

**A RESOLUTION RECEIVING THE REPORT ON THE
DOWNTOWN CARRBORO TRANSPORTATION STUDY
Resolution No. 167/2004-05**

WHEREAS, the Carrboro Board of Aldermen seeks ample opportunities to develop and implement initiatives which enhance the viability of downtown.

NOW, THEREFORE BE IT RESOLVED by the Carrboro Board of Aldermen that the Aldermen has received the report on the downtown transportation study and provides the following comments:

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This is the 14th day of June in the year 2005.

Final Report

Downtown Traffic Circulation Study

Town of Carrboro, NC



Kimley-Horn
and Associates, Inc.

June 2005

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DOWNTOWN CARRBORO TRANSPORTATION STUDY

EXECUTIVE SUMMARY

From a transportation perspective, pedestrian and street life in general is a sure sign of success in a downtown. Today, downtown Carrboro has achieved vibrancy and a degree of prosperity. However, a questionnaire completed by 45 citizens in December 2004 revealed the following data regarding downtown Carrboro:

- More than half indicated that crosswalks and signals at crosswalks need improvement
- More than half indicated that downtown intersections need improvement for bicyclists
- Nearly half of motorists surveyed said the presence of pedestrians and bicyclists needs improvement
- More than half support a redesign of Main Street, Greensboro Street and Roberson Street

The purpose of this plan is to describe various ideas about how the transportation system can be used and improved to expand and enhance the vibrancy of downtown Carrboro. Through a rigorous process of data collection and analysis, a team of traffic engineers, urban planners and landscape architects offer concepts for a balanced plan for downtown Carrboro. The plan builds on previous work including the Downtown Design Guidelines adopted in 1992 and the New Vision for Downtown Carrboro formulated by hundreds of citizens in a three-day charrette held in 2001. These guidelines and vision establish the philosophical framework for this plan.

An implementation plan is presented in Section III. The recommended order of projects is listed below. Pre-requisites for project 9 — the redesign of East Main Street include projects 2, 3 and 7. To gain NCDOT approval of project 9, the Town also may consider project 12 — the extension of Hosier Street as a pre-requisite. Doing so would complete a network of interconnected streets that could support the conversion of Main Street to a “complete street.”

1. Weaver Street Repaving
2. Roberson Street Extension
3. Railroad Agreement
4. Walkability Improvements
5. Bikeability Improvements
6. Bus Stop Improvements
7. Roberson Street Improvement
8. Greensboro Street Corridor Improvements
9. East Main Street Redesign
10. Town Hall Roundabout
11. Jones Ferry Roundabout
12. Hosier Street Extension
13. Gateway Roundabout

I. INTRODUCTION

Smokestacks were a common sign of economic success during the industrial age in America. Later, the spotted owl and the return of other endangered species were an icon of success during environmental awareness periods in America. Today in twenty-first century America, the pedestrian and street life in general is a sure sign of success in urban life.

Some cities in Florida and California are identifying districts where pedestrians come first, with accommodation of all others! Conflict among different modes of transportation is not only inevitable; it is welcomed in a vibrant, prosperous downtown. The key to success is managing that conflict so that the appropriate balance is achieved and maintained in a safe and efficient manner.

Today, downtown Carrboro has achieved vibrancy and a degree of prosperity. There is a very successful music scene and emerging arts and food experience. No other town Carrboro's size can brag about having a popular food co-op next to a successful Harris Teeter grocery store, plus numerous excellent restaurants. Today, downtown Carrboro's street life is active, particularly near the Weaver Street green and most especially on Thursdays and weekends.

However, the pedestrian is not yet treated as a first priority in downtown Carrboro. That is because the street system is designed primarily to move traffic and all other modes secondarily. Proof of this situation is found on most street corners by pedestrians who are confused about where and when to cross, despite the presence of traffic signals.

The purpose of this plan is to describe various ideas about how the transportation system can be used and improved to expand and enhance the vibrancy of downtown Carrboro. Specifically, the ideas generated by Carrboro citizens during a three-day charrette held in 2001 are evaluated.

For example, there are at least four oddly-shaped intersections that are confusing to pedestrians, bicyclists and some motorists. This plan includes new designs that would reduce confusion and clearly delineate safe places to cross these busy streets. Furthermore, Carrboro has achieved national recognition for the creation of bikeways, however, that success has had limited penetration into the downtown area. This plan considers facilities to close gaps in the bikeway network.

Through a rigorous process of data collection and analysis, a team of traffic engineers, urban planners and landscape architects offer concepts for a balanced plan for downtown Carrboro. The plan builds on previous work including the Downtown Design Guidelines adopted in 1992 and the New Vision for Downtown Carrboro formulated by hundreds of citizens in a three-day charrette held in 2001. These guidelines and vision establish the philosophical framework for this plan.

If the purpose of towns and cities is to maximize the exchange between people and organizations, then access is penultimate.

- Access by pedestrians to all buildings, streets and intersections
- Access by motorists to conveniently distributed parking lots
- Access by bicyclists to all streets and bicycle parking areas
- Access by patrons of the bus system to safe and well-marked bus stops
- Access by delivery trucks from preferred truck routes to markets
- Access by citizens and visitors to meet and greet each other

Access is an evolving factor as downtowns grow. Downtown Carrboro has evolved into a network of streets and paths that offer travelers real choices among fare-free buses, shared-use paths, pleasant sidewalks, well-distributed public and private parking lots and multilane streets with synchronized traffic signals. In sustainable cities and towns, growth is accommodated through increased use of walkways, bikeways and transit rather than wider roads.

Study Area

The study area considered by Kimley-Horn and Associates is bounded by the following:

- Town Hall and the Farmer's Market on the west
- Franklin Street and the Chapel Hill town limit on the east
- Shelton Street just north of Fitch Lumber and the Harris Teeter store on the north
- Old Pittsboro Road just south of Carr Street on the south

Timeline of Pertinent Events

- The NC 54 bypass opened to traffic in 1952 and was widened to a multilane highway in 1992. This facility is designed to carry "through traffic" (motorists without a downtown origin or destination) around downtown. This is important if Carrboro implements strategies that increase travel time on downtown streets, leading to perhaps a distinct split between motorists who choose not to stop and shop that will travel via the bypass and those who have an origin or destination downtown who will travel downtown.
- Traffic studies were done in the mid-1970's and repeated in the mid-1980's that led to multilane streets and synchronized traffic signals. The system works reasonably well for traffic, despite obvious vehicle queues during weekday peak periods that extend a full block on Weaver Street, Greensboro Street and occasionally on Main Street.
- Carrboro Downtown Business District *Guidelines for Design*, prepared by Lucy Carol Davis Associates in 1990. This very readable document begins a new era for downtown Carrboro whereby pedestrians begin to take precedence over the automobile.
- *Guidelines for Design* adopted by Board of Aldermen March 10, 1992
- Community Visioning Workshop, March 25, 2000 (100 participants)
- Carrboro Vision 2020: Policies through the year 2020, adopted December 5, 2000. Significant policies are established by the Board including a goal to "double commercial square footage in the downtown from that existing in the year 2000." Traffic demand management strategies are adopted that assume increases in traffic volume that are tempered

through the use of parking lots at the downtown perimeter served by shuttles to bring people downtown.

- Downtown Visioning Charrette, September 13-15, 2001 (with hundreds of participants)
- Preliminary Vision, presented to Board of Aldermen by Walkable Communities on November 10, 2001
- Charrette Report, Walkable Communities, Inc.; February 2002
- Downtown Traffic Circulation Study and Streetscape Plan initiated March 2004

Community Vision

Carrboro citizens are widely recognized for their passionate involvement in community activities. Their collective vision for downtown is captured in two documents of which the guiding document is entitled *Carrboro Vision 2020*, adopted by the Board of Aldermen in December 2001. Further information is provided in Appendix A and in a report entitled *Downtown Visioning Charrette Report*, submitted in February 2002 based on extensive citizen involvement over a three-day period in September 2000. Overarching goals adopted by the Board of Aldermen that are central to this study are listed below in no particular order.

1. “Double commercial square footage in the downtown from that existing in the year 2000”
2. Downtown accessibility by all travel modes
3. “As a general policy, established roads should be widened to accommodate bike lanes and sidewalks, but not to provide additional lanes for automobiles”
4. Improve pedestrian comfort and safety
5. Improve downtown parking

Guidance provided by Town staff at this study’s kickoff meeting in March 2004 included the following:

- Keep traffic moving and maintain unique character of downtown Carrboro
- Identify transportation infrastructure to accommodate downtown growth
- Study recommendations of the New Vision report (February 2001)
- Consider rail station at Main Street with connections to UNC and Carolina North
- Weaver Street improvements have been delayed three years waiting for this study so consider scheduling Weaver Street reconstruction before other streets
- Consider strategies to shift some travel from auto to other modes
- Maximize the supply of on-street parking spaces

Additional guidance provided by Town staff in July and again in September 2004 included the following:

- Strong support for improving pedestrian safety and convenience
- Vehicle trips that stop to shop in downtown Carrboro are valuable and transportation strategies should not discourage such trips
- Service vehicles and trucks need to be accommodated
- Traffic signal at Main and Lloyd Streets took a lot of effort, with strong community support, and should be retained

- Consider advantages and disadvantages of on-street parking in different configurations including parallel, diagonal, and diagonal back-in type
- Consider different types of on-street bikeways
- Consider improved connectivity of downtown streets and strategies to mitigate neighborhood concerns about connected streets

Historic District and Properties

There are historic properties and districts within the study area. These are currently listed on the National Register of Historic Properties. Public improvements should be designed to enhance, if possible, and not detract from these historic resources. If the Town decides to pursue state or federal funding for transportation improvements there will be a review of potential impacts on historic resources listed on the National Register. If it is determined, based on the initial environmental review, that an environmental document under the National Environmental Policy Act is required then a study of project alternatives that avoid right-of-way acquisition and visual impacts on the historic resources will be required. This requirement could add years to the implementation schedule.

Problem Statement

Downtown Carrboro has one of the most vibrant small-town economies in North Carolina. The design of most buildings in relation to the street system supports a downtown where pedestrians enjoy the environment. However, pedestrian comfort and safety can be improved with investments of public and private funds as new buildings are constructed. Street design changes could reduce travel speeds, create a buffer space between moving vehicles and pedestrians, and ease a traffic bottleneck that now affects quality-of-life at the Weaver Street “Green” and nearby public spaces. More detailed information on existing conditions is presented in Appendix B.

II. PUBLIC REVIEW OF ALTERNATIVE DIRECTIONS

According to legend, former major league baseball great Yogi Berra was once purported to say “If you come to a fork in the road, take it.” Whether correctly attributed to him or not, the saying relates to downtown Carrboro as two different forks (directions) are available and citizens are being asked to consider both. Following is a brief description that accompanied exhibits displayed for public review at Century Center on the evening of December 2, 2004. The two alternatives are derived from two very different philosophies about public spaces and are called:

- A. It ain’t broke, so don’t try a big fix
- B. Complete streets are just what this town needs

Direction A — It ain’t broke, so don’t try a big fix

If you believe the economy in downtown Carrboro is thriving; traffic congestion is not that bad; there are some wonderful open spaces; the mix of the good, the bad and the ugly adds character; pedestrians and bicyclists seem to get around just fine, and growth can continue without major street improvements then read further.

