

BICYCLE NETWORK STRATEGY

February 2019

GRUBB PROPERTIES
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Clay Grubb (pictured center front) wins the American Diabetes' Association Bikeathon along with another young rider in Lexington, North Carolina. He rode over 60 miles to raise money for diabetes research and education.

A LETTER FROM CLAY GRUBB

I had a magical childhood in the small town of Lexington, North Carolina. My mother had her own business and, as the youngest of three boys by seven and four years, I was often left to my own means. I embraced that independence, often transporting myself to school, doctor's appointments and my grandparent's house via my bicycle. My favorite spots were John's Drug Store downtown for a homemade lemonade and Lanier True Value Hardware, which still is the anchor retailer to this day. In my early days, I rode to Grimes Elementary School on a spider bike with a banana seat. Later I would own a Rampart bike with a fake gas tank and shock absorbers. Other kids and I would build ramps for jumping to test out the shocks down by the creek.

Biking was part of the Lexington culture. One of the primary fundraisers each year was the Diabetes Bike-a-thon. Each year, I would ride 60 miles and was often one of the top fundraisers. One year I won a Schwinn Super La Tour. That bike was my pride and joy; it had the lightest frame I had ever witnessed. Things changed, however, when the interstate system came through and many folks started to move out of the city limits to the county. The hospital moved to be near a major interchange by the interstate to become more of a regional draw, and my doctor decided to follow. I remember my mom's friends worrying to my mom that I would still try to ride my bike to the doctor. The street leading to the now-far-away hospital was lined with fast cars, no bike lanes, and limited sidewalks.

With suburban sprawl gaining control of our city, biking started to disappear from my life. But it made a resurgence years later when I attended the University of North Carolina's School of Law. I lived next to Glen Lennox and each morning I took on the hill along Highway 54/Raleigh Road on my way to classes on campus. This is the same hill that Roy Williams, UNC's national-championship-winning basketball coach, so comically talks about failing to ride up his first couple of tries in his radio interview about life at Glen Lennox. The head of real estate education at UNC, David Hartsell, would also laughingly tell me of his experiences riding up that hill to campus – shared by countless others, I am sure. In fact, I presume my father rode his bike up that hill in the 1950s when he was living at Glen Lennox and attending law school. But doing so today would be far more dangerous. Without a dedicated lane or sidewalks, bikes today are forced onto Highway 54 where it crosses under Highway 15-501, a place where it isn't unusual for cars to reach speeds exceeding 60 miles an hour.

After moving to Charlotte, I rode some in my neighborhood but eventually got rid of my bike due to the inhospitable nature of Charlotte's streets. It wasn't until Charlotte's U.S. National Whitewater Center opened in 2006 with mountain biking trails did I find myself back on a bike. I took up mountain biking with great enthusiasm and still crave sunny weekends to ride.

And in 2015, I discovered I could use Charlotte's new greenway system to ride almost all the way to Grubb Properties' new office headquarters without being forced to ride along any treacherously busy roads. Of course, those last three blocks crossing and then riding alongside a busy street are without a doubt extremely dangerous.

Almost every person's first reaction when I told them I was biking to work was, "That's dangerous." In 2018, I remember having a beer with the Assistant City Manager and telling him I had started riding to work more often. His first question was whether I had been hit by a car yet. "Everyone I know in Charlotte that rides their bike to work has been hit by a car," he added. Those types of comments make one nervous about riding and to feel defeated and sad about our cities.

Fortunately, in the fall of 2017, I was invited to Copenhagen by the Knight Foundation It was there I became able to envision the possible magical future of Glen Lennox, Chapel Hill, and even Charlotte. Morning rush hour in Copenhagen was the most intimidating experience I could imagine. You set on the edge of the bike path as thousands of bikes zoom past within inches of each other. There was no room for me. How was I going to push into the sea of bikes without wobbling around, knocking folks off their bikes, and ruining the seemingly perfect rhythm of movement? At last, a break appeared and I was flowing along beside my fellow bikers. I quickly realized that folks are happy to have a new rider among their commute. They greet you, they smile, and your imagination runs wild with wonder about each of your fellow commuters. Two thirds of the people in Copenhagen, the young and the old included, commute to work by bike. They primarily do it because it is the fastest way to get to work and surest way to be on time. Yes, it is much healthier, and it is good for the environment, but their capitalistic instincts to be selfish with their precious time is the greatest driver of this mode of transportation.

In Copenhagen I was introduced to Mikael Colville-Andersen of Copenhagenize. He showed us what he had done to transform the Russian city of Almetyevsk into a biking culture, as well as all the different design features they were working on to make biking more efficient, safer and, equally important, more fun. I couldn't shake the dream of how perfect this could be for Glen Lennox. Glen Lennox could transform into the Lexington I cherished as a child and so much more – with working folks, schoolkids and even law students all riding their bikes in the morning, instead of battling the horrendous highways that now seem to imprison the neighborhood.

I have brought much of what I learned in Copenhagen into Charlotte, Atlanta, and to our entire culture of all we are doing at Grubb Properties. I truly appreciate the importance of eliminating our reliance on cars, not just for our climate, but as a core component of affordable housing. The average American spends 15% of their earnings supporting what has become a trillion-dollar addiction in America – commuting. Housing costs have soared to the point we are in a crisis.

Something must give. I think it should be the car as we know it today. New developments like driverless cars, Uber, Lyft, docked and dockless bike sharing, and scooters show that we are desperate for change that is not only positive but truly sustainable. I plan to make sure Glen Lennox is not only a part of this change but a leader.

Glen Lennox was the premiere cutting-edge community in the 1950s, helping to solve that era's housing crisis. I am confident it can play an important role for the twenty-first century. To that end, Grubb Properties is the first North American developer to hire Copenhagenize to transform one of its developments into a state of the art cycling- and pedestrian- friendly community. However, I am confident we will not be the last. I look forward to seeing the evolution of Glen Lennox as well as the many other communities that I believe will follow our path.

I owe a huge thank you to Charles Thomas of the Knight Foundation for the invitation to Copenhagen and the life-changing introduction to Copenhagenize. Most important, I want to thank you for taking the time to care enough to read this report. I hope you will become an active biker along the streets of Glen Lennox and proponent of biking throughout your life.

Sincerely,
Clay Grubb
CEO of Grubb Properties

Copenhagenize Design Co. is a leading urban design & communications consultancy specialising in all matters relating to bicycle culture: planning, infrastructure, design and communications. When it comes to urban cycling and life-sized cities, we approach every job from a human perspective - using design, anthropology, sociology and rationality as our points of departure.



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GLEN LENNOX
CHAPEL HILL EST. 1950

PROJECT SUMMARY

Glen Lennox is a truly unique environment, representing one of the first mid-century modern planned communities in the country. Erected in 1950 at the start of America's "Golden Age," the 140-acre development was a thriving center of living, shopping and industry for its 1,200 residents, the University of North Carolina and the Town of Chapel Hill.

Led by Grubb Properties, Glen Lennox's revival is inspired by and pays tribute to the history and personality of the mid-century modern theme and the indoor-outdoor lifestyle that define the neighborhood. Featuring open design concepts, tasteful architecture and a network of connected greenspaces, Glen Lennox will lead the future of Chapel Hill with an unrivaled retail, office and living setting that pays homage to the property's unique and storied past.

Grubb Properties and Copenhagenize Design Co. have developed a partnership to analyze and understand how Glen Lennox might become a less car-oriented community in the future. With the help of the recommendations in this report, Glen Lennox can return to its leadership position as one of the town's most innovative properties. This is consistent with the community's original philosophy – to provide a diverse, functional district built on a human scale that incorporates lessons learned from advances in contemporary urban planning.

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A BICYCLE-FRIENDLY FUTURE FOR GLEN LENNOX



INTRODUCTION

Neighborhood planning in the 21st Century requires 21st Century solutions for a modern generation of renters, homebuyers and citizens. Glen Lennox is perfectly positioned to be a beacon for innovative community design from both real estate, mobility and urban planning perspectives. Understanding the historical context of the Glen Lennox project vision brings to light the importance of developing modern communities with intelligent mobility goals.

1.1

A CHANGING AMERICAN LANDSCAPE

Over the past half century, American communities have undergone an urban transformation, with family-focused, lower density neighborhoods emerging close to – and on the periphery of major urban centres across the nation. A rise in the number of these communities presented American families and individuals with many new opportunities: the freedom and choice to escape the bustle of high-density urban centres, purchase a home with some land, live closer to nature, and easily access essential goods and services by automobile. Spurred by a surge in popularity, lower density communities have rapidly shaped the modern American landscape.

With opportunity came new difficulties, as the development of lower density communities created new transportation, environmental, health and lifestyle challenges for a changing America. Today, the demographic makeup in these neighborhoods are not the same as when they were newly-established communities, which brings a whole host of new challenges. Modern household makeup, lifestyle choices, and transportation behaviors reflect modern circumstances.

Household Change

The United States Census indicates that during the rise of lower density communities in the 1950s, nearly 80% of American households consisted of families with an average of 3.7 members. This flourishing of American family life fueled the demand for lower density communities with family-oriented housing design. Fast forward to today, where less than 50% of American households consist of married couples with children, family sizes are decreasing and there is a growing trend of individuals living independently or together in households. In 2017, at least 30% of American households were not nuclear families, reflecting the new modern realities of American life. This shift in household composition presents new housing and transportation demands; more options are needed to reflect the modern diversity of American lifestyle choices.

Less than 50% of American households consist of married couples with children

Traffic Increase

Successful low and medium density community design was built upon the assumption that every family and household owned a personal automobile to easily access work, retail, and recreation destinations. These communities offered desirable residential neighborhoods, but required almost every trip to be taken by personal vehicle. This auto-centric community design has promoted the increase of American vehicular ownership but also introduced car-dependency challenges. An abundance of vehicular traffic has led to an increase in commuting time. The 2017 American Community Survey found that "the nation has experienced an increase in commuting time", and is increasing each year. These figures highlight intensified traffic volumes, congestion, and an imminent need for innovative solutions in cities across the nation.

The nation has experienced an increase in commuting time

Mobility Behaviours

While household structure is shifting and vehicular ownership expands across the country, not every American has access to a personal vehicle or chooses to commute by automobile. In 2014, the United States Department of Transportation reported that 4% of American families and 18% of individual households did not own a vehicle. Reflected in household and automobile trends, more and more Americans are choosing to live independently, many of which, without a car. Looking towards the future, communities must accommodate this growing trend of vehicle independent Americans, by designing more walkable and bikeable neighborhoods.

In 2014, the United States Department of Transportation reported that 4% of American families and 18% of individual households did not own a vehicle

America has undergone a substantial spatial change over the past fifty years as lower density community design has shaped the nation and presents new housing and mobility challenges to modern cities. Developers, urban planners, and architects are embracing new design practices to address challenges and plan for the future – attempting to ensure we do not continue to develop on additional arable land and find ways to alleviate congestion and isolation. The adoption of innovative practices – such as Complete Streets policies – transform neighborhoods into life-sized communities with more housing and transportation options for all types of residents, ensuring access to green space and essential amenities.

Integrating a mix of commercial and residential units, as well as transit and mobility-oriented design into development projects all strive to enhance the quality of life for current residents and attract future residents.



Once the image of a desirable community for modern Americans, the low-density communities of the suburbs pose significant issues to modern cities







GLEN LENNOX, THE FACE OF CHANGE

Enter Chapel Hill – the Glen Lennox neighborhood development is poised to be a national leader by integrating innovative housing and transportation solutions that aim at enhancing resident quality of life and attracting future residents. The redevelopment of Glen Lennox plans on increasing local density, offering more commercial and retail mixed-use spaces, and improving sustainable transportation options within the neighborhood. The Chapel Hill 2020 Comprehensive Plan has identified the redevelopment of Glen Lennox as an important partnership (capital improvement project) to diversify Town opportunities and facilitate community connectivity. Glen Lennox has set a bold goal for the neighborhood to achieve 50% of trips by transit, walk, and bike by 2030. It is Glen Lennox's mission to become the most bicycle-friendly neighborhood in the Carolinas.

Glen Lennox will achieve 50% of trips by transit, walk, and bike

In this report, Grubb Properties and Copenhagenize Design Co. will put forward analyses and recommendations for Glen Lennox to incorporate innovative design solutions that aim to:

- ***Make the community a safe place for all ages and abilities to ride a bicycle***
- ***Improve access to local sustainable modes of transportation***
- ***Enhance connectivity to the rest of Chapel Hill and the surrounding region***

Through the gradual implementation of these concepts and designs, residents will have more dedicated biking, walking, transit, and combined transportation options to major destinations within Chapel Hill and the Triangle Region. In partnership with the Town of Chapel Hill, Glen Lennox is leading transformative solutions in the region and will be a national example for future development projects.



Glen Lennox was ahead of the curve when it built its first homes in the 1950s. Today, the community strives to redefine itself and again be a forward-thinking neighborhood for a modern generation.

CITY CONTEXT & PLAN REVIEW

Before embarking on a specific analysis of the Glen Lennox site and surrounding neighborhoods to begin offering non-motorized recommendations, it is key to understand the greater Town planning context. Any bicycle-specific implementation in Glen Lennox should contribute to the greater Chapel Hill community at large, and build upon the dedicated planning efforts from local government. This assessment strengthens the understandings of the needs, challenges and opportunities inherent in Glen Lennox.

1.2

HOW BICYCLE-FRIENDLY IS CHAPEL HILL?

The Town of Chapel Hill has been taking incremental steps to enhance its mobility options and become a more walkable, bikeable, and transit-oriented environment. Over the past decade, much focus has been directed towards improving cycling conditions and increasing cycling facilities. Chapel Hill is home to an extensive number of greenways that provide residents with separated, leisurely routes for all ages and abilities. These 17 miles of greenways are cherished by locals and generally experience an average of 10,000 users per month.

...bicycle facilities on Chapel Hill streets are limited with a total of 11 miles of painted bike lanes and 4 miles of sharrows.

However, bicycle facilities on Chapel Hill streets are limited with a total of 11 miles of painted bike lanes and 4 miles of sharrows (shared lanes). Currently, there are no on-street protected bicycle routes, which offer direct routes and are physically separated from vehicular traffic by a barrier such as bollards, curbs or planter boxes. West Cameron Avenue bike lane is the most frequently travelled bicycle route with approximately 1,000 cyclists per day because it is an important connector between greenways and the University of North Carolina. Painted lanes like West Cameron Ave are sufficient for confident bicycle riders, but do little to attract people who may not yet feel comfortable riding on the road. While conducting public outreach for the Bike Plan, the Town discovered 53% of participants do not feel safe riding a bike in Chapel Hill. When asked what the primary barriers to cycling were, participants identified hilly terrain, lack of network connectivity, and insufficient infrastructure on main roads.

13% of the population walks, 12% takes public transit, and 2% rides a bicycle when travelling to work

To further examine the connection between mobility perceptions and behaviors, the 2013 Chapel Hill Journey to Work study reported that 13% of the population walks, 12% takes public transit, and 2% rides a bicycle when travelling to work. These percentages provide a limited glimpse into travel habits of all residents because they only reflect commuting trips to work and do not capture trips to school, errands, or leisure. The University of North Carolina (UNC) is the largest institution in Chapel Hill and it's student body comprises half of the Town's population. The 2015 UNC commuter survey discovered that 14% of UNC students and 5% of UNC employees ride a bicycle to campus. Contrast in journey to work and University ridership numbers demonstrate varying levels of comfort and travel behaviours amongst Chapel Hill residents. These figures also stress the imminent need for connecting safe cycling facilities in the community.

...53% of Town outreach participants do not feel safe riding a bike in Chapel Hill.



Local greenways offer ample protection in certain locations, but often to not connect to on-street protected bicycle facilities.

CHAPEL HILL'S TOWN PLANNING VISION

Guiding the Town's efforts to address mobility issues and opportunities, Chapel Hill has produced a number of relevant planning documents: Chapel Hill 2020 Comprehensive Plan, Town of Chapel Hill Greenways Master Plan, Chapel Hill Bike Plan, and Chapel Hill Mobility and Connectivity Plan. These documents outline the Town's mobility vision, goals, and implementation strategy. Of the four plans, three are focused on improving Chapel Hill cycling conditions and network connectivity. Each section includes a summary of the document contents, in relation to Chapel Hill mobility, and then identifies how Glen Lennox will be helping to accomplish Town goals.

2020 Comprehensive Plan (2012)

The Comprehensive Plan is an overarching document that directs Chapel Hill's future development to create attractive, vibrant communities abundant with opportunities for current and future residents. The document is guided by five big ideas and six key themes. One of the guiding themes for the future of Chapel Hill is "Getting Around", in which the document emphasizes the need to promote sustainable transportation options and connectivity to support the rest of the Town's goals.

Focus on Glen Lennox

The first big idea from the Comprehensive plan is to "Implement a bikeable, walkable, green communities plan by 2020", while the second is to "Increase the ratio of workforce housing by 2020". Partnerships with private developers has been recognized as a strategy to achieve Town targets, and Glen Lennox will be addressing both of these targets by increasing housing density, as well as promoting green mobility options in the neighborhood.

Greenways Master Plan (2013)

An update of the 2006 version, the Greenways Master Plan focuses on further developing the existing recreational trails throughout Chapel Hill. These greenways serve a vital role in the cycling connectivity of Chapel Hill. Through land acquisition and partnerships with developers, the Town will address existing gaps and connections to regional routes, while providing residents with more alternative transportation options to get around.

Focus on Glen Lennox

One of the Greenways goals is "To develop specific trails as alternatives to automobile transportation." Further building greenway cycling facilities in Glen Lennox will help the community reach this goal and move Chapel Hill towards reaching higher sustainable transportation mode shares. One of the identified Town priority greenways, Highway 54 route, approaches the southern edge of Glen Lennox and is the product of private developments. The master plan identifies building bicycle facility "connector routes" through Glen Lennox to connect to Highway 54 route and the Little Creek trail.

Chapel Hill Bike Plan (2014)

The Chapel Hill Bike Plan is the official document to outline bicycle specific objectives, strategies, and implementation. The plan emphasizes three key themes: safety, convenience, and choice. Creating the document involved public outreach to investigate cycling behaviors and preferences, as well as an analysis to discover Chapel Hill cycling challenges and assets. From this work, the plan identifies policy recommendations, short term infrastructure projects over the next 10 years (with associated priority ranking), and general bicycle facility improvements.

Focus on Glen Lennox

While collecting public feedback, residents identified that Raleigh Rd and Fordham Blvd are important corridors that need to improve cycling safety, especially at the intersection of the two roads. An analysis of the existing cycling facilities in and around Glen Lennox indicates that there is a gap connecting to the Little Creek greenway, just north of Glen Lennox, as well as gap along the Highway 54 route along Raleigh Rd. Bike Plan recommendations for the Glen Lennox site include: a north-south greenway from Highway 54 up to Little Creek, an extension of the Highway 54 greenway to Fordham Blvd, an extension of Highway 54 greenway up to Lanark Rd (adjacent to Fordham Blvd), and a bike lane along Brandon Rd to facilitate Fordham crossing.

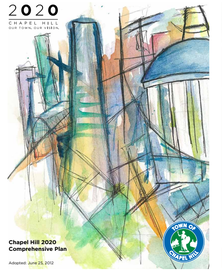
Mobility and Connectivity Plan (2017)

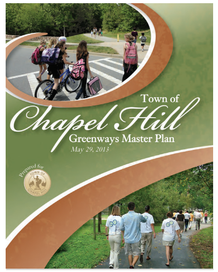
The Mobility and Connectivity Plan is an effort to create an integrated strategy for the development of transportation systems within Chapel Hill. The goal of the plan is to "achieve a 35% bicycling, walking, and transit commute combined modeshare in Chapel Hill by 2025." The plan promotes complete streets practices and strives to remove mobility barriers, while enhancing user experience. Through the plan, the Town has developed two classifications of mobility networks: major street corridors and priority non-motorized corridors. The mobility plan further builds on the Bike Plan, elaborating on topics such as bicycle parking, connections to transit, bike share, and how to cultivate an active transportation culture within Chapel Hill.

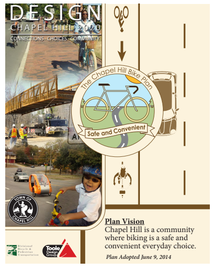
Focus on Glen Lennox

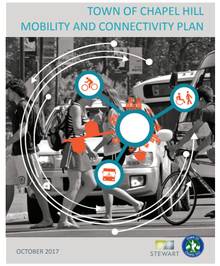
Both Raleigh Rd and Fordham Blvd are federally owned highways, undergoing road improvements within the next ten years. Fordham Blvd will be widened, multi-use pathways will be constructed, and intersection crossings will be made safer. Site improvements along Raleigh Rd will expand greenways and improve crossing safety along Glen Lennox. The non-motorized priority corridor - Cross Cities Connector - runs adjacent to the Glen Lennox site and incorporates the above recommendations.

For spatial references, see map on page 21.









CYCLING IN AMERICAN AND INTERNATIONAL CITIES

Much can be learned by following the lead of international cycling cities such as Copenhagen and Amsterdam. Communities across America have begun taking measurable steps towards becoming more bicycle-friendly and follow in these good examples. The following is a list of American communities that are home to a University and have comparable populations to Chapel Hill, as well as international cycling communities with established best practice design. This list allows us to benchmark Chapel Hill's bicycle progress in an American and international context. The following cities have been ranked in order from lowest to highest bicycle mode share to emphasize the conditions that have allowed for increased ridership.



Wilmington, Delaware

Identifying a need for safe and accessible bicycle facilities, the City of Wilmington created its Bicycle Plan in 2008. The plan proposes an integrated greenway and on-street facilities network, which also connects to the state network. Additional bicycle parking is also identified to be installed around the City. It is unclear as to how much Bike Plan progress has been made in the past decade.

- Population: 71,500
- Walk Mode share: 6%
- Transit Mode share: 13%
- ***Bike Mode share: 0.6%***



East Lansing, Michigan

Home to Michigan State University, East Lansing has an unconnected series of bicycle off and on-street networks. Furthermore, cyclists must register their bicycle with the Town and students must also register their bicycle with the university. Despite the City's barriers to cycling, East Lansing has a similar bicycle mode share to Chapel Hill.

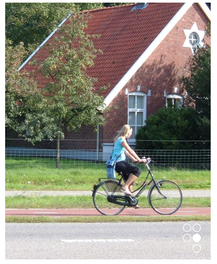
- Population: 48,700 - 2015
- Transit Mode share: 7%
- Walk Mode share: 21%
- ***Bike Mode share: 3.1%***



Davis, California

Dubbed the "Bicycle Capital of the United States", the City of Davis has a comprehensive Bike and Pedestrian Program to improve the walk, bike, and transit experience. The dedicated bicycle network is comprised of over 70 miles of pathways, 50 miles of bike lanes, 2 miles of bicycle boulevards, 1 mile of cycle track, and 2 miles of buffered bike lanes. To assist bicycle movements, Davis has numerous grade-separated crossings, overpasses, underpasses, and bicycle intersection lights. Davis strives to become a world-class bicycling city, achieving a bicycle mode share of 30% by 2020.

