Chapter 5 – Recommended Design Considerations

Policy and Guidelines

General street spacing and connections into the existing transportation hierarchy will be monitored by local officials when reviewing new development plans proposed for the community. They will make sure that a sustainable system is maintained. Special policies and guidelines that the City of Durham and the Town of Chapel Hill may want to consider for amending their development review process are summarized below.

Street Spacing and Access

Local officials should consider street spacing guidelines to promote efficient development of an expanding transportation system. Ultimately, these street spacing guidelines could be used as "rules of thumb" during the development review process. Spacing guidelines recommended for collector streets are summarized below.

Land Use/Type of Collector Street	Intensity	Access Function	Approximate Street Spacing
Very Low Intensity Residential	Less than 2 dwelling units per acre	High	3,000 to 6,000 ft apart
Low Intensity Residential	2 to 4 dwelling units per acre	High	1,500 to 3,000 ft apart
Medium and High Intensity Residential	More than 4 dwelling units per acre	High	750 to 1,500 ft apart
Activity Center	Mixed-use residential/commercial	Medium	750 to 1,500 ft apart

In addition to these recommendations, it is desirable to provide all driveway access on collector and local streets. In some cases, however, it may be warranted to provide property access from an arterial roadway.

Design Elements

As the public realm, streets need to reflect the values of the community and reinforce a unique 'sense of place' to be enjoyed by citizens – whether in urban, suburban, or rural contexts. This is especially true for a collector street system in that it serves as the backbone for local mobility, property access, and non-vehicular transportation modes.

In recent years, municipalities across the country have started implementing **"complete streets"** as one way to transform their transportation corridors from vehicle-dominated roadways into community-oriented streets that safely and efficiently accommodate all modes of travel –not just motor vehicles. The complete street movement does not advocate for one size fits all; a complete street in an urban area may look quite different from a complete street in a more rural area. However, both facilities are designed to balance mobility, safety, and aesthetics for everyone using the travel corridor. Furthermore, design considerations supportive of complete streets include elements in both the traditional travel corridor (i.e., the public realm) as well as adjacent land uses (i.e., the private realm) for reinforcing the desired 'sense of place.'

The following design considerations serve to create the foundation for implementing complete streets:

- Travel lane width
- Pedestrian circulation
- Bicycle circulation
- Transit accommodations
- On-street parking
- Median treatments
- Street lighting
- Street trees
- Pedestrian crossings
- Stream crossings

Each of these design elements is discussed in more detail below.

Travel Lane Width

Motorists typically drive at a speed which they perceive to be safe. Therefore, one of the primary design elements for managing vehicle travel speeds is lane width. This is typically measured between the yellow centerline of a street and the outside white lane line or edge of gutter. Over the last 50 years, communities across the country have

studied the range of recommended travel lane widths published by the American Association of State Highway and Transportation Officials (AASHTO) and adopted their maximum range from these guidelines (i.e., 12 feet) as their minimum design standard.

Today, excessive travel speeds are one of the top concerns for citizens and elected officials alike. The use of other travel modes within the corridor is often discouraged because of safety concerns associated with excessive travel speeds. One solution for addressing these excessive travel speeds is traditional traffic calming; these spot improvements, however, sometimes only shift the problem to other streets.

A second solution gaining momentum among design professionals across the country is to incorporate varying minimum travel lane width standards into local rules and regulations that offer some flexibility to better relate design speed and posted speed limit. Forthcoming publications by the Institute of Transportation Engineers (ITE) and the Congress for New Urbanism (CNU) recommend the following general relationships between travel lane width and anticipated travel speeds:

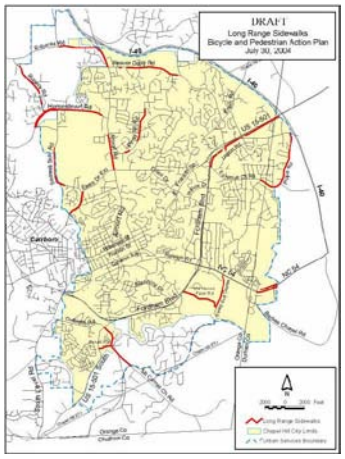
- 10 ' travel lane = 20 MPH
- 11 ' travel lane = 25 MPH
- 12 ' travel lane = 35 MPH

The application of varying travel lane width standards for the collector street system would allow design officials the flexibility to reinforce a 'constant ' travel speed (by design) that is supportive of more livable, complete streets. The City of Durham currently requires an eighteen foot travel lane with a 35 mph speed. The Town of Chapel Hill currently requires an eleven foot travel lane with a recommended speed limit of 25 to 35 mph.