This study shows that traffic level of service is reasonable, that crash statistics are within expected levels, and there is no shortage of willing people who walk, bicycle and ride transit in downtown Carrboro. Furthermore, the Town invests little in capital expenditures for transportation and some other investment would not be possible if the Town were to shift funds to pay for new capital projects. The prospect of attracting state and/or federal transportation funds is problematic given budgetary limitations and competitive aspects among municipalities. However, this is not to be confused with the “Do Nothing” approach. The following list of projects, while shorter than in Direction B, is nevertheless provided:

- A.1 Fix sidewalks, street corners, and crosswalks to meet federal accessibility guidelines (Americans with Disabilities Act Accessibility Guidelines).
- A.2 Replace pedestrian push buttons and signal heads with the new pedestrian countdown signals throughout downtown Carrboro.
- A.3 Adjust traffic signal timing at several intersections to spread-out the vehicle queues that presently accumulate in the 100 block of Weaver Street. Consider spreading queues to the 200 block of Weaver Street and also on East Main Street.
- A.4 Fix stormwater drainage systems, mill street surfaces, repave, and restripe streets to more clearly delineate bicycle lanes including intersection treatments that show bicyclists where to wait such that detectors are tripped and bicyclists get the next greenlight in the signal cycle. Intersection striping and pavement markings should be replaced using patterns approved in the federal Manual of Uniform Traffic Control Devices.
- A.5 Close existing truck (service) driveway from Greensboro Street to the Carr Mill Mall/ Weaver Street Market and replace with on-street loading zones on the east side of Greensboro Street between the intersection of Weaver Street and the entrance to Harris Teeter. The loading zones can be provided without widening Greensboro Street.
- A.6 Alter the traffic flow in the 100 block of Weaver Street to provide one lane of one-way westbound traffic between Main and Greensboro Streets. Add on-street parking.
- A.7 Restripe South Greensboro Street to clearly mark a left-turn lane for southbound traffic to turn onto Roberson Street.
- A.8 Widen, repave and restripe Roberson Street between Greensboro Street and Sweet Bay Place to accommodate the cross-section adopted/approved by the Board of Aldermen.
- A.9 Work with UNC-CH, Norfolk-Southern Railroad, NCDOT, and others to extend Roberson Street from Sweet Bay Place to the Arts Center site to better distribute traffic to and from this anchor development in downtown Carrboro.
- A.10 Work with NCDOT and the Town of Chapel Hill to implement new traffic signal timing at East Main Street and Rosemary Street to allow for free-flow movements when pedestrians aren't present.
- A.11 Work with NCDOT and the Town of Chapel Hill to retime traffic signals at East Main Street and Lloyd Street to install southbound right-turn-on-red presence detectors so the signal won't change when a vehicle turns right-on-red from Lloyd Street to westbound Main Street.
- A.12 Convert the section of Roberson Street adjacent to Armadillo Grill to one-way southbound operation and add on-street parking.
- A.13 Restripe travel lanes through the intersection of Main Street/Weaver Street/Roberson Street to squeeze lanes to only 11-feet in width. Consider rebuilding curbs or at least use paint to box-out paved areas where vehicles are prohibited. In this way, the intersection

will be narrowed for vehicles and expanded for pedestrians. Restripe crosswalks using high-visibility type crosswalk markings on all crossings. Consider operating the intersection with two-way stop-sign control rather than a traffic signal. Delays on Main Street would be greatly reduced. Roberson and Weaver Streets would be converted to one-way operation leading away from the intersection. The only other approach affected by removal of signals would be Carr Mill Mall which is a private parking lot.

- A.14 Consider replacing traffic signals with modern roundabouts on West Main Street at two intersections: Weaver Street and Jones Ferry Road. These aren't required based on traffic congestion or safety, however vehicle and pedestrian delays and crashes would be reduced with conversion to modern roundabouts.

Direction B — Complete streets are just what this town needs

If you believe that downtown Carrboro has done amazingly well for itself but could do even better by addressing traffic congestion, hostile intersections, some bad urban design, and passing lanes on East Main Street that contribute to speeding then read further.

The term “complete streets” refers to slow-speed, two-lane streets with safe and convenient facilities for pedestrians, bicyclists, transit patrons and bus operators. Carrboro has a good start but changes are necessary to not only improve public safety but also to support additional building space downtown. Representative projects of “Complete Streets” are listed below:

- B.1 All projects listed above under Direction A.
- B.2 Implement streetscape features on West Main Street between Jones Ferry Road and Laurel Street to enhance walkability. This includes working with private property owners to close existing “pull-in” type parking in front of buildings and replacing it with sidewalk cafes, landscaping, enhanced signage, wider sidewalks and on-street parking.
- B.3 Add on-street parking on the west side of West Main Street in front of Town Hall.
- B.4 Restripe all intersections to continue bicycle lanes through the intersection to enhance existing conditions requiring cyclists to share (mix) with vehicular traffic. Continuous bicycle lanes would be provided throughout the study area on Main Street, Weaver Street, Jones Ferry Road, and a route defined as Carr Street, Maple Street, Roberson Street, Libba Cotton bike path, Railroad Street, and Brewer Lane.
- B.5 Construct a complete street connecting the Roberson Street extension with Brewer Lane (a distance of 750 feet) on top of the Norfolk-Southern Railroad right-of-way to serve local traffic as an alternate route to using East Main Street.
- B.6 Reconstruct East Main Street between the railroad tracks and Franklin Street to provide one through lane in each direction, one bicycle lane in each direction, intermittent on-street parking spaces, and raised-curb pedestrian-refuge islands at strategic crossings.
- B.7 Create town-center style premier outdoor public open-space at the historic “Point” just outside the front door of The Spotted Dog restaurant by narrowing Weaver Street and a portion of Main Street to expand the area inside the brick wall and replace the trees with umbrella-tables. Citizens and visitors could bring food to the area and enjoy the public space without looking at traffic because the landscaping would be built up at the edges.
- B.8 Purchase the Christmas tree lot and replace it with high-quality public plaza with a pathway connecting Weaver Street and Main Street, thus beginning a north-south axis in

this downtown that is oriented east-west. A pathway would facilitate use of the municipal parking lot between Main and Roberson Streets for those walking to the Weaver Street Green.

- B.9 Expand retail space between the Weaver Street Market and the Carr Mill Mall by building on top of the existing truck delivery apron. Building facility equipment such as chillers and boilers must remain, however these can be concealed from view of any new retail space. More active use of the green space between the truck delivery area and the intersection of Greensboro and Weaver Streets should be considered; perhaps with the introduction of benches and unpaved pathways leading to the benches. Relocation of the Carrboro Century Center fountain and pool to this space should be considered as a means of activating this space.

Refer to Appendix C for a discussion of study methods and preliminary results. Refer to Appendix D for a discussion of other alternatives that were considered early in the study; most of which included ideas that have been transformed into the above lists for Direction A and Direction B.

The consultant recommends that the Town of Carrboro implement a Walkway Spot Enhancement/Improvement Program. This program would be focused primarily on small scale improvement projects to enhance pedestrian, bicycling, and vehicular safety.

There are numerous recurring improvement needs throughout the study area. These issues would need to be studied in detail at specific locations with additional survey data not currently available to provide a finalized recommendation and specific solutions. In many instances these issues need to be solved as part of a larger project to provide continuity throughout all or a section of the study area.

III. IMPLEMENTATION AND PHASING PLAN

Based on public comments at the December 2, 2004 meeting, surveys, and a March 15 Board of Aldermen review, the consultant offers the following recommendations, listed in terms of the phasing of implementation. Reasons to support the phasing recommendations also are identified below. Town staff and/or leaders should initiate presentations to downtown groups and associations to improve public relations and understanding of the goals of each project/program listed below.

- A. Weaver Street Repaving** — Town funds have accumulated in the capital improvement budget to repave and restripe Weaver Street. It is recommended that the restriping occur as soon as practical, with new pavement markings installed that would narrow the travel lanes slightly to ten feet on each side of the center double yellow lines, leaving a four-foot wide bicycle lane between the travel lanes and the gutter pan. A smooth edge between the asphalt pavement and concrete gutter pan is recommended so that bicyclists won't hit a rough edge. Drainage inlets should remain in (or moved to) the transverse position and be marked by a 30-foot long solid white advance stripe to warn bicyclists. Signalized intersections on Weaver Street have insufficient space to continue striped bicycle lanes. Since removal of existing exclusive left-turn lanes would create longer vehicle queues and delay, it is recommended that the bicycle lane striping be discontinued in advance of the beginning of

the left-turn lane striping near the intersection, with the addition of appropriate regulatory signs indicating “Bike Lane Ends”. The bicycle lane should begin again on the far side of the intersection with the appropriate “Bike Lane Begins” sign and pavement marking. In either the Weaver Street contract or a subsequent downtown-wide signal enhancement contract, the Town should install bicycle-detectors to trigger changes in traffic signals by lightweight bicycles. Bicycle lanes should not be striped across any pedestrian crosswalks. Crosswalks should be striped across Weaver Street at the following locations: west of Elm Street, west of Lindsay Street (new), west of Oak Street (new), east of Center Street (new), both sides of Greensboro Street, midblock at Weaver Street Market and another midblock at the nursery/tree lot (new), and west of Main Street. For added visibility, all crossings of Weaver Street as well as intersecting streets should have high-visibility type 12-inch wide white longitudinal lines parallel to the direction of traffic, spaced one to two feet apart but avoiding the wheel paths. ADA-compliant wheelchair ramps should be built (or rebuilt) at Elm, Lindsay, Oak and Center Streets. Some driveways to private property should be regraded to create a four-foot wide flattened (ADA-compliant) sidewalk/driveway apron. New 20-mph speed limit signs should be posted on the far side of signalized intersections. A landscaping budget should be included to create hedge-screens between the public right-of-way and any private parking lot fronting Weaver Street, as long as driveways are not blocked and sight distance is not limited. If unable to negotiate easements with adjoining property owners, consider installing a short ornamental urban-style fence. Intersection sight distance triangles should be preserved along Weaver Street at Elm, Lindsay, Oak and Center Streets by trimming hedges and bushes, limbing-up trees, mowing tall grass, and lowering walls and fences. From a drivers-vantage point stopped on one of these side streets, looking down Weaver Street in both directions, the driver should be able to see clearly for 225 feet without pulling into the bicycle lane on Weaver Street. Signs for “No Right Turn on Red” should be installed on all approaches to signalized intersections along Weaver Street.

B. Roberson Street Extension — Owners of the Arts Center site are working with the Town of Carrboro, UNC-CH and Norfolk Southern Railroad to permit a private street crossing of the railroad tracks, aligned roughly with Roberson Street.

C. Railroad Agreement — The Town should initiate meetings and activities designed to reach agreement with UNC and the Norfolk Southern Railroad to discuss the terms and conditions for approval/acceptance of the following (listed in chronological order of occurrence):

1. Potential for joint-use of the rail right-of-way for a new public street. Tracks could be imbedded in asphalt paving that would be used by cars except during train events when all cars would be gated-off. The new street would be built on top of the rail for a distance of 750 feet between Brewer Lane on the south and the Arts Center driveway crossing of the tracks on the north. The private drive would be purchased from the Arts Center and converted to public use so reimbursement of the private investment in the crossing would be expected. The benefit of implementing this new public street crossing and connection to Brewer Lane would be to entice NCDOT to agree to change the cross-section of East Main Street between the railroad tracks and Franklin Street to have one through lane in each direction instead of two, freeing-up space to create community-friendly uses such as bicycle lanes and/or on-street parking.
3. Main Street crossing improvements for smoother rubberized crossing for bicyclists and pedestrians.

4. Shared use of the trackage from UNC “south” to the UNC “north” campus by light-rail vehicles with a station location near Main Street. Further study is needed by a light-rail expert on shared use and operation of the tracks along with street traffic. There are examples nationwide of dual usage including operation of historic streetcars along Market Street in San Francisco, however the regulatory environment for creating new operating environments is unclear and beyond the scope of this transportation study. Additional right-of-way in the rail corridor would help, but it is constrained by topography and a cemetery to the west and impending development to the east.

D. Walkability Improvements — The Town should prepare a map showing the approximate location of all downtown locations that will be improved for pedestrians including new sidewalk easements, hold a public hearing to receive comments, issue an RFP for design services, negotiate sidewalk easements where necessary with private property owners, and let a construction contract to include all of the improvements. Funding can come from future Powell Bill funds expected from NCDOT. If these are insufficient to complete this work in a timely manner, the Town should consider a referendum for a bond initiative or the creation of a “Project Development Financing” district to use tax-increment financing. If deemed desirable by the Board of Aldermen, a non-binding townwide referendum can be held prior to a decision to create the tax-increment district. The improvement package should be comprehensive and include all of the following:

E. Walkable Intersections

1. Retime traffic signals to adjust the cycle length to a more pedestrian-friendly 60-seconds (or thereabouts) compared with the current 120-second cycle. Fixed-time patterns should be established and revised bi-annually when the Mobility Report is updated by DCHC MPO. A signal coordination plan should be revised to adjust vehicle queue lengths that avoid spillover from one block to the next. At high right-turn volume intersections, inclusion of a “lead pedestrian interval” of two to four seconds for pedestrians to cross first before the vehicles receive a green light to turn. Signs regulating “no right turn on red” should be posted at all downtown intersections. Signs routing UNC area traffic to the 54 Bypass should be considered for posting near campus and out at Fayetteville Road and Highway 54.
2. Install pedestrian countdown signals downtown to show pedestrians how much time remains to cross a crosswalk before vehicle arrival.
3. Removal of pedestrian signal push-buttons. Most are difficult to reach for mobility-impaired citizens. With new fixed-time signals operating on a 60-second cycle with countdown signals there should no longer be a need for push buttons.
4. Curb ramps should be built to comply with the Americans with Disabilities Act (ADA) such that two ramps are provided on each corner. The width of flat sidewalk space at the top of the ramps should be at least four feet, as per ADA. Where this is impractical due to building proximity, consideration should be given to building a curb extension/bulbout into the street. Careful vertical and horizontal design and construction should be ensured to create a smooth ride and walk from sidewalk to ramp to gutter pan to street pavement by a wheelchair or pedestrian with mobility impairments. Existing curb ramps that need repair or do not meet ADA guidelines should be rebuilt.
5. Crosswalk widths and striping should be provided at all downtown intersections using high-visibility type longitudinal (with the direction of traffic flow) stripes that avoid wheel paths.