- Population: 66,500 - 2015
- Walk Mode share: 4% (UCDavis 7%)
- Transit Mode share: 6% (UCDavis 19%)
- ***Bike Mode share: 21% (UCDavis 45%)***



Enschede, The Netherlands

In the early 20th century, the small Dutch city of Enschede had some of Europe's highest bicycle modeshares. Similar to the rest of the world, Enschede experienced a dramatic decline in bicycle ridership at the end of the 20th century; however, strong cycling policies ensured that the bicycle regained its past popularity. Enschede has achieved this through prioritizing a continuous and integral bicycle network. Similar to Chapel Hill, Enschede is a relatively small community with a popular educational institution, the Universiteit Twente.

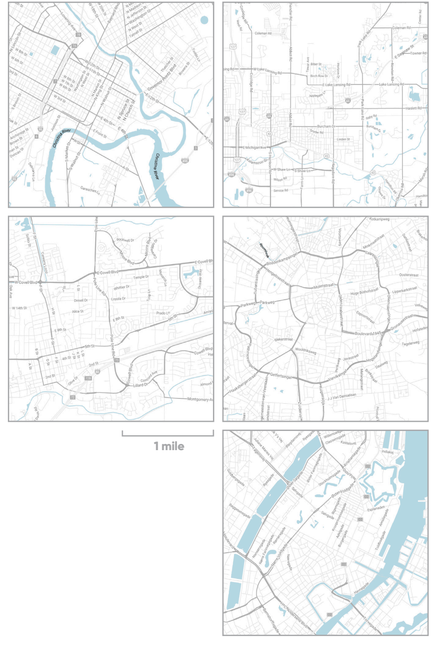
- Population: 157,000
- Walk Mode share: Approximately 25%
- ***Bike Mode share: Over 40%***



Copenhagen, Denmark

The Danish 'City of Cyclists' has one of the world's highest bicycle modeshares. Copenhagen is a global leader in providing cyclists with best-practice, protected bicycle facilities. Approximately 62% of people working and studying in Copenhagen arrive by bicycle. Copenhagen also offers connections between different types of transportation, such as the ability to take your bike onto the commuter train.

- Population: 580,000 (2014)
- Walk Mode share: 10%
- Transit Mode share: 17%
- ***Bike Mode share: 62% local & 45% including surrounding communities***



GLEN LENNOX IN CONTEXT

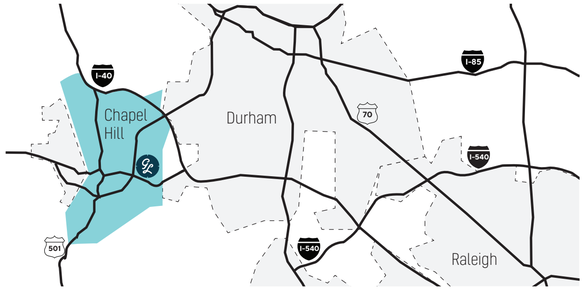
Taking a quick dive into the physical context and understanding the potential strengths, weaknesses, opportunities and threats will allow for a more informed assessment of how to move forwards in Glen Lennox with innovative recommendations for a bicycle-friendly future.

THE GLEN LENNOX NEIGHBORHOOD

Glen Lennox has been dedicated to providing its residents with a welcoming community since its establishment in 1953. For six generations, the neighborhood has embodied the charm and attraction of living in a friendly and convenient community with a total of 396 single floor apartments and a local shopping area. Even though the neighborhood is a product of its birth era, the neighborhood continues to offer affordable rental options for Chapel Hill residents.

Acknowledging its historic and local value, the Town of Chapel Hill created a Neighborhood Conservation District Zoning Overlay for the Glen Lennox property to "protect distinctive neighborhood characteristics". Glen Lennox is committed to preserving this iconic character, while preparing for the future by establishing an attractive residential, office, retail, and recreational destination. As advertised, it will be the "confluence of innovation and opportunity", while creating a "centre of creativity and commerce".

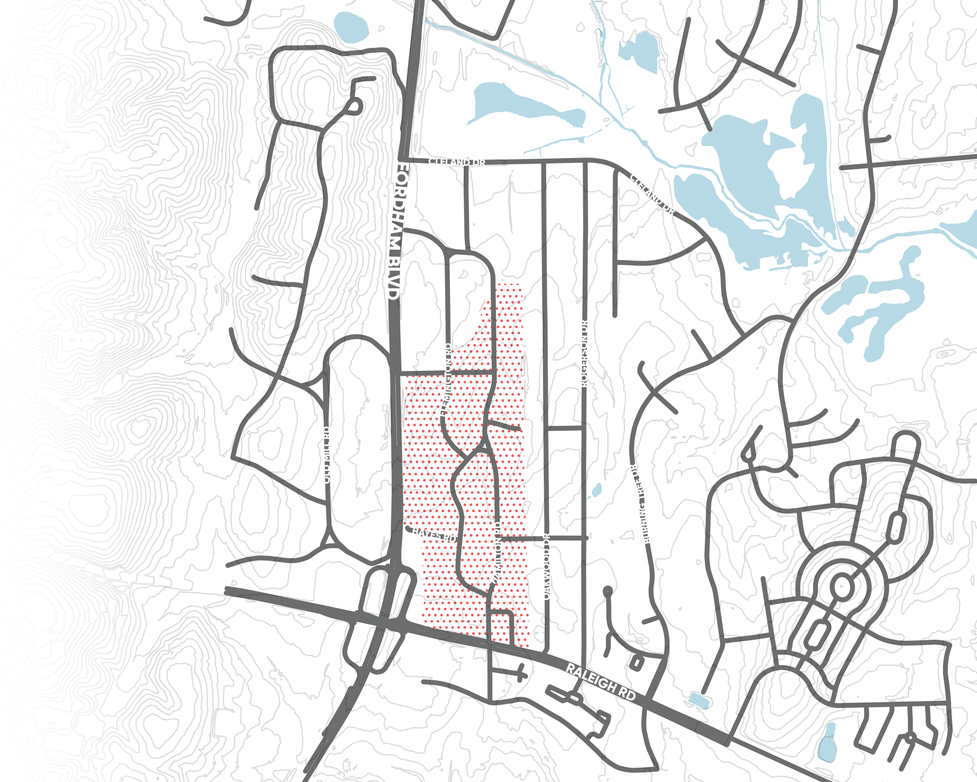
Glen Lennox aspires to become an innovative and desirable destination, which is further granted by its accessibility from local and regional locations. Located within the Triangle region of North Carolina, Glen Lennox is framed by the University of North Carolina in Chapel Hill, North Carolina State University in Raleigh and Duke University in Durham. Due to its proximity to universities and the Research Triangle Park, Glen Lennox is situated within one of the top five employment and population growth markets in the nation.



The Property

The Glen Lennox property is approximately 70 acres of land along a relatively flat ridgeline. The subtle topography of Glen Lennox, and the eastern areas of Chapel Hill make it a leisurely biking destination. Capitalizing on the natural assets of the Eastern side of Chapel Hill, the Town has developed numerous greenway trails that are easily accessible from Glen Lennox, such as the Bolin Creek Trail, Little Creek Trail, the East 54 Highway trail.

Currently there are no on-street bicycle facilities around the Glen Lennox site, however, the Chapel Hill Bike Plan has identified future projects along Raleigh Road. When travelling west along Raleigh Road, bicycle riders will encounter steep elevation gains towards UNC and downtown. Many of the Town's major destinations are either north or west of the Glen Lennox site, and are within a quick 15-20 minute bike ride up the hill.



UNDERSTANDING THE GLEN LENNOX LANDSCAPE

Strengths Weaknesses Opportunities Threats (SWOT) Analysis:

With an understanding of the U.S., Chapel Hill and Glen Lennox context, more informed decisions can be made about how to ensure that Glen Lennox becomes the most bicycle-friendly community in the Carolinas, while also facilitating Chapel Hill and greater Triangle bicycle connectivity. A Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis is a strategic tool to simplify and better understand complex decision making processes. The following SWOT analysis frames the challenges and opportunities, as well as inform where project funding and attention must be prioritized when transforming Glen Lennox into a bicycle friendly community.

S

- The Glen Lennox neighborhood is located 2.5 miles, or approximately a 15-20 minute bike ride from the University of North Carolina and a number of important local destinations.
- Town council is agreeable in promoting the bicycle as a viable transport option and is willing to help improve the bicycle friendliness of Glen Lennox as an important community in Chapel Hill.
- Glen Lennox was granted Neighbourhood Conservation District zoning and the redevelopment project is identified as an important Chapel Hill Capital Improvement Project.

W

- The Chapel Hill Bike Plan does not always promote bicycle infrastructure for all ages and abilities and sometimes proposes infrastructure that is not suitable for certain road contexts from a user experience perspective.
- Many Chapel Hill residents have demonstrated a perception that it is currently not safe enough to ride a bicycle in their community.
- Many of the existing on-street bicycle facilities in Chapel Hill are painted lanes or sharrows, which do not attract riders of all ages and abilities, and also do not connect to Glen Lennox.

O

- There is a growing demand for more sustainable transportation options in Chapel Hill.
- Glen Lennox will fill in existing cycling infrastructure gaps in the greenway network and on-street bicycle routes, facilitating community connectivity and mobility corridors.
- Chapel Hill's mild climate, young demographic, and upcoming cycling projects create the conditions for an unharnessed bicycle potential.

T

- Both Raleigh Rd and Fordham Blvd experience very heavy traffic flow, which could potentially cause bicycle and vehicle conflicts as well hamper positive perception for utilitarian bicycle use among all types of potential users.
- When travelling west along Raleigh Rd, towards UNC and downtown, there are elevation changes that deter some bicycle users.
- The auto-centric urban design and the vehicular dependance in Chapel Hill will present difficulties and resistance to introducing bicycle design to community streets.

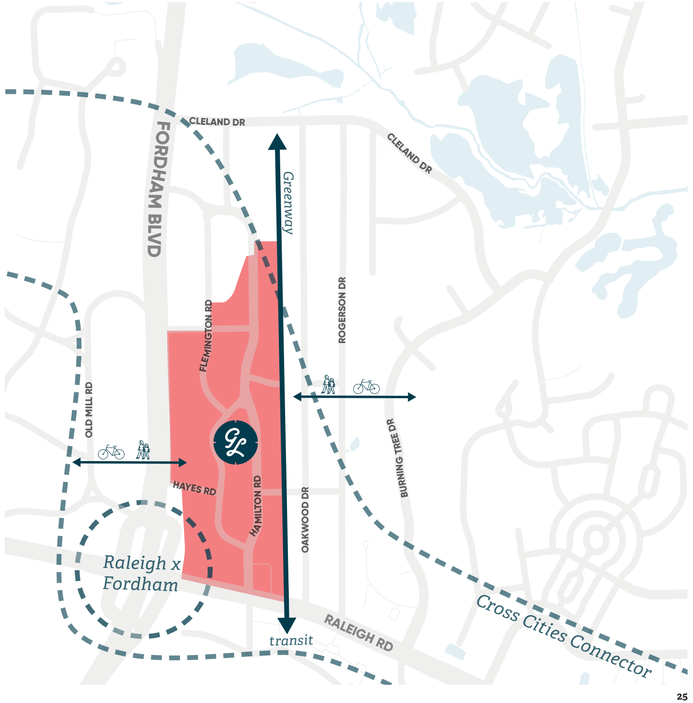
Mobility Plan Goals for Glen Lennox

Chapel Hill's outward expansion is restricted by a green belt development ban. For this reason, the 2020 Chapel Hill Comprehensive Plan identifies Glen Lennox, along with other development sites, as opportunities to build up housing stock and densify the community. After redevelopment, Glen Lennox will be one of Chapel Hill's densest neighborhoods, offering various affordable housing types and making it easier to get around the community. To suit the needs of the modern American lifestyle, Glen Lennox has prioritized sustainable transportation options within the neighborhood and facilitating community connectivity. As identified in the Chapel Hill Mobility Plan, Glen Lennox will:

- Serve as a vital link for the Cross Cities Connector, a priority non-motorized transportation corridor
- Enhance the walkability and bikeability within the neighborhood and to Chapel Hill destinations
- Improve crossing safety at Fordham Boulevard and Raleigh Road
- Introduce Transit-Oriented Design to ensure access to public transportation
- Create a new north-south greenway route that will connect to the Town and regional greenway networks
- Install bike lanes on designated routes in the neighborhood.

As identified by the Mobility Plan, Glen Lennox is situated at the intersection of two vital street corridors. Raleigh Road (highway NC-54) is a major east-west corridor that connects the University of North Carolina to communities East of Chapel Hill, and on average experiences 25,000 to 50,000 cars a day. While Fordham Blvd (highway 15-501) is a state corridor that cuts Chapel Hill north to south, experiencing 30,000 to 50,000 cars a day. Both corridors have been assigned site improvements for pedestrian, bicycle, and vehicular facilities over the next 10 years, and will experience upgrades within the same time frame as Glen Lennox redevelopment.

Glen Lennox strives to become the most bicycle friendly neighborhood in the Carolinas, and will prioritize creating safe, convenient bicycle facilities. By preserving past character and facilitating future growth, Glen Lennox will be an exemplary community of walkability and bikeability for the future of Chapel Hill.



WHO LIVES THERE TODAY?

The scenic, welcoming nature of Glen Lennox has attracted residents to the neighborhood since the 1950s. Dozens of families have lived in the neighborhood and these residents have also changed over time. To better understand these current residents and how they get around their community, the Copenhagenize team held a series of public workshops to understand mobility experiences in and around Glen Lennox. During these workshops, residents shared their travel behaviors, preferences, and desires for the future.

American census data allows us to zoom into the Glen Lennox and Meadowmont area to explore the demographics currently residing in this 1 square mile of Chapel Hill. Within this focus area, resident median age is 31 years old, and households have an average of 2.2 members. Of these households, 50% are comprised of married couples. Resident demographics, median incomes, and site observations, indicate that Glen Lennox is home to many young families with average incomes. Understanding how these families, as well as surrounding neighbors, get around Glen Lennox offers insight on neighborhood transportation opportunities and limitations.

Household Median Income



Glen Lennox Household Median Income = $57, 300

National Household Median Income = $57, 600

Transportation behaviors are key indicators because they shed light on how urban design impacts people's everyday lives. Whether traveling to employment, education, shopping, and/ or leisure destinations, people are constantly moving around their communities. Having options to freely move around one's neighborhood impacts quality of life. Access to walking and biking facilities further enrich a community and provide options for people to leisurely enjoy their home. By capturing how people actually get around, versus their desire to get around, we can identify existing mobility gaps and propose improvements.

What do we know already?

The Town of Chapel Hill and University of North Carolina have investigated travel behaviors within the community. Public outreach from the Chapel Hill Mobility Plan discovered that 93% of respondents own a vehicle, and 73% of these people use a vehicle as their primary means of transportation. Meanwhile, the 2015 University of North Carolina Mobility Plan explores student and employee travel behaviors when commuting to campus. With half of the Chapel Hill population either studying or working at UNC, its findings are reflective of behaviors across the town.

30% of UNC employees and 70% UNC of students live within a bikeable 5 miles of the university.

In the report, survey responses identified that 30% of employees and 70% of students live within a bikeable 5 miles of the university. When asked why employees do not cycle to campus, 16% of respondents reported they did not feel safe and 10% stated insufficient infrastructure. While 17% of students responded that they did not ride a bicycle because they felt unsafe, 13% cited insufficient infrastructure, and 19% claimed it is too hilly. These findings suggest that to increase the current 14% student and 5% employee bicycle ridership rates, conditions need to feel safe and comfortable.

PUBLIC OUTREACH

In March of 2018, the Copenhagenize team visited Glen Lennox to engage with local residents, neighbors, and stakeholders. The team met with a number of community and official stakeholders and hosted three workshops with UNC students, Glen Lennox and Chapel Hill residents to inquire about their mobility behaviors and experiences of getting around the community. Holding these sessions provided insight into the options available to residents in order to tap into this knowledge and begin to understand mobility challenges and how and where to provide more transportation options. The workshops were structured along the following three sections:

Mobility Survey

Each participant filled out an anonymous Mobility Survey to provide details on their demographics, travel behaviours, and mobility preferences. Survey responses illustrate how people living in Glen Lennox and surrounding neighborhoods get around their community, and how they wish transportation options could improve in the future.

Travel Patterns and Barrier Mapping

To further understand people's experience of getting around Glen Lennox and Chapel Hill, participants were asked to mark on a map the common routes they take and the barriers or challenges they encounter when traveling.

Bicycle Friendly Visioning

The final activity sought to explore the connection between current mobility patterns and what residents desire for the future. Residents are instructed to imagine the future of Glen Lennox and discuss the vision with the group.

People drive – a lot

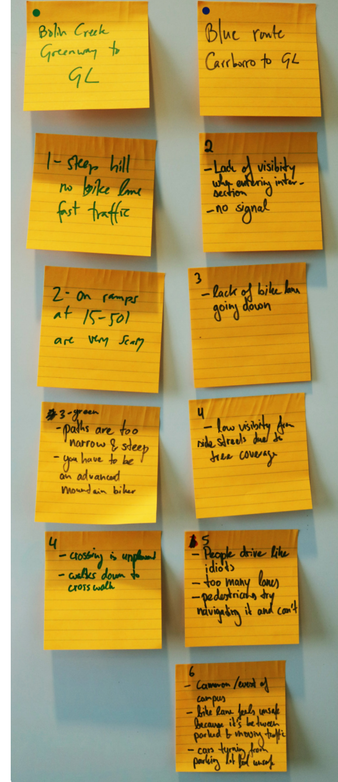
Survey responses confirmed that driving is, on average, the primary means of getting around Chapel Hill. Reflected in survey responses and Chapel Hill outreach, nearly every household owns at least one vehicle, and uses it on a daily basis. People feel that common destinations such as downtown, Carrboro, UNC, and shopping centres are most easily accessible by vehicle. For this reason, many people expressed that owning a vehicle was necessary because they felt they didn't have any other choice: walking and biking is not safe enough, and the bus is not reliable. Overwhelming dependence on vehicles indicates that the residents of Chapel Hill and Glen Lennox lack viable alternatives to reach their destinations.

"I had to buy a car because I make frequent trips to places that have no bus routes to them"

People bike for fun

Survey responses suggest that, after driving, people's secondary mode of transportation is walking, followed by riding a bicycle. Residents shared that most homes own multiple bicycles and accessing a bicycle is not a problem. Even though most people have access to a bicycle, they do not choose to walk or bike to their destinations. Alternatively, the Chapel Hill Mobility Plan and workshop surveys report that people predominantly use a bicycle for recreational, leisure, or health purposes. When enjoying leisurely bicycle rides, families and individuals will meander along the numerous greenways throughout the community. While most Chapel Hill residents have access to a bicycle and enjoy riding a bicycle for fun, but people do not bike as a main mode of transportation.

"Greenways are great! Nice, safe, and you can daydream while you bike"





WHAT IS IT LIKE TO WALK AND BIKE IN AND AROUND GLEN LENNOX TODAY?

To explore the walking and cycling experience of Chapel Hill residents, the Copenhagenize team lead an interactive mobility mapping exercise. The intent of the activity was to explore the barriers and challenges that people face when taking common routes around the community. Through mapping their experiences, participants were able to share stories and collectively discuss how they felt about walking and biking around Glen Lennox and Chapel Hill.

From mapping resident experiences, participants resoundingly agreed that they would like to walk and bike to their destinations, but hold reservations about existing conditions. This hesitation was captured in the following statement:

"I won't bike unless it's protected"

Participants expressed a collective desire to cycle more, but only if existing conditions improve. During the mapping activity, aspects of their community were identified that make cycling uncomfortable, unsafe, or prevent them from riding.

In line with the UNC Mobility Plan and the Chapel Hill Mobility Plan, participatory mapping reiterated that residents feel riding a bicycle is not safe. Street safety and crossings were the most common themes to emerge during the Chapel Hill Mobility feedback, followed by facility conditions, and connectivity. Themes of safety and crossing also arose during workshop mapping; participants stated that roads and intersections in Chapel Hill are not designed for active modes of transportation. Framed by Raleigh Road on the South and Fordham Boulevard on the West, Glen Lennox specifically faces many of these safety challenges. Residents want to ride their bicycles to get around, but many mobility challenges make it feel unsafe and risky.

"Safe crossing is currently the biggest problem"

"If it's safe for kids, it will be safe for everyone!"

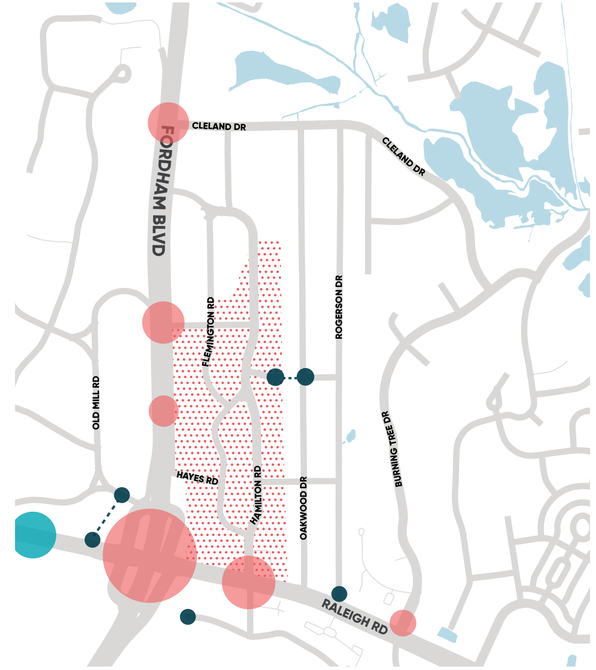
Barriers make people feel unsafe

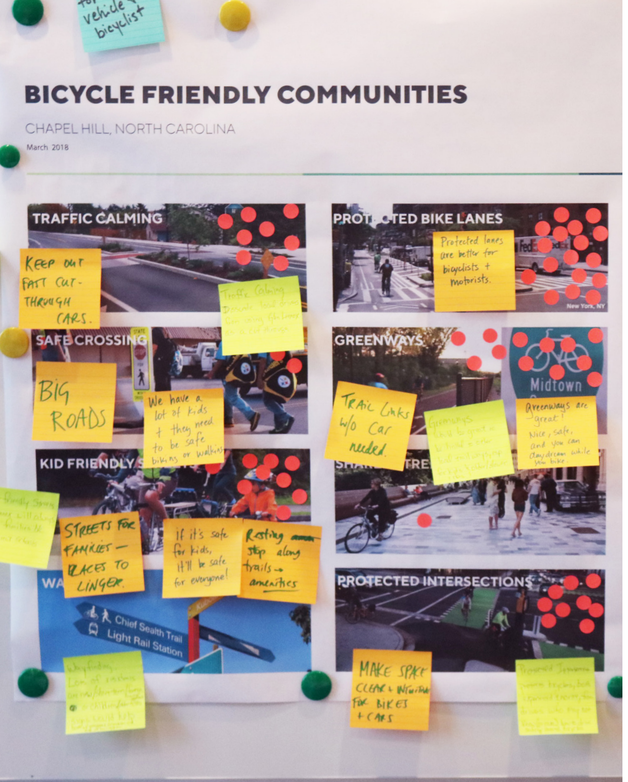
While safety overall was mentioned as the biggest challenge to walking and biking in Chapel Hill, certain phiysical conditions make people feel unsafe. Two major barriers identified in the Chapel Hill Mobility Plan are gaps in the existing network and lack of protected facilities. Similar to these findings, the mapping activity identified specific barriers that people encounter while moving on foot or bike. The map to the right identifies specific barriers like unsafe crossings, missing infrastructure, and poor visibility for walking and biking.

