform, and walls and structures, all limit sight distance along the walkway to, in some cases, just a few feet. This poor visibility may have contributed to bicyclist crashes at some driveway and side street locations since motorists must pull across the walkway area to gain a sufficient view of the walkway itself as well as the traffic lanes.

Sight distance is an issue at many side streets and driveways.

The Estes Drive intersection has sight distance limitations at all corners, increasing the risk of right-turn-on-red crashes with pedestrians and bicyclists. At Homestead Road, we observed that the combination of the wide turning radius and recently planted small trees on the northwest corner may induce right-turning motorists on Homestead Road to pull across the walkway before checking to the right for pedestrians about to cross.

The key sight distance problems along the corridor are most likely related to the age of the older sections of the roadway and lower design standards that were in place at the time of construction. The topography also contributes to sight distance issues.

Potential short-term solutions

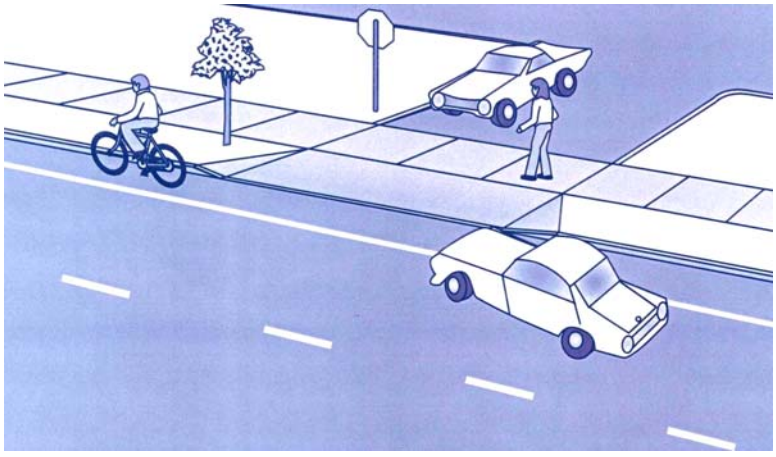
- *Add warning signs at driveways such as "Yield to pedestrians and bicyclists."*
- *Keep foliage trimmed; remove/relocate shrubbery immediately adjacent to the walkway.*

Motorists must pull across the walkway crossing area to view either pedestrians or oncoming traffic.

- *Add stop bars before driveway crossings – Striping stop bars prior to the walkway at commercial/ institutional driveways might encourage exiting motorists to check for pedestrian (and bicyclist) traffic prior to pulling across the walkway. [Note YMCA driveway – stop bar is in the middle of sidewalk crossing area.]*

Potential longer-term solutions

- *Continue raised sidewalk across all driveways – This treatment helps to slow vehicles entering and exiting the roadway, and convey that sidewalk users have the right-of-way at driveway crossings.*
- *Evaluate right-of-way and whether banks, etc. can be re-graded / altered to improve sight distance.*
- *Develop landscape planting and maintenance guidelines for the entire corridor.*



Maintaining sidewalks at grade across driveways helps slow turning vehicles and reinforce pedestrian right-of-way. (photo, Oregon Bicycle and Pedestrian Plan)

For an all-around safer travel environment along Airport Road, as well as a more welcoming pedestrian environment, the sight distance problems are a key, but difficult issue. In conjunction with overall improvements, a long-term plan should include addressing the right-of-way, sight-distance issues. As well as providing more space for pedestrians and bicyclists, these issues have a critical bearing on safety for those traveling along the corridor, especially as volumes of pedestrians and bicyclists, as well as motor vehicles, increase.

Problem 8 – High crash area

The area around Umstead Drive and Hillsborough Street exemplifies a number of the problems in the corridor but also poses particular problems. The highest count of pedestrians in the corridor was obtained in this area along with the third highest count of bicyclists. This area also accounts for a large proportion of the bicyclist and pedestrian crashes that have occurred over five years along the corridor. Nearly two-thirds of the pedestrian crashes and one-fourth of the bicyclist crashes with motor vehicles have occurred in this short sector.

Hillsborough Road area - steep grades, poor sight distance, and multiple driveways create hazardous conditions for bicyclists and pedestrians.

Three of the bicyclist crashes occurred when motorists traveling south on Airport Road turned left into a commercial driveway northeast of the intersection, failing to yield to northbound bicyclists. Two of the pedestrian crashes also involved this location: one pedestrian was struck while crossing to the business northeast of the intersection, and one was struck by an exiting motorist while crossing the driveway.