Traverse lines that currently exist can be removed and replaced with longitudinal lines (also known as zebra stripes). Install new crosswalks at the following intersections:

- a. Jones Ferry Road and Main Street
 - b. Laurel Street and Jones Ferry Road (across Laurel only)
 - c. Elm Street and Weaver Street (across Elm only)
 - d. Lindsay Street and Weaver Street (only one Weaver Street crossing needed)
 - e. Oak Avenue and Weaver Street (only one Weaver Street crossing needed)
 - f. Center Street and Weaver Street (only one Weaver Street crossing needed)
 - g. Sunset Drive and Rosemary Street (Sunset and Rosemary)
 - h. Merritt Mill Street and Rosemary Street (Merritt Mill only)
 - i. Merritt Mill Street and Main Street /Franklin Street
 - j. Brewer Lane and Main Street
 - k. Roberson Street and Sweet Bay Place
6. Seek opportunities to shorten pedestrian crossing distances by constructing curb extensions/bulbouts at intersection corners. Alternatively, consider building a minimum six-foot wide median island as a pedestrian refuge at signalized or mid-block locations.
 7. Build raised-curb islands to replace existing painted islands at the intersections of Main/Laurel/Weaver and Main/Jones Ferry. These will ultimately be demolished if and when modern roundabouts are constructed at both intersections. Should the Town expect to build the roundabouts within the next five years, then the painted islands can be improved instead by using flexible plastic vertical markers that delineate the island. This would be much less expensive than building new curb.

F. Walkable Sidewalks

1. Repair all damaged sidewalks. Reconstruct sidewalks that also serve as driveway aprons such that ADA guidelines are met for slope, grade and width. Negotiate sidewalk easements with all applicable property owners to create a minimum five-foot wide sidewalk and four-foot wide verge. To maintain an urban character (and avoid a suburban look), four-foot wide verge areas should not be planted with grass, instead hardscape with intermittent street trees using tree pits are recommended. Many locations in downtown Carrboro have a four-foot wide sidewalk and two-foot wide verge. In these locations, an additional three-foot easement is recommended. Where slopes exist, the easement agreement should include public investment (capital and maintenance) in a low seat wall made of stone to create the desired sidewalk and verge width and provide a place for pedestrians to sit. Most will not, but the consistent use of stone walls will continue the practice that is already prevalent in front of many private properties downtown, adding to the character of the district.
2. Once a suitably wide verge is created, relocate all benches, trash receptacles, sign posts, utility poles, newspaper racks, etc. to the verge.
3. Build a raised crosswalk across Weaver Street at either Lindsay or Oak Street to aid pedestrians by slowing vehicles to 20 mph (which is the posted speed limit). Ramps for vehicles to cross the raised crosswalk should be designed for 20 mph without discomfort. The flattened top of the crosswalk should provide a ten-foot wide pedestrian area. Drainage impacts could be minimized by locating the crosswalk near the high elevation along Weaver

Street (which is west of Lindsay Street) such that water would flow down the street away from the crosswalk and therefore not be impeded by the crosswalk itself.

4. Negotiate with the owner of the nursery/tree lot between Weaver Street and Main Street to develop a public-private project that would allow the Town to build a ten-foot wide brick path with a few benches and seat walls. The path would wind around plantable areas where the trees and plants for sale could be grown and displayed. The existing sales desk could be integrated into the pathway area. The path would connect the municipal parking lot south of Main Street with the Weaver Street “green” along a direct route. If negotiations go well, the Town should consider building a raised crosswalk across Weaver Street connecting the path with the Weaver Street “green” path system. A new mid-block crosswalk should be striped across Main Street to facilitate pedestrians crossing to the municipal parking lot.
5. Retain a consultant to develop a wayfinding signage/graphics/downtown branding package. From a transportation perspective, the wayfinding signage should direct motorists and pedestrians to area attractions and municipal parking lots. The package should include a flyer, brochure, or postcards showing the location of all public parking for distribution through outlets all over downtown. Recognition of established “districts” within the downtown area should be maintained.
6. Walkways and paths linking sidewalks with municipal parking lots should be made ADA compliant. If an alternate path is ADA-compliant, wayfinding signs directing pedestrians to the ADA pathway should be installed. The gravel walkways linking municipal lots with Main Street (one at the railroad and the other in the historic 100 block) should be paved with concrete, asphalt or a pervious paving treatment.
7. Install rubberized inserts into the gaps between rail track and asphalt pavement where Main Street crosses the railroad tracks to improve the ride for bicyclists and walking for pedestrians.
8. Consider installing special enhanced paving treatments within the following intersections:
 - a. Weaver Street and West Main Street (could be omitted if roundabout is approved here)
 - b. Jones Ferry Road and Main Street (could be omitted if roundabout is approved here)
 - c. Shelton Street and Greensboro Street
 - d. Carr Street and Greensboro Street
 - e. Main Street/Franklin Street and Merritt Street (could be omitted if roundabout is approved at this location)
9. Enhance views along sidewalks that front public and private parking lots by installing landscaping as visual screens. When landscaping is not applicable due to insufficient right-of-way and uncooperative property owners, use short ornamental urban fences instead. Ideally, parking lots fronting sidewalks would be relocated behind new buildings that are built closer to the property line, as per the Downtown Business District “Guidelines for Design” adopted by the Town in 1993 (see “Public/Private Setback Zones” section).
10. Update development guidelines to promote side street access and shared parking lots as a way to close “main street” driveways. Infrequent conflicts between turning vehicles and pedestrians will enhance the walking experience.

11. Midblock paths and walkways should be negotiated with property owners, particularly as redevelopment plans are created. Blocks longer than 500 feet are candidates for some form of midblock walkway "splitting" the block.
12. Redesign Greensboro Street to calm traffic and facilitate pedestrian crossings. Improvements from Carr Street on the south to Shelton Street on the north are identified that will enhance the safety, comfort and convenience of pedestrians. These include using specialty paving treatments within gateway intersections on Greensboro Street at Carr Street and also at Shelton Street. Also, narrowing the number of through lanes southbound to one along the frontage of Southern States, Harris Teeter and Fitch Lumber combined with marking high-visibility crosswalks at intersections is recommended. Consider negotiating acquisition of right-of-way to enhance the front of Fitch Lumber by replacing existing diagonal parking with a combination of sales area (under a new awning) and a sidewalk and verge with additional street trees.
13. A nighttime inventory of streetlights and the luminance created therein is recommended. Good levels of lighting are important for maintaining a safe and secure pedestrian realm during the evening. The standard cobra head fixture serves the auto, but does not provide lighting appropriate for pedestrians. Because they move at a slower pace, pedestrians have a smaller field of focus than people moving in a vehicle. They look at more detail, and stop more frequently and for longer periods of time. Thus they require shorter light standards to direct more intense light onto a smaller space. The light standards also work with street trees and the architecture of adjacent buildings to establish a human scale and pedestrian-supportive environment. In residential areas, one foot-candle is sufficient, whereas two foot-candles are appropriate in retail areas. Uniformity levels should not exceed a ratio three to one. Lighting guidelines follow:
 - a) Adequate and aesthetically pleasing lighting should be provided for safety, security, and a greater sense of comfort for pedestrians of all abilities. Lighting should allow pedestrians to quickly and accurately recognize cues to enable safe navigation.
 - b) The appropriate height for pedestrian lighting is between 12 and 20 feet high. Light standards also may be combined on one post. Low, pedestrian-oriented lights can be affixed to a post and direct light onto sidewalks, while the same post also may accommodate auto-oriented lights and directed towards the travelway realm.
 - c) In some cases, lighted bollards may be appropriate for illuminating a pedestrian pathway or a pedestrian refuge islands in the travelway.
 - d) It is preferable for fixtures to be closely spaced with lower light levels per fixture rather than further apart with intense and variable light levels, which can be uncomfortable for pedestrians.
 - e) Lamps should provide broad spectrum lighting.
 - f) In pedestrian supportive areas, low-pressure sodium lights should not be used, as they create an unnatural yellow cast, which reduces safety and the quality of the environment.
 - g) Glare should be minimized and lights should be directed down and away from eye level when pedestrians are either standing or sitting.
 - h) Lighting systems that provide higher levels during more active times of the early morning and evenings should be considered. For example, employment areas could have pedestrian level lighting to supplement standard street lighting which could be timed to dim or shut off when pedestrian activity is lower. This reduces energy costs and potential "sky glow" impacts.

- i) Lighting fixture and pole designs, color, and amenities such as banners should contribute to the identity of the district.
14. Street trees should be planted such that, once established, shade is provided for pedestrians. In areas with older very mature trees, an urban forester should be consulted to devise a programmatic tree replacement strategy so that when the older trees begin to die naturally, younger well-established trees will fill-in some of the area and avoid a stark change. Tree “pits” are now the preferred ground cover for street trees, replacing the older tree “grates.” An urban forester will recommend the size and shape of tree “pits” to fit specific tree species.
- G. Bikeability Improvements** — The Town should retain a consultant and contractor to complete a design/build project that will install bicycle detection capabilities at all signalized intersections throughout Carrboro. The California Department of Transportation (Caltrans) recently completed a successful demonstration project that shows that video (camera) technology detected greater than 98 percent of bicyclists who were waiting for a green light without any cars or trucks at the intersection. This avoids bicyclists waiting at a specific spot to trigger a super-sensitive in-pavement loop detector and it saves time and effort by bicyclists to avoid going over to push the pedestrian signal pushbuttons. The consultant should initiate discussions to reach agreement with NCDOT on the use of suitable technology in Carrboro, perhaps using federal transportation enhancement funds, state bicycle program funds, state direct-allocation funds, or federal congestion mitigation air quality funds. As streets are repaved in downtown Carrboro, consideration should be given to restriping them with 11-foot travel lanes and 5-foot wide bicycle lanes (for state roads) or 10-foot travel lanes on town roads, if feasible. Proper pavement marking and signing should be installed as per the MUTCD particularly in intersection areas. Throughout downtown, bicycle route signs should be posted on streets that provide interconnectivity between the bicycle lanes and shared-use paths radiating from downtown. Cost ranges from a low of \$25,000 per intersection to as much as \$100,000 based on the Caltrans demonstration project.
- H. Bus Stop Improvements** — Amenities at bus stops should include seating, overhead shelter, shade, a map of the area, a bus route map and either a bus schedule or status board showing arrival time of next bus. For comfort, nearby should be marked crosswalks, public toilets, newsstand/magazines and books, and convenience items such as drinks and snacks for sale. Ideally, the bus stop is located where activities draw other people to the immediate vicinity, such as the Weaver Street “green” or Main Street businesses. Most existing bus stops in downtown Carrboro have a bench and bus route schedule. A shade tree should be planted preferably on the south side of the bench. The Town of Carrboro should consider a new form of shelter, perhaps inspired by a local artist. Triangle Transit Authority has a new design for shelters at future rail stations that could be one form of inspiration. Funding would likely be required by the Town of Carrboro for the incremental cost of each shelter above the cost of Chapel Hill Transit’s existing shelters.
- I. Roberson Street Improvement** — The Town should initiate a two-block long improvement of Roberson Street to construct the ultimate street section as per Board policy adopted previously. New off-street parking provisions should be arranged so that the north side of Roberson Street may be redeveloped from existing surface parking lots to new mixed-use buildings. New replacement parking should be as close as possible to the block, perhaps on the existing Carr Mill Mall employee (surface) parking lot along Sweet Bay Place. The

minimum footprint for a parking deck is 125 feet wide by 250 feet long. Alternatively, an alley could be built along the southside of historic Main Street buildings to interconnect the parking lots and thereby close-off existing driveways along Roberson Street. Once connected over the railroad tracks and over to Main Street, then the short section of Roberson Street that is oriented north-south can be converted to one-way southbound operation and space re-used for diagonal on-street parking. This will help balance the loss of parking as buildings replace surface parking lots. Furthermore, the Town should initiate a public-private partnership with owners of the large surface parking lot along Sweet Bay Place at Roberson Street to consider a parking deck on a portion of the site. The intersection of Roberson Street at Greensboro Street should remain stop-controlled because of the proximity to the signal at Greensboro and Main Streets, however, turn lanes can be provided on both Roberson and Greensboro Streets to facilitate turning movements. High-visibility crosswalks should be striped across Roberson at the following locations: east of Greensboro, west of Maple Avenue and west of Sweet Bay Place.