Pedestrian Circulation

The pedestrian realm is present and should be provided for in all developed areas. In urban areas, this means the provision of a sidewalk on each side of the street, often accompanied by shade trees and places of rest. In more suburban areas, a two-way shared-use path can substitute for sidewalk. In the rural to natural environment, the multi-use paths may meander away from the street system and converge into a trail system with great success. In all

developments, including those of low density near the rural realm, sidewalks or paths should be provided. Similar to other features of street design, provisions for pedestrian circulation are unique to each context. The pedestrian realm should provide for recreational and functional activity, and should be a safe and inviting environment both day and night. A successful pedestrian environment is a place where people gather to interact, observe, linger, and pass through, and is beneficial to commerce, the safety of the community, and to the development of transit. Both the City of Durham and the Town of Chapel Hill provide regulations that incorporate sidewalks on both sides of the street. It is recommended that Durham's design standards reference the pedestrian plan to ensure that the correct facility type (i.e. sidewalk, shared-use path, etc.) is being specified.



Chapel Hill Bicycle and Pedestrian Plan

Bicycle Circulation

Bicycling provides both transportation and recreational opportunities for citizens, employees, and visitors alike. Bicycle facilities can range from wide outside lanes with no striping to marked bicycle lanes to off-road bicycle paths (i.e., shared-use paths/greenways). The target user for each application and the unique circumstances of the particular roadway help to determine the bicycle treatment that is most appropriate. For example, experienced bicyclists often feel comfortable riding in mixed-flow traffic with no specific bicycle facilities provided. Marked bicycle facilities or adjacent bicycle paths are desirable for cyclists with basic or beginning skills.

In transportation planning, bicyclists are often separated into three levels of bicycling ability. An improvement deemed adequate for one group may not be suitable for another group. Therefore, user profiles are established to help local officials target appropriate bicycle improvements. Three profile user groups for bicyclists are:

- **Experienced** riders can handle most traffic conditions. Some experienced riders travel mainly for recreation while others use the bicycle for primary transportation. This group is comfortable riding on collector streets and is best served by direct access to destinations via the existing street system. Requirements include sufficient width on the roadway for an on-street bicycle lane or

wide shoulder so that neither the motorist nor the bicyclist needs to change positions when passing.

- **Basic** riders comprise the majority of adult or teenage riders in the United States. This group uses bicycles too infrequently to develop advanced cycling skills and prefers comfortable direct access to destinations via low volume streets or designated bicycle facilities. Most basic riders ride for recreation; however, for some members of this group bicycles may be the primary means of transportation to work or school.

- **Children** riders lack experience mixing with vehicular traffic and their bicycle use is primarily for recreation and may be monitored by their parents. This group prefers residential streets with low motor vehicle speed limits and traffic volumes. Well-defined separation of bicycles and motor vehicles on collector streets should be required as a minimum. Ideally, separate bike paths would be provided as part of a greenway system.

In addition to user groups, the 'toolbox' established by transportation professionals for implementing bicycle improvements across the country usually contains at least four design elements or alternatives – wide travel lanes, on-street bicycle lanes, shared multi-use paths (i.e. greenways), and bicycle routes. These applications are generally characterized by:

- **Wide Travel Lanes** — These facilities allow a motorist to safely pass a bicyclist while remaining within the same lane of travel. This improvement is considered a significant benefit and improvement for experienced and basic cyclists. The typical recommendation is 14 feet for the width of a wide travel lane meant for use by both motorists and bicyclists. Continuous stretches of pavement wider than 15 feet may encourage speeding on the undesirable operation of two motor vehicles in one lane.