"The 54 intersection is why my kid doesn't ride her bike to school"

General barriers encountered while walking and biking around Glen Lennox include:

- ***Heavy, fast traffic***
- ***Drivers not paying attention to people walking or biking***
- ***Absent signage and wayfinding***
- ***Lack of safe facilities***
- ***Hilly terrain***
- ***Poor connections from greenways to on-street facilities***





WHO ARE THE GLEN LENNOX RESIDENTS OF TOMORROW?

Census information and public engagement shine light on who currently lives in Glen Lennox and how they get around, but what will the future of Glen Lennox look like? Glen Lennox strives be a national leader and an attractive neighborhood for many new residents. The redevelopment process will offer prospective residents various housing options, nestled in a neighborhood that promotes a comfortable quality of life. The neighborhood will feature access to greenways, parks, recreational open space, as well as community centres for people to enjoy at their leisure. Built structures are undergoing renovations and future plans estimate:

- around 1,400 multifamily units
- over 500,000 sq ft of office space
- over 100,000 sq ft of retail
- a new hotel

Workshop participants were asked to envision and discuss a bicycle friendly future for Chapel Hill. A large poster displayed twelve different features of a bicycle friendly community to demonstrate how a neighborhood can look when active transportation is prioritized. Each participant was asked to vote for their preferred features by assigning stickers on the bicycle friendly poster. After three workshops, the poster was able to spur significant discussion about the desired features of a bicycle friendly Glen Lennox. Through this activity, members were able to share what is important to them and discuss their vision for the future.

The top five features identified were:

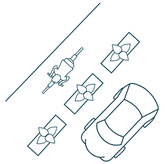
1. Protected Bike Lanes

2. Greenways

3. Kid Friendly Streets

4. Protected Intersections

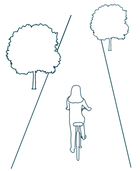
5. Traffic Calming



1. Protected Bike Lanes

The clearest take-away from discussions surrounding the future of Glen Lennox is that people value protected, dedicated spaces to walk and ride a bicycle. Whether participants identified as confident or cautious bicycle riders, or not interested at all, everyone agreed that protected bicycle lanes are safest for all road users. Safety is people's most prominent concern, and separating vehicles from bicycles helps to ensure people feel safe. Participants said they would like to see protected bicycle facilities in the future of Glen Lennox.

"Protected lanes are better for bicyclists and motorists"



2. Greenways

Another means of providing Glen Lennox residents with protected bicycle facilities is to create more Greenway connections, away from the street network and more connected to nature. Greenways are a desirable link to Chapel Hill trails for commuting and leisure uses. These facilities provide mobility options to families with children, seniors, and those wanting to casually get around town. Chapel Hill residents highly value Greenways and wish to see more throughout Glen Lennox.

"Greenways would be great to link to other local trailways, esp for kids and older, slower riders"



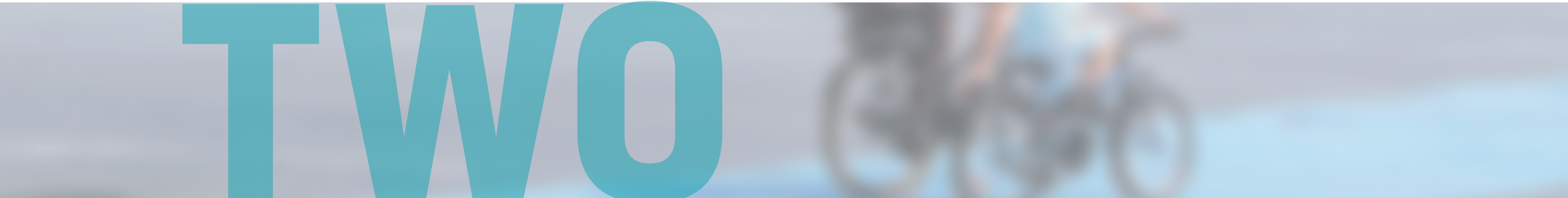
3. Kid Friendly Streets & Protected Intersections

Participants' third most common response was split between kid friendly streets and protected intersections. General feedback throughout the entire workshop series focused on ensuring safety for everyone, especially children. The importance of creating bicycle friendly communities with kid friendly streets was echoed in each activity. Participants expressed that protected intersections, traffic calming, and safe crossings are also integral features of kid friendly streets.

"Protects bicycles, both experienced and novice, from drivers who may not know (or care) how to drive safely around bicycles"

TWO

REGIONAL
CONTEXT
MAPPING



TAKEAWAYS

1. ***The bicycle is the only transport mode that rivals the car in Chapel Hill, since the majority of local destinations can be accessed within a bikeable distance of Glen Lennox.***
2. ***Many existing bicycle routes do not connect users directly to destinations in Chapel Hill nor do they offer a level of safety for users of all ages and abilities.***
3. ***Strong opportunities exist to better connect future and existing transit users to more distant destinations through bicycle-transit trip-chaining.***
4. ***The major street corridors in Chapel Hill offer the most direct connection opportunity by bicycle, if they can be made safe through protected facilities.***

INTRODUCTION

Glen Lennox's future success as the most bicycle-friendly community in the Carolinas strongly depends on how convenient and comfortable the bicycle can become to residents and other Chapel Hillians. There are many factors that determine how widespread the bicycle will be adopted in a given city and many of these factors are rooted in the perception and experience of cycling. Important questions to this effect often take the following forms:

Is biking a reliable mode of transportation for me? Does it get me where I want to go quickly? Do I feel safe when I ride my bike?

The most successful cycling communities, such as Copenhagen or Amsterdam, are the result of planning efforts that establish the infrastructure and conditions to make cycling the most convenient and therefore the most logical choice of transportation for the largest number of people possible. This chapter focuses on the elements that influence whether or not Glen Lennox residents might presently feel like the bicycle is convenient for them, offers an analysis of Chapel Hill's proposed bicycle-related planning efforts and benchmarks Chapel Hill against international best practice. As the mandate for Glen Lennox strives for the development of an ultra bicycle-friendly community, all analyses, even though they consider greater Chapel Hill, are focused through the lend of current and future Glen Lennox residents. Due to the relatively small size of Chapel Hill as well as Glen Lennox's standing as one of the Town's capital projects, the analyses also outline and demonstrate the potential of Chapel Hill becoming more bicycle friendly as a whole, connecting to and through Glen Lennox.

The chapter is structured to answer the three questions of reliability, directness and safety:

First it focuses on the most important destinations found in Chapel Hill and the larger Triangle region as a means of understanding where Chapel Hillians work, shop and spend leisure time on a daily basis.

Secondly, the chapter focuses on existing street design, bicycle infrastructure, public transit and land use, and the challenges and opportunities to create connections and make Glen Lennox the most bicycle-friendly community in the Carolinas.

The last section analyzes Chapel Hill's street network to determine streets that are the most important for local connectivity to Glen Lennox and long-term non-motorized mobility planning.



The iconic image of the Glen Lennox community has the opportunity to be redefined as a forward-thining neighborhood that prioritizes intelligent mobility

UNDERSTANDING

DESTINATIONS

To position Glen Lennox as the most bicycle friendly community in the Carolinas a thorough analysis of the existing conditions on the ground are necessary – requiring an in-depth inventory of what is in, around and beyond the site. Understanding the layout, concentration and distance to important destinations can start to give us a sense of where existing andf future Glen Lennox residents might need and want to travel. In turn, this allows for insightful recommendations to improve the travel experience in the area.

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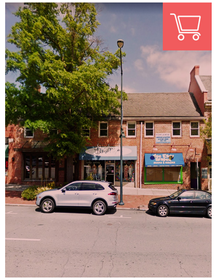
LOOKING BEYOND GLEN LENNOX FOR RESIDENT DESTINATIONS

With the redevelopment of Glen Lennox there will be a newly invigorated, modern and vibrant community within Chapel Hill whose residents will attend UNC, work in the Research Triangle Park and go out for meals on both Franklin Street and within the Glen Lennox property. As examples such Copenhagen or, in the American context, Portland show us – the widespread adoption of the bicycle goes hand-in-hand with utilitarian rather than recreational cycling. The goal of making Glen Lennox the most bicycle-friendly community in the Carolinas therefore hinges upon ensuring that residents can use the bicycle to get where they want to go. As a result, any analyses of the current bicycle infrastructure, future planning efforts and the identification of gaps and barriers must first be rooted in the simple questions:

Who are Glen Lennox residents and what destinations might be important to them?

Looking beyond Glen Lennox also brings tremendous opportunity to the Town of Chapel Hill. By connecting Glen Lennox residents to the destinations in Chapel Hill and beyond, other folks will benefit from a well-connected network. Furthermore, Glen Lennox's standing as one of the Town's capital projects means that once completed, the development itself will also be an important destination. New commercial locations, 102 000 square feet of office space as well as convenient access to regional public transit services such as the GoTriangle bus routes and the planned LRT will make Glen Lennox an important part of Chapel Hill's urban fabric. By preemptively creating bicycle connections between Glen Lennox and the rest of Chapel Hill, the town would be harnessing the opportunity to alleviate some of the traffic congestion on Raleigh Road and Fordham Blvd and addressing some of the concerns about congestion on these corridors voiced by Chapel Hillians in the 2015 community survey.

To begin, an inventory of important destinations give us an understanding of how Glen Lennox sits within the context of the Town. The identified destinations can generally be divided into four different categories: commercial, institutional, employment and recreational.



Commercial

Like many North American municipalities, Chapel Hill's large malls and big box store complexes make up the main shopping destinations. However, Chapel Hill's vibrant core with Franklin Street acting as the commercial main street offers many shopping options beyond major chains and also is where most restaurants are found. In recent years, smaller commercial spaces were established as part of new residential developments such as Meadowmont or the Southern Village, which model traditional village centres and give residents local shopping opportunities within walking distance.



Employment

The Triangle region's density of universities means that a high percentage of the population either being employed in research or administration. In 2014, UNC's staff as well as the employees at UNC hospital on campus, jointly had almost 20,000 people working on campus. This number is more than ⅓ of Chapel Hill's entire population. A similar picture can be found in Durham, where Duke University and its associated hospital also are the largest employers in the city. Another major employment destination is the Triangle Research Park, which is located halfway between Chapel Hill and Durham and is where research campuses of such internationally known tech companies like IBM or Cisco are found. It is important to note that there obviously are many employees who do not work in research and administration but rather in the service or industrial sectors. However, these can often be found in Chapel Hill's downtown or the commercial centres and do not offer as high concentration of employment opportunities.



Institutional

One of the defining characteristics of Chapel Hill and the entire Triangle region is the high density of universities. Around half of Chapel Hill's population are students and UNC, located at the heart of Chapel Hill, is not only an important institutional body within Chapel Hill, but also a significant employment and recreational centre. As Glen Lennox currently has a higher percentage of children than the Chapel Hill average, the location of schools is especially relevant to the analyses. Other important centers such as City Hall, Chapel Hill library and the Raleigh-Durham International Airport also fall into this category.



Recreational

The recreation category predominantly focuses on the recreational and leisure destinations in the Carrboro/Chapel Hill region such as community centres, venues for culture & sports, as well as recreational spaces such as parks. The category includes destinations like the Rainbow Soccer Fields north of Glen Lennox and the Carrboro Farmer's Market, which, while commercial, also acts as a place of leisure. These destinations like parks can be leveraged for active transportation as they often already offer protected non-motorized mobility options and connections.



Cycling in Meadowmont on a painted bicycle lane, adjacent to the Glen Lennox property.

WHERE DO PEOPLE GO IN CHAPEL HILL?

Regional Destinations:

When looking at the regional destinations surrounding Chapel Hill, it is notable that all destinations outside of the Carrboro/Chapel Hill agglomeration are most easily, and in some cases exclusively, reachable via highways 501 and Interstate 40. This is hardly surprising as highways offer the quickest connections between cities in the Triangle region and most of the regional destination are institutions such as an airports, business parks and mall complexes, which are often located near highways in the North American urban context. Since most of these destinations are also outside of the 3 mile radius most people are willing to regularly cycle, it is clear that the bicycle cannot be the primary mode of transportation for Glen Lennox to access regional destinations. However, opportunities of harnessing the bicycle for intermodal trip-chaining (the process of using more than one mode of transportation per trip) is a viable alternative that will be presented later in this report.

Local Destinations:

The local destinations are the ones that Chapel Hillians visit on a daily basis, such as grocery stores, schools and employment centers. When we map these out, we tend to see specific areas within Chapel Hill with distinct types of destinations, rather than a big mix all over. Stores and commercial corridors (with the exception of Franklin Street) are located on or in close proximity to the town's major streets such as Raleigh Road, Fordham Boulevard or M.L.K. Jr Boulevard. Schools and community centers, on the other hand, are not located on the major arterials, but rather in close proximity to larger collector streets such as Estes Drive. They generally are on the edge of the residential developments they serve. Places of employment and other institutional buildings such as Chapel Hill City Hall are found in and around UNC's campus in the town's core.

The map to the right outlines that in order to reach important destinations in Chapel Hill, it is necessary to access the town's major streets since destinations are often found right on those streets, offer the necessary connections between places of employment, institutions and commercial space.

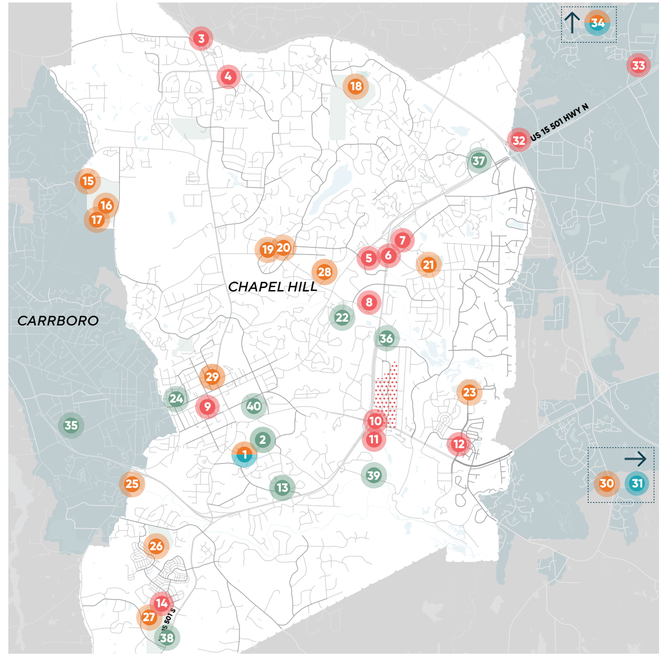
3 Chapel Hill North
4 Timberlyne
5 Village Plaza
6 Eastgate Mall
7 Rams Head Plaza
8 University Plaza
9 University Square
10 Glen Lennox
11 Glenwood Square
12 Meadowmont
14 Southern Village
31 Research Triangle
32 Patterson Place
33 South Square

1 UNC / UNC Hospital
15 Chapel Hill High School
16 Smith Middle High School
17 Seawell Elementary School
18 East Chapel Hill High School
19 Phillips Middle School
20 Estes Elementary School
21 Ephesus Elementary School
23 Rashkis Elementary School
25 Frank Porter Graham Elementary
26 Culbreth Middle School
27 Scroggs Elementary School
28 Chapel Hill Library
29 Chapel Hill City Hall
30 Raleigh-Durham Int. Airport
34 Duke University / Duke University Hospital

1 UNC / UNC Hospital
31 Research Triangle Park
34 Duke University/ Duke University Hospital
37 Blue Cross/Blue Shield

2 Kenan Stadium
13 Dean Smith Center
22 Community Center
24 Hargraves Community Center
35 Carrboro Farmers Market
36 Rainbow Soccer Complex
38 Southern Community Park
39 Botanical Gardens/Finley Golf Club
40 Hooker Fields

Glen Lennox
Commercial
Recreational
Employment Centers
Institutional





Walking by Raleigh road can an overwhelming experience - with a high level of vehicular traffic.

DESTINATION ACCESSIBILITY FOR ALL MODES OF TRANSPORTATION

A Walk-shed for Glen Lennox:

The concept of a walk-shed is a powerful tool in assessing and understanding the walkability of a neighborhood – the ability to reach destinations easily and accessibly by foot. By visualizing the walk-shed along accessible streets rather than simply applying a buffer radius, it is possible to precisely show which destinations are accessible as well as identify significant gaps and barriers such as highways or large lots, which prolong a trip.

In order to understand the opportunities and challenges Glen Lennox faces in becoming the most bicycle-friendly community in Chapel Hill and benchmarking Glen Lennox's active transportation potential, this chapter expands the walk-shed concept to the bicycle, car and public transit service. Such a comparison allows for a quick visualization of the potential benefits the bicycle can bring to Glen Lennox residents in light of the strengths and limitations of each mode of transportation.

For the sake of comparing the four modes accurately, each map was created using the same travel shed of 10 and 20 minutes. The justification for this time intervals are based on numerous studies in both the North American and international context, ranging from the 20 minute neighbourhood, a planning approach where essential services are all located within a 20 minute distance by bike, foot or public transit, the 3 mile cycling standard in the North American planning context (which translates into 20 minute bike ride at a leisure pace), as well as the studies that have found that a 10 minute walk for transit and a 20 minute walk for essential services such a groceries are about the maximum a person is willing to walk.

The walk-shed shows that Glen Lennox has the potential to become a highly walkable neighborhood. Especially as the population and destination density within the development increases, residents will be able to reach many essential services such as employment centers and shops within a 10 minute walk. Further, the bus stops for the four local bus routes that run through or right by Glen Lennox are easily accessible by foot (which will be addressed in the public transit section) as well as the stop for the GoTriangle route to Raleigh.

Since most people are only willing to walk further than 10 minutes if absolutely necessary, walking alone is not a viable transportation option for Glen Lennox residents. Town-wide destinations such as UNC, Franklin Street, as well as most grocery stores are not accessible even within a 20 minute walk. It is important to note as well that the map shows the walkability potential of Glen Lennox and that the current reality on the ground can be quite hostile to pedestrians. The street configuration of Raleigh Road and Fordham Blvd, for example, gives very few crossing opportunities. Additionally, although not explicitly forbidden, the environment of Fordham Boulevard, which acts as a federal highway, does not lend itself to pedestrian use.





20 minutes

Destinations which fall on the walk shed

CHAPEL HILL TRANSIT BUS SERVICE TO GLEN LENNOX

FREQUENCY OF SERVICES

LINE	TIMES OF SERVICE	AVERAGE FREQUENCY	PEAK FREQUENCY	SATURDAY SERVICE
G	6:23am - 7:43pm	Every 47 minutes	-	Every 60 minutes from 9:00am-4:00am
HU	5:20am - 10:05pm	Every 31 minutes	20 minute service in the afternoon	No
S	8:40am - 7:00pm	Every 17 minutes	10 minute service during morning & evening rush hour	No
V	6:59am - 6.50pm	Every 44 minutes	-	Every 80 minutes from 9:30am-5:30am

Comparing Chapel Hill Public Transit bus lines' hours of service shows that public transportation is only viable to Glen Lennox residents during peak hours of service, creating conditions for residents not to reliably use it.

A Public Transit-shed:
In the 2015 Chapel Hill community survey the Glen Lennox-Meadowmont area was one of the few neighborhoods to express high satisfaction with their public transit connectivity both within Chapel Hill and beyond. When asked about the local service provided by Chapel Hill Transit specifically, Glen Lenn residents expressed satisfaction, but not high satisfaction. The reasons for both the high satisfaction with regional transit as well as lower satisfaction with local public transit can be easily understood when visualized in a public transit-shed map.

Glen Lennox residents currently have access to stops of four local bus routes (the G, S, V and HU lines) as well as the regional GoTriangle 800 line to Raleigh within a 10 minute walk. As the vast majority of GoTriangle bus stops are located in Chapel Hill's core, E Franklin St & Raleigh Rd, Glen Lennox is one of the few residential neighborhoods in the Carrboro/Chapel Hill agglomeration within walking distance of a regional bus line. The local routes G, V and S also provide connections to the GoTriangle line 400.

When focusing on local travel exclusively, the only corridor that is well connected by public transit within a 20 minute commute time and sees frequent service is Raleigh Rd between Glen Lennox and UNC.

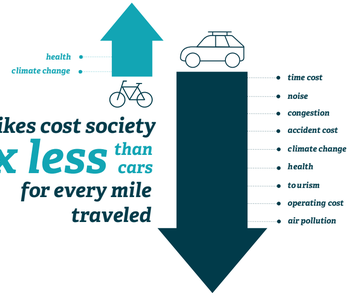


While this is an important connection for Glen Lennox residents, other parts of town, even within close proximity to Glen Lennox, are underserviced. University Place, an important commercial destination for Glen Lennox residents, is only reachable by the G line.

Public transit use is additionally complicated by the infrequent service. The result of this is that public transit travel time is often upwards of four times the amount the same trip would take by car.







Bikes cost society 6x less than cars for every mile traveled



"The average Raleigh-Durham resident ***spends 23 hours annually*** *sitting in car traffic"*

A Car-shed:

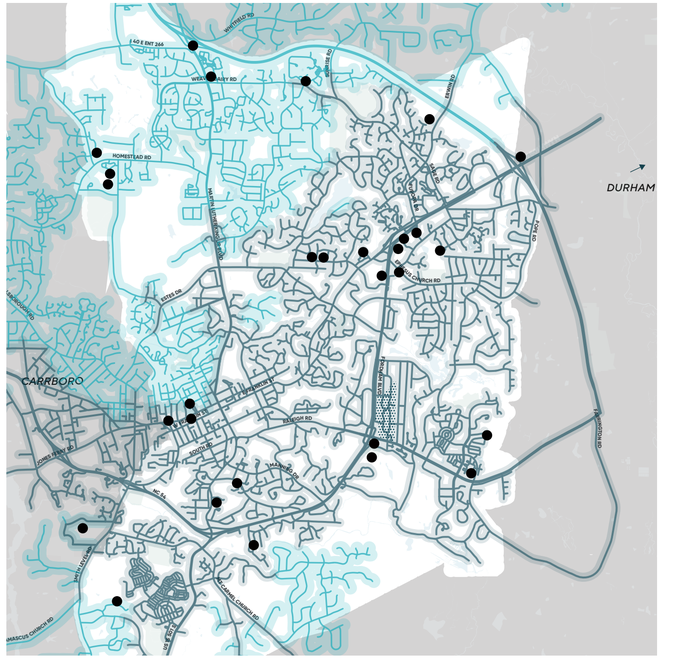
Hardly surprising, the car currently offers the highest level of mobility to Glen Lennox residents. Especially the development's location on the eastern end of Chapel Hill as well as on the corner of two major streets in Chapel Hill, Raleigh Rd and Fordham Blvd, lead to long-range connectivity. This connectivity enables Glen Lennox residents to easily access regional destinations such as Research Triangle Park, Duke University or even Raleigh-Durham International within 20 minutes. In comparison, the same trips by public transit will often take over an hour. Further, due to Chapel Hill's compact geography, every street in Chapel Hill is reachable within 20 minutes.



approx. 20 minutes

Similar to public transit use, however, the most significant weakness of travelling by car within Chapel Hill is reliability.