- J. Greensboro Street Corridor Improvements** — Traffic calming and pedestrian crossing improvements along Greensboro Street between Carr and Shelton Streets may be combined with turn lane improvements along South Greensboro Street. This will help encourage the use and redevelopment of Roberson Street. Southbound traffic on Greensboro should be given an exclusive left-turn lane at Roberson Street. Existing pull-in parking for the Trading Post furniture store and the former Scotts Rental building should be curbed and replaced with off-site parking in the nearby Municipal Parking Lot or new on-street parking provided along Greensboro and Roberson Streets. South of Roberson, Greensboro Street should be narrowed to provide one 11-foot wide traffic lane in each direction. Excess pavement should be removed and replaced with a combination of business-friendly on-street parking and pockets of landscaping for visual enhancement as a district gateway. The intersection of Greensboro and Carr Streets should be repaved using color asphalt or streetprint in the entire intersection, as a gateway treatment. Trees and bushes should be trimmed. At Main Street, the Town should several parking spaces in the municipal parking lot for use by Cliff's Market so that the existing gravel lot at the corner can be landscaped and enhanced as public space. North of Weaver Street, the Town should work with NCDOT to initiate a restriping plan that would make the following changes:

- Relocate truck delivery and staging from off-street between Weaver Street Market and Carr Mill Mall to on-street along a 140-foot long stretch of the east side of Greensboro Street, closing the existing driveway and ceasing the current operation of trucks that back down Greensboro Street into the driveway. Widening of Greensboro Street will be necessary to achieve this traffic improvement.
- Install marked crosswalks crossing Greensboro Street north and south of Short Street, south of Poplar Street, and on the south side of Parker Street. Crosswalks at Short and Poplar should be high-visibility type longitudinal markings. The crosswalk at Short Street (north side) should be enhanced with a median refuge island for pedestrian safety and traffic calming effect. This would preclude left-turn movements into the Harris Teeter lot which should occur at the northerly Harris Teeter driveway.
- Install specialty paving through the intersection of Greensboro and Shelton Streets as a district gateway treatment.

- Eliminate the second southbound lane between Shelton Street and Short Street in order to calm traffic and enhance pedestrian safety at crosswalks. A left-turn lane should be maintained at one of the Harris Teeter driveways (preferably the northernmost).
- Redesign the Fitch Lumber entrance to align with the future street along the abandoned rail right-of-way, eventually connecting with Lloyd Street.
- Construct a sidewalk on the west side of Greensboro Street from the bus stop that is just north of Shelton Street to the dentist office that is just north of Weaver Street, a distance of about 1,000 feet. Easements would be needed from Fitch Lumber and six residential properties. Existing street trees could be used as the verge, with construction of the sidewalk built between the street trees and existing buildings.
- Turn stormwater grates to the bicycle-friendly position and resurface as needed to remove ruts and rough edges between the grates and surrounding concrete.

K. East Main Street Redesign — There is an imminent opportunity to work with the redevelopment of the Arts Center site to analyze traffic levels of service using the design concept of eliminating one travel lane in each direction (there are currently two in each direction between Rosemary and the railroad tracks) and resurfacing / restriping East Main Street with one through lane in each direction, one striped bicycle lane in each direction, and an intermittent left-turn lane at intersections. Traffic signal timing should be adjusted at Lloyd Street to maximize throughput of traffic on Main Street, permit right-turns on red from southbound Lloyd Street and install presence detectors under the pavement on Lloyd Street so that right-turn traffic does not trigger a change in the traffic signal (only left turns would trigger the change to green). At Rosemary Street and Main Street, a realignment is recommended that would “T” Rosemary Street into Main Street at roughly a 90-degree angle. The realignment would require acquisition of two on-site parking spaces from the new Padgett Station coffee house, however their driveways on both Main and Rosemary should remain and the store should receive a waiver from the parking requirement. New on-street parking on Rosemary Street would more than make-up for the loss of two on-site spaces. There is a crash history at this intersection, attributed in part to the acute angle at which these streets intersect. The traffic signals at this intersection would have to be repositioned and retimed to avoid longer queues on Main Street (which are possible with the narrowing to one lane in each direction). Queue lengths on Rosemary Street will increase over existing conditions. New crosswalks should be marked one each across Main Street and Rosemary Street using high-visibility type longitudinal markings. There will be an area where asphalt pavement can be removed and replaced with landscaped public space adjacent to the intersection. There are currently several large shade trees that could provide shade over a nice public seating space.

L. Town Hall Roundabout — The Town should pursue \$400,000 to plan, design, construct and acquire a small amount of right-of-way to replace traffic signals with a modern roundabout at the intersection of West Main/Laurel/Weaver Streets. Currently there is little congestion and no recurring crash history to be concerned about, however, the following benefits may be achieved with the conversion:

- Shorter and safer pedestrian crossings
- Changing left-turn movements into low-speed right-turn yield maneuvers, thus increasing the relative safety for motorists and passengers

- Increasing street capacity for cars that will permit changing Main Street to one lane in each direction. This will free-up space on the west side of Main Street just north of the roundabout to provide on-street parking. The additional parking will support events at the Farmers Market and Town Hall.
- Free-up space on Main Street and Weaver Street to provide interconnected bicycle lanes. There is currently a gap in the striped bicycle lanes along West Main Street from Hillsborough Road to Jones Ferry Road. That gap could be closed with conversion to modern roundabouts.

M. Jones Ferry Roundabout — Following the successful conversion at the Town Hall roundabout, the Town may want to complete the West Main Street redesign by converting traffic signals to a modern roundabout at West Main Street/Jones Ferry Road. Benefits similar to the Town Hall roundabout would accrue and may spark some revitalization for existing businesses in the vicinity. West Main Street between the two roundabouts can be redesigned to provide one lane in each direction with one striped bicycle lane in each direction and intermittent on-street parking.

N. Hosiery Street Extension — The Town should initiate community meetings to sketch ideas and parameters under which Hosiery Street or a parallel alignment could be extended across the railroad mainline and use the right-of-way of the old rail spur linking to Greensboro Street. At Greensboro Street, the driveway to Fitch Lumber would be reconstructed to align with the new street along the rail tracks and the adjacent Harris Teeter driveway would be closed on Greensboro Street and relocated to the new street extension. An alternate alignment would traverse the field immediately south of the existing inbound driveway serving the Carrboro Community Health Center. On the west side of the railroad tracks, the right-of-way is roughly 25 feet wide which is sufficient to provide a two-lane two-way street. The street could be used by locals as an alternative to Main and Weaver Streets. The new connection also could enhance business for Harris Teeter so consideration should be given by the Harris Teeter property owner to permit a sidewalk easement on the south side of the new street. The benefit of such a street connection would be local accessibility across the railroad tracks saving local citizens time as they avoid peak hour congestion on Main, Weaver and Greensboro Streets. It would also enhance the safety of pedestrians and bicyclists who may currently cross the tracks without the benefit of a formalized crossing. Traffic calming features can be integrated into the design of this street connection to ensure reasonable travel speeds that may discourage usage by “through” traffic.

O. Gateway Roundabout — The Town should work with the Town of Chapel Hill to discuss opportunities to enhance the border intersection at Franklin Street/East Main Street/Merritt Mill Road/Brewer Lane. If and when any adjacent property owners announce plans to redevelop a corner site, the Town should initiate discussions of converting the signalized intersection to a modern roundabout. There is insufficient right-of-way to effect the conversion today, and less than compelling justification to use eminent domain; however if a willing property owner is interested in the opportunity that a public investment in street improvements might bring to their property value, then the Town should be ready to talk.

APPENDIX A: COMMUNITY GOALS

The Vision 2020 document adopted by the Board of Aldermen embraces the following concepts to preserve and maintain the character and history of downtown Carrboro:

- Balanced growth occurring at a reasonable rate.
- “Double commercial square footage in the downtown from that existing in the year 2000”
- Retain unspoiled areas
- Provide central open space for the public to meet and mingle
- Music, festivals and an outdoor public art gallery
- Central library and a senior center
- Hub of activity with Carrboro Century Center as the downtown focal point
- Activities for all ages including young adults
- Year-round use of the Farmers Market
- Shops that sell everyday goods
- Downtown accessibility by all travel modes
- Network of greenways or shared-use paths away from roadways linking neighborhoods with downtown destinations
- Evening and weekend bus service to UNC Chapel Hill campus
- Multilingual signs and transit information
- Growth-of-way plants along streets and roadways
- “As a general policy, established roads should be widened to accommodate bike lanes and sidewalks, but not to provide additional lanes for automobiles”
- Improve pedestrian comfort and safety
- Consider pedestrian-only spaces
- Improve downtown parking
- Promote perimeter parking lots served by frequent shuttles
- Improve downtown sidewalks
- Improve lighting along sidewalks
- Provide shade along sidewalks
- Medium-rise building heights
- Develop under-utilized property downtown

APPENDIX B: EXISTING CONDITIONS

The downtown transportation system has a variety of functions including but not limited to serving property owners with access by car, truck, emergency vehicle, bus, walking and bicycling. Main Street, Rosemary Street, Greensboro Street, and Jones Ferry Road are all considered thoroughfares by the appropriate levels of state and metropolitan government, so therefore those streets and roads serve a mobility function to move the same cars, trucks, emergency vehicles, buses, bicycles and pedestrians through the downtown. Each of these functions is described below:

Access and Mobility

Humans first sought access. Only after several millennia, as trading and military forces created the need for speed and long-distance travel did higher forms of mobility develop. Following World War II, American engineers created what is known as the functional classification system to define a hierarchy of streets and highways with lower level streets emphasizing access to abutting land and higher level highways, expressways and freeways restricting access in order to increase speeds and facilitate longer distance travel. Today, studies are underway to update and append the functional class system to account for urban context; that is, the buildings, land use and pedestrian activity that comprise urban character. It is expected that adjustments can be made in the future to help blend streets into their environment. For example, major streets serving an historic district would no longer look like expressways.

Pedestrians

Table B.1 lists in rank order intersections with the most pedestrians crossing during peak periods. Table B.2 lists in rank order intersections with the highest combination of pedestrians and vehicles, showing the extent of conflicts on downtown crosswalks.

Table B.1 Intersections with Highest Number of Pedestrians

Rank Order	Intersection	Number of Pedestrians
Most	Main/Weaver/Roberson Streets	384
2	Main/Greensboro Streets	328
3	Weaver/Greensboro Streets	291
4	East Main/Rosemary Streets	289
5	East Main/Lloyd Streets	243
6	East Main/Franklin/Merritt Mill Road	197
7	West Main/Jones Ferry Road	135

Source: Carrboro Mobility Report Card, counts conducted fall 2003

Table B.2 Intersections with Highest Sum of Pedestrians and Conflicting Traffic

Rank Order	Intersection	Combined Volume in Crosswalk (pedestrians plus vehicles)
Most	Main/Weaver/Roberson Streets	1824 (pm peak hour) 1400 (lunch peak hour)
2	Main/Lloyd Streets	1651 (lunch peak hour)
3	Main/Greensboro Streets	1269 (pm peak hour) 969 (lunch peak hour)
4	East Main/Rosemary Streets	1230 (lunch peak hour)
5	East Main/Franklin/Merritt Mill Road	1138 (lunch peak hour) 644 (pm peak hour)
6	Weaver/Greensboro Streets	1118 (am peak hour) 879 (pm peak hour)
7	West Main/Jones Ferry Road	837 (pm peak hour)

Source: Carrboro Mobility Report Card, counts conducted fall 2003

Safety of pedestrians is an important factor in this study. Figure 1 shows the number of crashes involving pedestrians from January 2000 through December 2003. The most crashes (four) occurred at the intersection of Main/Weaver/Roberson Streets. At this intersection, there are 60 potential points of conflict between vehicles making various turning and through movements. Along the crosswalks at this intersection, there are an additional 24 points of potential conflict between pedestrians and vehicles. The quantification of points of potential conflict underscore the general sense felt when one tries to cross any of these streets on foot; that is, it's confusing and scary.

Bicyclists

A large percentage of travel in Carrboro is on bicycles, according to a plan prepared by the Town in 1989. This can be attributed to the fact that parking is scarce at the University, and many UNC students and staff live in Carrboro. The Town has included bicycles in all parts of its planning, and the result is a comprehensive bikeway system that is among the best in the State. A good bicycle facility encourages ridership and therefore reduces congestion and pollution. Bikeway systems must be regularly re-evaluated and upgraded to meet future demands.

The Town's major objective is to increase the safety of bicycle riders in town. Crash statistics for the period from January 2000 through December 2003 were obtained from the North Carolina Department of Transportation which compiles police reports from Carrboro Police, the Sheriff and Highway Patrol. Crashes involving bicyclists are shown on Figure 1. The intersection with the most reported crashes involving bicyclists was East Main at Rosemary Street.

According to the Carrboro Bicycle Policy (adopted 1989), bicycle safety is improved in any of three ways:

1. Complete separation of bicycle traffic from motor vehicle traffic. The Libba Cotton Bikepath which runs along the railroad track is an example of a separated facility.
2. Separating bicycles from motor vehicles on the same roadway by use of designated bikelanes. Bikelanes exist on portions of major streets throughout Town (but not necessarily in the downtown study area) including Weaver Street, Jones Ferry Road, Greensboro Street, Main Street, and Hillsborough Road.
3. Automobiles and bicycles using the same roadway. Separation is typically not needed on less traveled residential streets. Bicycles and motor vehicles can share the roadway without major safety problems.