Since Hillsborough is a collector and connecting road, this intersection is a busy one at the bottom of steep, curving hills on north and south-bound approaches that both contribute to motor vehicle and bicycle speed and limit sight distance. There are also curves on Hillsborough and Umstead that limit sight distance from those approaches. Adding to the mix are a number of commercial driveways near the intersection, busy transit stops on each side of the street south of the intersection, and the Bolin Creek Trail intersection with Airport Road. The intersection at Hillsborough Street / Umstead Drive may pose special difficulties for both pedestrians and bicyclists, since vehicles may build up high speeds on the steep down-grades from either direction on Airport Road and make high speed left turns into the commercial driveways, or similarly rush or “cut the corner” at the intersection, and/or violate a red signal.

Bus stop midblock dash (Note the hazardous drainage grates that reduce usable bicyclist space.)

Potential short-term solutions

- *Evaluate signal timing and clearance interval compared with bicycle speeds and stopping distance requirements.*
- *Enforce traffic signal compliance.*
- *Enforce speed limit.*
- *Add bright-yellow warning signs on intersection approaches.*
- *Consider relocating "Foster's" bus stop to south of the #720 and #730 Airport Road combined driveway.*

Potential long-term solutions

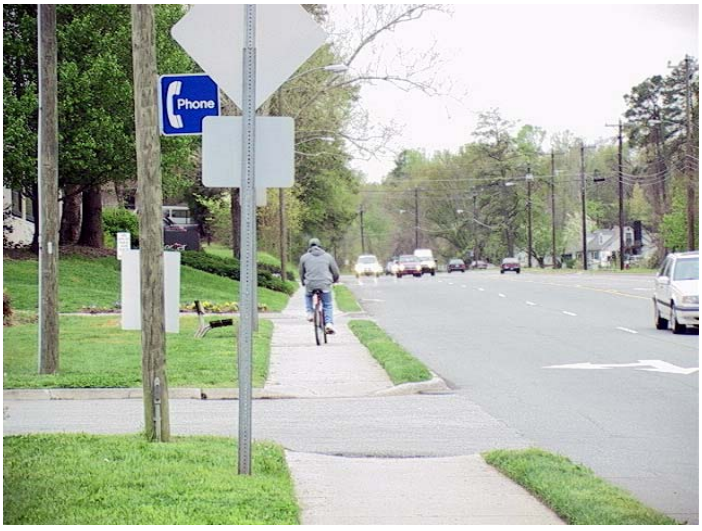
- *Add center raised median; restrict left turns except at intersection.*
- *Add crosswalks and pedestrian signals to all legs of intersection.*
- *Access management - Evaluate / reconfigure number of driveways and access.*
- *Trail access improvements.*

As noted above, a variety of factors contribute to the Hillsborough / Umstead area being a high crash location. Perhaps the treatment with the most promise for reducing crashes would be the addition of the center raised median. This would not only provide some traffic calming that would hopefully reduce motor vehicle travel speeds, but would also restrict left turns to the intersection and force motor vehicles to slow to make left turns with a left turn pocket. It should also make the turns into the businesses near the intersection operate more like a "right in, right out" configuration.

There also needs to be some effort to improve access to the Bolin Creek Trail by bicyclists, particularly, which may help to reduce wrong-way riding. If a trail underpass is implemented, this could remedy some of the problems.

Problem 9 – Wrong-way and sidewalk riding

Bicyclists are allowed to use the walkways as a bike path throughout the Airport Road corridor. Many bicyclists currently riding in the corridor seem to ride on the east side sidewalks, no matter which direction they are traveling. Sidewalk riding is risky since motorists do not expect vehicles to be on the sidewalk, and wrong-way riding compounds the problem as motorists do not expect vehicles to be approaching from the right as they pull out of driveways and intersections. Even if they scan for pedestrians, motorists may not detect the approach of bicyclists traveling at higher speeds, before pulling out.



Wrong-way riding on the sidewalk increases bicyclist risk of crashes with motor vehicles entering and exiting the roadway.

Sidewalk riding in any direction poses risks, particularly in this hilly corridor where cyclists may build up high speeds traveling down the steep

hills. The individual crash analyses show that at least 41% of the crashes with motor vehicles involved sidewalk riding. And 30% percent of the crashes involved both sidewalk and wrong-way riding. Crashes that may be occurring with pedestrians are not typically reported to police, but in some areas the sidewalks are too narrow to adequately accommodate both bicyclists and walkers.