Due to congestion, which was listed as the number one concern expressed by Chapel Hillians in the 2015 community survey, commute times can often double depending on the time of day. As Fordham Blvd and Raleigh Road were identified by residents as the streets in Chapel Hill that experience the most congestion by far, residents of Glen Lennox are especially affected by varying commute times.





More than **65%** of North Carolina residents are overweight or obese

A Bike-shed:

As previously mentioned, the widespread adoption of the bicycle as a mode of transportation strongly depends on the utility it offers in conveniently reaching destinations. The Glen Lennox bicycle shed map demonstrates that there is strong potential for this utility on a local level. Within a 20 minute ride, almost ⅓ of Chapel Hill's geographic area can be covered by bicycle, which includes most important destinations within Glen Lennox.

The potential benefits to Glen Lennox residents of using a bicycle for local traffic instead of public transit or the car are also immediately noticeable. Within the same time period of 20 minutes, the areas reachable by bicycle vs by public transit are significantly higher, and the car only saves a small amount of time when comparing the travel time to major destinations. Another advantage of the bicycle is its reliability as it is not affected by congestion or infrequent service.

Within a 20 minute ride, all key destinations in Chapel Hill can be reached by bicycle



It must be acknowledged that the bicycle offers few advantages beyond the boundaries of Chapel Hill as all major regional destinations are outside the range most people would consider comfortable to ride on a daily basis. However, the bicycle's potential in creating better connections for Glen Lennox residents and other Chapel Hillians to regional bus lines will be discussed later on in this chapter.

As the shed maps are high-level analyses that only marginally consider factors such as street design, topology and land use, the following chapters will analyze the ground-level conditions in order to understand the realities of using a bicycle in Glen Lennox and beyond.



UNDERSTANDING

THE EXISTING STREET NETWORK & BIKE LINKS

In order to offer an informed assessment of Glen Lennox and its surrounding areas, it is key to first understand the local street network and existing bicycle facilities in place today. From this, we can identify the factors that make an environment bicycle friendly and offer stronger recommendations for improvement as Glen Lennox moves towards a future of smarter mobility options.

2.2

WHAT CAN BE LEARNED FROM INTERNATIONAL BEST-PRACTICE?

One of the most commonly used frameworks to understand cycling potential in North America communities is a study from the Portland Bureau of Transportation, that assessed the four types of cyclists (see to the right), a study the Town of Chapel Hill has also looked to in the 2014 bike plan and has been replicated similarly in locations all across America.

These studies demonstrate that when asked, the majority of people are open to the idea of using a bicycle (around two-thirds of the population), but that only a small fraction – often labelled as the 'strong & fearless' and 'enthused & confident' – are currently confident enough to presently cycle on their local roads. This study demonstrates the enormous latent potential of getting people onto bicycles if safe and reliable conditions are made accessible to users.

The main reservations expressed by this majority of 'interested but concerned' citizens generally surround safety as the most important barrier to entry. In most North American cities where bicycles laws and a lack of infrastructure often force bicycle users to either compete for space with cars or take long detours on local roads and green paths, these reservations are understandable. Only in the last decade have some American cities invested in bicycle infrastructure on a broader scale. The mindset that the bicycle is purely recreational and only usable to a small, brave fraction of the population is slowly changing. Grubb Properties sees an opportunity to partner with the Town of Chapel Hill to speed up this process in the Triangle Region and turn to international best-practice examples that would help increase the widespread adoption of the bicycle as an everyday mobility option.

The Town of Chapel Hill is seriously committed to the bicycle as viable mode of transportation as the community grows and develops more sustainable mobility habits. This chapter is forward looking and seeks to contrast the Town's planning efforts to international best-practice bicycle urbanism, in an effort to understand how Glen Lennox can best be leveraged and integrated into a sustainable mobility network that attracts new cyclists to hop on their bikes in the greater Chapel Hill area.

Four Types of Cyclists

- **No Way No How**
- **Interested but Concerned**
- **Enthused and Confident**
- **Strong and Fearless**



●○○○ *There is usually a third of the population that will not or cannot ride a bicycle*

○●○○ *Most people state that they would use their bicycle if they felt it was a safe and connected option*

○○●○ *A small number of people are existing bicycle users and will ride in most but not all conditions*

○○○● *Only a tiny fraction of the population define themselves as 'cyclists' who will ride where and whenever*









WHAT BICYCLE FACILITIES EXIST NEAR GLEN LENNOX TODAY?

Before reviewing existing infrastructure in Chapel Hill through an international best-practice lens to identify opportunities for Glen Lennox and Chapel Hill as a whole, it is important to first understand what currently exists on the ground. The Town of Chapel Hill currently has four different types of bicycle facilities: off-street greenways, sharrows, painted lanes and buffered painted lanes. This section defines each existing and planned infrastructure type and discusses its level of perceived and actual safety and comfort to a bicycle user in Chapel Hill.

Sharrow

A sharrow, a portmanteau of the words 'shared' and 'arrow', is a pavement marking used to indicated that a traffic lane is meant to be shared between motorists and bicycle users. It is predominantly used on quiet neighbourhood streets in the North American context, but sometimes can even be found on large arterial streets such as Martin Luther King Boulevard in Chapel Hill. For many local streets where cars are forced to drive at a slow speed, shared lanes offer a relatively high level of comfort, although these streets usually do not offer the most direct routes for bicycle users. Investing in traffic-calming elements such as speed bumps, bump-outs or traffic diverters formalize these routes and guarantee that shared streets are actually shareable.

Buffered Painted Lanes

Buffered painted lanes are regular painted lanes that have been amended with a painted buffer (or additional horizontal distance) of about one foot width. These painted buffers can be found on some streets with high traffic volumes in Chapel Hill and are meant to signalize to motorists that a higher safety distance should be kept from cyclists. Although buffered lanes can be found on streets with high traffic volumes and speeds, they do not necessarily offer users a higher level of perceived and actual level of comfort and safety, without a physical separation and protection from heavy motorized traffic.

Painted Lanes

The majority of existing bicycle infrastructure in Chapel Hill is comprised of painted lanes, which are strips of dedicated road space for bicycle users marked by solid paint lines and bicycle pictograms. While painted lanes in the North American context are often found in the 'dooring zone', that is the dangerous space between parked and moving traffic, Chapel Hill's painted lanes are predominantly found adjacent to the sidewalk curb to the right of moving traffic. However, many painted lanes in Chapel Hill are found on high volume arterial or collector roads with AADT numbers exceeding 10,000 cars per day, meaning that the high traffic volume and speeds greatly increases bicycle users' discomfort. This also does not offer a sense of security for more apprehensive citizens to consider riding their bicycle.

Off-Street Greenways

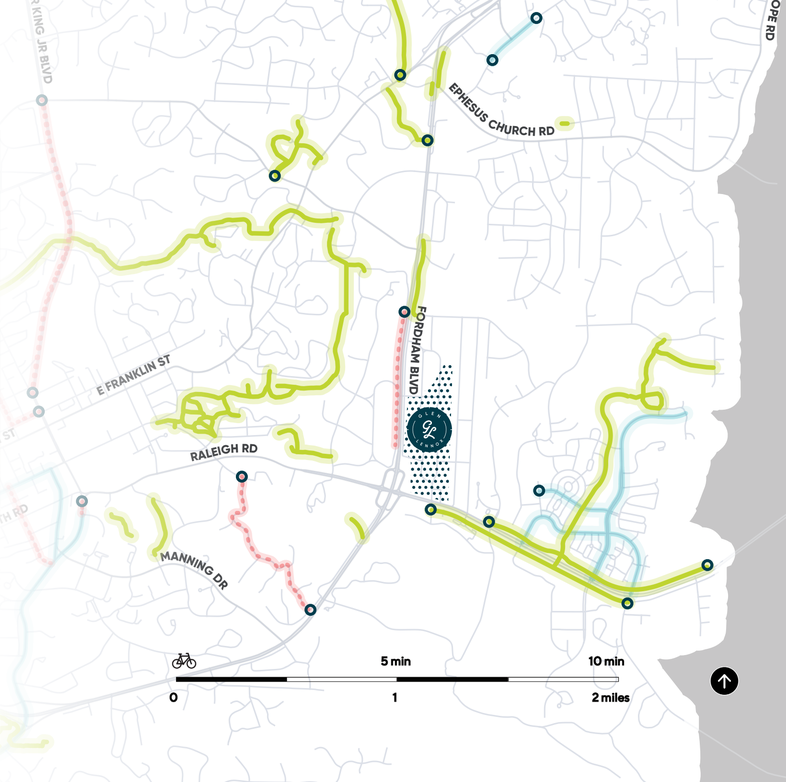
Off-street greenways are comfortable paths exclusively for bicycle and pedestrian connections through parks or forested property and are physically separated from Chapel Hill's street network. The high density of such paths and the regular distribution throughout the town create a surprisingly dense network of comfortable routing options using off-street greenways. However, due to Chapel Hill's topography, many off-street paths are quite steep and therefore contain a certain barrier to entry for all types of potential bicycle users. These routes also do not offer a clear differentiation between pedestrian and bicycle space which can sometimes lead to confusion and potential conflict.











TYPES OF EXISTING BICYCLE INFRASTRUCTURE

- Sharrows
- Off-Street Greenways
- Painted Lanes
- Abruptly ending facility without safe connection

CHAPEL HILL BICYCLE FACILITIES IN AN INTERNATIONAL CONTEXT

When we look to the most bicycle-friendly communities in the world, one of the defining factors is that ***the physical conditions of the built environment are created to ensure that bravery isn't required to ride a bicycle in an urban setting.***

Instead, infrastructure is built with an "All Ages and Abilities" (AAA) framework to provide comfort to all users regardless of age, physical limitations or cycling experience. Commendably, Chapel Hill has adopted and committed to an All Ages and Abilities framework in the 2017 Mobility Plan.

The positive effect of systematically applying All Ages and Abilities standards to planning efforts is astounding. Copenhagen, arguably the most bicycle-friendly city in the world, has been planning from an All Ages and Abilities perspective since the 1970s and has been able to increase their bicycle modal share from 9% in the 60s to over 50% in 2017. The universal applicability of and opportunity resulting from Danish design standards for bicycle infrastructure can be seen in other international contexts, an example being the Russian city of Almetyevsk. In 2015, Almetyevsk built a Copenhagen-style protected network from scratch and within two years were able to increase their bicycle modal share to 7%. North American cities such as San Francisco and Vancouver have been investing in all ages and abilities infrastructure with similar positive effects of doubling their bicycle mode share, proving that such standards are implementable in North America as well. Grubb Properties' goal of creating the most bicycle friendly community in the Carolinas is deeply rooted in and inspired by bringing international best-practice bicycle

infrastructure to Glen Lennox. The hope is that safe connections beyond the development's limits ensure that Glen Lennox residents and other Chapel Hillians can comfortably ride to and from the development to Chapel Hill's many destinations.

In recent years, the Town of Chapel Hill has been moving towards adopting a best-practice planning effort. The 2014 Bicycle Plan used a planning methodology based on AADT numbers (motor vehicle volume) and posted vehicle speeds, which in many ways resembles the design guidelines used for bicycle infrastructure in Copenhagen, and proposes Chapel Hill's first stretches of physically protected bicycle infrastructure on Rosemary Street and Cameron Avenue. As previously mentioned, the 2017 Mobility Plan additionally adopted an All Ages and Abilities framework, which is closely linked to the planning philosophy of a protected bicycle network. In the process of planning Glen Lennox's bicycle infrastructure, there is a strong potential for Grubb. Properties to build upon, partner and contribute to the iterative design process the Town of Chapel Hill has embarked on, especially as Glen Lennox is one of the town's capital projects.

In the Chapel Hill Bicycle Plan, the Town provides a methodology of determining the level of stress each type of road is given based on vehicle speeds and, in some contexts, AADT

Copenhagen's infrastructure built for all ages and abilities allows bicycle riders of all skill levels and backgrounds to join in, as seen below.



numbers. The Danish traffic planning guide, the underlying document that makes Copenhagen the most bicycle-friendly city in the world, however, argues that AADT numbers should always be considered when deciding how comfortable a given street is and what type of infrastructure would be required to make it feel safe and comfortable to users of All Ages and Abilities.





Vehicle Volume (AADT)	DANISH LENS ON CHAPEL HILL BIKE PLAN						
6000 or more	-	Paint	Curb Separated	Paint	Curb Separated	Paint-Buffered	Track with buffer	Track with Buffer
4000	-	Paint		Paint		Paint-Buffered		Track with buffer
2000	-	Shared	Traffic Calming	Paint		Paint-Buffered		Track with buffer
SPEED LIMIT	< 20 mph	25 mph		30 mph		35 mph		> 45 mph

AADT STRESS ANAYLSIS

- **Second Lowest Level of Stress**
- **Lowest Level of Stress**



Building on the recommendations for bicycle infrastructure in the Chapel Hill Bike Plan from 2014, this chart identifies four areas where facilities do not meet a Danish standard of safety for certain vehicle speed and capacity contexts











SPEED FATALITY RATES

- **Uninjured**
- **Injured**
- **Dead**

HOW DO WE EVALUATE THE LEVEL OF SAFETY FOR BICYCLE USERS?

To reach the 'interested but concerned' category of potential bicycle user, ***the physical infrastructure does not only have to address residents actual level of safety but also their perceived level of safety.***

Utilitarian cycling depends predominantly on an All Ages and Abilities framework where even inexperienced, nervous riders feel safe or where parents feel confident enough to let their children bike to school on their own. The factors that must be considered therefore need to go beyond speed and traffic numbers.

This analysis of both real and perceived safety builds upon the level of comfort analysis framework presented in the 2014 Chapel Hill Bike Plan. However, for the purpose of identifying the opportunities and threats to Glen Lennox becoming the most bicycle friendly community in the Carolinas, certain amendments were made to the analysis in order to reflect the specific needs of bicycle users in the Glen Lennox context and analyze the street network through an international best-practice perspective. As most considerations relevant to Glen Lennox would benefit the bicycle-friendliness of Chapel Hill as a whole, the analysis was conducted for the entire town. The following factors were considered in addition to the three factors presented in the Chapel Hill Bike Plan (AADT numbers, posted speed, level of protection):

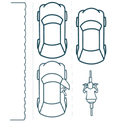


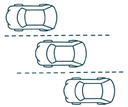
Steep Slope

Located in the Piedmont area, the terrain in Chapel Hill is quite hilly and has a height difference of nearly 500 ft between the town's highest and lowest point. Since Chapel Hill's downtown is located on a plateau and Glen Lennox is near the lowest point of the town, reaching most destinations in Chapel Hill requires bridging a serious difference in elevation. As biking uphill is significantly more strenuous than riding on flat terrain, routes must be found that offer a manageable grade for every-day cyclists to maintain infrastructure for All Ages and Abilities. The common standard that is applied in an international context is that a prolonged grade of 5% is the maximum grade acceptable for utilitarian cycling. While this standard is not always applicable in particularly hilly cities such as Chapel Hill, streets that exceeded the 5% grade over a long distance were deemed uncomfortable in this analysis. The topography data was sourced from the Town of Chapel Hill's GIS data site.

Commercial Corridors

High-density commercial corridors generally are more uncomfortable for bicycle users than other streets. In many contexts the AADT numbers and posted speeds may call for low physical protection for cyclists, but the on-street experience for cyclists often requires higher levels of protection. Especially in the case of painted lanes, bicycle users will frequently encounter cars or delivery trucks parked in the bicycle lane and are forced to move onto the sidewalk or into moving traffic. The high density of destinations also increases the amount of cars turning into parking lots. This increases the likelihood of right-turn collisions, one of the most common collisions between cars and bicycle users. Physical separation on commercial corridors therefore protects a bicycle user's space and raises awareness among motorists when turning. As Chapel Hill's commercial corridors are predominantly concentrated in the town's core or along the highway, some of these needs for physical protection are already being addressed by the Town through the proposal of Chapel Hill's first protected cycle track on Rosemary Street.



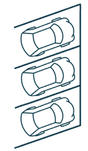


High number of car lanes

Similar to blocksize, the number of travel lanes significantly impacts both the real and perceived level of safety for bicycle users. More lanes generally correlate to higher levels of daily traffic as well as higher travel speeds due to separate lanes for turning and through-traffic. An additional consideration is that the higher numbers of lanes, similar to long block sizes, create a scale for bicycle users that creates difficulties in gauging speed and distance, thereby leading to more discomfort.

On-street car parking

Parking is one of the biggest concerns for both cyclists and motorists and its removal for bicycle infrastructure is often at the centre of municipal political discourse. On larger streets, parking often contributes to a lower level of safety as bicycles are often placed in the dooring zone where the sudden opening of doors is one of the main causes for cycling collisions. Chapel Hill, however, is in the fortunate situation where many streets have very limited on-street parking. Additionally, parking on smaller local streets actually contributes to a higher level of comfort as the parked cars slow down moving traffic. Parking as a measurement for safety level is therefore only applied to a few commercial streets in the urban core of the town.









A truly traffic-calmed street, like this example in Montreal, forces cars to travel at very low speeds through bends in the road

Some existing painted lanes on quieter streets in Chapel Hill offer enough separation so long as speeds remain low, as is the case here on W Barbee Chapel Road

Painted lanes on busier streets can become quickly and cheaply protected like these in Toronto to offer a better sense of safety for users

INTERNATIONAL EVALUATION OF EXISTING AND PROPOSED INFRASTRUCTURE

When viewing Chapel Hill's existing infrastructure through an international best-practice lens, the majority of corridors currently do not serve potential bicycle users of all ages and abilities. The streets that require priority protection for the majority of potential bicycle users to feel comfortable are arterial and collector streets that have a long range, high AADT numbers and primarily see painted bicycle lanes today.

In the Chapel Hill Bike Plan, the Town puts forward plans to implement a significant mileage of protected bicycle infrastructure that in the long-term has the potential to form a network that encompasses every important destination in Chapel Hill and offers direct routing options. While the long-term vision is aligned with currents in international best-practice bicycle planning, this evaluation focuses exclusively on the short-term projects put forward by the plan as those routes appear to be the most important additions to the current network. Understanding the existing and proposed infrastructure allows Grubb Properties to evaluate where connectivity gaps might exist around Glen Lennox and which facility recommendations might be amended in the short term for safer connections between Glen Lennox and the greater Chapel Hill area.

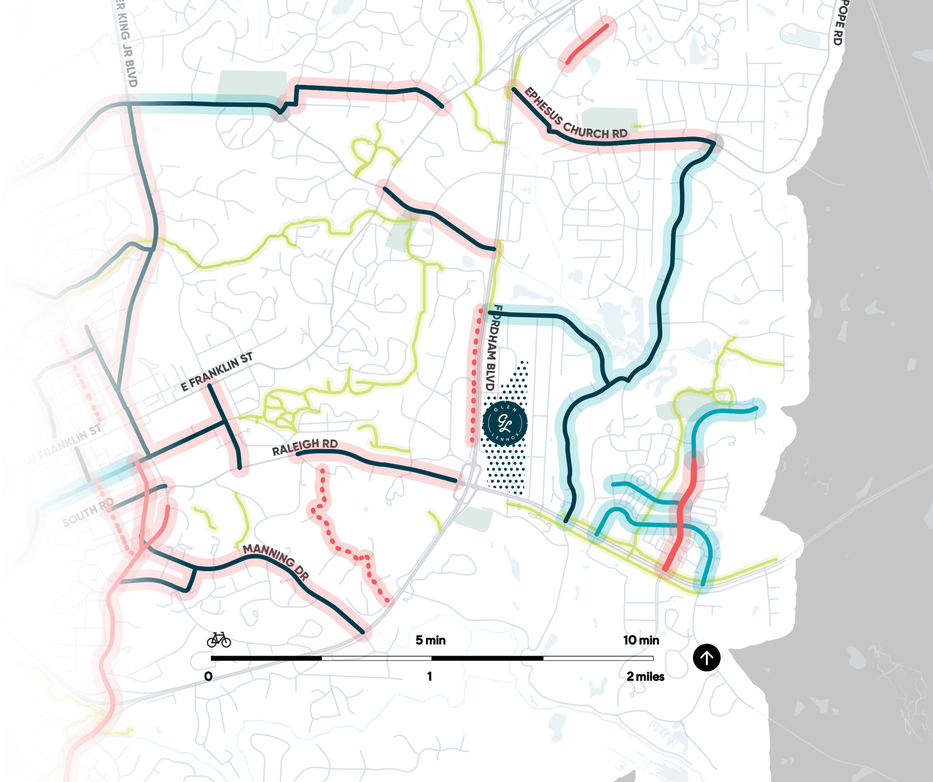
While the map to the right does convey that the majority of bicycle facilities today in Chapel Hill would need to be upgraded when applying an international best-practice framework, the Town of Chapel Hill's longstanding practice of placing painted lanes between the sidewalk and moving cars means that the required interventions to achieve comfort for users of All Ages and Abilities are neither expensive nor require an extensive street redesign in the short term.

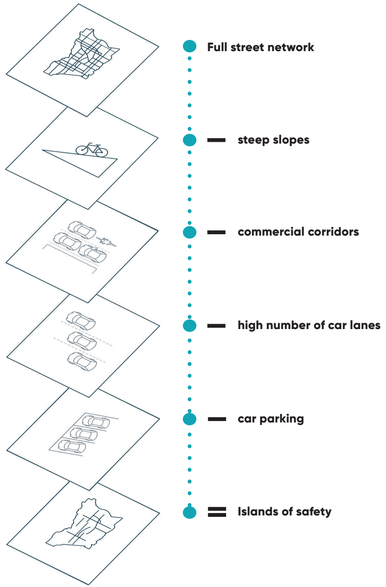
Laurel Hill Road and Christopher Road, denoted by the dotted red lines, fall into a category of corridors that would be advised to remain as shared streets, but would benefit from traffic calming measures to create a slow-speed shared environment. The painted lanes and buffered painted lanes on streets such as Meadowmont Lane and S. Columbia Street, denoted by the solid red lines, see heavy enough traffic to require physical protection. In the short-term, temporary solutions such as posts, planters or Jersey blocks are inexpensive and easily implementable in the Chapel Hill context. In the long-term, more permanent vertical protection such as raised cycle tracks or a median buffering the bicycle infrastructure from moving traffic further formalize the bicycle infrastructure and create a feeling of safety to all users.