The second major objective is access to major origin-destination points. In building a bikeway system, the Town has three priorities listed in descending order:

1. Connect the existing bicycle system with major community facilities such as schools, Town Hall, and the Downtown, as well as providing access to important points outside the Town, such as the University.
2. The system should expand to connect high density areas. An example of such an area is the apartment communities on Smith Level Road and BPW Road.
3. Lower density developments should be connected with the existing system. Consideration also should be made for safe bicycle facilities for recreational purposes.

Transit Routes

Public transportation service between downtown Carrboro, neighborhoods, the UNC community, Chapel Hill and various park-and-ride lots is provided by Chapel Hill Transit. It is a municipal department within the Town of Chapel Hill that operates fixed route and demand responsive service within approximately a 25 square mile service area. In January 2002, the system became fare-free. Chapel Hill Transit produces over 142,000 annual hours of service, has a budget of over \$11 million. At the end of the 2003-2004 fiscal year, fixed route ridership was over 4.5 million.

The Town of Carrboro the University of North Carolina and the Town of Chapel Hill are partners in the operation of the transit system. Each sponsor is interested in providing safe, reliable and efficient transportation services to its constituents. Also each sponsor has an appointed advisory board that provides advice regarding the operation and funding of transit services.

Route CW connects downtown with various neighborhoods in northwest Carrboro, the UNC campus and downtown Chapel Hill. Service through the study area includes bus stops along East Main Street, Weaver Street, and Hillsborough Street. Service is provided twice hourly during

peak periods and hourly during the off-peak. Service is provided between 6 a.m. and 9 p.m. Travel time between Carrboro Century Center and UNC campus is about six minutes.

Route J operates along Main Street and Jones Ferry Road connecting downtown Carrboro with Franklin Street in Chapel Hill, the UNC campus, the Jones Ferry Park and Ride lot, and neighborhoods to the south and southeast of downtown. Travel time between downtown and the UNC campus is about seven minutes. Service is provided every 15 to 20 minutes from 6 a.m. to 7:30 p.m. at which time buses depart hourly. Late-night service is provided to anyone on Friday and Saturday nights in a program called Safe Ride, connecting downtown Carrboro with the Franklin Street corridor from 11:15 p.m. to 2:30 a.m.

Streets

The trip between the UNC campus and northwest Carrboro is important because there are two viable routes to use including downtown Carrboro and the NC 54 bypass. It is debatable whether through traffic (that which does not stop along the way) uses the bypass or downtown. However, travel time comparisons between the signalized intersections of Manning Street/Columbia Street (on the UNC campus) and Main Street/NC 54 Bypass (in northwest Carrboro) during the afternoon peak period show an average of 11 minutes through downtown Carrboro compared with 4 minutes and 30 seconds along the NC 54 bypass. There was very little congestion experienced along either route during the 4:30 to 5:00 p.m. period on Monday, August 30, 2004 when the data were collected.

Level of service is a common term used in municipal government to identify varying levels of benefit received by citizens at varying levels of investment of public funds. In the transportation lexicon, level of service is used to denote different degrees of comfort and convenience experienced by motorists. The term also can be applied to pedestrians, bicyclists and transit patrons.

Level of Service A represents excellent conditions while Level of Service F denotes the worst condition, characterized by streets with no sidewalks, narrow lanes that don't accommodate bicyclists, and traffic congestion that delays motorists and bus patrons. LOS D represents the typical maximum acceptable delay for an intersection as a whole during any one given peak hour in an urban setting. In other words, LOS E and F typically indicate the need for improvements and higher potential for queue spillback. Traffic level of service (LOS) is based on the amount of delay in seconds per vehicle experienced by an individual driver, averaged over all motorists at an intersection.

Due to the shorter-than-average block lengths in downtown Carrboro, the level of service method understates the perceived congestion levels. That is, the recently prepared Carrboro Mobility Report Card suggests all downtown Carrboro study intersections operate at LOS B or better. However, based on observation by KHA the recurring queues on Weaver and Greensboro Streets would suggest LOS F operations at least during portions of the peak hour.

Parking

An August 2002 report of the Town of Carrboro Parking Task Force identifies “Town involvement in expanding parking availability as a critical component in reaching the town’s goal of doubling commercial space in the downtown area.” The report states that “the most critical immediate shortcoming in the central downtown area was a shortage of convenient short-term public parking in particular areas.” This problem may have been addressed with the 2004 opening of a new municipal lot in the middle of the 100 block of Main and Roberson Streets, behind the right-of-way of historic Main Street buildings. A driveway and walkway connect the new parking lot with Main Street.

The Parking Task Force report recommends “collaboration with NCDOT to provide on-street parking on the following streets: Roberson Street, sections of East and West Main Street, East and West Weaver Street, and North Greensboro Street.” Additional on-street parking was considered for streets within the study area that are at least 38 feet wide (measured from curb-face to curb-face). This is the critical dimension to provide one 11-foot wide travel lane in each direction and one 8-foot wide bay of on-street parking on each side of the street. The following streets in the study area were considered, as shown in Table B.3.

Table B.3 On-Street Parking Analysis

Street	Section	Existing Width (feet)	Peak Hour Traffic Volume (vehicles per hour)	On-street Parking Recommendations
East-West Streets				
West Main St.	Ashe – Laurel	45	450	Recommended with roundabout and one-lane each direction.
East Main St.	Lloyd – Rosemary	46		Not recommended unless Main Street converted to one lane each direction.
Roberson St.	Greensboro – Maple	38 *	165	Recommended when street is improved.
Weaver St.	Greensboro – Main	30		Recommended with conversion to one-way traffic (woonerf concept)
Rosemary St.	Main – Merritt Mill	36		Consider, if Main/Rosemary intersection converted to “T”
North-South Streets				
Greensboro St.	Shelton Street – Old Pittsboro Rd.	34		Not recommended. Too narrow.
Laurel St.	Main – Jones Ferry	28		Not recommended. Too narrow.
Lloyd St.	Main – Cobb	24 - 32	140	Not recommended. Too narrow.
Merritt Mill Rd.	Main – Rosemary	24		Not recommended. Too narrow.

* denotes future street width of Roberson Street, as adopted by Carrboro Board of Aldermen in 2003.

APPENDIX C: STUDY METHODS AND PRELIMINARY RESULTS

Travel Safety

Table C.1 presents recent crash histories at intersections within the study area. **Table C.2** presents a comparison of street segment crash rates with expected crash rates that are based on statewide averages in North Carolina for similar types of urban streets. In some cases like Weaver Street the street segments are much shorter than those used to calculate statewide averages which could skew the data as evidenced by the much-higher-than-average crash rates on some Carrboro street segments. Nevertheless, this study addresses traffic safety comprehensively and holistically.

At the intersection of Main Street/Weaver Street/Roberson Street/Carr Mill Mall parking lot there are 60 potential points of conflict between vehicles making various turning and through movements. Along the crosswalks at this intersection, there are an additional 24 points of potential conflict between pedestrians and vehicles. Improvements for this intersection (described in the next chapter) would reduce the points of potential conflict to 22 vehicle-to-vehicle conflicts and 13 pedestrian-vehicle conflicts. This represents a 58 percent reduction in conflict points that are likely to have a commensurate decrease in crashes and near crashes. The key to reducing conflict points is the conversion of the 100 block of Weaver Street and the 100 block of Roberson Street to one-way movement and the restriction of left-turn movements from Main Street. The easterly extension of Roberson Street to intersect with a new street built on top of the railroad with full turning movements provided at Brewer Lane and East Main Street will replace lost access created with turn restrictions at Main Street/Weaver Street/Roberson Street/Carr Mill Mall. Further reductions in conflict points are possible, however it would require left-turn restrictions to and from the Carr Mill Mall parking lot that could have deleterious economic hardships on that business. For this reason, left-turn movements to and from the Carr Mill Mall parking lot are retained in Alternative 4.

Table C.1: NCDOT (and Town of Carrboro) Crash Rate Summary by Intersection
Crashes per Million Entering Vehicles, 2000-2003 — 3 years of data

Study ID	Intersection	Total Crash Rate	Injury Crash Rate	# Pedestrian Crashes	# Bicycle Crashes
1	Main Street/Franklin Street at Merritt Mill/Brewer Lane	47.11	14.5	1 (+1)	1
2	Main Street at Rosemary Street	68.49	17.12	0	2 (+1)
3	Main Street at Lloyd Street	100.85	28.01	0 (+1)	1
4	Main Street at Roberson Street/Weaver Street	64.94	32.47	3 (+1)	0 (+1)
5	Main Street at Greensboro Street	55.91	18.64	1 (+1)	0 (+1)
6	Greensboro Street at Weaver Street	50.74	25.37	1	2
7	Main Street at Jones Ferry Road	31.06	0	0	0
8	Main Street at Laurel Avenue/Weaver Street	88.12	32.04	0	0
9	Greensboro Street at Roberson Street	52.83	37.74	0	0
10	Greensboro Street at Carr Street	52.83	15.09	0	0

Note: No fatalities were recorded over the three year period; **Bold** indicates the highest three rates

Table C.2: NCDOT Crash Rate Summary by Roadway Segment
Crashes per 100 Million Vehicle Miles, 2000-2003 (3 years)
Statewide average = 422.44 Total Rate & 142.04 Injury Rate

Roadway Segment	Total Crash Rate	Injury Crash Rate	# Pedestrian Crashes	# Bicycle Crashes
Main Street from Weaver St. to Merritt Mill/Brewer St. (0.7 mi)	575.22	160.11	2	8
Weaver Street from Main St. to Laurel Ave (0.4 mi)	2087.41	956.73	2	2
Roberson Street from Greensboro St. to Main St. (0.1 mi)	3913.89	2283.1	1	0
Greensboro Street from Old Pittsboro Rd to Shelton St. (0.3 mi)	1144.47	443.77	2	3
Jones Ferry Road from Main St. to Laurel Ave (0.1 mi)	718.15	0	0	0
Rosemary Street from Main St. to Merritt Mill Rd (0.1 mi)	707.94	88.49	0	2

Note: No fatalities were recorded over the three year period; **Bold** indicates a segment exceeds the statewide average

Transit Level of Service

Rebalancing downtown streets could impact the level of service provided by Chapel Hill Transit if traffic levels of service deteriorate. Increased delays on Carrboro streets would affect buses ability to maintain schedule and reliability of schedule is arguably the primary issue faced by CHT today, an unintended byproduct of the high demand created when the service went fare-free in 2002.

Travel Demand

To ensure wise use of public resources, candidate transportation improvements are typically evaluated to determine effects on existing traffic conditions as well as forecasted conditions 20-years after construction. Based on an assumed completion of construction in 2010, this study includes an evaluation of conditions 20 years hence in 2030. Travel demand forecasts were obtained from the best available forecasting tool, the Triangle Regional Travel Demand Model. Each unit of local government in Orange, Durham and Wake Counties developed population and employment forecasts for their community at a zonal level. The zonal system is finely divided, with downtown Carrboro subdivided into about 15 zones. Growth at UNC and other Triangle institutions also is factored into the travel projections. Planned transportation improvements including Phase I of the Triangle Transit Authority's regional rail system also is included. Weaver Street is not included in the model. Therefore, the model over-forecasts traffic on Main Street. Coincidentally, the omission of Weaver Street in the model network better reflects Alternative 4 which assumes a woonerf on Weaver Street.

Preliminary results for 2030 suggested an average annual increase of 1.3 percent during the morning peak hour and 24-hour daily traffic volumes. Afternoon peak hour traffic projections are higher with an average annual increase of 1.7 percent. Compounded over the 27-year study horizon these projections result in a substantial increase over 2004 conditions. These

percentages were used to factor-up the base traffic counts at each of the 10 study intersections. In mid-November 2004 the consultant was provided with updated traffic projections that are lower than before. The updated projections suggest an average annual increase of 1.1 percent during the morning peak hour and 1.3 percent during the afternoon peak hour. These updated projections will be reflected in the final report.

Rerouted Traffic

Conversion of Weaver Street to a one-way woonerf prompted the need to consider how traffic would be re-routed. Due to the minimal number of interconnected streets around the downtown area, this study assumes nearly all of the diversion to occur on Main Street.

Extension of Roberson Street to Brewer Lane was analyzed assuming a direct re-routing of some traffic along that route.

Capacity Analysis Methods

In theory, streets can accommodate a high number of vehicles, however several factors are typically present that reduce street efficiency. The maximum number of vehicles passing a point on a street, referred to as capacity, is a function of speed and the number of lanes. Providing more than one lane in each direction accommodates more traffic but it also permits speeding and potentially dangerous conflicts with pedestrians whose line of sight is blocked by other cars. A strong argument can be made for downtown streets with only one lane in each direction. At 20 mph, one lane on a street can carry 1800 vehicles in a busy one-hour period. That figure is reduced somewhat if a pedestrian waits beside the road for the cars to pass before crossing. The capacity is reduced further if the pedestrian crosses in front of the vehicles. However, the greatest reduction in capacity occurs if a traffic signal is installed, reducing capacity by at least 50 percent. This explanation is provided as a prelude to discussion of existing and future traffic volumes and lays the groundwork for later discussion of eliminating some traffic signals in downtown Carrboro.