North- and south-bound bicyclists must also gain access to the Bolin Creek greenway trailhead from the sidewalk, virtually ensuring that southbound cyclists will be traveling the wrong-way on the sidewalk/bike path when the trail is their destination. We observed this pattern occurring.

Potential short-term solutions

- *Bicyclist education about the hazards of sidewalk riding and wrong-way riding.*
- *Motorist education and police education about right-of-way issues (pedestrians and bicycles on the sidewalk, crossing driveways and side streets have the right-of-way).*
- *Slow traffic speeds through enforcement and other methods so cyclists feel more comfortable sharing the roadway.*

Potential long-term solutions

- *Complete bicycle lanes throughout corridor; then consider placing restrictions on side-walk and wrong-way riding.*
- *Provide bicyclist access from each side of Airport Road to Bolin Creek Trail.*
- *Expand trail network. Trails provide alternate facilities for bicyclists who are uncomfortable sharing arterial streets with motor vehicles. In order to provide a viable alternative, trails must connect to places bicyclists want to go and have safely designed intersections where they cross roadways.*

A corridor with a center, raised median and bike lanes throughout, as well as slower vehicle speeds, should ease the problem of bicyclist wrong-way and sidewalk riding. Some bicyclists probably now ride incorrectly because they feel uncomfortable in the street with fast moving motor vehicles. Bike lanes should improve their comfort level by giving them their own "space," while the center, raised median should have a traffic calming effect. Additionally, a raised median would restrict left-turning access to designated locations, reducing the number of conflict points at driveways and some side streets. If vehicle speeds remain high after installation of the median, then more speed enforcement will be necessary. As mentioned above, trail access improvements would also help.

Problem 10 – Wide, multi-lane intersections are unpleasant and difficult for pedestrians and bicyclists to negotiate

Where there are signalized intersections, the high speed of many vehicles in the corridor creates a long 'dilemma zone' and probably contributes to signal violations, very dangerous for pedestrians and bicyclists, as well as other motorists. The large numbers of through and turning lanes, turning traffic, and wide turn radii at the larger intersections also result in long crossing distances with high exposure for pedestrians and bicyclists attempting to cross at intersections. Older or slower pedestrians may feel they cannot cross in a single phase, while bicyclists may be trapped in the intersection by a signal change. Four pedestrian crashes and

12 bicyclist crashes with motor vehicles occurred at or near signalized intersections, particularly Hillsborough/ Umstead, Estes, and Piney Mountain.

Crossing a wide Weaver Dairy intersection with turning cars and cars encroaching into crosswalk

The intersections at Homestead Road, Weaver Dairy Road, and others in the newer section are extremely wide and "un-friendly." We also noticed that many motorists tend to drive through the red signal without coming to a complete stop before making right turns on red from Homestead Road onto Airport Road. This behavior likely occurs at other signalized intersections as well. Bicyclists wanting to make lane changes in anticipation of left turns face a difficult challenge at all locations along the corridor due to the speed differential between motor vehicles and bicycles. Sight distance problems may increase crash risk at Estes Drive and at Homestead Road (and possibly others) where plantings or other obstructions are obscuring the view.

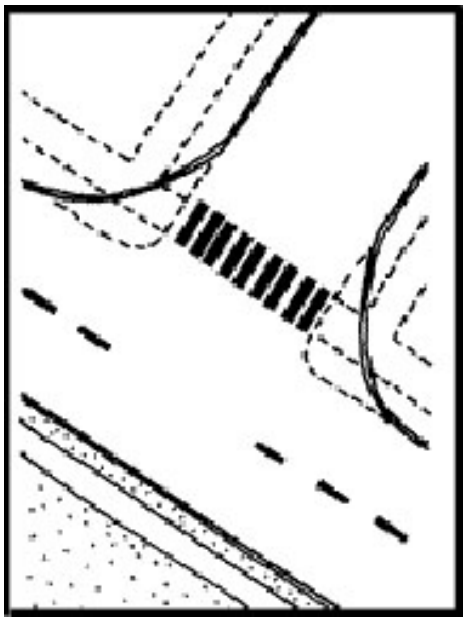
A number of intersections lack crosswalks and pedestrian signal heads at some sides, even though pedestrians should be expected to cross at all legs (e.g., north side of Hillsborough, north and west sides of Estes, Westminster, Weaver Dairy). Of perhaps lesser importance, signal-head location is poor at some intersections (e.g., Homestead Road) requiring detours by pedestrians to use push-button activators on some approaches.