- **On-Street Bicycle Lanes** — These form the portion of the roadway that has been designated by striping, signing, and pavement markings for the preferential or exclusive use by bicyclists. Bicycle lanes make the movement of both motorists and bicyclists more predictable. State and national

design manuals for the construction of on-street bicycle lanes generally recommend a minimum of 4 feet in width measured from the edge of gutter for a bicycle lane and a minimum of 5 feet in width when adjacent to on-street parking. Collector streets create good places to stripe bicycle lanes.

- **Shared-Use Paths** — These facilities can serve bicycles and pedestrians in one "non-motorized" transportation corridor either adjacent to or completely independent of (e.g., a greenway) the street system. One path usually accommodates two-way travel and is constructed up to 12 feet in width to facilitate passing and mixing of modes. These facilities are typically separated from a motor vehicle travel lane by 5 feet or more. One drawback to shared-use paths is the number of safety conflicts at intersections and driveways presented by having a two-way facility on only one side of the street. The location of destinations along the path may also lead to additional street crossings in order to access homes and businesses opposite the path.

- **Bicycle Routes** — In some instances, a portion of the community's existing street system may be fully adequate for efficient bicycle travel with conventional signing, making striping unnecessary. The most common example of these types of streets is in residential neighborhoods where low traffic volumes and low travel speeds allow bicyclists to comfortably mix with traffic. Typically, the posted speed limit on these streets should be 25 miles per hour or less for these unmarked facilities. Where appropriate, trail-blazing signage may be installed to designate "bicycle routes" on some of these streets to alert bicyclists to certain advantages of the particular route over other routes.

The most appropriate bicycle network for the southwest Durham and southeast Chapel Hill area is a combination of the four design elements mentioned above. With an emphasis on the needs of the "basic user," certain design elements will be preferred to provide comfortable direct access to destinations. The preference among the four design treatments for any one street segment will be a function of traffic volumes, travel speeds, right-of-way constraints, adjacent land uses, and route directness.

Transit

As single-occupancy auto transportation is met with the challenges of rising fuel prices and heavy traffic congestion, attention is increasingly paid to various forms of transit. Transit is ideally situated along collector and arterial corridors with urban or higher density suburban. Transit benefits from a dense interconnected street pattern, preferably mixed in land use to support good ridership.

Areas targeted for enhanced transit service, such as the study area, should be supported through land use and zoning policies that support transit-oriented development and reflect the benefits of increased access to alternative modes of travel. Examples include appropriate densities and intensities for supporting transit use, parking ratios that reflect reduced reliance on the automobile, and setback and design guidelines that result in pedestrian supportive urban design. In addition, potential transit service identified for transportation corridors within the community should take into consideration the land use, density/intensity, and urban design characteristics of the surrounding environment before selecting proposed technologies or finalizing services plans. A challenge for this study area is how to attract transit-supportive development densities before the higher frequency of transit service is actually provided. City and Town development policies should be oriented to encourage transit-supportive development near future transit stations and along high-frequency bus routes.

On-Street Parking

On-street parking is essential to support pedestrian-oriented retail. It is also beneficial to the comfort and safety of pedestrians. Although important, on-street parking reduces the capacity of a street by as much as 30%. When planning where on-street parking will be located, it is important to consider traffic and access as well as future land use potential. Future land use — rather than existing land use alone — should be considered to prevent future parking retrofits due to a lack of adequate planning.

Medians

Medians provide for pedestrian refuge, control access, reduce vehicular conflicts, increase safety, and enhance the street environment. As desired by the community, medians can be incorporated into collector street designs. When medians are landscaped, the preferred width is 10 feet. A minimum 6-foot width is acceptable at intersections. This is especially true of existing streets that will be connected to new development, e.g. Lancaster.

Lighting

Pedestrian-level lighting should be provided on collectors. At intersections and mid-block pedestrian crosswalks, conventional cobra-style street lights illuminate the roadway and increase motorist awareness of conflicts. On collector streets, street lights should illuminate the sidewalk and alert drivers to the presence of pedestrians in crosswalks. Pedestrian-scale street lights should be lower than conventional street lights and provide more illumination on the sidewalk. Typical light spacing is between 50 feet and 80 feet; this varies, however, depending on light type, illumination intensity, and fixture height.