Traffic counts and coordinated traffic signal timings were obtained from the Town of Chapel Hill. Existing pedestrian crossing volumes are shown in *Figure C.1* and existing traffic turning movement volumes are shown in *Figure C.2*. Traffic signal plans were obtained from NCDOT and intersection geometry was obtained from field reviews and aerial mapping. Traffic reroutes were established based on proposed revisions to the network geometry. A one-way pair was analyzed (Alternative 1) between the 100-block of Weaver Street (westbound) and Main Street (eastbound) resulting in the traffic volumes shown in *Figure C.3*. Year 2030 traffic volumes were based on the existing traffic volumes with growth factors applied. The growth factors were obtained from the Triangle Regional Model and were as follows: 1.3% annually for the AM peak, 1.4% annually for the Mid-Day peak, and 1.7% annually for the PM peak over 27 years of growth to 2030. The existing network with traffic growth to year 2030 is shown in *Figure C.4*. The one-way pair traffic in year 2030 is shown in *Figure C.5*. As a result of later analyses, the network was revised to provide an alternative with Weaver Street one-way (westbound) and Main Street maintained as two-way (Alternative 4). The future traffic for the revised alternative scenario is shown in *Figure C.6*.

The peak hour traffic volumes for each of the three periods were analyzed in “Synchro 6” capacity analysis software using Highway Capacity Manual methodology. Traffic capacity analyses were performed for the ten (10) study intersections in Carrboro for existing year 2003-2004 and future year 2030 conditions. Existing year 2003-2004 analyses were based on traffic counts conducted for the AM, Mid-Day, and PM periods. Future year 2030 analyses were based on the existing traffic volumes with growth factors applied. Sidra software (aaSidra 2.0) was used to evaluate the operation of roundabouts at select locations. Early in the study, roundabouts were considered at seven (7) of the study intersections.

Capacity Analysis Findings

The most up-to-date intersection level of service calculations, performed within the final months of this study (April 2005) are reported in Table 6. The year 2030 traffic projections, provided by MPO staff, were revised prior to re-analyzing the traffic. The columns in Table 6 labeled Redesigned Streets are consistent with Section III of this report.

The ten (10) study intersections were shown to operate with acceptable LOS in the AM, Mid-Day, and PM peak hours under existing traffic for the current geometry with the exception of the Main Street at Merritt Mill intersection. However, it was noted both through field observations and viewing queue results in the analysis that the LOS values were not completely indicative of the actual delay that drivers experience in Carrboro along the primary streets. Short block lengths and inadequate storage lanes create congestion in downtown Carrboro that appears to exceed what the existing LOS indicates, especially along Greensboro Street. Although LOS is one way to compare geometric alternatives, it is not the only measure of traffic congestion. During the study, both the levels of service and the anticipated queuing concerns along the major roadways are considered while keeping in mind the need to maintain and enhance the walkable characteristics of the downtown area.

For the most part, a comparison of existing network geometry and a one-way pair consisting of the 100-block of Weaver Street and Main Street (Alternative 1) shows acceptable operation. **Table C.3** shows the existing year traffic comparison. A connector roadway also was provided to remove traffic from Roberson Street at Main Street, diverting those vehicles to Brewer Lane. Main Street and Weaver Street operate in a free-flow condition with the proposed network revisions. With or without the one-way pair in the year 2030, more intersections start to operate unacceptably and queue conditions worsen. **Table C.4** shows the future year traffic comparison. Deficiencies of the one-way pair starting in the current year and worsening for future conditions are listed as follows:

- The one-way pair significantly increases traffic on westbound Weaver Street and southbound Greensboro Street, increasing queue lengths and congestion.
- The one-way pair forces a merge to one lane westbound on Main Street past Lloyd Street which will be over-capacity or requires a two-lane section one-way on Weaver Street, which is not preferred due to pedestrian safety concerns.

Based on the results of the traffic analysis comparison with the one-way pair, further review of the geometric constraints, and coordination with the Town of Carrboro staff, an alternative was developed that keeps the one-way roadway on Weaver Street (westbound), but maintains two-way traffic on Main Street (Alternative 4). This revision allows the major traffic movements

westbound along Main Street to continue along the normal path, avoiding the intersection of Greensboro Street at Weaver Street. **Table C.5** shows the future year traffic comparison of Alternative 4 to the baseline (existing) network. It should be noted that queuing concerns still exist with or without the proposed changes to the downtown roadways. The Town should seek alternate access roadways, cross connections between parking lots, and seek to discourage through traffic that may have other reasonable alternate routes available. Alternative 4 also included an access roadway to parallel Main Street from west of Merritt Mill Road to connect with Roberson Street. This collector roadway will not divert major movements that are traveling west along Main Street, but it will serve to provide alternate access to businesses and help to facilitate traffic movements between south Greensboro Street and the east side of downtown Carrboro.

Some key features of Alternative 4 are as follows:

- Allows the heaviest movements (westbound in the PM peak) to continue to be split between Weaver Street and Main Street.
- Allows for two through lanes westbound at Lloyd Street while eliminating the merge created with the one-way pair (one lane splits to Weaver Street, and the other stays on Main Street).
- Eliminates the traffic signal at the Main/Roberson/Weaver Street due to the proposed geometry (note that the signal also was eliminated in the one-way pair alternative).
- Reroutes left-turn traffic from northbound Greensboro Street at Weaver Street to Main Street, allowing two full southbound lanes through the intersection to reduce queue spillback north of Weaver Street.

Alternative 4 is shown in **Figure C.7**.

Table C.3: Existing Year 2003-2004 Peak Hour Level of Service (Delay in seconds per vehicle)
Existing Conditions and Alternatives

#	Intersection	Existing Street Circulation						Weaver/Main Street One-Way Pair Circulation With Roberson/Lloyd Street Connector					
		Signalized/Unsignalized (Existing Conditions)			Roundabout Alternative			Signalized/Unsignalized			Roundabout Alternative		
		AM	Mid-Day	PM	AM	Mid-Day	PM	AM	Mid-Day	PM	AM	Mid-Day	PM
1	Franklin St. @ Merritt Mill Rd	B (12.4)	F (86.6)	D (43.2)	A (6.2)	A (7.6)	A (7.6)	B (12.4)	F (86.6)	D (43.4)	A (6.2)	A (7.6)	A (7.6)
2	Main St. @ Rosemary St	C (22.1)	C (24.8)	B (19.9)	A (5.9)	A (6.6)	A (8.0)	C (22.1)	C (24.8)	B (19.9)	A (5.9)	A (6.6)	A (8.0)
3	Main St. @ Lloyd St.	A (7.3)	A (7.7)	A (7.7)	A (3.5)	A (3.9)	A (4.2)	A (7.9)	A (7.9)	A (8.0)	A (4.1)	A (4.2)	A (4.7)
4	Main St. @ Roberson Street/ Weaver St	C (25.6)	C (21.2)	C (24.9)	A (7.9)	A (6.4)	A (7.0)	B (10.9)*	B (13.1)*	C (22.9)*	NA	NA	NA
5	Greensboro St. @ Main St	C (31.7)	C (21.9)	C (25.0)				D (44.6)	C (32.5)	D (49.9)			
6	Weaver Street @ Greensboro St	C (22.9)	C (24.8)	C (32.1)	A (7.9)	A (6.5)	A (8.6)	C (24.2)	C (29.4)	E (79.4)	A (7.3)	B (10.7)	E (63.9)
7	Main St. @ Jones Ferry Rd	B (14.4)	B (13.4)	B (15.3)	A (5.0)	A (5.0)	A (5.3)	B (18.6)	B (16.4)	B (18.8)	A (6.0)	A (5.9)	A (6.2)
8	Weaver St. @ West Main St	B (16.8)	B (11.0)	B (15.2)	A (5.7)	A (5.4)	A (5.4)	C (23.5)	B (12.5)	C (20.4)	A (4.6)	A (5.4)	A (5.6)
9	Greensboro St. @ Roberson St	A (0.4)	A (0.7)	A (2.1)				A (0.4)	A (0.7)	A (2.6)			
10	Greensboro St. @ Carr St	A (1.8)	A (3.3)	A (6.9)				A (1.8)	A (3.5)	A (8.6)			

Note: Conversion of traffic flow to one-way in the 100 block of Weaver Street affects traffic circulation patterns on parallel and connecting streets.

*Shown as signalized operation for LOS comparison, but free-flow on Weaver/Main Streets anticipated with one-way pair conversion.

NA — not applicable (roundabout not proposed with one-way pair)

Table C.4: Future Baseline Conditions and One-Way Pair Alternative Comparison
Future Year 2030 Peak Hour Level of Service (Delay in seconds per vehicle)

#	Intersection	Existing Street Circulation						Weaver Main Street One-Way Pair Circulation With Roberson/Lloyd Street Connector					
		Signalized/Unsignalized (Existing Geometry)			Roundabout Alternative (No Additional Revisions)			Signalized/Unsignalized			Roundabout		
		AM	Mid- Day	PM	AM	Mid- Day	PM	AM	Mid- Day	PM	AM	Mid- Day	PM
1	Franklin St. @ Merritt Mill Rd	C (22.4)	F (251.0)	F (366.7)	A (7.1)	C (25.3)	C (33.9)	D (38.7)	F (115.9)	F (155.0)			
2	Main St. @ Rosemary St	F (84.8)	C (33.0)	D (51.8)	A (6.3)	B (14.0)	F (133.3)				A (6.3)	B (14.0)	F (133.3)
3	Main St. @ Lloyd St	A (7.9)	A (8.9)	B (12.5)	A (3.8)	A (5.5)	C (30.9)	F (954.4)	F*	F*			
4	Main St. @ Roberson Street/ Weaver St	C (34.7)	E (57.4)	F (712.9)	C (33.0)	B (12.3)	E (73.6)	Free-flow	Free-flow	Free-flow			
5	Greensboro St. @ Main St	D (37.3)	C (30.7)	F (99.5)				F (160.0)	F (116.1)	F (401.4)			
6	Weaver Street @ Greensboro St	E (55.1)	D (38.0)	F (148.2)	D (36.1)	B (13.6)	F (120.3)	C (26.7)	F (93.3)	F (244.1)			
7	Main St. @ Jones Ferry Rd	B (17.1)	B (16.7)	C (30.7)	A (5.6)	A (5.8)	A (7.5)	C (28.5)	C (23.3)	C (31.1)			
8	Weaver St. @ West Main St	B (19.4)	B (11.9)	B (16.8)	A (6.1)	A (6.0)	A (6.7)	C (24.3)	D (37.7)	F (136.4)			
9	Greensboro St. @ Roberson St	A (0.8)	A (1.7)	F (392.9)				A (0.8)	A (1.8)	F (393.7)			
10	Greensboro St. @ Carr St	A (6.4)	E (43.6)	F (958.0)	A (3.7)	A (4.2)	A (4.7)				A (3.7)	A (4.2)	A (4.7)

*Exceeds HCM calculation methods

Table C.5: Future Baseline Conditions and One-Way Weaver Street [Recommended] Alternative Comparison

Future Year 2030 Peak Hour Level of Service (Delay in seconds per vehicle)

#	Intersection	Existing Street Circulation						Weaver Street 100-Block One-Way Conversion With Roberson/Main Street Connector					
		Signalized/Unsignalized (Existing Geometry)			Roundabout Alternative (No Additional Revisions)			Signalized*/Unsignalized			Roundabout		
		AM	Mid-Day	PM	AM	Mid-Day	PM	AM	Mid-Day	PM	AM	Mid-Day	PM
1	Franklin St. @ Merritt Mill Rd	C (22.4)	F (251.0)	F (366.7)	A (7.1)	C (25.3)	C (33.9)	C (26.6)	F (93.5)	F (91.1)			
2	Main St. @ Rosemary St	F (84.8)	C (33.0)	D (51.8)	A (6.3)	B (14.0)	F (133.3)	B (16.9)	B (19.0)	D (48.3)			
3	Main St. @ Lloyd St.	A (7.9)	A (8.9)	B (12.5)	A (3.8)	A (5.5)	C (30.9)	A (9.2)	A (9.5)	B (14.1)			
4	Main St. @ Roberson Street/Weaver St.	C (34.7)	E (57.4)	F (712.9)	C (33.0)	B (12.3)	E (73.6)	Free-flow	Free-flow	Free-flow			
5	Greensboro St. @ Main St.	D (37.3)	C (30.7)	F (99.5)				E (65.2)	D (53.3)	F (143.5)			
6	Weaver Street @ Greensboro St.	E (55.1)	D (38.0)	F (148.2)	D (36.1)	B (13.6)	F (120.3)	B (18.9)	C (22.9)	C (24.4)			
7	Main St. @ Jones Ferry Rd	B (17.1)	B (16.7)	C (30.7)	A (5.6)	A (5.8)	A (7.5)	C (23.5)	C (20.0)	D (51.2)	A (7.7)	A (6.8)	B (10.9)
8	Weaver St. @ West Main St.	B (19.4)	B (11.9)	B (16.8)	A (6.1)	A (6.0)	A (6.7)	C (25.1)	C (25.0)	B (14.3)	A (5.0)	A (5.2)	A (5.8)
9	Greensboro St. @ Roberson St.	A (0.8)	A (1.7)	F (392.9)				A (1.1)	A (2.9)	F (395.6)			
10	Greensboro St. @ Carr St.	A (6.4)	E (43.6)	F (958.0)	A (3.7)	A (4.2)	A (4.7)				A (3.7)	A (4.2)	A (4.7)

*Signal timing was optimized for the network to account for geometric revisions and traffic shifts.