Potential short term solutions

- *Enforce traffic signal compliance.*
- *Complete crosswalks and add pedestrian signals on all legs of signalized intersections. [Consider special paving treatments to increase conspicuity of pedestrian areas.]*
- *Correct or add proper curb cuts.*
- *Restrict right-turn-on-red maneuvers. Partial restrictions could indicate "No RTOR when pedestrians present."*
- *Check signal timing to ensure timing is adequate for slower pedestrians to cross and for approaching bicyclists to clear the intersection following change to yellow.*

Bike pockets for through bicyclists should be striped to the left of right-turn only lanes.

- *Consider providing a leading pedestrian interval (before left turns are allowed), or other alternate signal phasing, which gives pedestrians a head start and helps increase conspicuity of crossing pedestrians to turning motorists.*
- *Stripe / add bike pockets to right side of left turn lanes and to the left side of right-turn only lanes to help bicyclists position properly.*
- *Dash bike lanes through intersections, particularly at wide signalized intersections to indicate the through path for bicyclists.*



Curb radius realignment shortens crossing distance. (from, Making Streets That Work, Seattle DOT, 1996)

Potential long term solutions

- *Narrow curb radii– reduces crossing distance and turn speed.*
- *Complete sidewalks and two curb cuts per corner at all sides of intersections. Bring curb cuts in line with crosswalks.*
- *Add alternate paving treatments to crosswalk areas. Paving treatments may help increase pedestrian conspicuity.*
- *Add crosswalks and pedestrian signal-heads at all sides of* ***signalized*** *intersections.*
- *Add median refuge / extension with curb cuts to crossing areas along with center pedestrian activator button. A median refuge allows slower pedestrians to cross the roadway in two phases. (Examples: At Weaver Dairy, evaluate using an unused left turn lane for median refuge space. At Westminster, evaluate possibility of adding curb cuts, refuge pocket to an existing concrete median.)*
- *Locate pedestrian signal heads to optimize use and view.*

Median may be extended to create a refuge at intersections. (photo, ITE Pedestrian and Bicycle Council)

Once again, provision of a corridor with a center, raised median and bike lanes should aid with the problems mentioned above. Intersection crossings by both pedestrians and bicyclists will be made easier with a narrower corridor that should lead to slower motor vehicle speeds. Enhanced treatments such as textured crosswalks may help to focus attention on pedestrians. Narrowing the turning radii at the larger intersections would also help by reducing the crossing distance and slowing turning vehicle speeds. The median can also be extended to provide a refuge at intersections allowing crossing in two phases when needed. Bike lanes should be appropriately marked to the left of motor vehicle

right turn lanes. Bike pockets for left turning bicyclists should also be provided at major intersections, although only experienced cyclists may be able to negotiate the traffic for these maneuvers. At the wider intersections, consideration could be given to dashing bike lanes through the intersection to indicate the appropriate path of the bicyclist. Over the longer term, bicycle traffic patterns may warrant consideration of other facilities / pavement markings to assist with bicyclist turning movements.

Problem 11 – Wide curb radii / cross sections at some connecting streets and driveways
There are wide turn radii at some driveways and also at some of the smaller side streets along the corridor (Airport Drive, Mt. Bolus Drive, others). For example, the cross section on the Airport Drive approach (approximately 50 feet back) to Airport Road is approximately 30 feet, while the distance in the crossing area at Airport Road is approximately 80 feet. (There is a bus pull-out upstream of the crossing area which probably influenced this design, but it results in a very wide crossing.) The excessive width of many crossings along the corridor increases the exposure and time for pedestrians crossing these streets. The wide turn radii allow motorists to enter and exit the main road at a high rate of speed. The visibility of pedestrians waiting to cross is also reduced since the curbs are often set back from the travel-way. All of these factors may increase the risk of serious motor vehicle collisions with pedestrians and bicyclists at these locations and also places the burden on pedestrians and cyclists to hurry across these wide streets along the corridor.

Potential short/long term solutions

Skewed intersection re-alignment (photo, P. Lagerwey)

- *Curb radius reductions / realign skewed intersections to right angle - This treatment helps reduce exposure of pedestrians and bicyclists by narrowing the crossing distance at driveways and intersections. Extending the corner can also increase visibility of pedestrians waiting to cross at intersections. Narrowing the curb radius at driveways and intersections may also help to slow the speed of turning vehicles, and hence slow the corridor overall.*

Altering the curb radius may be a relatively low-cost solution of changing concrete, and adding planting or buffer areas if drainage or other utilities are not affected. Simultaneously with this improvement, two curb cuts per corner could be installed properly at perpendicular angles to the roadway, and crosswalk striping or paving treatments can be completed as

needed. Pedestrian signal heads, if at a signalized location, should be checked for adequate timing and best location.