Street Trees

Street trees should be provided along collector streets and spaced such that they create a continuous canopy. Small species of trees can be spaced as closely as 30 feet apart. Larger species will need to be placed 40 to 50 feet apart. A few examples of street trees recommended for use include: Red Maples, Allee Chinese Elm, Bosque Chinese Elms, and Ginkgo.

Pedestrian Crossings

Collector streets can be attractive places to walk. At intersections and mid-blocks where pedestrians frequently cross the street, crosswalks and appropriate refuges (minimum of 6 feet wide) should be provided.

In all cases, ADA (Americans with Disabilities Act) accessible curb ramps should be provided at each crossing. At unsignalized intersections, AASHTO, state, and local guidelines should be consulted to determine sight distance triangles before striping a crosswalk. A curb extension at crosswalks helps pedestrians.

Stream Crossings

Street patterns are affected by natural features. Streams and other bodies of water present challenges to creating interconnected street networks. Without significantly compromising water quality, stream crossings should be pursued for vehicular connections every 2,500 feet to 3,000 feet. As a rule of thumb, the North Carolina Division of Water Quality discourages more than one street crossing a stream between branch locations (locations where the stream branches out into two or more waterways).

Traffic Calming

Unfortunately, there are instances when even the most well-designed collector streets experience prevailing travel speeds well in excess of posted speed limits. The inclusion of traffic calming measures in these affected areas may mitigate these issues.

Overview

Traffic calming is quickly becoming a common term for addressing citizen concerns of traffic speeds. The Institute of Transportation Engineers has identified and published 'best practices' for traffic calming. Individual communities, including Durham and Chapel Hill, typically develop policies and protocols specific to their local traffic conditions and citizen expectations. Specific policies and protocols generally include definitive 'warrants' and a 'toolbox' of preferred traffic calming solutions to assist local officials with the design and implementation flexibility to best represent the values and vision of the community.

Measures

Various traffic calming measures incorporated throughout the United States are grouped into three types of categories – passive, vertical deflection, and horizontal deflection. These general categories are summarized below.

Passive traffic calming measures continuously alter a driver's perception of the travel corridor and include gateway treatments, street trees, sidewalks, bicycle lanes, pavement marking/textures, and signage. Together, these design elements signify to the driver that they have entered into a 'livable' street in which all travel modes are afforded equal access to the travel corridor.

Passive — Use of contrasting materials to clearly define crosswalks

Vertical traffic calming measures represent features that drivers must navigate over to proceed on their desired travel path and may include treatments such as speed humps, speed tables, raised crosswalks, and raised intersections.

Vertical— Raised crosswalk using a contrasting paving pattern

Horizontal traffic calming measures represent features that drivers must navigate around to proceed on their desired travel path and, in some cases, may divert drivers to other travel routes altogether. Typical treatments include chokers, bulb-outs, medians, traffic circles, roundabouts, realigned intersections, and chicanes.

Horizontal— Bulb-out at an intersection

Toolbox

Traffic calming measures described below are commonly found in the traffic calming 'toolboxes' of communities all across the country. They are included for the City of Durham's and Town of Chapel Hill's consideration.

Speed Humps –Speed humps are commonly referred to as the 'sleeping policemen' in the roadway. These vertical devices typically measure between 3 and 4 inches in height at their center and extend the full width of the travel lanes before tapering at the outside

lane line to allow unimpeded bicycle travel. Speed humps should not be confused with speed bumps typically found in shopping mall parking lots. Spacing of successive speed humps along a roadway determines the speed at which motorists travel between devices.

Installation of speed humps typically costs between $2,000 and $5,000, depending on materials incorporated into the design.