Table C. 6: Existing and Future Year 2030 Conditions with Existing and Projected Volumes
Peak Hour Level of Service (Delay in seconds per vehicle)

#	Intersection	Existing Street Circulation						Future Year					
		Existing Geometry			Redesigned Streets			Existing Geometry			Redesigned Streets		
		AM	Mid-Day	PM	AM	Mid-Day	PM	AM	Mid-Day	PM	AM	Mid-Day	PM
1	Franklin St. @ Merritt Mill Rd.	B (12.5)	F (80.0)	D (49.6)	A* (3.7)	A* (4.9)	A* (5.1)	B (13.8)	F (122.5)	F (139.5)	A* (4.4)	A* (8.5)	B* (10.0)
2	Main St. @ Rosemary St.	C (23.9)	C (25.8)	C (20.7)	A (4.5)	A (6.8)	B (12.0)	C (27.4)	C (28.8)	C (27.2)	A (4.6)	A (9.7)	D (54.1)
3	Main St. @ Lloyd St.	A (7.6)	A (7.9)	A (8.1)	A (4.8)	B (10.6)	B (13.0)	A (7.8)	A (8.4)	B (12.8)	A (5.3)	B (13.9)	F (104.9)
4	Main St. @ Roberson St./ Weaver St.	C (27.2)	C (23.5)	C (30.3)	B (17.7)	C (23.7)	E (75.4)	C (27.9)	C (28.7)	F (83.0)	C (20.8)	D (38.1)	F (189.4)**
5	Greensboro St. @ Main St.	C (30.2)	C (23.0)	E (57.4)	C (32.2)	C (27.1)	C (31.2)	C (31.6)	C (26.1)	F (95.4)	C (33.3)	D (43.9)	F (90.6)
6	Weaver St. @ Greensboro St.	C (21.0)	C (23.6)	C (34.9)	B (17.4)	B (15.7)	B (20.0)	C (24.5)	C (26.8)	F (151.9)	B (18.7)	B (18.5)	F (88.7)
7	Main St. @ Jones Ferry Rd.	B (15.5)	B (13.8)	B (16.1)	A* (3.0)	A* (2.7)	A* (3.2)	B (16.3)	B (14.2)	B (19.6)	A* (3.1)	A* (3.2)	A* (3.9)
8	Weaver St. @ West Main St	A (9.6)	A (7.1)	A (8.0)	A* (3.2)	A* (3.2)	A* (3.3)	A (9.7)	A (7.5)	A (8.6)	A* (3.3)	A* (3.4)	A* (3.9)
9	Greensboro St. @ Roberson St.	A (0.4)	A (0.6)	A (1.5)	A (1.6)	A (2.1)	A (3.6)	A (0.4)	A (0.8)	A (3.4)	A (1.7)	A (2.8)	B (13.1)
10	Greensboro St. @ Carr St.	A (1.6)	A (3.0)	A (4.4)	A (1.6)	A (3.0)	A (4.4)	A (1.9)	A (4.7)	C (20.8)	A (1.9)	A (4.6)	C (21.0)
11	Arts Center North @Main St.				A (0.8)	A (0.7)	A (1.9)				A (0.9)	A (1.2)	B (19.0)
12	Arts Center East @Main St.				A (0.8)	A (0.7)	A (1.0)				A (0.9)	A (0.8)	A (1.3)

Signalized/Unsignalized, * = Roundabout

** LOS F is based on existing traffic signals. A modern roundabout was tested and produced year 2020 pm peak LOS B, however severe right-of-way impacts preclude this as a recommended change.

APPENDIX D: ALTERNATIVES CONSIDERED

Overall, the Town of Carrboro wishes to enhance the experience and expand the “downtown” character to the edges of the study area. Public investment in infrastructure is envisioned in order to support the enhancement and expansion goals. Various alternative public investments that were considered in this study are described. Various elements of each alternative were transformed into Direction A and Direction B as described in the main body of this report. To serve as a baseline for comparison purposes, the so-called “Do Nothing” alternative is included. Following discussion, various elements of different alternatives may be combined to create a “preferred” alternative.

Alternative 0: Do Nothing — allowing downtown Carrboro to grow without major changes to the street system is always an option. In the future, any hope for significant state or federal funding for transportation projects downtown would require consideration of the “Do Nothing Alternative.” As shown in Table 4, year 2030 growth will result in congested Level of Service F traffic conditions at 7 of the 10 downtown study intersections. Delay and queue lengths could be quite long, leading many regular commuters to choose alternate routes. It is unlikely Carrboro would realize their objective of doubling the amount of non-residential building space downtown because traffic congestion would keep prospective businesses and customers away.

Alternative 1: One-way Couplet — considered only for the 100 block of West Weaver Street and the 100 block of West Main Street whereby westbound traffic would be routed via Weaver Street and the return (eastbound) traffic flow would use Main Street. Greensboro Street and all other study area streets would remain two-way. A short one-way connector lane also was considered through the existing Christmas tree lot to link the one-way sections from Weaver to Main Street. Advantages and disadvantages of this alternative are listed below:

Alternative 1: One-Way Couplet	
Advantages	Disadvantages
Reduces traffic congestion on Weaver Street	Lacks public support
Improves public safety for all users (Goal 4)	Lacks merchant support
Simplifies pedestrian crossings (Goal 4)	Typically confuses drivers
Allows for added on-street parking (Goal 5)	Contributes to speeding
Simplifies traffic, pedestrian and bicycle movements at intersection of Main/Weaver/Roberson	Increases congestion on East Main Street approaching the railroad tracks
Allows for safer pedestrian crossings at intersection of Main/Weaver/Roberson Streets	
Creates a usable public open space by widening “The Point” adjacent to The Spotted Dog restaurant by narrowing Weaver and Main Streets. Can put umbrella tables out there.	

Alternative 2: Ease Level of Service Goal — an easing of the Town’s level of service goal could maintain two-way streets with the addition of on-street parking on any street that is at least 38 feet wide (examples include sections of East and West Main Street). Parking maneuvers could increase traffic delays, prompting through traffic to use alternate routes such as the NC 54 Bypass. Customers of downtown businesses could face more congestion, but their overall travel time might not change if they snag a parking place in front of their destination. Advantages and disadvantages of this alternative are summarized below:

Alternative 2: Ease Level of Service Goal	
Advantages	Disadvantages
Increases parking supply and distributes spaces throughout downtown (Goal 5)	Increases traffic congestion
Buffers pedestrians from moving cars (Goal 4)	Lacks NCDOT support
Allows for shorter pedestrian crossings due to narrowing of streets (Goal 4)	May require Town ownership of streets if NCDOT support is not provided

Alternative 3: Interconnect streets — a city street system is analogous to a human skeleton wherein streets, like bones, are typically connected with one another. Specific street connections were not considered because it is outside the scope of this study. Interconnecting streets may encourage local traffic to avoid using downtown streets, thus providing some relief from traffic congestion; however it may lead to increased traffic volumes on streets with single-family homes. There are treatments (such as traffic calming) that can minimize and mitigate the impact of higher traffic volumes by maintaining reasonable speeds on residential streets, however, there are not as many way to avoid the impact of more vehicles. The consultant believes that, over time, residential property values on these interconnected streets would increase due to demand for housing that is truly walking distance to a cultural center with a mix of uses, a plethora of activities, and opportunities to meet and greet friends from all over Carrboro. Winning approval on this point, however, is problematic.

Alternative 3: Interconnect Streets	
Advantages	Disadvantages
Relieves traffic congestion	Increases traffic volume on residential streets
Offers alternate routes	Outside the scope of this study
Avoids multilane additions to streets (Goal 3)	Politically unpopular

Alternative 4: Roberson Extension and Weaver Woonerf — the bend in Roberson Street north to intersect Main Street avoids another crossing of the railroad, however it complicates the signalized intersection at Main and Weaver Streets. The traffic signal provides for clear and safe turning movements for vehicular traffic, but it is confusing for pedestrians. Pedestrian movements across this intersection are important to the success of downtown as this could be considered the “100 percent” corner (defined as the best corner to locate a business because of the high level of activity) in Carrboro and it is on a main pedestrian route between the Weaver Street Green and the nearest municipal parking lot. It also connects the east and west sides of downtown Carrboro.

Alternative 4 considers changing this short block of Roberson Street to serve one lane of one-way southbound traffic leading away from Main Street. On-street parking opportunities could be added on one (diagonal) or both (parallel parking) sides of Roberson Street. A street extension (with bicycle lanes and sidewalks) could be built on top of the existing shared-use path and on top of the existing railroad tracks southward to intersect with Brewer Lane. This short street could be called Railroad Street. This could be considered in conjunction with agreements by the property owner and could be integrated with their plans to redevelop their property. This would only involve minor changes to Brewer Lane.

In February of 2003, the Board of Aldermen adopted a wider cross-section for Roberson Street that would eventually increase from the existing 40-foot wide right-of-way to 68 feet in width. The additional right-of-way is envisioned to add on-street parking, tree planting areas and wider sidewalks.

The Weaver Street woonerf is identified in the *New Vision* report as “a compromise between full closure” [as suggested by some Carrboro citizens] and the traffic-clogged street that now blows exhaust fumes into the Weaver Street Green. “The design philosophy of the woonerf is to create visual cues to motorists (through good design) that the street belongs to the people who are not in vehicles, but they are willing to share the space with those who need access. Motorists are treated as the intruder and usually feel uncomfortable driving at speeds in excess of 10 mph.”

During most peak periods today, traffic in both directions is stopped and some motorists would appreciate the ability to speed-up to 10 mph. However, it is the close spacing (300 to 500 feet) between signalized intersections and the excess demand of vehicular traffic that causes the peak period queuing, delays, noise and emissions that detract from the area.

Alternative 4 considers changing the 100 block of Weaver Street into a one-lane one-way westbound woonerf. Intersections at either end of the woonerf would be simplified, thus leading to shorter queue lengths and diminished impacts on the Weaver Street Green. Another benefit includes the creation of “new” public space that could be converted from striped traffic lanes today into more on-street parking and/or bicycle lanes, wider sidewalks and/or landscape strips separating pedestrians on the sidewalk from moving cars. Furthermore, the elevation of Weaver Street itself could be lifted to match the sidewalks and thereby eliminate the need for curbs, as these form barriers to citizens in wheelchairs. Drainage of surface water could be accomplished through the introduction of “valley gutters” separating the travel lane and the on-street parking.

The benefits to pedestrians, bicyclists and citizens enjoying the Weaver Street Green are real, however deliberations must consider where the traffic will go if they won’t use Weaver Street. One obvious and one not-so-obvious answer were considered in this analysis. First, maintaining two-way traffic flow on Main Street would accommodate some of the diverted traffic. Second, the extension of Roberson Street along the railroad tracks to Brewer Lane would add critical new capacity parallel to Weaver Street. Queues could be reduced by restriping Greensboro Street and eliminating the traffic signal at Main and Weaver Streets.

Alternative 4: Roberson Street Extension/Weaver Woonerf

Advantages

Relieves traffic congestion
Offers alternate routes
Simplifies intersections (Goal 4)
Enhances public space along Weaver
Extends urban street grid thereby supporting downtown growth objectives (Goal 1)
Increases supply of on-street parking (Goal 5)
Vast improvement in walkability along Weaver Street and use of the Weaver Street green

Disadvantages

Requires public awareness and outreach to convey project objectives
Requires changes to established driving patterns
Some worsening of traffic congestion on Greensboro Street (counter to Goal 3)
More traffic pressure on Greensboro Street and in the 100 blocks of East and West Main Street

Alternative 4 could be implemented by a public-private partnership involving key property owners, the Town of Carrboro and the North Carolina Department of Transportation. Alternative 4 is summarized below.