There have been recent improvements such as re-aligning the skewed intersection at Stephens Street. North Street/South Columbia Street also poses difficulties for pedestrians and bicyclists due to the wide angle intersection of Columbia Street with Airport Road. We understand that plans are already under consideration for improving this intersection and thus, we will not address that intersection in this report.

Problem 12 – Trail access issues

Bicyclists leaving the Bolin Creek trail currently must either ride off the curb at the trail head, or turn north or south down the east side sidewalk, again contributing to wrong-way, sidewalk riding. Those continuing south or crossing to the west side of Airport Road or toward Umstead have confusing alternatives at present. There is no crosswalk access on the north side for pedestrians or bicyclists continuing west. Bicyclists from both directions on Airport road must also access the trail via the east side sidewalk, again creating a situation for potentially hazardous wrong-way, sidewalk riding.

Currently, east side only access to the Bolin Creek trail from Airport Road contributes to sidewalk / wrong-way riding.

Potential short term solutions

- *Add crosswalk and pedestrian signal head for trail users wanting to cross at north side of Hillsborough intersection (short term solution, relative to the underpass).*
- *Warning pavement on the trail in advance of intersection with Airport Road (and other streets).*
- *Add planted median or painted buffer around bollards at entrances.*
- *Clear vegetation from signs; stop sign is currently so far from trail that it is not easily seen.*

Potential long term solutions

- *Directional and informational signs / maps / brochures might be provided at key entrances for newcomers to the trail. Bicycling maps are also a way to provide safety tips for both motorists and bicyclists about bicycling issues. Cautions about sidewalk and wrong-way riding could be included.*

Bolder underpass (photo by D. Burden)

- *A trail underpass is under consideration that will connect the Bolin Creek Trail on the east side of the corridor with an extension planned on the west side. This treatment should alleviate some of the difficulties with bicyclist access that may contribute to wrong-way riding and discourage bicyclists from Airport Road from using the trail. Designs will hopefully allow convenient bicyclist access from both sides of Airport road as well as convenient pedestrian access. The trail extension will enhance opportunities for activity.*

Problem 13 – Bus stop issues

We have already addressed some of the issues about access to bus stops – both gaps in the sidewalks and lack of crossing access to stops. Location of each stop should be evaluated carefully; with improved access, some stops would perhaps better serve more riders by being relocated to a more appropriate nearby location. At present, lack of sidewalks and curb cuts at a number of stops may prevent access by some pedestrians. Other problems include:

- There is no paved waiting area at several locations, nor curb at some stops.
- Where there is curb, few if any midblock stops have a curb cut.
- There is a lack of shelters at most bus stop locations.
- There is no seating at a number of stops.
- There is a lack of shade at a number of stops.
- The location of at least one stop between two commercial driveways may present potential safety problems due to the interaction of alighting pedestrians and traffic turning into and out of adjacent driveways.

Taylor Street area bus stop – Airport Road

Potential short-term solutions

- *Add waiting platforms with curb cuts.*
- *Add bus shelters and seating to those stops without them.*
- *Add bicycle parking to park and ride locations. Consider covered parking.*
- *Evaluate location and design of transit stops in terms of safety, bicyclist and ADA (Americans with Disabilities Act) access, as well as convenience or proximity to origins and destinations. Some stops could perhaps be relocated to the far leg of a nearby signalized intersection, which is typically safer for pedestrians who leave the bus (since they are less likely to step out into the street from in front of the bus and be struck by oncoming motorists).*
- *Consider relocating the Foster's market (stop #3449) to south of driveway at 730 Airport Road.*

Alighting pedestrians may face conflicts with vehicles turning in and out of commercial driveways.

Potential long-term solutions

- *Continue to evaluate the demand for bicycle parking at transit stops; over time, demand could increase.*

Well-planned transit enhances the multi-modal use of a corridor. Accessibility and ease of use are keys to increasing transit trips by bicyclists and those accessing the bus by walking.

Improvised bus stop seating along Airport Road

We can imagine that on a rainy morning, those with automobiles and the possibility of driving might decide to do so rather than face walking along muddy paths, and then waiting on a wet, grassy, or muddy right-of-way with no shelter and no buffer from passing vehicles splashing rain.