The evaluation of the proposed infrastructure follows the same principles as the evaluation of existing infrastructure. The focus is on comparing the current planning practice in Chapel Hill to international best-practice planning. The patterns that emerge are also quite similar to the existing infrastructure analysis. Arterial and collector streets would benefit from higher levels of bicycle protection while the painted lane standard applied on smaller streets is suitable when compared to international best-practice. Estes Rd Ext, for example, sees AADT numbers exceeding 12,000 cars per day, which means that physical protection such as posts or curbs are required to provide all ages and abilities protection.

EVALUATION OF EXISTING AND PROPOSED INFRASTRUCTURE

- **Proposed bicycle facility**
- **Conforms with international standard**
- **Facility upgrade recommended/traffic calming**
- **Existing Greenway**





HOW DISCONNECTED IS GLEN LENNOX WITHIN CHAPEL HILL?

The Chapel Hill Bike Plan's level of comfort analysis, which was the starting point for the analysis presented in this chapter, already shows that ***the majority of arterial and collector streets in Chapel Hill are currently uncomfortable for bicycle users due to high speeds and traffic volume.***

However, speed and annual daily traffic are only two of the factors that determine whether or not streets are truly comfortable to users of All Ages and Abilities. Taking additional factors such as speed, car volume, slope, lane numbers, land use and car parking into consideration, an analysis shows us that a large number of Chapel Hill's smaller residential streets are indeed comfortable but that the collection of comfortable streets offer few safe connections through the Town.

The main factor for this disconnect of safe routes, along with the presence of heavy vehicular corridors, is slope. As Chapel Hill is quite hilly, the street layout does not follow a grid, as is commonly found in other North American municipalities, but rather follows the topography of the terrain. This results in the city's arterial and collector roads predominantly following flatter slopes. Since most of these roads are not comfortable to bicycle users today, the absence of a grid means that there are few connectors left to connect hilly neighbourhoods. The effects can especially be seen in flatter areas such as the area east of Glen Lennox as well as in the downtown core where a more regular street layout still allows for connectivity to users of all ages and abilities, for example on the Burning Tree Drive/Pinehurst Drive corridor. Furthermore, segments that have a steeper incline than 5% for long stretches are generally deemed uncomfortable to many utilitarian cyclists. It is important to note that this not only affect local streets but also sections of the off-street greenways network.

Other factors such as on-street parking and commercial corridors increase the risk of collisions as bicycles are in the 'dooring zone' (where bicycle users are in risk of running into abruptly opened car doors) or delivery vehicles will park in the space reserved for bicycles. While most commercial corridors also see high AADT numbers, many streets have already been deemed uncomfortable in the Chapel Hill Bike Plan. However, key connections such as Market Street in the South Village, which was deemed comfortable in the Chapel Hill Bike Plan, does not offer All Ages and Abilities protection.

As a result, many important landmarks and destinations in Chapel Hill are only comfortably reachable by taking long detours or, in some cases, are isolated to a point that they are only reachable when taking uncomfortable routes. Almost all Chapel Hill schools, for example, exist in such isolation. The map to the right demonstrates this, with only the portions of accessibly safe corridors identified for bicycle users.

From the viewpoint of Glen Lennox residents, one can see that any areas east of Fordham Blvd are quite interconnected for bicycle users of all ages and abilities and offer a lot of routing options for inter-neighborhood travel. Any connection to the west, however, is quite fragmented and currently doesn't allow for any fully comfortable routing options between Glen Lennox and important Chapel Hill destinations. The major takeaway from the map therefore is that the protection of direct arterial streets in Chapel Hill, such as Raleigh Road, MLK Boulevard and Franklin Street, not only creates direct connections within the town but is vital if the bicycle is to be made an accessible mobility option for all. Without these protected links, the network of local roads is not sufficient to ensure that communities like Glen Lennox are well-connected to a more bicycle friendly Chapel Hill.



UNDERSTANDING

LOCAL TRIP-CHAINING POTENTIAL

Prioritizing bicycle links from Glen Lennox to the surrounding communities can be streamlined when looking at potential connections to existing and proposed public transit. Integrating different modal options into citizens travel patterns allows flexibilty in mobility and a diversity of services for Chapel Hillians to choose from.

2.3

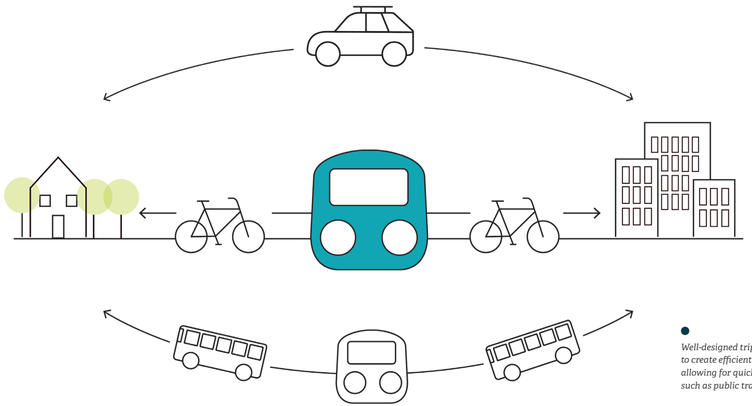
WHAT IS TRIP-CHAINING AND HOW DOES IT MAKE GLEN LENNOX MORE BIKE-FRIENDLY?

Even in cities with great public transit networks, it isn't always possible to easily take transit from door to door. The reality often is that people live outside of transit's service area, make unconventional trips through the city or simply live too far from a transit stop to make the trip to easily accessible by foot. The concept of intermodality, or trip chaining, attempts to find solutions to make the trips to and from public transit stops faster and more convenient.

Intermodality can take many forms. Regional transit lines, including GoTriangle, often have Park-and-Ride facilities where commuters can park their car on an associated parking lot and take transit to their final destination. In cities with bike share systems, docking stations are placed next to transit stops and in some cases buses are equipped with bike racks that allow a few commuters to bring along their bicycle.

As the public transit maps in the previous sections show, increasing the ability to conveniently trip chain holds great potential for Glen Lennox. Depending on your location in Glen Lennox, the walk to the nearest stop for the SJV and HU bus lines as well as the GoTriangle stop for the 800 bus can exceed 10 minutes. Taking the same trip by bicycle will only take about 3 minutes.

The following section analyzes the potential benefits convenient trip chaining would bring to Glen Lennox residents and other Chapel Hillians and identify which routes would have to prioritized and formalized in making trip chaining between the bicycle and public transit a viable option.



Well-designed trip-chaining has the opportunity to create efficient mobilitity options for citizens, allowing for quick transfers between modes such as public transit, biking and walking.

IDENTIFYING IMPORTANT TRANSIT CORRIDORS FOR CHAPEL HILL AND GLEN LENNOX

Successful trip chaining depends on promoting accessible intermodality, which means that the easy and clear transitions between different modes of transportation must be facilitated as much as possible. Some of these positive efforts have already been implemented across Chapel Hill. For example, the existing Park and Ride facilities at the Friday Center near the Glen Lennox site have clear signage as well as pedestrian paths that lead between the parking lot and the bus stop. Similarly, UNC uses an icon that marks their park and ride facilities, which creates easily identifiable signage that allows users to find affiliated parking lots and bus stops quickly. Further, such iconography builds a local marketable brand for local park and ride facilities. The signs are kept in the blue tone that is used for UNC's visual identity but also Chapel Hill Public Transit's bus colors, which establishes intermodality as a truly local branded option.

In order to improve the bicycle-friendliness of Glen Lennox within the greater Chapel Hill area and further harness the bicycle for its trip chaining potential, a degree of focus on bicycle-to-public transit connections is necessary above and beyond placing bicycle racks next to a bus stops. The City of Boulder, Colorado, for example, proposed so-called "Mobility Hubs" in their 2014 Transportation Master Plan, which allow for the easy transition between the bicycle and public transit at multiple locations. The design elements include secured and sheltered bicycle parking, real-time information screens on bus arrival times, the integration of bike and car share as well as designated bus and bike lanes leading up to the stop. Such integration, in conjunction with clear signage, allows for all modes to be highly visible and facilitates clear and easy transitions between them. While not all design elements are necessary at every transit stop in Chapel Hill, some bus stops could benefit from the inclusion of these elements. Especially along the proposed bus rapid transit line along MLK Boulevard as well as the GoTriangle routes to Durham and Raleigh would be prime candidates for the promotion of such intermodality in Chapel Hill.

The analysis presented in the map on the right identifies the transit corridors currently most important in Chapel Hill, meaning that each local and regional bus line in Chapel Hill predominantly services at least one of these corridors. From a Glen Lennox resident's perspective, it is especially important to ensure easy connections to routes that follow major transit corridors other than Raleigh Road as the Raleigh Road corridor currently is the only one that is easily accessible from Glen Lennox by public transit. As a result, public transit users are more aware of the intermodal options available to them and so long as connections can be better created to and from these hubs for residents, there is opportunity to promote more trip-chaining and regional connectivity for Chapel Hill.



Recognizable park and Ride signage at UNC allows for brand recognition of the service to promote efficient trip chains between car and bus.

In order to create better connections for Glen Lennox residents and a large portion of Chapel Hillians, the map not only identifies the most important corridors but also the stops where intermodal transitions are the most feasible due to the high number of local and regional bus lines accessible at these bus stops. These are the stops in Chapel Hill that lend themselves most to incorporating some of the design elements seen in the mobility hubs presented in the Boulder plan. The design elements would not only make it easier for Chapel Hillians to bike, walk, drive or take public transit to these important stops, but would also formalize their importance as transit hubs. As a result, public transit users are more aware of the intermodal options available to them and so long as connections can be better created to and from these hubs for residents, there is opportunity to promote more trip-chaining and regional connectivity for Chapel Hill.

The City of Boulder, Colorado has put together a number of essential elements in the concept of a 'Mobility Hub' which promotes trip-chaining and intermodality.



Bus Lines Accessible within Important Transit Corridors

Chapel Hill Routes:

A - CCX - CL - CM
CPX - CRX - CW
D - DM - DX - F
FCX - G - HS - HX
J - JFX - N - NS
NU - PX - RU - S
T - U - V

GoTriangle Routes:

400 - 420
800 - 805

EXISTING PUBLIC TRANSPORTATION CORRIDORS

Chapel Hill Transit routes

GoTriangle routes

Important combined transit corridors

Important transfer points





HOW CAN THE BICYCLE HELP PROMOTE BETTER TRIP-CHAINING?

The main argument for formalizing and promoting bicycle-to-public transit trips in Chapel Hill becomes clear when comparing the travel times between a trip completed only by public transit and a trip completed in part by bicycle. Although travel times can be reduced through trip-chaining to access almost all locations, the analysis presented in this chapter uses a potential trip between Glen Lennox and Duke University as an example. By car, this trip currently takes between 15 and 20 minutes. The same route completed by public transit requires Glen Lennox residents to take the S,V,G, HU or Go Triangle 800 line to downtown Chapel Hill before transferring to the GoTriangle route 400 towards Durham. ***This trip can take between 1 hour 8 min to 1 hour 15 min, almost an hour more than the trip by car.***

By formalizing a bicycle connection to the nearest GoTriangle 400 line bus stop at the intersection of E Franklin Street and Estes Road, the time of the trip can be significantly shortened to as little as 43min. While this is still longer than taking the car, a regular public transit commuter between Glen Lennox and Duke University could reduce their daily commute time by more than an hour each day through targeted trip-chaining.

The implementation of a mobility hub at the intersection of E Estes Drive and E Franklin Street would not only benefit Glen Lennox residents but the greater community. Similar time savings of 25 minutes or more per public transit trip to destinations in Durham through bicycle trip-chaining can be seen from almost all residential developments in eastern Chapel Hill, most of which are located within a 10 minute bike ride from the E Estes Drive/E Franklin Street intersection. As 26% of Chapel Hill's population works in Durham according to the 2015 Chapel Hill Community Survey, the mobility hub at this location has the potential of significantly increasing not only Glen Lennox's bicycle-friendliness but also for Chapel Hill as a whole.

EXAMPLE:

From Glen Lennox to Duke University...

Bus Only:



G

Transfer
RSX/405

1 hr 15 min

Bike-to-Bus:



Bike
RSX/405

43 min

TRIP CHAINING POTENTIAL

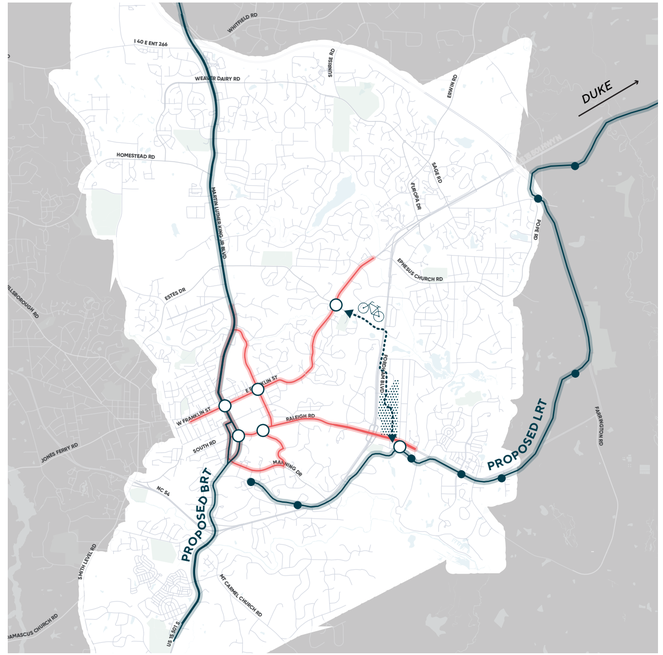
- **Existing transit routes**
- **Trip Chaining Route**
- **Potential transfer points**





POTENTIAL BICYCLE LINKS BASED ON TRIP CHAINING POTENTIAL

In order to make the bicycle a viable option for trip-chaining to Glen Lennox residents and other Chapel Hillians, comfortable and convenient routes must exist between areas where mobility hubs might be located, potential transit stops, and residential neighbourhoods. In the case of Glen Lennox, when looking at the local and regional destinations, it becomes clear that safe bike connections must be created at both the northern and southern entrances to the development that extend towards locations of potential and existing transit stops. Creating efficient links tho these important transfer points positions Glen Lennox within a network of transit options to get to various destinations in Chapel Hill and beyond – an improvement on the relatively small number of bus stops around the property today.



TRIP CHAINING CONNECTIONS

- **Important combined transit corridors**
- **Important transfer points**
- **Proposed public transit improvements**

UNDERSTANDING

REGIONAL ACTIVE TRANSPORTATION POTENTIAL

Building upon destinations, street experience and public transport connections, it is key to understand how the existing street network might offer the greatest connectivity potential to the bicycle in Chapel Hill. This section aims to look at the connections present and absent to pedetrians, bicycle users and motorists today in an attempt at understanding where to prioritize bicycle facilties that will truly connect Glen Lennox residents.

2.4

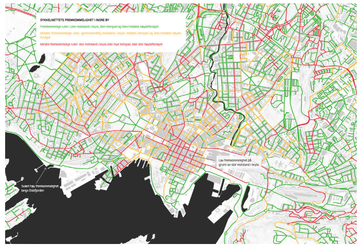
EXPLAINING

SPACE SYNTAX ANALYSIS

Space Syntax analysis is a tool developed at University College London (UCL) that compares the connectivity of a city's streets to understand the overall connectivity of a network. The analysis can either focus on determining which streets create the shortest paths to destinations or determine which streets have the highest 'through-potential'. While it ignores other factors such as traffic speed, AADT numbers or overall comfort, the analysis clearly shows which streets offer the quickest and most connected ways for citizens to reach their destinations.

Space Syntax can be especially helpful when looking at the strengths and weaknesses of an existing street network from the persepectives of different modes of transport – showing us which streets would offer the most direct connections for bicycle users or pedestrians. As recreational cycling facilities in the North American planning context tend to be indirect and often disconnected from each other, understanding network connectivity can help planners determine important on-street additions to the existing network that strengthen the everyday use of the bicycle. The Norwegian city of Oslo, for example, used Space Syntax analysis to determine the most important routes that could be targeted for a network expansion, which helped contribute to a higher bicycle modal share.

As Chapel Hill is approaching bicycle planning from the All Ages and Abilities perspective, the results from the space syntax analysis are only useful to increasing cycling as long as factors such as speed and AADT numbers are considered and included in the planning process.



The City of Oslo in Norway used Space Syntax Analysis to identify the priority streets for bicycle links (in red) that correlate to the most connected streets in the road network

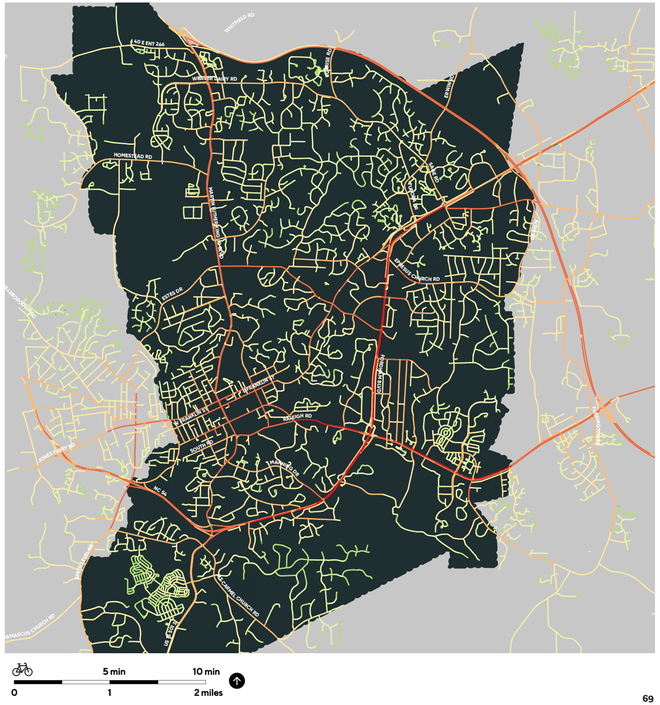
SPACE SYNTAX ANALYSIS

Driving

When performing a space syntax analysis, an assumption must always be set – namely the distance that a user will typically travel using a certain mode of transportation. When looking at street networks for cars, this assumed distance is well beyond the border of Chapel Hill, as all of the Town can be accessed within a 20-minute drive.

The overarching pattern that can be seen from the car-focused space syntax analysis is that the connectivity of streets closely coincides with the street designation assigned by NCDOT and Chapel Hill DOT; the most connected streets in the space syntax analysis are the interstates (in red), the second highest are arterials, the third highest are major collector roads, etc.

From the Glen Lennox perspective, it is notable that the development is located at the Fordham Boulevard/Raleigh Road interchange, which are the two streets with the highest space syntax connectivity score in Chapel Hill from a car perspective. As current Glen Lennox residents, residents of neighboring developments and potential future residents have all identified the same intersection as the predominant barrier that prevents them from cycling and walking for transport in the local area, this intersection is currently one of the most car-friendly places in all of Chapel Hill from a connectivity perspective. This creates an immense need for re-imagining a junction for all users of all modes and abilities.





SPACE SYNTAX ANALYSIS

Walking

The space syntax analysis for pedestrian connectivity uses the same assumptions as presented in the walkshed analysis earlier in this chapter. These assumptions are that people are only willing to walk for about 20 minutes on average, which is about a mile in distance. The space syntax map therefore measures the connectivity of Chapel Hill's street network based on one mile trips.

Hardly surprising, the most connected streets in Chapel Hill from a pedestrian perspective are in the downtown core around the UNC campus. The reasons for this high connectivity are the tight street grid, which allows for turning opportunities, as well as the straight, direct roads that create opportunities for easy travel throughout the downtown. The connectivity drops off significantly in the residential areas of Chapel Hill where the street network is winding and dominated by hills and cul de sacs. Most major roads in Chapel Hill (such as Raleigh Road) can be seen as offering mid-level connectivity when analyzing the street network from a pedestrian perspective. The main reason for this is the long block sizes, which were designed for travel speeds of 35 mph, seven times the average speed of a fast-moving pedestrian. The experience of walking on these streets therefore is one with infrequent turning opportunities.

From a Glen Lennox perspective, there is apparent potential for the neighborhood to be an active transportation hub within Chapel Hill. The streets and trails between Glen Lennox and Meadowmont are some of the best connected corridors outside of Chapel Hill's downtown for pedestrians. While the success of making the Glen Lennox area more walkable also relies on accessibility of destinations, the space syntax analysis shows the ample capacity for Glen Lennox's success as a medium density walkable neighborhood connected to the rest of the Town through public transit links.

THROUGH-POTENTIAL

High

Low

SPACE SYNTAX ANALYSIS

Biking

Keeping with the pedestrian approach, the space syntax analysis from a bicycle perspective is based on the distance that can be covered within a 20 minute bike ride at a leisurely pace, which is about 3 miles. While some of the takeaways are quite similar to the space syntax analysis from a pedestrian perspective, such as the high connectivity of the downtown network and the Glen Lennox area, some important differences become apparent.

From a bicycle perspective, the most connected streets are the major arterial corridors in Chapel Hill. This deviation from the pedestrian analysis is predominantly based upon the fact that the long-range connectivity of the bicycle is three times higher than that of the pedestrian and a large portion of Chapel Hill can therefore be reached within a 3 mile ride. In order to successfully connect Glen Lennox to the rest of Chapel Hill by bike and establish the bicycle as an everyday mode of transportation, it is therefore paramount to ensure that these direct arterial connections are feasible options for bicycle users. The connectivity analysis further underlines the importance of connections on major arterial roads as these also tend to have the lowest slope grade, highest density of destinations as well as the highest opportunity for connections to public transit service.

The map also highlights that greenway trails are great for recreational purposes, but do not offer the connectivity necessary for utilitarian cycling. While the establishment of further greenways in Glen Lennox and beyond is desirable and great for the character and leisure opportunities for Glen Lennox residents, their implementation must coincide with protected on-street facilities on major roads, if Glen Lennox and surroundings do indeed want to establish the bicycle as a valid mode of transportation for everyday use.

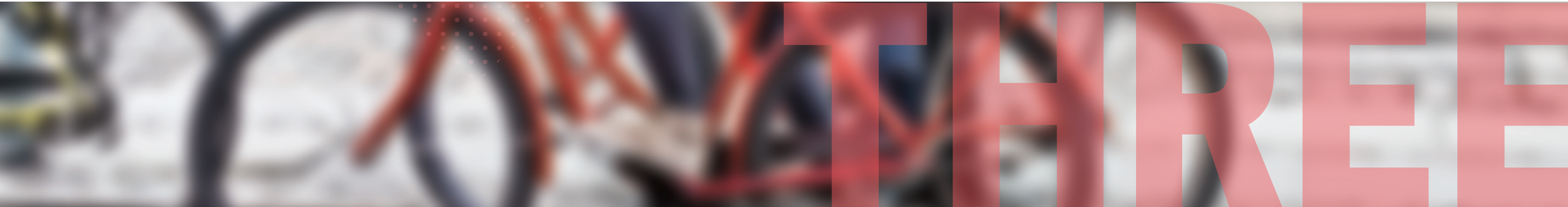
THROUGH-POTENTIAL

High

Low



BARRIER ANALYSIS





As Glen Lennox moves into its next phase as a forward-thinking community, it is essential to understand what existing barriers contribute to local mobility issues today.