Speed Table/Raised Pedestrian Crosswalk – A speed table is a very long, broad speed hump that can be either parabolic or trapezoidal in design. Trapezoidal speed tables could accommodate raised pedestrian crosswalks on the flat portion of the device for mid-block crossings when designed to a sufficient width — typically 10 feet or greater. These devices also are more appropriate for streets with larger vehicle traffic (i.e., bus and fire trucks).

Installation of a speed table is slightly more expensive than a speed hump with prices ranging between $2,000 and $15,000, depending on materials incorporated into the design.

Intersection Bulb-Out – Bulb-outs extend the sidewalk or curb line out into the parking lane of a street to effectively reduce the street width. These measures greatly improve pedestrian crossings by reducing the crossing distance and improving the ability for pedestrians and motorists to see each other. Curb extensions also can help reduce turning speeds at an intersection and provide additional space for curb ramps and/or level sidewalk landings where space is limited. Bulb-outs are only appropriate where on-street parking exists and curb extensions should never reach into travel lanes, bicycle lanes, or shoulders.

Installation of bulb-outs typically cost between $2,000 and $20,000 per corner; cost can greatly increase, however, when drainage improvements and/or utility pole relocation is necessary.

Choker – A choker intentionally extends the curb line along a street into the travel lanes, usually designed with a wide sidewalk or landscape area, to create a 'pinch point' for vehicle movement. Chokers can be created by extending both curbs into the travel lane, or they can be created more dramatically by widening only one side at a mid-block location. They can also be used at intersections to create a gateway effect when entering a street. These devices have a dramatic effect on travel speed by requiring motorists to yield to each other or slow down. This treatment is usually only appropriate for low-volume, low-speed streets.

Installation of a choker typically costs between $5,000 and $20,000, although major drainage improvements associated with implementation could significantly raise project costs.

Raised Center Median – Raised center medians are islands along the centerline of a street that narrow the real and perceived travel lane width. Raised medians help achieve speed reduction by creating a horizontal shift and blocking along view of the road ahead. A raised center median may be enhanced aesthetically and provide neighborhood identify by adding landscaping.

Installation of raised medians varies greatly among desired applications; however, short 'gateway' center medians typically cost between $10,000 and $20,000 depending on length, landscaping, and irrigation considerations.

Neighborhood Traffic Circle – A neighborhood traffic circle is a raised circular island constructed in the center of a local residential street intersection. These devices reduce vehicle speeds by forcing motorists to maneuver around them and are sometimes used instead of stop signs. Neighborhood traffic circles are commonly landscaped (i.e., bushes,

flowers, or grass) to enhance aesthetics. Yield signs, not stops signs, should be used with neighborhood traffic circles.

The occasional larger vehicle passing through an intersection with a neighborhood traffic circle (i.e., fire truck or moving van) could be accommodated at the intersection by creating a mountable curb in the outer portion of the circle. Studies show no significant impact on left or right turns for these vehicles; left turns can be made across the front of the circle just as with standard intersections.

Installation of a neighborhood traffic circle typically costs between $15,000 and $20,000, including landscaping.

Raised Intersection – Raised intersections are flat, raised areas covering entire intersections with ramps on all approaches. These intersections may include brick or other textured materials on the flat sections to delineate pedestrian crosswalks. The longer flat fields plus ramps, which may be more gently sloped than speed humps, enable slightly higher design speeds that may be suitable for slowing speeds on higher volume streets. The brick or other textured materials improve the appearance of raised intersections, draw attention to these traffic calming devices, and may further enhance speed reduction.

Installation of a raised intersection typically costs between $50,000 and $150,000 with limited texture paving. This cost greatly increases for signalized intersections.

Chicane – Chicanes are curb extensions on otherwise straight streets that cause travel lanes to bend one way and then back the other way to the original alignment of travel. Chicanes achieve speed reductions for forcing a horizontal shift and blocking long views of the road ahead. Landscaping may be provided in the curbed island created by the chicane to enhance the aesthetics.

Installation of a chicane typically costs between $5,000 and $15,000, including landscaping.