In a user, visual preference study conducted in Sarasota County Florida, surveys of transit users, non-users and transit professionals found that the presence of a bus shelter was the most important element to a bus stop being an attractive stop (among

all groups). A bench (without a shelter) was the second-ranked factor. Other factors deemed important were shade (trees or an overhang shading the stop area), a vertical curb at the stop, and trees leading along the street to the stop. (Ewing, 2000). (Advertisements present at the stop were negatively associated with preferred stops.)

Problem / Challenge 14 – Encouraging more bicycling and walking

It seems clear from the pedestrian counts and transit use data, that most of the walking along the corridor is utilitarian (for the purposes of going to work, attending class) – resulting in trips to and from the nearest transit stop or to town or campus. Some apparent recreational walking and bicycling was observed, particularly in the areas close to the Bolin Creek Trail, and the YMCA. Pedestrian and bicyclist traffic near the trail was also higher on the weekend, supporting the observation that recreational users are accessing the trail from Airport Road. There is also the highest pedestrian and bicyclist activity in the Hillsborough / Umstead area where the Bolin Creek Trail, two transit stops, as well as a commercial area with a number of restaurants and other services, may be desirable destinations.

Other than transit stops, there seem to be relatively few other "destinations" along the corridor. Among current destinations are the Town center, UNC campus, the Timberlyne and Chapel Hill North shopping areas, and parks, trails, and other activity centers (such as the YMCA). Input from the public forum showed that residents near the northern commercial centers need sidewalks and other measures to improve bicycling and pedestrian access. Improvements in walking conditions in the areas closer to town and campus should also encourage more pedestrians to walk to school and work from nearby areas along the corridor. Serious gaps in the sidewalk facilities on the west side of Airport Road, and on the west leg of connecting major streets such as Estes Drive, limit access of pedestrians from those areas to the YMCA, Bolin Creek Trail and other destinations.

Until more amenities are developed in some segments of the corridor, there is little incentive at present to walk for shopping, dining, etc., in those areas. It is expected that the number of destinations along Airport Road will increase as development increases along the corridor in the years ahead.

Accessible, attractive, convenient bus stop (photo by D. Burden)

Along this corridor, far more bicyclists, as well as pedestrians, were observed at locations close to campus and town than further out the corridor. Whereas pedestrians may not be as likely to walk the four miles from the outer-most reaches of the corridor to the town center and campus often, this trip length is well within the range of average bicycle trips. Thus, there seems to be significant potential for increasing bicycle commuting from destinations all along the corridor if appropriate improvements are made, including slowing traffic speeds.

To encourage more walking and bicycling, care must be taken to provide a connected network of attractive pedestrian and bike-friendly roadways and paths, not simply the most basic facilities. The goal should be to make traveling by bicycle or on foot attractive and viable options for many trips and purposes.

Long term solutions

A multi-modal boulevard (Photo by Dan Burden)

- *Develop a unified "boulevard" look in the use of street trees, paving treatments, lighting, transit stops, street furniture, complete sidewalks and bikeways with proper curb cuts and alignments, and other design elements that invite multi-modal use.*
- *Plant shade trees in buffer strips and/or center median. It may be highly desirable to bury utility lines, and install mast arm traffic signals to reduce future maintenance issues and allow the growth of mature street trees. Buried utilities would also be more aesthetically pleasing to walkers and bicyclists.*
- *Add attractive pedestrian-level lighting along walk ways.*
- *Develop attractive landscape plan that restricts the use of shrubbery, vines, and low-growing vegetation. These types of plantings may require high maintenance and conflict with the pedestrian right-of-way and use of the median for crossing midblock, or may hinder feelings of personal safety, obscure signs, etc.*
- *Develop a land-use plan that encourages diverse uses, building close to the roadway, pleasing open spaces / parks, trails, etc. The current Chapel Hill comprehensive plan calls for the creation of mixed use activity centers throughout Town. Three activity center locations have been identified along Airport Road in addition to the town center, around Hillsborough Street, near Homestead Road, and the Timberlyne / Chapel Hill North area.*
- *Develop a complete multi-use path network that encourages both recreational use and travel to destinations.*
- *Provide accessible, well-designed bicycle parking at all major destinations such as shopping centers, businesses, institutions, park and ride lots, and others.*
- *Adjacent new or re-development should provide convenient pedestrian and bicyclist access that connects with Airport Road facilities.*

To effectively encourage residents to choose bicycling and walking for more trips of all kinds, facilities need to be comfortable and attractive as well as reasonably safe. It will be a challenge, but one that will be worth it in the long run, to address the overall design of

Airport Road to create an appealing pedestrian and bicycle corridor that can still accommodate large numbers of motor vehicles, traveling at a safe speed.