TAKEAWAYS

1. ***The design of intersections today in Glen Lennox creates certain issues of safety and perception for vulnerable road users that must be rectified in the redevelopment.***
2. ***A number of additional bicycle and pedestrian cut-through connections can be created throughout the Glen Lennox site for maximum permeability.***
3. ***Infrastructure barriers around the periphery of the site create an enormous disconnect for residents and visitors of Glen Lennox today that seek to use non-motorized means of transportation.***

INTRODUCTION

An individual's barrier to mobility can manifest itself in many different forms. While a train line with fencing might be impossible to cross and thus creates a physical barrier, a major state highway might be difficult and uncomfortable to traverse from a perception of safety.

The experience of driving through a city and identifying gaps in the road network cannot completely translate to mobility from a non-motorized perspective. Things that may seem completely passable from a car may be either incredibly awkward, uncomfortable and frightening to many local citizens on foot or on bike. Analyzing city environments from this nuanced perspective can help us plan better spaces, places and networks for bicycle users and pedestrians.

Glen Lennox – in its goal to be the most bicycle friendly community in the Carolinas – can only benefit from taking a critical look at its own existing site, proposed site planning and surrounding neighborhoods in the aim at identifying pain points that can be improved. Through this process of critical reflection, we can develop a list and roadmap of areas and elements to offer safer and more comfortable recommendations for non-motorized transport forms.

This chapter aims to do exactly that – surveying the Glen Lennox property inside and out and identifying what barriers can and should be improved for existing and future active commuters. The chapter begins with an investigation into the types of intersections found today in Glen Lennox and their design elements that can be better thought-out in future phases. Secondly, it goes into the internal permeability of the existing street network and proposed street network in the development agreement in order to ensure maximum possible permeability for all users. Finally the chapter concludes with an examination of the priority peripheral barriers that require design interventions to ensure that Glen Lennox truly does become a bicycle-friendly neighborhood.

ANALYZING

EXISTING INTERSECTIONS

Looking in-depth at the intersection design in Glen Lennox today can influence the design principles for bicycle users and pedestrians in the future phases of development. Based on the five intersection types identified to the right, the following section highlights the design elements of intersections in Glen Lennox found across the site that might require considerable reflection. The analyses on the subsequent pages indicate that generally a disproportionate amount of space in Glen Lennox intersections are allocated to automobiles today, which might negatively affect other modes of transportation and their ability to effectively move through the neighborhood.

TYPES OF INTERSECTIONS IN GLEN LENNOX



Four way intersection

When two streets intersect at a perpendicular angle, appropriate signage must be used to indicate right-of-way to all road users. Four-way residential intersections can be dangerous for vulnerable road users when stop signs are not present to slow the flow of traffic.

Three way intersection

Three-way intersections generally see three streets of equal size converging at a junction. Such a meeting point requires appropriate signage to allow all vulnerable users to make turns safely and with equal priority to car traffic.

T intersection

T intersections represent the end of one street that meets a through street at a perpendicular angle. Without proper consideration taken to slowing speeds, and controlling traffic, motorists often cut corners at unsafe speeds or speed through – offering little priority to the side street.

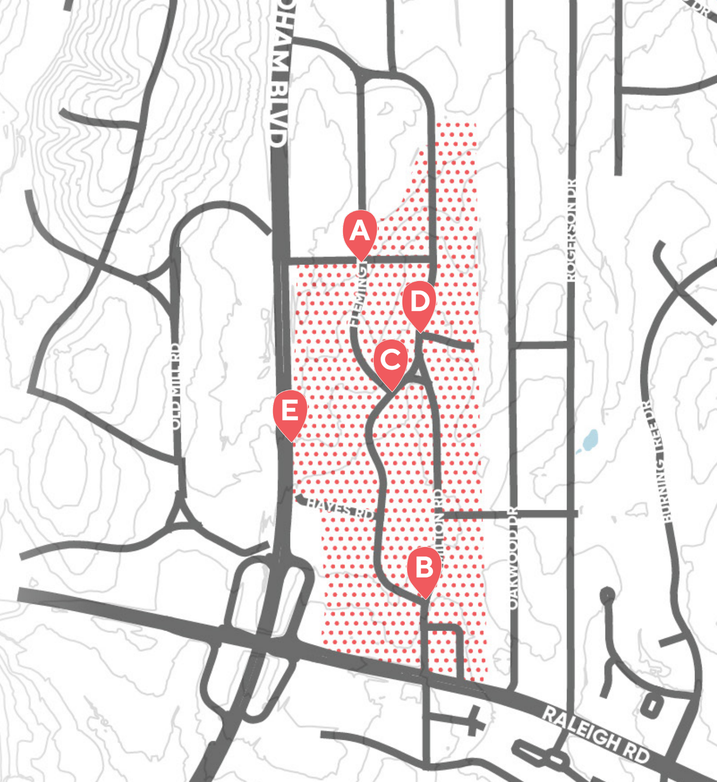
T laneway

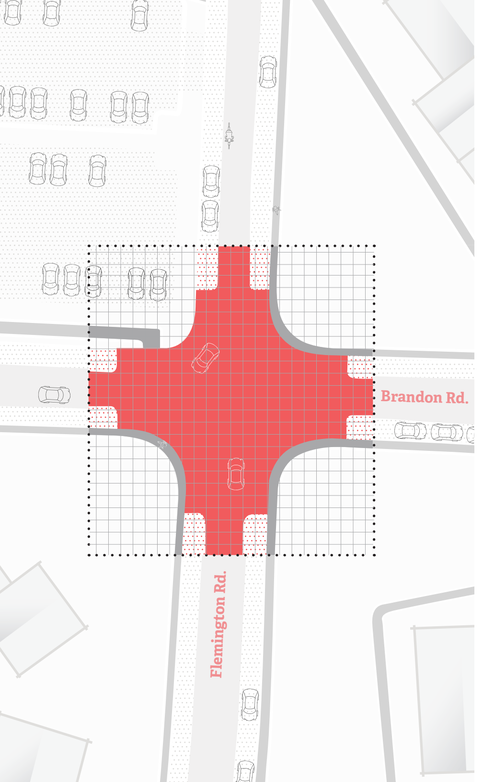
A T laneway is characterized by a dead end lane meeting a through street. This intersection must be met with appropriate signage and crosswalk characteristics to indicate that the lane is not a connection corridor, giving vulnerable users safe passage on the through street.

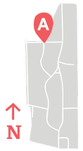
Parking bay

While parking bays allocate adjacent road space for parking, they often disrupt the desired path of cyclists and pedestrians with vehicles backing in and out of a space. 90 degree parking spaces create blind spots for motorists that further disrupt the safety of approaching vulnerable road users.









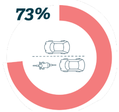
FOUR WAY INTERSECTION

BRANDON & FLEMINGTON

"The Arrogance of Space" Analysis

The aerial map to the left shows a visual breakdown of how much space is allocated to each transport mode at the intersection of Brandon and Flemington Road – a typical four way intersection. 73% of the total impermeable surface at the intersection is allocated to road space for vehicles. This heavy distribution of space towards cars is created through a lack of programmed design in the intersection, threatening the safety of crossing pedestrians and cyclists who share the space. The illustration to the right breaks down the specific design elements that pose barriers to the safety of vulnerable road users at this type of intersection, and offers suggestions for amelioration.

SPACE DISTRIBUTION AT BRANDON & FLEMINGTON INTERSECTION



Road space



Pedestrian space



Parking space

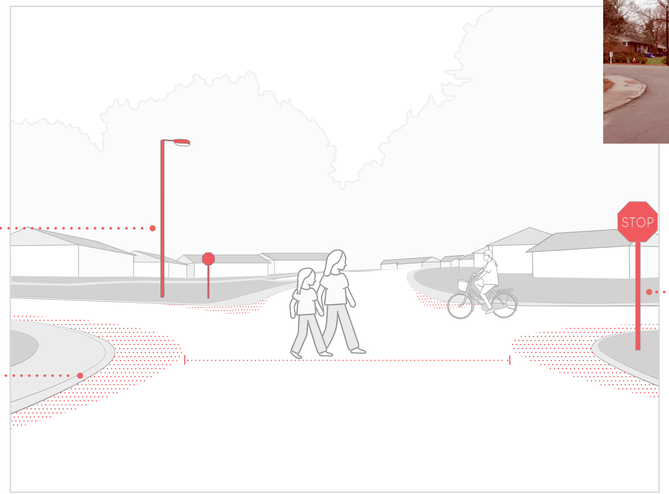
Existing design elements

The four way intersection design at Brandon and Flemington does not adequately encourage motorists to stop and look for vulnerable road users. There is a need for traffic calming elements like bump-outs on the street corners to encourage reduced speeds for turning cars, and stop signs on Maxwell as well as Flemington to reduce the speed of through traffic and heighten driver awareness. Visibility for all road users is also threatened at night by limited street lighting.



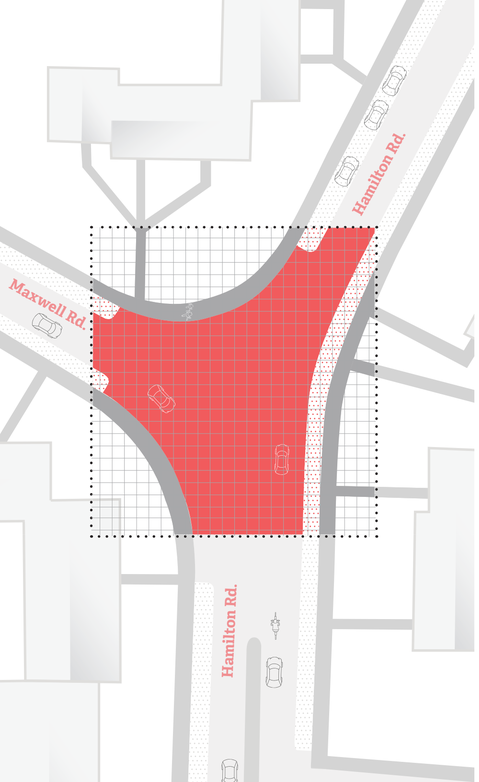
There is an inadequate amount of street lighting – illuminating the street signage

The width and design of the curbs on street corners in Glen Lennox are too narrow for safe pedestrian crossing. There should be bump-outs to encourage reduced turning vehicle speeds



There is no signage to warn that this is not a four way stop for cars. This poses a hazard to vulnerable road users approaching the intersection

Brandon Rd.





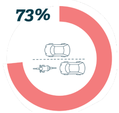
THREE WAY INTERSECTION

MAXWELL & HAMILTON SOUTH

"The Arrogance of Space" Analysis

This aerial map of the three way intersection between Maxwell Rd. and Hamilton South Rd. offers a visual perspective of just how wide the road space is today in many spots around Glen Lennox. Comprising 73% of the impermeable surface in the area, the high amount of space allocated towards cars at this intersection, and lack of stop signs, encourages speeding, and threatens pedestrians from crossing the street, or cyclists from making a left turn across traffic. The specific design elements that need addressing at this intersection are highlighted to the right.

SPACE DISTRIBUTION AT MAXWELL & HAMILTON SOUTH INTERSECTION



Road space



Pedestrian space



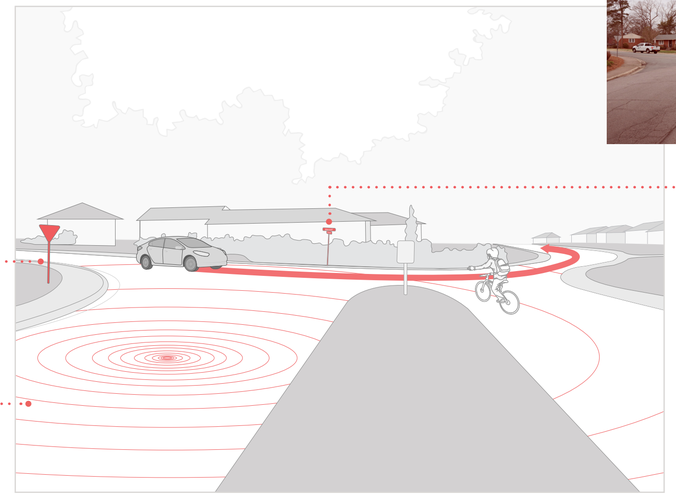
Parking space

Existing design elements

The intersection at Maxwell and Hamilton South is particularly perilous for cyclists and pedestrians today. Signage is sparse – with only one street sign on the far end of Maxwell, that is not lit by a street light at night, or legible from every entrance to the intersection. The use of a yield for cars poses a hazard to cyclists approaching the intersection. The excess amount of impermeable surface in this area poses added discomfort for vulnerable users in warmer months as the sun is reflected off the asphalt, and does not offer any clear delineation between users for safety.

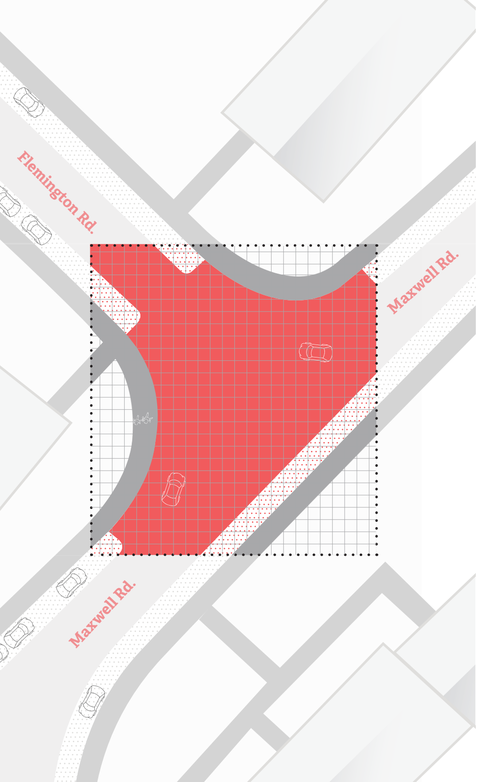
The yield sign does not sufficiently slow down car traffic on this wide three way intersection to protect cyclists and crossing pedestrians

This intersection contains an excess amount of impermeable surface that is not offering any protection for cyclists from fast moving cars





There is only one street sign in the distance and it isn't lit or legible from every entrance to the intersection





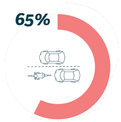
T INTERSECTION

MAXWELL & FLEMINGTON

"The Arrogance of Space" Analysis

The aerial map to the left offers a breakdown of how much space is allocated to each transport mode at the intersection of Maxwell and Flemington Road. Although the proportion of impermeable surface allocated towards road space in this intersection is lower than both four and three way intersections, the corners are still still sufficiently wide that allow cars to make elongated, fast turns without being forced to check for approaching pedestrians and cyclists. The rendering to the right breaks down the specific design elements that pose significant issues to safe pedestrian crossing at this intersection and bicycle use.

SPACE DISTRIBUTION AT MAXWELL & FLEMINGTON INTERSECTION



Road space



Pedestrian space

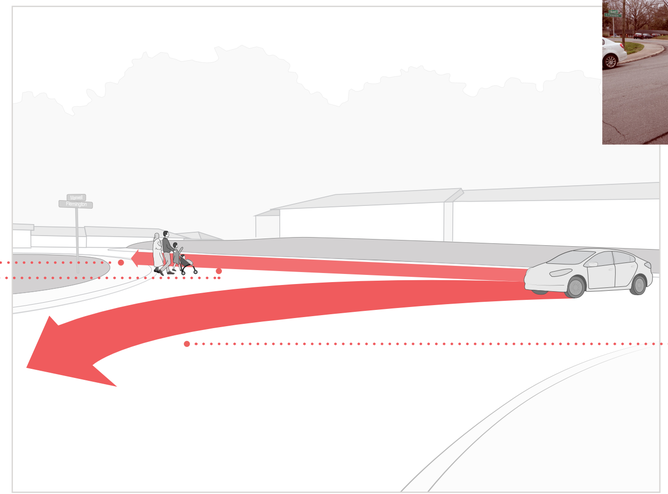


Parking space

Existing design elements

The T intersection at Maxwell and Flemmington is currently designed to facilitate motorists driving at unimpeded speeds. The wide turning radius created by set back curbs allow for cars to make sweeping turns, and without a stop or yield sign, there is no incentive to slow down on Maxwell. This threatens the safety of vulnerable road users. Pedestrians are further unwelcomed from crossing Maxwell by the lack of mountable curb access on the far sidewalk or the visual indication of a crosswalk.



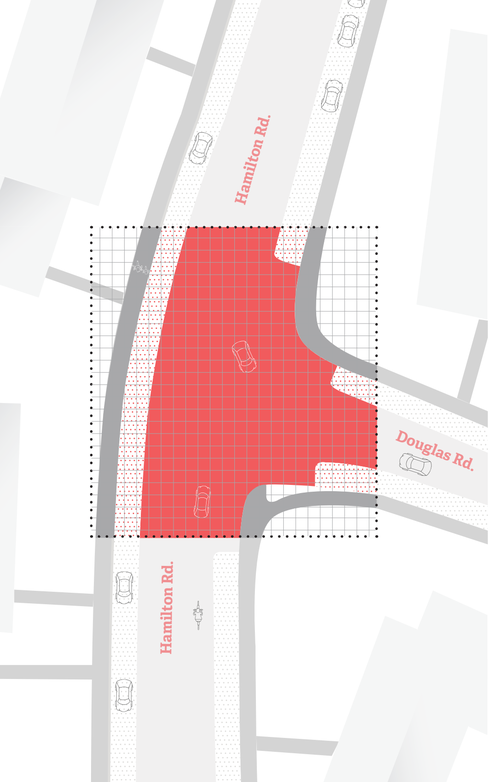


There is no stop sign to slow down through traffic on Maxwell

Lack of mountable curb access for pedestrians across the street impedes crossing for all ages and abilities

Very round corners of the intersection allows cars to round turns at unsafe speeds due to wide turning radii

Flemington Rd.





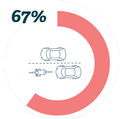
T LANEWAY

HAMILTON & DOUGLAS

"The Arrogance of Space" Analysis

This aerial map depicts the T laneway where Hamilton Road meets Douglas Road. Since Douglas is a lane and thus a dead-end, the intersection opening is unnecessarily wide and daunting for pedestrians, considering that following Hamilton will be the most desired route for foot traffic and bicycle use. The rendering to the right offers visual cues to specific existing design elements that threaten safety and ease of navigation for pedestrians and cyclists.

SPACE DISTRIBUTION AT HAMILTON & DOUGLAS INTERSECTION



67%

Road space



18%

Pedestrian space



15%

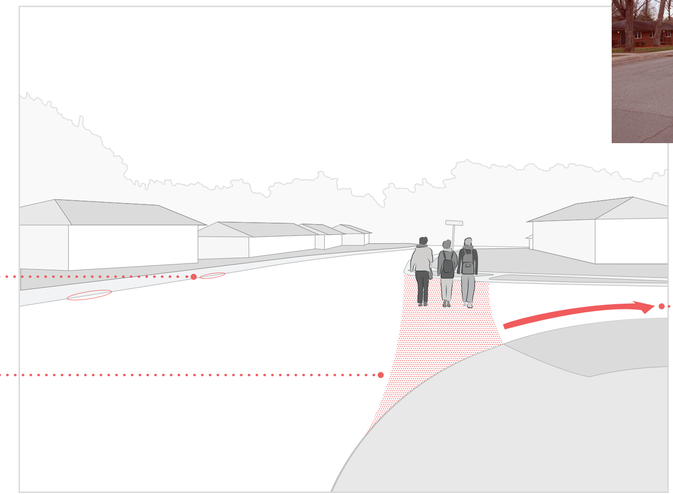
Parking space

Existing design elements

At the intersection of Hamilton Road and Douglas Road, there is no indication that this area is meant for slowing down. Douglas, to the right, is a dead end meant for beginning and ending trips. This would be better communicated to residents traveling by car, bike and foot if there were a change in texture/surface height when turning onto Douglas, and if there were a 'dead end' sign. This would signal priority for through movement, while creating a safer bicycle and pedestrian straight ahead along the street. Pedestrians are further inconvenienced by the lack of mountable curbs on the far side of Hamilton.

There are no curb ramps on the far side of Hamilton for pedestrians of all ages and abilities

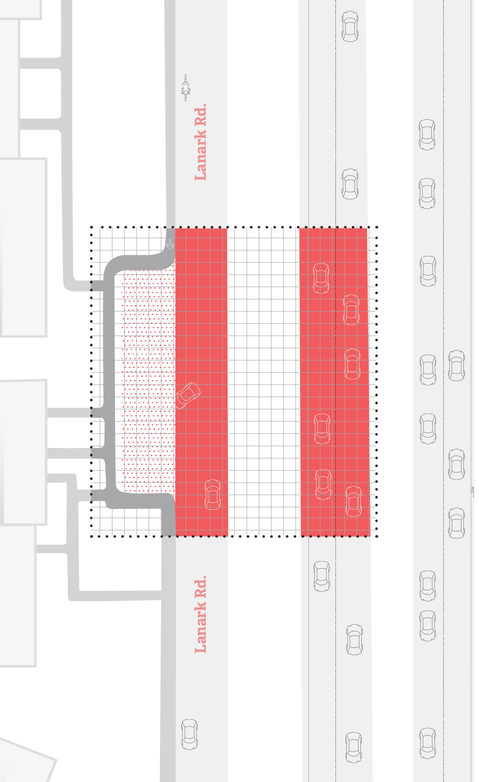
There is no indication that the intersection at Hamilton and Douglas is an area for slowing down at the end of a trip, allowing safer passage for vulnerable users



There is no 'dead end' sign to inform motorists/cyclists that Douglas is not a cut through

Hamilton Rd.







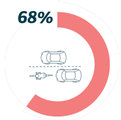
PARKING BAY

LANARK ROAD

"The Arrogance of Space" Analysis

This aerial map of a parking bay on Lanark Rd. offers a quick visual analysis of how much space is dedicated to each transport mode. Of the impermeable space in the area, 91% is dedicated to road space and car parking combined. Since Fordham Boulevard has a relatively dense and fast moving flow of car traffic, the road space on Lanark Rd. could be better designed if it were more safe and welcoming for vulnerable road users to occupy. The design elements highlighted to the right break down some barriers to safety that currently exist for pedestrians and cyclists on Lanark Rd.

SPACE DISTRIBUTION AT LANARK RD.