Application of Measures

Several communities across the country have developed neighborhood traffic calming programs (NTCP) to implement traffic calming judicially and efficiently in order to meet citizen concerns. As

Durham and Chapel Hill considers the installation of traffic calming measures on its streets, the evaluation process should reflect the following steps (Durham has formal application and evaluation process):

- **Problem Identification/Needs Assessment** – Most successful traffic calming programs include a petition process that allows neighborhoods to request an evaluation of traffic characteristics. The evaluation should be designed to assess the degree of complaint and may include license plate surveys, speed studies, field observations, and traffic volume counts. Thresholds or 'warrants' may be developed that would designate a street as eligible for traffic calming.

- **Establish Traffic Calming Toolbox** – Local officials should establish a set of preferred traffic calming measures that address cut-through or speeding problems; including pros/cons associated with each measure and a typical design for implementation.

- **Plan Selection/Course of Action** – The most important element for creating a successful traffic calming program is to involve impacted residents, the general public, and stakeholders such as city staff and emergency response agencies when developing a course of action. Some communities establish official traffic calming committees that review all citizen requests and studies to ensure consistency with decision-making. It is also recommended that a minimum approval rate for locally-affected residents be established before implementing any traffic calming improvements to ensure their acceptance.

- **Implementation/Installation** – Timely installation of warranted traffic calming measures is important for a traffic calming program to maintain integrity. Intended funding mechanisms should be clearly documented including the roles and responsibilities for the city or town and petitioning neighborhood residents. This may include options for neighborhood transportation assessments and participation requirements for construction and maintenance.

- **Monitoring/Evaluation** – Studies should be completed after implementation of traffic calming measures to evaluate the effectiveness of the solution. Based on the study, minor adjustments may be required for the traffic calming measure to achieve the desired outcome.

Land Use Coordination

Land use plans describe desired patterns of land use for the study area. For the most part, areas that are currently undeveloped will allow all types of land use in the future. **Figure 5.1** shows the future land use plan within the study area. **Table 5.1** provides a correlation between land use and collector street spacing.

Table 5.1—Land Use and Street Function

Land Use/Type of Collector Street	Mobility Function	Access Function	Approximate Street Spacing	Natural Feature Impacts
Residential	Medium	High	1,500-2,000 ft	Low
Commercial	High	High	1,500-2,000 ft	Low
Industrial	High	High	½-1 mile	High

Collector streets connect to one another, to local streets, and to arterials. They have the potential to offer multiple routes to citizens as neighborhood units are formed. Commercial and industrial collectors have the potential to form the outer or inner boundaries of these activity centers. They have higher capacities and provide for a higher level of mobility compared with residential collector streets. Residential collectors are likely to be key interior streets. They provide the same level of access and will be spaced at more frequent intervals depending on the density such that citizens are provided multiple routes to their destination.

Southwest Durham - Southeast Chapel Hill Collector Street Plan

Figure 5.1 - Future Land Use Plan

Kimley-Horn and Associates, Inc.

SW Durham County and SE Chapel Hill COLLECTOR STREET PLAN

County Boundary
Corps of Engineers Land
Study Area

Future Land Use

Low Density Residential (4 DU/Acre or less)
Low-Medium Density Residential (4-8 DU/Acre)
Medium Density Residential (6-12 DU/Acre)
Medium-High Density Residential (8-20 DU/Acre)
Recreation / Open Space
Commercial
Institutional
Office

0 0.125 0.25 0.5 Miles

Street Design

The illustrations that follow represent sample typical collector street cross sections that could be incorporated into the development review process. Their application to a specific development scenario will depend largely on the adjacent land use, access control, and the type of facility that it is connecting.

The typical cross sections and plan view illustrations capture a range of rights-of-way from 50 feet to 75 feet. The travel lane widths shown in these illustrations are sometimes narrower than the standard 12 feet now provided by the North Carolina Department of Transportation. It is important to note that proposed collector street standards incorporated into this report for roadways that are maintained by the North Carolina Department of Transportation must receive design approval prior to their implementation. NCDOT does allow narrower streets in "Traditional Neighborhood" developments.

The *Southwest Durham County and Southeast Chapel Hill Collector Street Plan* recommends three general categories for collector streets within the community: residential, commercial, and industrial. Each of these is discussed below.