In addition to the safety and appeal of the travel ways leading to destinations, the design of the community itself affects the amount of walking and bicycling that will occur. Desirable destinations must be within reasonable walking and biking distance. In a nationwide survey of pedestrian and bicyclist attitudes and behaviors, more than one-fourth of walking trips were reported to be less than ¼ mile in length during a typical summer day and two-thirds of all walking trips were one mile or less (National Survey of Pedestrian and Bicyclist Attitudes and Behaviors – Highlights Report). The current Chapel Hill Comprehensive Plan call for developing activity centers along the corridor should help, but providing a mix of uses throughout the corridor would increase the number and variety of trips that could be made on foot or by bicycle. Consideration could be given, for example, to encouraging the University to locate the commercial areas of Chapel Hill North along Airport Road instead of to the interior of the tract. This type of dense, pedestrian-style development might help to slow traffic along the corridor, as well as provide more visible walking and bicycling destinations for people living and working along Airport Road.

Conclusions

In order to create a more pedestrian and bicycle-friendly environment along Airport Road, a number of key issues will need to be addressed.

Pedestrians and bicyclists need assistance to safely cross this busy roadway, particularly in the section with TWLTL. Many pedestrians, including those accessing a number of midblock transit stops, must cross at non-signalized locations. Pedestrians often must wait in the unprotected center turn lane, with traffic speeding by, for a gap in the next lanes to complete their crossing. Replacing the TWLTL with a raised center median would assist pedestrians in crossing the roadway by allowing them to cross two lanes at a time, and have a refuge to wait for a gap to complete crossing. Providing median pockets (curb cuts) at high midblock crossing locations will improve access by pedestrians and bicyclists. A median and median pockets would also provide protection to bicyclists accessing the roadway from non-signalized locations.

Pedestrians and bicyclists often face conflicts with left-turning motorists throughout the area with TWLTL. A raised median should also improve this situation by restricting left-turn locations to certain intersections and other designated locations. A raised median should also improve motor-vehicle safety, since research has shown that divided, multi-lane roads have significantly lower rates of total crashes, compared to undivided roads. Additionally, a crossing facility that included a raised median was the unanimous choice of participants at the public input session. Numerous other comments during the public input session supported the use of raised medians to help pedestrians cross the roadway. One participant wrote, “The biggest single improvement that could be made would be to install raised landscaped median strips along the old part of Airport Road similar to those on Airport Road north of Homestead.”

At present, a number of gaps in the sidewalk make it difficult for many pedestrians to complete trips or to access transit. Where sidewalks exist, walking conditions are unpleasant because of narrow and non-existent buffers between the high-speed traffic lanes and the walkway and a lack of shade along the walkways. Curb cuts and crossings are frequently misaligned and crosswalks and pedestrian signal-heads are lacking at some signalized intersections. Closing the gaps in the walkways, providing appropriate access through proper curb cuts at all crossings and transit stops, and providing crosswalks and pedestrian signal heads at all sides of signalized intersections will help to provide a complete network of accessible pedestrian facilities in the Airport Road corridor.

The goals of enhancing the pedestrian environment should include adding as much width to the buffer between pedestrians and traffic lanes as possible. Ideally, a vertical buffer (*i.e.*, tall shade trees) will also be planted throughout the corridor in either the buffer, the median, or both, to increase separation between pedestrians and the traffic lanes, provide visual narrowing of the roadway, and enhance the comfort of the walking and bicycling environment. It may be necessary to incorporate plantings outside the walkways to complete a canopy.

There is currently not a consistent space for bicyclists on the Airport Road corridor. When bicyclists are surveyed, bike lanes are consistently preferred as the facility of choice. Chapel Hill has gone through an extensive public process and has also identified bicycle lanes as the preferred facility for bicyclists in most situations. An added benefit of designating bicycle lanes is that space may be reallocated from existing motor vehicle lanes to the bikeways. Narrowing the travel lanes through re-striping may help to slow motor vehicle speeds through the corridor, better enabling bicyclists to enter the roadway, share the road, and maneuver for turns. These improvements may help to reduce the practices of riding on the sidewalk and wrong-way riding, which themselves are risky behaviors.