Road space



Pedestrian space

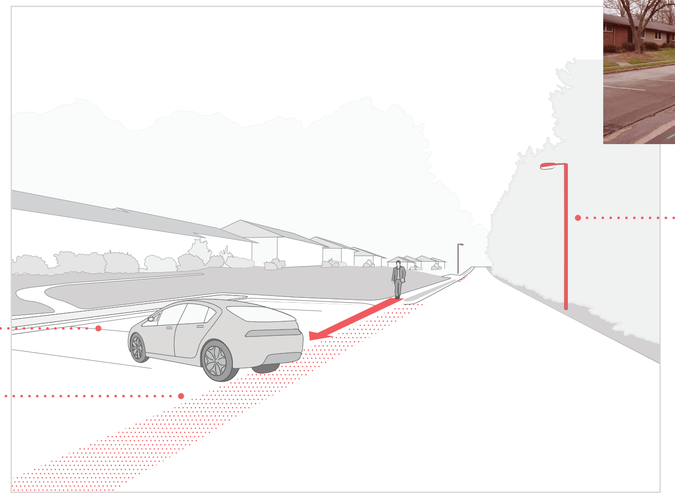


Parking space

Existing design elements

On Lanark Road, sidewalks and safe spaces for cyclists are disrupted by cars turning in and out of the parking bay. The desired route for pedestrians is also disrupted by the parking bay, and the 90 degree angled parking spaces worsen blind spots for motorists backing up. In the evening, these safety threats are heightened by the lack of lighting on the side of the road where collisions would be most likely to happen.





There is an insufficient amount of street lighting, and it is on the opposite side of the street from the parking bay

Parking spaces angled at 90 degrees worsen blind spots for motorists backing up

There are no pavement markings to warn cyclists and pedestrians of cars backing up.

Lanark Rd.

ANALYZING

PEDESTRIAN & BICYCLE PERMEABILITY

In any vibrant neighborhood, permeability – or opportunity to move through a space – for pedestrians and bicycle users is a key to success. Permeability in the form of pedestrian-only paths has been a defining feature of the Glen Lennox property through the years. Grubb Properties envisions a future for this community where permeability for both pedestrians and bicycle users is easy, comfortable and entices people to leave their cars behind.

This section presents an analysis of the basic street grid in the current Glen Lennox development as well as the plans for the realignment and enhancement of those streets presented in the development agreement. This analysis is completed from a pedestrian and bicycle user perspective, looking at optimal pedestrian and bicycle densities for a street network. By comparing the ideal pedestrian and bicycle grid to the current and future street grid, it is possible to see where gaps existing in the network that can be improved as the development proceeds.

3.2





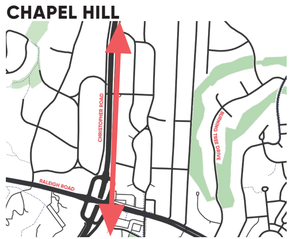
DIFFERENT SPEEDS, DIFFERENT NEEDS

When planning for a pedestrian and bicycle-friendly community, it is important to recognize that walking, biking and driving all experience very different speeds. Normal travelling speeds for pedestrians are about 3 miles per hour, an urban bicycle rider will on average move at 12 to 15 miles per hour and cars generally travel at speeds from 25 and 30 miles per hour in an urban context. It is therefore comlex to plan a catch-all street grid that serves all modes of transportation effectively without an excessive amount of pavement.

The functionality of a street grid, regardless of mode, depends on providing ample turning opportunities at logically spaced-out intersections. Less permeability, for example in the form of crescents, cul-de-sacs or long blocks, makes it difficult to reach destinations as they force people to take longer and more indirect routes. In the North American planning context, the most indirect paths have often been assigned to pedestrians and bicycle users while the car is provided the most direct routes.

The success of Glen Lennox as the most bicycle-friendly community in the Carolinas therefore hinges upon providing pedestrians and bicycle-users with connection option within Glen Lennox that are equal or even better than those for the car.

Determining the preferred distance between intersections within a site can be difficult; a block that feels too short when travelling at high speeds by car can seem long and daunting as a pedestrian, especially if pedestrian amenities such as sidewalks or proper crossings do not exist. Early urban planning theorists who studied the functionality of street grids, such as Jane Jacobs or Leon Krier, advocated



●○○
A one minute walk in New York City often corresponds to one city block, offering turning opportunities every minute or so to pedestrians.

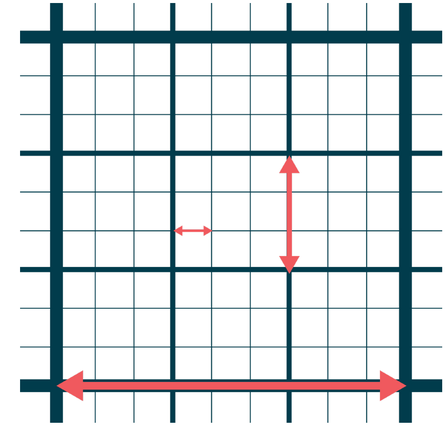
○●○
In Copenhagen, bicycle users will find protected bicycle lanes every minute or so, also fostering ease-of-use for bicyclists navigating the city.

○○●
In Chapel Hill today, road infrastructure – in the form of interstates – offer motorists speedy connections every minute or two at marked exits.

that block sizes should be as small as possible to provide a maximum number of choices and routes to reach a destination. More recent work by the Harvard School of Design additionally recognizes that there is a need for intersections to be properly spaced out to give all modes of transportation appropriate turning options.

When comparing some of the most bikeable and walkable environments in the world, such as Manhattan or Copenhagen, the conclusion scholars have come to is that walking or taking a bike becomes a viable transportation option when turning choices are provided every 1 to 2 minutes. In New York, the average Manhattan block size is 267 feet, which translates into a walk of slightly over a minute per block. Inner-city Copenhagen, one of the most bikeable neighborhoods in the world, has established a minimum grid bicycle network that also provides its users turning choices with protected bicycle infrastructure every 1 to 2 minutes. The prevalence of the 1 to 2 minute logic can be seen in Chapel Hill as well. For cars, the exits along Fordham Blvd are spaced out at this distance as well as most other arterial and large collector streets.

Glen Lennox's density of streets and destinations is of course different from Manhattan's (as can be seen when comparing the grids at the same scale) and it is neither viable, nor desirable to use Manhattan's grid as the blueprint for the development of a medium density mixed-use development. However, the standard of providing turning choices every 1-2 minutes for each mode of transportation is a standard that should most certainly apply for a pedestrian and bicycle-friendly Glen Lennox.



Drive
Bike
Walk
1-2 minute ride

BIKING AND WALKING PERMEABILITY ON THE GLEN LENNOX STREET NETWORK

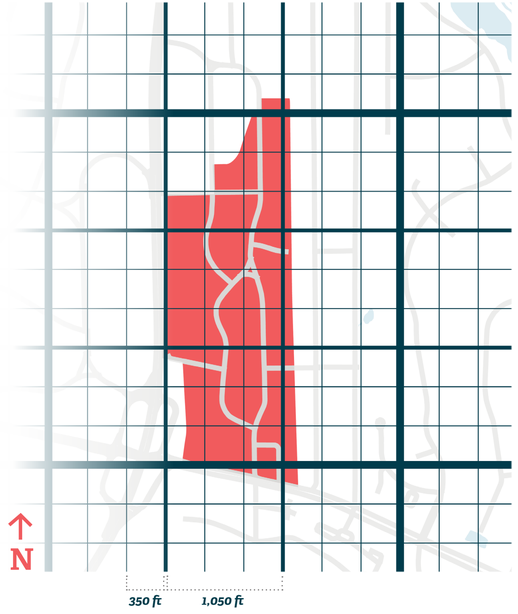
Glen Lennox Today

As mentioned in the previous section, a general rule for a connected neighborhood is for every mode of transportation to have viable turning choices at 1-2 minute intervals, either in the form of streets or pedestrian and cycling-specific paths and cut-throughs. In a low to medium-density residential context, which Glen Lennox is today, the provision of such turning options for pedestrians and bicycle users can be found in intervals higher than 2 minutes. The reason for this is that streets in a residential context generally used as thoroughfares and do not have the density of destinations as mixed-use or commercial neighborhoods. People therefore tend to travel down a specific corridor for a longer time. Based on planning standards from other residential environments, the applied standard for a permeability analysis of communities such as Glen Lennox is a block size of 350 ft for pedestrians. This is the standard used for the grid overlay seen in the map on the right.

Since bicycle users travel at speeds approximately three times higher than pedestrians, connections planned specifically for bicycles may occur at a frequency that is three times higher than pedestrian intervals (every 1050 ft).

As can be seen from the map, the current street network provides evenly spaced-out north-south connections with Hayes Street, Maxwell and Hamilton Roads that closely match the 350 ft pedestrian distance between corridors. However, the lack of north-south connections on the eastern Glen Lennox border as well as the convergence of Hamilton, Maxwell and Lanark Road into one corridor on the southern side of the site do pose some challenges to north-south travel.

East-west connections for pedestrians and bicycle users through Glen Lennox are sparse when relying on the street network alone as Brandon Road is the only continuous connection across the community (yet does not offer connections further towards the Oakwood neighborhood). The high concentration of pedestrian walkways in Glen Lennox currently mitigate this lack of east-west street connections to an extent, but many are indirect, unintuitive to non-residents and are not designed for bicycles. One of the major goals of Glen Lennox's redevelopment therefore has to be to maintain and improve upon such non-motorized permeability for pedestrians and, where required, bicycle users.

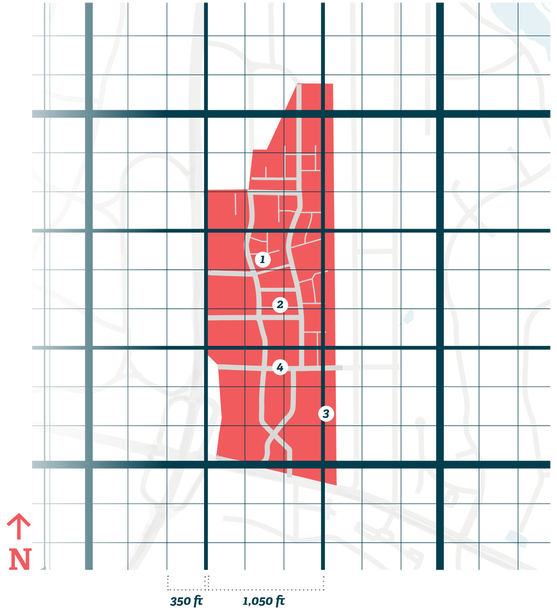


Glen Lennox Tomorrow

When comparing the current Glen Lennox street network to the proposed street realignments in the development agreement, several pain points for pedestrians and bicycle users emerge:

1. The current crescent-like character of Maxwell Road is being removed in favor of a direct thoroughfare
2. Maxwell and Hamilton function as equally spaced out parallel north-south options
3. The inclusion of the off-street greenway creates another much needed north-south option on the eastern border
4. The connection of Lanark and Berkley Road (which currently do not connect) as well as the new construction of Glen Lennox Dr and Muirhead allow for more continuous east-west connections throughout the site

Another notable amendment to the site is the creation of five new intersections (there will be 13 intersections in the new Glen Lennox instead of 8 today), which offers all modes of transportation more turning options. While this is positive step for a more bicycle-friendly Glen Lennox, the overlay of the optimal grids for bicycle and pedestrian connections in the map to the rights demonstrates the necessity for non-motorized cut-throughs to create an effective and practical bicycle and pedestrian network in Glen Lennox.





IDENTIFYING POTENTIALLY PERMEABLE POINTS

The Glen Lennox redevelopment offers ample opportunities to create a walkable and bikeable community with a best-practice network for these modes. This section focuses on applying the theoretical bicycle and pedestrian grid presented in the previous section to the current iteration of Glen Lennox's site plan.

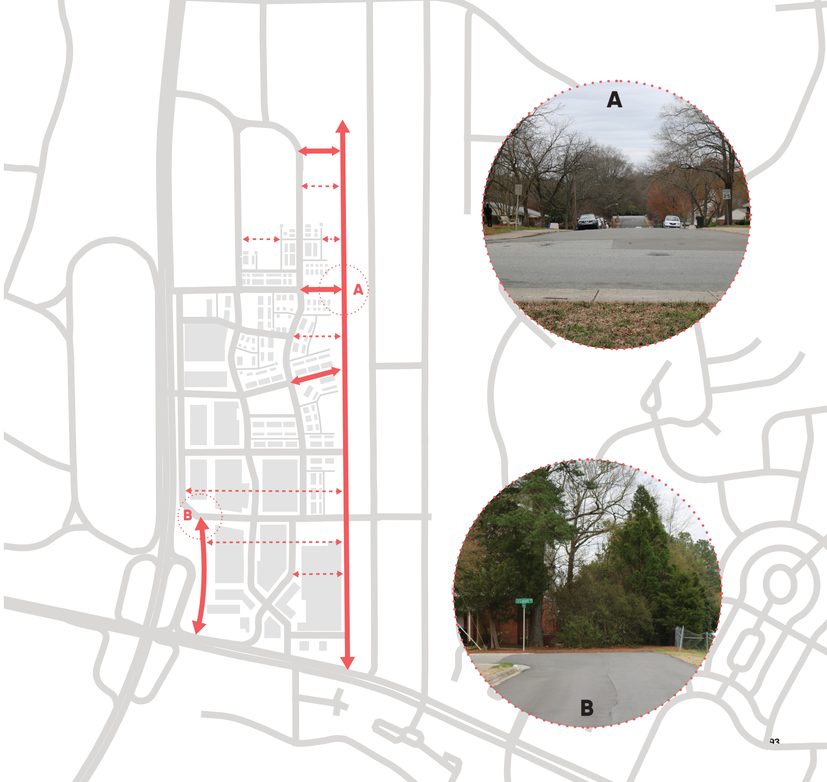
Cohesive links in the bicycle network can be formalized by implementing best-practice bicycle infrastructure and wayfinding on key corridors, such Lanark, Berkley, Muirhead and Brandon Roads, as well as through creating a high density of connections to the proposed off-street greenway. A key element in completing these links will be to create off-street connections in places where on-street through-travel is not possible, for example creating a connection from Hayes Rd towards the Glen Lennox Shopping Center or Brandon Rd towards the off-street greenway. For optimal bikeability, the Glen Lennox site plan can be improved with three new bicycle-focused cut-throughs throughout the development site. More precise design recommendations will be presented in the next section, but it is important to stress that the success of these cut-throughs depend upon their directness, formalization and visibility.

Working on-site and with adjacent land owners to create non-motorized connections at existing dead-ends is essential if Glen Lennox is to be a bicycle-friendly community.

Smaller, informal pedestrian cut-throughs are necessary in addition to bicycle connections in order to increase permeability for walking. In particular, there are two elements that should be considered to build upon the development plan. First, in the current plan the site's permeability decreases towards the south where the mixed-use development will be, mainly due to the proposed building massing. As the majority of destinations are found in this area of the site, the density of the network, however, should increase. Architecturally, there is an opportunity to build these walkways into the building form as well. Secondly, it is important to extend each east-west corridor to the greenway at the periphery, as only a high density of possible entrances and exits allow for the greenway to be a highly usable transportation option and not only a recreational corridor.

Pedestrian cut throughs

Bicycle cut throughs



BEST-PRACTICE CUT-THROUGH DESIGN



Bicycle cut-through in Vancouver, Canada

Direct connections between on and off-street facilities

To create a functional network for pedestrians and bicycle users, the placement and design of off-street paths and cut-throughs must follow the same logic of a conventional street grid. A regular street intersection is constructed to allow people approaching it to assess their routing options from afar or, in the case of irregular intersections, provides easily understandable signage or signals that explain who has priority. Pedestrian and bicycle cut-throughs must be placed the same way, meaning that, where possible, they form a direct continuation of the road. For example, the current Brandon and Hamilton Road T-intersection could be converted into a four-way stop in which one corridor is only accessible to bicycle users and pedestrians – otherwise vulnerable users are constantly waiting for all cars to speed past before safely crossing.



Raised-crossing in Boulder, Colorado

Raised crossings 1

The transition between on and off-street infrastructure always creates the potential for conflict points where cars, bicycles and pedestrians encounter a chance of collision. However,design elements such as raised crossings with changes in road texture force cars to slow down and signify to all users that the intersection requires extra vigilance. The result is an increased awareness of the possible presence of vulnerable modes of transportation, which lowers speeds and decreases the level of stress for all road users, a key element to making Glen Lennox a bicycle-friendly community.

Road Chokers 2

Similar to raised crossing, additional traffic-calming elements such as planters (large flower pots placed on the road that narrow the roadway) or chokers (physical curbs that also narrow the roadway) can slow down car traffic and also decrease the amount of road space bicycle users and pedestrians must cross, thereby creating a more comfortable environment for these modes of transportation. Such elements are especially important when the proposed greenway crosses Berkley Road as many users will be continuing on the green path instead of turning.



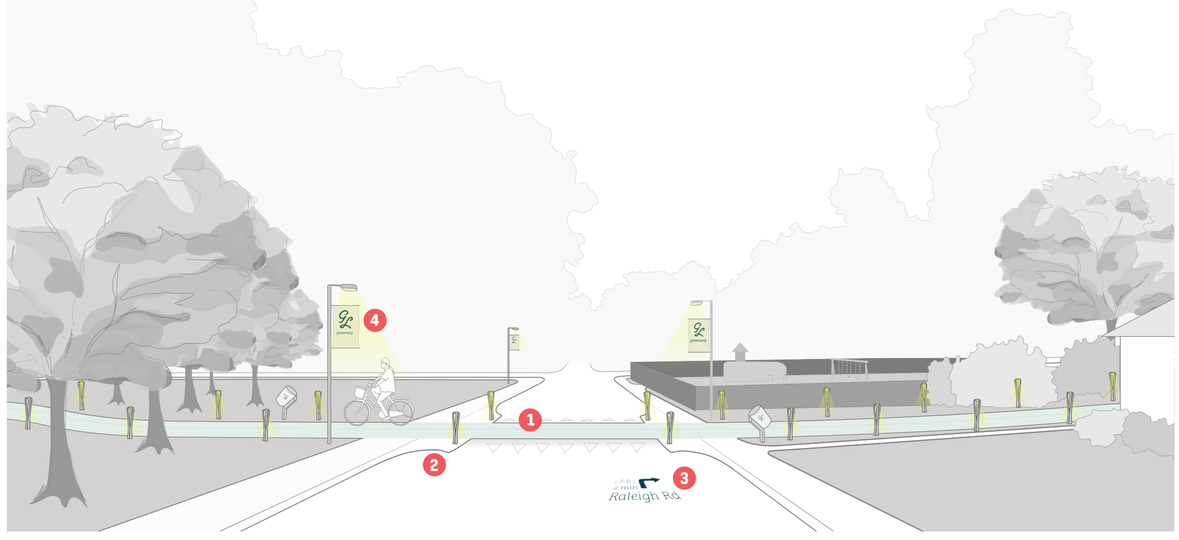
Innovative lighting in New York City

Wayfinding & Signage 3

The success of Glen Lennox as a bicycle-friendly community will in large part rely on providing a comprehensive bicycle and pedestrian network with both on-street and off-street facilities as well as additional cut-throughs. Without proper signage and wayfinding that formalize each element, the transition between these different facilities may be confusing as users may not know where a cut-through leads or connects to. The creation of a comprehensive design language that is as easy and intuitive can help mitigate this, as the redeveloped Glen Lennox aims to be an important destination for all Chapel Hillians. Additionally, wayfinding and signage provides opportunities to further brand and promote bicycle usage in Glen Lennox.

Lighting features 4

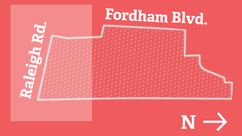
The usability of a network relies on its users feeling and being safe. Proper lighting not only draws attention to the existence of cut-throughs and the off-street greenway in the dark, formalizing them as part of the network, but also provide its users with a higher level of comfort and functionality when using biking or walking at night. Proper lighting is also essential to making the facilities universally accessible as many members of society are more likely to be and feel less safe in an environment with insufficient street lighting. Innovative lighting examples also exist to ensure that lower density parts of the neighborhood are not constantly plagued by light pollution.



ANALYZING

PERIPHERAL BARRIERS

While a permeability within the Glen Lennox site is key to understand how to best develop the community in the future, identifying the major peripheral barriers is even more essential to ensuring the logical and efficient route connections to-and-from important Chapel Hill destinations. It is through these connections that Grubb Properties can ensure that residents truly have the option to use the bicycle as an everyday mode of transportation.



3.3



FORDHAM BOULEVARD ON AND OFF RAMPS

The on- and off-ramps leading from Fordham Boulevard onto Raleigh Road act as major barriers just to the edge of Glen Lennox that often prevent surrounding residents from considering the bicycle a reliable mode of transportation on the eastern side of Chapel Hill. In the Copenhagenize focus groups of March 2018, Glen Lennox residents and neighbors alike mentioned a number of different factors that lead to their discomfort crossing through the interchange. The following is a recap of those comments:

- The lack of safe sidewalks makes you feel uncomfortable and invisible to drivers exiting the off-ramps at high speeds.
- A lack of signals and other design elements do not slow cars down when exiting Fordham Boulevard as cars currently treat the stop sign merely as a yield sign.
- A lack of protection in the form of bicycle infrastructure creates a scenario where it is possible to be hit by cars turning right towards the on-ramps from Raleigh Rd.
- A lack of visibility for both bicycle users and cars when passing under the bridge on Raleigh Rd is created due to the underpass infrastructure and vegetation growth. Residents feel like they are blindly riding towards cars exiting Fordham Blvd that cannot see them, which is especially problematic when travelling downhill towards Glen Lennox at higher speeds.
- A lack of proper lighting through the underpass to make it accessible 24 hours.

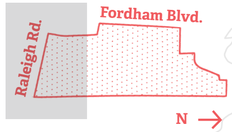
The majority of these perception comments are a result of the on and off-ramp design that does not sufficiently slow down traffic and allow for vulnerable users to safely cross the junction. As Fordham Blvd is a major road with high speeds (45 mph and higher) and eventually turns into a highway, drivers exiting the road are functioning at a different speed and are not necessarily aware of pedestrians and bicycle users. To make pedestrians and bicycle users feel and be safe while passing through this intersection, major design changes are required that physically slow down traffic and/or provide a high level of protection and visibility for vulnerable road users.