Residential Collectors

Residential collector streets serve primarily residential land uses and associated traffic. These streets are potentially popular for functional and recreational walking and bicycling and could be incorporated into comprehensive community pedestrian and bicycle plans. Context sensitive street design is essential for residential collectors to prevent excessive travel speeds. Design elements recommended to reinforce the residential character of these streets include:

- Pedestrian facilities both sides of the street (i.e., sidewalk or multiuse path)
- Street trees
- Lighting (i.e., pedestrian scale)
- Left-turn lanes at major intersections
- Traffic calming (as necessary)
- Small curb radii at intersections (15 to 20 feet)
- Ten- or eleven-foot travel lanes
- Striped bicycle lanes

Although roadway capacity is not a primary focus for residential collector streets, appropriate intersection treatments are important to

the overall functionality of the street. Exclusive left-turn lanes should be considered where residential collector streets intersect arterial roadways. Mini-roundabouts should be considered at collector-collector intersections. Intersections with local streets generally would not require exclusive left turn lanes. All decisions for providing left turn lanes should be made on a case-by-case basis by the local Engineer.

It is recommended that a 60 to 70-foot right-of-way continue to be protected for future residential collector streets. Typical cross sections and plan view illustrations are provided in **Figure 5.2 Residential Collector – Type A**, **Figure 5.3 Residential Collector – Type B**, and **Figure 5.4 Residential Collector – Type C** at the end of this chapter.

Commercial Collectors

Commercial collector streets primarily serve commercial/office land uses; however, the recommended street design standards for commercial collector streets may be appropriate for areas transitioning between residential and non-residential land uses. It is recommended that the City of Durham incorporate commercial collector design standards into their Reference Guide for Developers standards. These streets have the potential to attract moderate traffic volumes and could experience excessive travel speeds. Context sensitive street design is essential for commercial collectors to prevent these streets from becoming popular cut-through traffic routes, resulting in an increase in concerns associated with excessive travel speeds. Design elements recommended to reinforce the commercial character of these streets include:

- Pedestrian facilities (i.e., sidewalk or multiuse path)
- Curb and gutter drainage system
- Street trees
- Street lighting (i.e., vehicle and pedestrian scale)
- On-street parking (where appropriate)
- Left-turn lanes at major intersections
- Traffic calming (as necessary)
- Small curb radii at intersections (15 to 25 feet)
- Intersection bulb-outs
- Centerline striping

It is recommended that a 70- to 75-foot right-of-way be protected for future commercial collector streets. Typical cross sections and plan view illustrations are provided in **Figure 5.5 Commercial Collector – Type A** and **Figure 5.6 Commercial Collector – Type B** at the end of this chapter.

Industrial Collectors

Industrial collector streets serve primarily light and heavy industrial land uses and uses that have a high potential for attracting high volumes of heavy vehicle traffic. Design elements recommended to reinforce the industrial character of these streets include:

- Pedestrian facilities (case-by-case basis)
- Street trees
- Street lighting (case-by-case basis)
- Left-turn lanes at major intersections
- Large curb radii at intersections (>25 feet)
- Intersection bulb-outs
- Centerline striping

It is recommended that a 60-foot right-of-way be protected for future industrial collector streets. Although the study area does not include industrial uses, it is recommended that the City of Durham and Town of Chapel Hill include industrial collector street design standards in their regulations for other areas beyond the study area. Typical cross sections and plan view illustrations are provided in **Figure 5.7 Industrial Collector** at the end of this chapter.

In some cases, the application of classification criteria (i.e. residential, commercial, or industrial) will result in a street being included in more than one category. In these situations, consensus building may be necessary to appropriately classify the street.

Figure 4.6 in Chapter 4, illustrates the recommended collector street plan for the southwest Durham and southeast Chapel Hill area based on classification criteria, spacing and access guidelines, street connectivity guidelines, and quantitative/qualitative characteristics for the existing and proposed transportation system. The new facilities identified in the figure show general alignment and intersections; however, the ultimate placement of new collector streets depicted in this plan should be flexible enough to account for unique social, environmental, and constructability issues associated with these corridors.