A majority of motor vehicles in the corridor are exceeding the speed limit, increasing the risk to pedestrians and bicyclists. Reducing motor vehicle speeds is a challenge. Traditional enforcement of speed limits (as well as signal compliance) is difficult and typically effective only when used consistently and frequently, and with significant consequences upheld by the courts. Narrowing traffic lanes to 11 feet or less through re-striping, or, through curb or median re-alignment, should have a slowing effect on motor vehicles as well as reduce the exposure of crossing pedestrians and bicyclists to traffic. The addition of a raised median, and the use of other visual narrowing techniques, such as completing sidewalks and buffer strips and planting street trees, could further slow the speed of the roadway. Curb or median realignment may also be useful in adding width to the buffer strip and walkways.

Large, multi-lane intersections with turning traffic are intimidating to pedestrians and bicyclists. Realigning wide curb radii or skewed intersections, improving sight distance, adding median refuges at intersections, and restricting right-turn-on-red maneuvers could improve safety at the larger intersections by reducing crossing distance / exposure, and by reducing conflicts between pedestrians and bicyclists with turning motor vehicles and

conflicts due to poor sight distance. Re-aligning curb radii at intersections should also make pedestrians waiting to cross at corners more conspicuous. Evaluating whether improvements are possible in signal timing that could improve traffic flow at 35 mph, and to ensure adequate crossing time for slower pedestrians as well as clearance time for bicyclists approaching a yellow phase, could improve conditions along the corridor. Adding special crosswalk paving treatments could further enhance conspicuity of pedestrians.

We have not, thus far, identified **roundabouts** as a treatment for the major intersections along the corridor; this treatment should, however, receive consideration. Recent research from the United States (IIHS, 2000) has found that roundabouts improve traffic flow and aesthetics considerably, while reducing motor vehicle injury crashes by as much as 76%. European experience also shows that the risk of pedestrian crashes decreases with the use of roundabouts over traditional intersections, and the slow-design speed reduces the risk of serious pedestrian injury in the event a crash does occur. Research has also found that motorists' acceptance of roundabouts increases with experience (IIHS, 2001). Furthermore, some agencies use roundabouts as a "gateway" into a community or neighborhood. Thus, for long-term improvement of the corridor, consideration should be given to the feasibility of converting one or more existing intersections along Airport Road into a roundabout design.

The large number of driveways and intersecting streets with sight distance problems along Airport Road contributes to unsafe and unpleasant walking and bicycling conditions. Developing a long-term plan to address the sight distance and sidewalk encroachment issues is an important component of creating a safe and encouraging environment for pedestrians and bicyclists. In the near term, it should be possible to develop and follow landscape planting and maintenance guidelines that adequately prevent plants from encroaching on the sidewalk, and from further hindering vision for motorists accessing Airport Road of pedestrians, bicyclists and other motorists traveling along the corridor. In the medium term, it should be possible to continue raised sidewalks across all driveways to encourage motorists turning into or out of Airport Road to slow and yield to pedestrians and bicyclists. And in the longer term, plans to improve the right-of-way and sight distance along the corridor should be developed along with widening the buffer between the sidewalk and roadway.

Transit stops often lack complete access with sidewalks and curb cuts as well as other amenities to attract use. Improving access and ease of use of the bus system along the corridor complements the goal of increasing walking and bicycling. Providing safe locations, proper access for pedestrians and bicyclists at transit stops, and sheltered waiting platforms away from the roadway, as well as excellent route service, enhances the appeal of transit and should help to increase combined trips.

Summary

Airport Road is the only feasible through route for all modes of travel from the northwest neighborhoods of Chapel Hill to the town center and the University of North Carolina campus. Providing connected bicycle and pedestrian facilities and crossing enhancements, along with treatments intended to slow motor vehicle speeds, should improve safety for bicycling and walking along the corridor as well as access to transit, shopping, and other

destinations. Creating a unified “pedestrian / bicycle / transit corridor” appearance by additional improvements in landscaping, lighting, paving treatments, transit stop treatments, and others should entice residents to walk and bicycle more along Airport Road. Providing appealing choices for active modes of transportation will enable residents to pursue healthier, less car-dependent lifestyles that will in turn have multiple benefits for the community.

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Acknowledgements

The authors would like to acknowledge the assistance of HSRC staff members: Charles Hamlett with photography and videotape observations, and Paul Kendall, Helen Chaney, and Priscilla Tsai with processing images and other aspects of the report. Jeff Grim, Jennifer Lewis, and Jane Love, interns with the Town of Chapel Hill Planning Department prepared the maps and aerial images used in this report.