- Extend Roberson Street to Brewer Lane on the 50-foot wide railroad right-of-way
- Restripe southbound Greensboro Street from Carr Mill to Carr Street
- Modify traffic signals at Greensboro/Weaver and Greensboro/Main
- Convert 100 block of Weaver Street to woonerf with one-way westbound operations
- Convert 100 block of Roberson Street to one-way southbound operations
- Remove traffic signals at Main/Weaver/Roberson Streets
- Create a truck parking bay to replace the existing on-site delivery area serving Carr Mill Mall. Restripe Greensboro Street from Weaver Street to the primary driveway to the Carr Mill Mall parking lot.

To gain the best public response (and fewest complaints), the best start to implement Alternative 4 improvements would be to begin with extending Roberson Street in conjunction with redevelopment of the Arts Center site and adjacent sites. A new connection along the railroad tracks to Brewer Lane would add capacity parallel to East Main Street and distribute traffic around the bottleneck at the intersection of Main/Weaver/Roberson Streets.

The additional capacity and spreading of traffic would be noticeable to the public and would mask the effect of other changes including conversion of Weaver Street to a woonerf operation. Therefore, in the private-sector driven implementation scenario, changes to Weaver Street could begin construction immediately following the opening of Roberson Street to Brewer Lane.

To test the Weaver Street concept, paint can be used to delineate lane changes before curbs are reconstructed. Similarly, hoods can be placed over traffic signal heads that aren't needed. In this way, public acceptance can be monitored over a two-week to two-month period before construction contracts are let for more permanent-type improvements to Weaver, Main and Greensboro Streets.

Furthermore, the Town could serve as the lead agency in a study, design and construction of a multistory parking deck on some portion of the current site of the existing private 250-space surface parking lot that is operated by Carr Mill Mall for their employees. Consideration should be given to "wrapping" the deck in a combination of retail-office-residential uses along the southern portion of the site to create improved buffers to the adjacent residential neighborhood. To provide adequate internal traffic circulation within the parking deck, it may not be possible to

wrap the eastern façade of the deck with anything other than parking uses. However, the architecture of the eastern façade should be given special treatment to enhance vistas from adjacent residential buildings. An extension of Carr Street should be considered to connect South Greensboro Street with Sweet Bay Place.

Roundabouts

To reduce motorist, pedestrian and bicyclist confusion at odd-angled intersections and to change the quality of traffic flow, modern roundabouts could be considered at the following intersections:

1. West Main Street/Weaver Street/Laurel Street (*see Figure D.1*)
2. West Main Street/Jones Ferry Road (*see Figure D.2*)
3. Main Street/Weaver Street/Roberson Street/Carr Mill parking lot (*see Figure D.3*)
4. East Main Street/Franklin Street/Brewer Lane/Merritt Mill Road (*see Figure D.4*)

These intersections have been analyzed to determine the feasibility of replacing the existing traffic signals with modern roundabouts. At these locations, roundabouts would enhance safety and reduce delay. Illustrations of the proposed geometrics of each intersection are shown in Figures D.1, D.2, D.3 and D.4.

Transit Service

The Weaver Woonerf (Alternative 4) would impact existing bus service by eliminating the eastbound service on Weaver Street. An alternate route could be Main Street, perhaps with a public plaza and bus stop on the lot currently used to sell Christmas trees. There could be a short walkway connecting Weaver Street with Main Street through this site.

Walkway Improvements

The intersection of Main/Weaver/Roberson has the most incidents of pedestrians hit by vehicles within the study area. Not surprisingly, it also has the greatest number of pedestrians crossing and the highest combined sum of pedestrians and vehicles in conflict. Casual observers note that it is a confusing intersection to cross on foot. The consultant studied the intersection and gathered input from users including individuals in wheelchairs. The traffic analysis notes that vehicle queuing problems are associated, in part, with the close proximity of signalized intersections. The consultant considered an improvement concept to this intersection (*see Figure D.5*) that includes the following measures in conjunction with changing Weaver Street to one-way westbound operation in the block between Main Street and Greensboro Street and changing Roberson Street to one-way southbound operation in the block between Main Street and Sweet Bay Place:

- Remove the traffic signal
- Reduce intersection width by reconstructing curbs (preferred) or using paint
- Create left-turn lanes in both directions on Main Street
- Provide one through-lane in each direction on Main Street
- Reconstruct driveway serving Carr Mill Mall so that inbound and outbound traffic are separated by a landscaped median and align with separate parking lot drive aisles.

- Restrict outbound traffic from Carr Mill Mall to right-turn movements on Weaver Street
- Create unique public open-space with “umbrella-tables” within “The Point”

Similarly, the intersection of East Main/Rosemary Streets could benefit from a rebalancing project to ease the confusion that pedestrians and bicyclists currently experience there. As shown in **Figure D.6**, one concept is to create two continuous flow traffic lanes (eastbound Main Street and westbound Rosemary Street). By providing wide raised-curb median islands, pedestrians would have safe refuge in the center of each street as they wait for a break in traffic. The conflicting movements (westbound Main Street and eastbound Main Street to Rosemary Street) would each have one lane of traffic that could be signalized. Level of service results indicate LOS B during the morning and LOS D in the afternoon peak hour with a 1,000 foot-long queue extending from this intersection through the next adjacent signalized intersection of Franklin/Main/Merritt Mill. With such a queue, it is possible that some westbound traffic would detour to Rosemary Street to use the continuous-flow lane in the afternoon.

As shown in **Figure D.7**, an alternative approach to improving safety at the intersection of East Main Street and Rosemary Street is to realign a short section of Rosemary Street through the parking lot of a fronting site to intersect East Main Street at a normal (90-degree right angle) intersection. Residual land could be sold to adjacent restaurants for use as sidewalk cafes.

APPENDIX E: RESPONSE TO “NEW VISION” RECOMMENDATIONS

The following is a response to recommendations contained in the “New Vision” report; recommendations made by Walkable Communities, Inc. in their February 2002 report documenting the community visioning charrette. The following is a summary of how each major recommendation is treated in this study (refer to previous pages for description of each alternative).

- Promote new buildings oriented to fill-in vacant and under-utilized sites facing major downtown streets **(all alternatives)**
- Encourage new buildings with a mix of uses that “share” parking and generate street life during all hours of the day and evening and weekend **(all alternatives)**
- Preserve free parking but add more on-street parking and consider time restrictions if necessary **(Alternative 4)**
- Adhere consistently to a streetscape and landscape master plan to build identity **(forthcoming)**
- Provide buffer space between sidewalks and moving cars by adding landscape edges or on-street parking **(Alternative 4 or where additional right-of-way or easements can be obtained)**
- Widen sidewalks to provide a minimum width of eight feet **(where additional right-of-way or easements can be obtained)**
- Narrow driveway widths
- Install two wheelchair ramps on each corner **(all alternatives)**
- Distinguish crosswalk areas using colored, textured or patterned surface materials
- Increase frequency of crosswalks and improve safety of each crossing **(all alternatives)**
- Install sidewalk bulb-outs to shorten pedestrian crossing distance at crosswalks (in 100 block of Weaver Street, Alternative 4)
- Provide pedestrian paths or links to shorten distance through downtown blocks
- Combine three different sources of lighting to create welcome, secure conditions for evening and nighttime strolls
- Consider replacing traffic signals with modern roundabouts designed for 15-20 mph vehicle speeds at up to seven downtown locations
- Convert East Weaver Street to a pedestrian priority street, also known as a woonerf, with one direction of slow-moving traffic allowed to pass through **(Alternative 4)**
- Provide bus stops conveniently and include bike racks, shade, benches, and bus information for riders **(all alternatives)**
- Utilize the rail corridor to include parallel shared-use path and passenger train service on the rails, in addition to existing infrequent coal shipments to UNC **(all alternatives, although a Roberson Street extension along the tracks requires more planning)**
- Promote bicycling and install signs and bicycle racks **(all alternatives)**
- Invest public funds to improve Roberson Street to spur redevelopment of private property that contributes to a lively downtown core **(Alternative 4)**

APPENDIX F: BICYCLE DETECTION PROJECT SUMMARY

Background and Purpose

Caltrans has undertaken a demonstration project to deploy a new technology, using a video image and tracking system, to detect and process bicyclists at selected intersections along state routes in three communities. The project shows that Video Image Detection System (VIDS) is an effective method to detecting bicyclists at traffic signal locations. The inductive loop typically used to detect vehicles at signalized intersections has not consistently been able to detect bicycles due to their small metallic mass. The purpose of the project was to field-deploy and evaluate Video Image Detection System (VIDS) equipment at test intersections for the purpose of detecting bicycles.

Six-Phase Approach

The demonstration project was conducted in six phases. The first phase produced a Feasibility Study and Technology Evaluation Report that studied available detection technologies. The study identified that the video image processing is a suitable detection technology currently available for bicycle detection. In the second project phase, the consultant invited video detection technology vendors to participate in a field evaluation demonstration. Four vendors accepted the invitation to participate in the VIDS equipment testing. Caltrans and consultant established a minimum level of accuracy for the demonstration tests and the vendors that met or exceeded the minimum threshold were eligible to bid on the final contract phase. All vendors exceeded the Caltrans video detection standard and were pre-qualified. The third phase of the project was to meet with city agencies and outreach to the bicycle communities to identify specific needs and concerns regarding bicycle detection at a signalized intersection. Comments and suggestions were gathered for inclusion into the project design. VIDS plans and specifications were prepared for the project sites in the fourth phase of the demonstration project. The design incorporated the latest Caltrans design standards and also included other upgrades to accommodate VIDS at the signal. The fifth phase was the construction phase of the project, which followed with the installation and commissioning of the video detection and other related traffic equipment. Iteris was the selected vendor for the bicycle detection through the standard bidding process. The final phase of the project involved a quantitative evaluation of the installed detection systems as well as a user satisfaction survey. This summary was prepared from the project findings and recommendations.

Effectiveness

The findings in this demonstration project conclude that video image processing technology is an effective method for bicycle detection application. From the project test results, the actual bicycle detection rate exceeded 98% per lane for the VIDS system. In most situations, the bicycle detection rate was 100%. Since the minimum Caltrans standard for front detection is 98%, the demonstration project exceeds Caltrans standards. Unlike loop detectors, VIDS has the ability to detect a bicycle's presence in the full width of an approach lane. Bicyclists do not need to position their bicycles at a specific location to trigger the detection sensor. VIDS also provides passive detection capability and no action from a bicyclist such as depressing a push button is needed. The seamless video detection process provides a safer and more effective crossing solution for casual bicyclists. Survey responses show the bicycle community was

receptive to the video detection system and was satisfied with the detection performance at the test locations.

User Satisfaction

A survey was conducted with assistance from the bicycle coalition groups to identify the effectiveness of the VIDS system. A standardized survey form was developed to focus the evaluation comments on the project objectives. Survey questions include intersections evaluated, travel direction, time of day, weather conditions, other vehicles' presence, satisfaction with detection system, and other comments requiring intersection operation.

Most bicycle crossings were completed under optimal (sunny) conditions. The survey responses covered evaluations for some of the test intersections. Bicyclists had overwhelmingly favorable responses to the installed VIDS systems. All responses had satisfied remarks for the system performance. All survey bicyclists were detected and granted a green light in the absence of other vehicles in the test intersection.

In summary, the bicyclists surveyed were satisfied with the VIDS system, but some respondents wish there were signs indicating a VIDS system is in operation. This would encourage them to remain on the roadway and not move on to the sidewalk to activate the pedestrian push button for their crossing. Aside from the detection system performance, one of the respondents also requested timing adjustment in conjunction with the VIDS system.

LESSONS LEARNED

- The bicycle detection zone needs to cover the full width of the approach as a bicycle may be positioned anywhere within an approach lane. The detection zone can extend beyond the limit line to allow the bicyclists to be continued to be detection once they leave the limit line. This will give more time to bicyclists to cross the intersection.
- Once cyclists were accustomed to the new detection system, they were able to proceed through the test intersections with less delay.
- False detection and missed detection of the video detection system could be reduced with proper camera location and system setup programming.
- Deployment of VIDS is typically faster than inductive loops. Because there is usually no roadway disturbance in the VIDS installation process, road closures are minimized.
- In conjunction with bicycle detection, the timing parameters may need to be adjusted to allow more time for a bicycle to cross the intersection starting from a stop at some locations. Although, the detection zone will allow the bicyclists to be detected longer and the signal would not change as quickly as with inductive loops.
- Not all bicyclists are comfortable positioning themselves on the roadway alongside motorized vehicles. These bicyclists feel they risk a higher chance of injury on the roadway, especially at a left turn lane. For these bicyclists, they will continue to use the sidewalk and crosswalk to cross an intersection regardless of the detection system employed.
- Cyclists unaware of the presence of the VIDS system continued to use pedestrian push buttons to cross the test intersections.

- Under lower ambient light conditions (such as an intersection without street lighting at night), the VIDS system cannot detect a bicycle due to the low video contrast between the bicycle and the background, if the bicycle does not have a headlight. Under this condition, a headlight or other light source on the bicycle is needed to trigger the VIDS system.