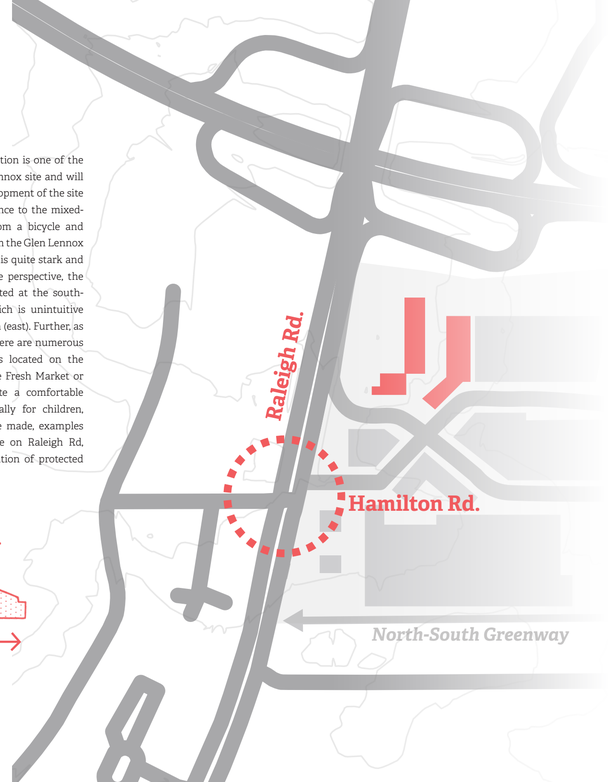


The entry and exit ramps for Fordham Boulevard create an enormous barrier for walking and cycling to Glen Lennox due to car speeds and visibility (photo from Google Street View)

THE SOUTHERN EDGE

The Hamilton and Raleigh Road intersection is one of the few existing entry points to the Glen Lennox site and will gain further importance once the redevelopment of the site is complete as it will be the main entrance to the mixed-use commercial section of the site. From a bicycle and pedestrian perspective, the transition from the Glen Lennox site onto one of Chapel Hill's main roads is quite stark and uncomfortable. Especially from a bicycle perspective, the only protected bicycle facilities are located at the south-eastern corner of the intersections, which is unintuitive and only allows for travel in one direction (east). Further, as heard in the March 2018 focus groups, there are numerous destinations for Glen Lennox residents located on the southern side of Raleigh Rd, such as the Fresh Market or Glenwood Elementary School. To create a comfortable and safe crossing environment, especially for children, numerous design interventions must be made, examples being protected pedestrian refuge space on Raleigh Rd, a reduction of traffic lanes and an addition of protected bicycle lanes along Raleigh Rd.

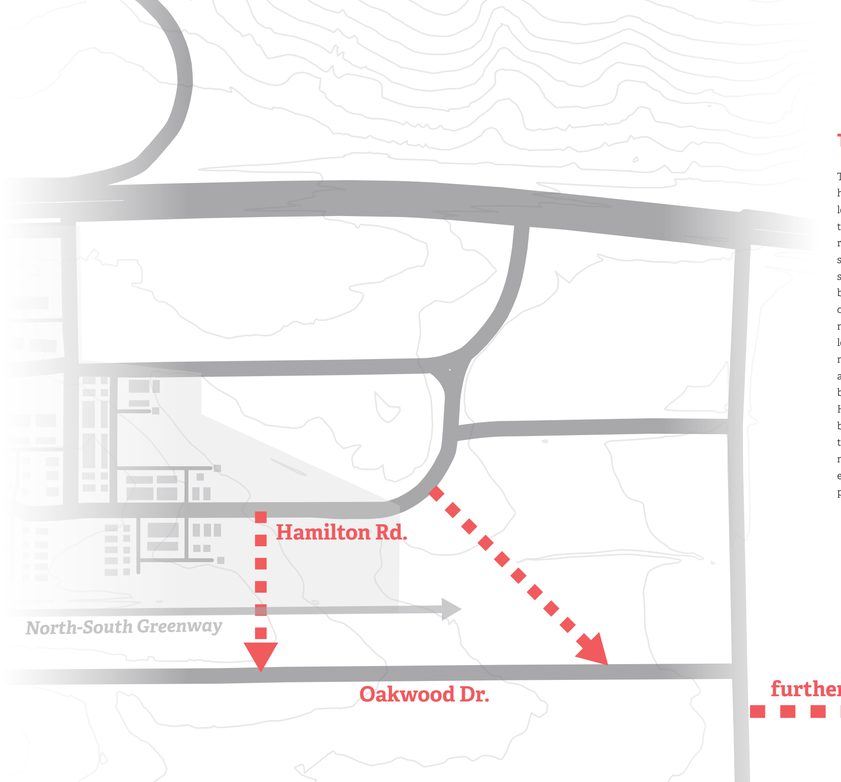




THE GLEN LENNOX SHOPPING CENTER

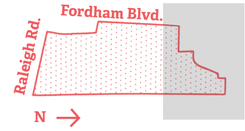
The Glen Lennox Shopping Center in its current form is a largely impermeable land use barrier due to the massing of the strip mall building itself. Although a small cut-through exists from the parking lot to the interior of the site, it is currently hidden and requires an extensive knowledge of Glen Lennox to find. In order to create better connections between Raleigh Road and Glen Lennox, thereby tying the site into the surrounding neighborhoods, it will be necessary to formalize this path and make it visible and obvious from Raleigh Road.





THE NORTHERN EDGE

The northern periphery of the Glen Lennox site currently has the least amount of physical barriers and, due to the low density of development surrounding Glen Lennox, has the highest potential for good permeability. However, as the residential Meadowmont and Booker Creek neighborhoods surrounding Glen Lennox were built around car-centric street patterns such as crescents and cul-de-sacs, the major barrier for pedestrians and bicycle users in this area is a lack of connectivity. Pedestrians and bicycle users are predominantly forced towards Fordham Boulevard or need to take long detours to reach their destinations. Glen Lennox and nearby residents specifically mentioned during engagement activities a desire to see pedestrian and bicycle cut-throughs between Cleland Drive and Emory Drive as well as between Hamilton Road and Oakwood Drive to increase permeability towards the north and east. Providing these connections will be especially important to establish the proposed north-south off-street greenway as a utilitarian corridor for eastern Chapel Hill instead of predominantly a recreational path.

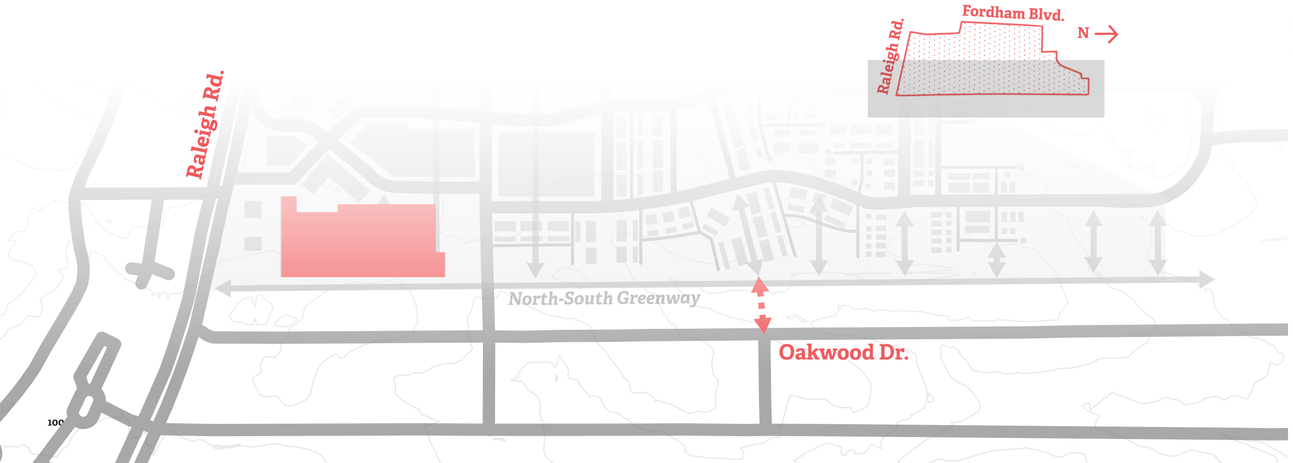


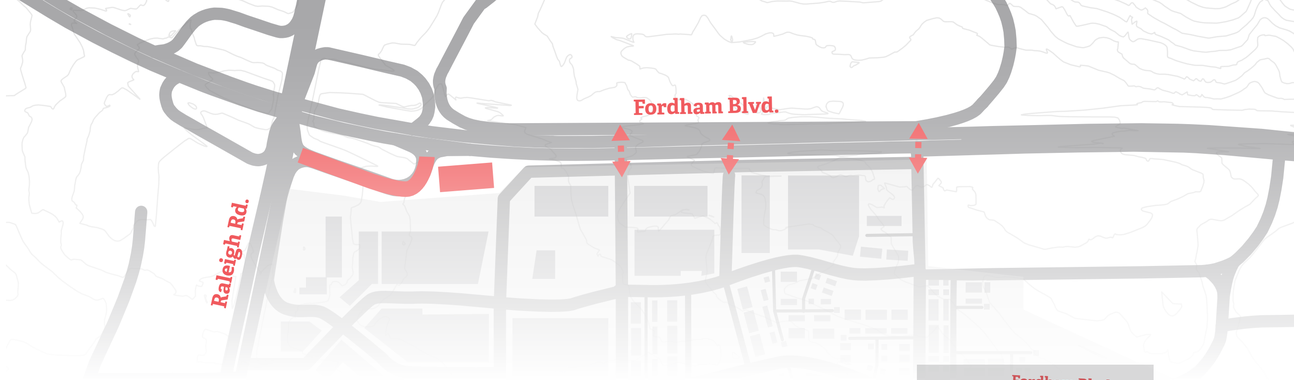
further connections at Cleland Dr.

THE EASTERN EDGE

The success of creating a walkable and bikeable environment not only relies on creating permeability within Glen Lennox but also on providing connections to neighboring destinations. The focus groups of March 2018 shed light on the transportation needs of current Glen Lennox and nearby residents– most of whom identified the lack of connections from Glen Lennox towards Oakwood and Meadowmont as a major barrier. Furthermore, the success of the proposed north-south Glen Lennox greenway as an everyday corridor instead of a recreational trail depends on creating as many convenient connections to and from neighboring residents at regular intervals. At a minimum, the number of exits towards Oakwood Drive should increase permeability to Hamilton Road and the north-south greenway, beginning with a bicycle/pedestrian connection at Douglas Road.

Within the Glen Lennox site, the proposed grocery store and parking complex on the south-eastern corner of the site would in its current iteration, become a large barrier to the permeability both within and connecting to the site for bicycles and pedestrians. Due to its large massing, the building would interrupt east-west permeability to and from the site between Raleigh Road and Berkley Road. When applying the optimal permeability for pedestrians to this stretch, however, there optimally would be two pedestrian cut-throughs along this corridor (as was seen on the analysis done earlier in this chapter). While in other contexts it could be adequate to offer less than optimal permeability, the density of destinations concentrated within the southern portion of the Glen Lennox site as well as the grocery store's standing as an important site itself, do necessitate optimal pedestrian permeability, especially towards the eastern border.





THE WESTERN EDGE

Fordham Boulevard, or North Carolina State Road 15-501, is a major road managed by the North Carolina Department of Transportation (NCDOT) that was identified as one of the most significant barriers to Glen Lennox residents and surrounding neighbors. Residents especially mentioned the lack of protected crossing opportunities along the entire Glen Lennox site and beyond, which force pedestrians and bicycle users to dash across fast moving vehicular lanes in two intervals and waiting on the median in the interim. While the development agreement currently ensures the construction of one light-phased crossing, the permeability analysis suggests that there would optimally be seven further crossings. As this number of at-grade crossings is unrealistic due to the constraints with NCDOT, there is the potential for further innovative crossings in the form of pedestrian and bicycle tunnels, similar to the tunnel below Raleigh Road along the Meadowmont Trail. The establishment of such further connections is vital as the majority of destinations in Chapel Hill lie to the west of Fordham Boulevard. Creating more connections across the road is a key intervention to making Glen Lennox a truly bikeable community within the greater Chapel Hill municipality.

While Fordham Boulevard along the northern portion of the site is a perceptual and safety barrier that cannot be crossed by residents of all ages and abilities, it is, to a certain extent, still possible to cross (albeit harrowing). On the southern stretch of the Glen Lennox site, the intensity of the Fordham Boulevard barrier is increased by the presence of additional physical land use barriers in the form the Raleigh Road interchange and the Brookdale Meadowmont grounds. As a result, this creates a stretch of nearly 650 ft of impermeable land that forces pedestrians to take exhaustive detours to either cross Fordham Boulevard at Brandon Road or Raleigh Road. Finding solutions to this major barrier will be an essential factor in paving the way for Glen Lennox's future as a bicycle and pedestrian friendly community, because the creation of connections westwards towards Chapel Hill's downtown and UNC will connect residents towards many important destinations.

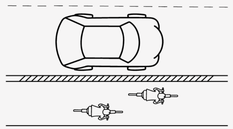
FOUR

CORRIDOR OPPORTUNITIES & STREET DESIGN

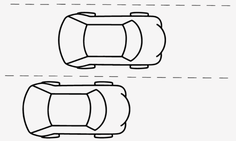
STREET DESIGN GUIDANCE

Design consistency is key to safety for people biking, walking, and driving. The streets within Glen Lennox should have similar design dimensions for each element of the street and use best-practice standards within the Carolinas context that are inspired by a Danish approach.

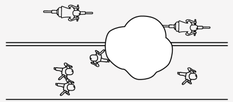
The following guiding design dimensions will create coherent high-quality street designs along Glen Lennox's corridors.



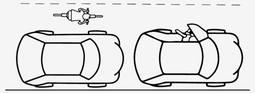
All bicycle lanes should be an absolute minimum width of 6 feet, preferably 7 or 8 feet for protected curbside raised lanes. These widths ensure slower and faster riders can pass one another in the same direction of travel, creating a bicycle network designed for all types of users.



Vehicle lanes should be 10 feet wide and a maximum of 11 feet wide on corridors with bus routes. Narrower lane widths slow vehicular traffic – ensuring speeds below 30 mph within the development, improving traffic safety by reducing fatalities and severe injuries. These standards are finding more and more application on US streets these days.



All sidewalks should have clear zones for walking, unobstructed by street furniture and landscaping. And wherever possible sidewalks shoudl be 8 feet wide in residential areas and 10 feet wide in commercial districts. On sidewalks with a minimum 8 feet of clear space, people can walk past each other more comfortably and maneuver around people with strollers or walking with children.



On-street parking should be limited to corridors where there is no off-street parking being built in garages or residential alleyways. Curbside parking can contribute to slowing speeds along select corridors where additional traffic calming measures are put in place. Parking lanes should ideally be 7 feet wide and up to a maximum of 8 feet wide.

BICYCLE NETWORK PLAN FOR GLEN LENNOX

The proposed bicycle network for Glen Lennox builds upon Chapel Hill's existing plans through best-practice bicycle infrastructure design, positioning Glen Lennox as the most bicycle-friendly community in the Carolinas. By implementing Danish design standards for bicycle infrastructure, Glen Lennox will serve as a beacon for creating a more bike friendly Chapel Hill and offer an example to surrounding communities.

At the core of the proposed bicycle network are two north-south spines; Maxwell Road and the Greenway on the east side of the community. TWo provide a bikeable network of streets that link to the north-south spines there are three key east-west corridors; Brandon Road, Glen Lennox Drive, and the Lanark and Berkele y Roads corridor. All of these corridors are within an easy 1-2 minute bikeable distance of one another, creating a bike network that meets the permeability standards outlined in Part 1 of the Network Strategy. Implementing high quality bicycle infrastructure on these corridors will offer the highest level of bicycle connectivity, creating a truly bikeable Glen Lennox neighborhood.

Hamilton Road and Hayes Road serve as additional north-south connectors though the design strategies employed are primarily focused on traffic calming these residential corridors.





NORTH–SOUTH STREETS

Adequate bicycle-focused north-south permeability is essential in a site that has such large roadway barriers on its periphery. Maxwell Road acts as the prime connector between the busiest areas within the Glen Lennox property and is a perfect 2-minute bike ride west of the Greenway, increasing site permeability for bicycling as described in Part 1 of the Network Strategy. The other key north-south street in Glen Lennox is Hamilton Road, which connects two distinct land uses within Glen Lennox, a residential neighborhood in the north end of the community and the village center in the south. On Hamilton Road the land-uses shift at the same location the corridor narrows – just north of Glen Lennox Drive. Two different street design strategies have been applied here to reflect the land use and right-of-way changes along Hamilton Road.

The following best practice examples showcase some of the design strategies for Glen Lennox's north-south streets.

4.1

Source: Seattle Greenways



Raised midblock crossing connects people from the neighborhood to Magnuson Park in Seattle. The crosswalks is raised across the roadway both prioritizing pedestrians and acting as a speed hump to slow vehicles.

Source: Kristen Langford

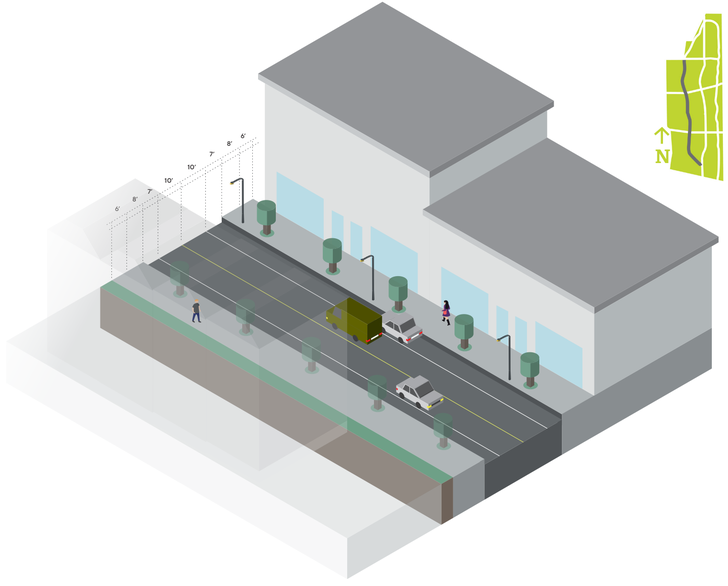


Raised bicycle lane and intersection design that uses curb extensions and textured pads in a Chicago neighborhood. The crosswalks and bicycle lanes are raised across the intersection ensuring people bicycling and walking are prioritized.

Source: Kristen Brookshire



Parking protected bicycle lane in a commercial distric of St. Louis, Missouri. On-street parking can serve to improve the experience for people cycling when bicycle lanes are placed directly next to the curb. Parking can act as a buffer between people bicycling and moving vehicular traffic.



MAXWELL ROAD

Opportunities

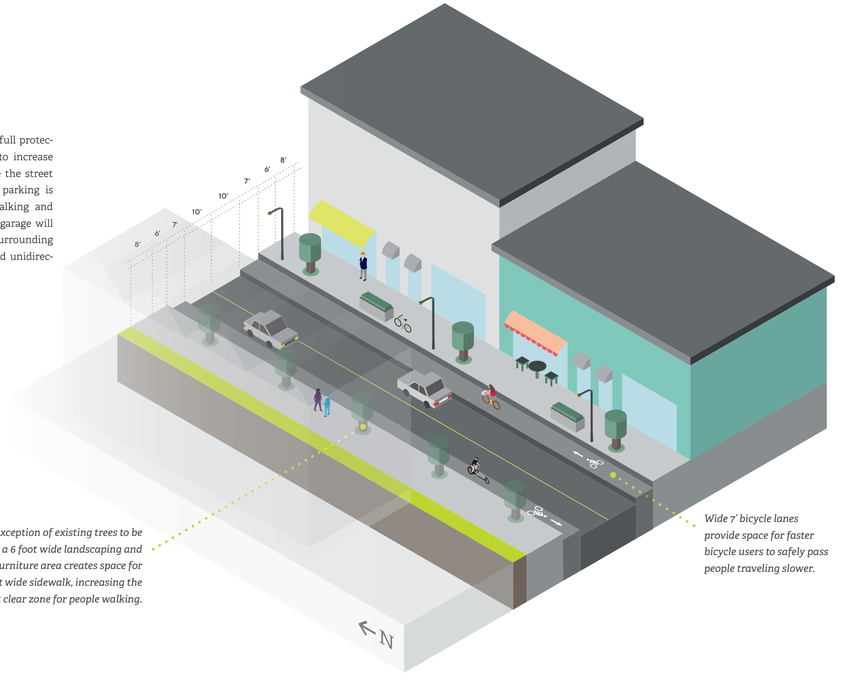
Maxwell Road is slated to be the main street throughout Glen Lennox, a mixed-used corridor with offices, homes and some retail spaces. Phase 1 development will bring over 200 apartments and substantial Class-A office space along the corridor, increasing the need for high-quality bicycle infrastructure to connect people biking along this soon-to-be bustling corridor.

The current design guidance does not accomodate all types of people bicycling and 10 foot travel lanes will be insufficient for people to safely bike in mixed traffic at traffic volumes greater than 2,000 average annual daily traffic (see Chapter 2). For comparison, nearby Cleland Drive has an AADT of 2,220 vehicles and this street has a lower density of land-use than is is planned for Maxwell Road, which will need space for safe cycling as a busier corridor.[1]

1 NCDOT Urban-Area Traffic Volume Maps: Chapel Hill 2015.

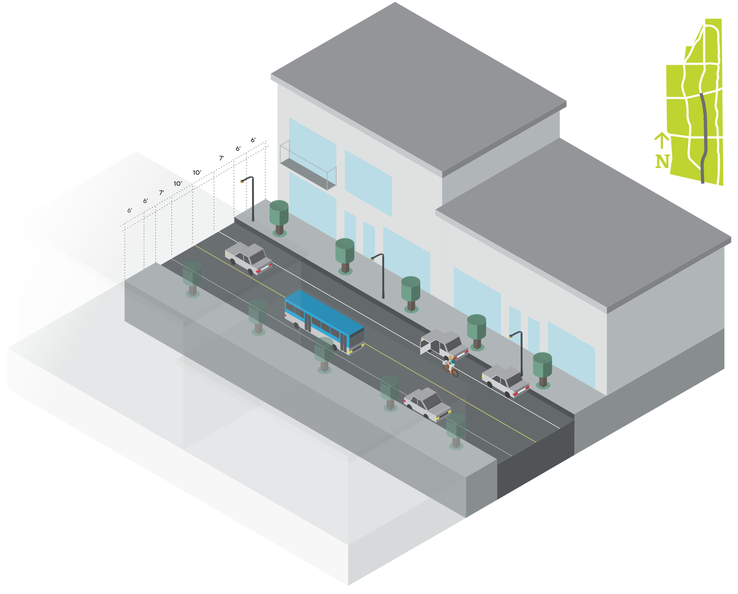
Proposed Design

The proposed design solution is a street with full protection for people biking and wider sidewalks to increase the sidewalk clear zones to 8 feet. To activate the street frontage along Maxwell Road the on-street parking is removed, increasing the space for people walking and biking. The construction of a shared parking garage will address much of the parking needs for the surrounding area. Parking lanes are transformed into raised unidirectional 7 foot wide bicycle lanes.



With the exception of existing trees to be preserved, a 6 foot wide landscaping and street furniture area creates space for an 8 foot wide sidewalk, increasing the sidewalk clear zone for people walking.

Wide 7' bicycle lanes provide space for faster bicycle users to safely pass people traveling slower.



HAMILTON ROAD
SOUTH OF GLEN LENNOX DR

Opportunities

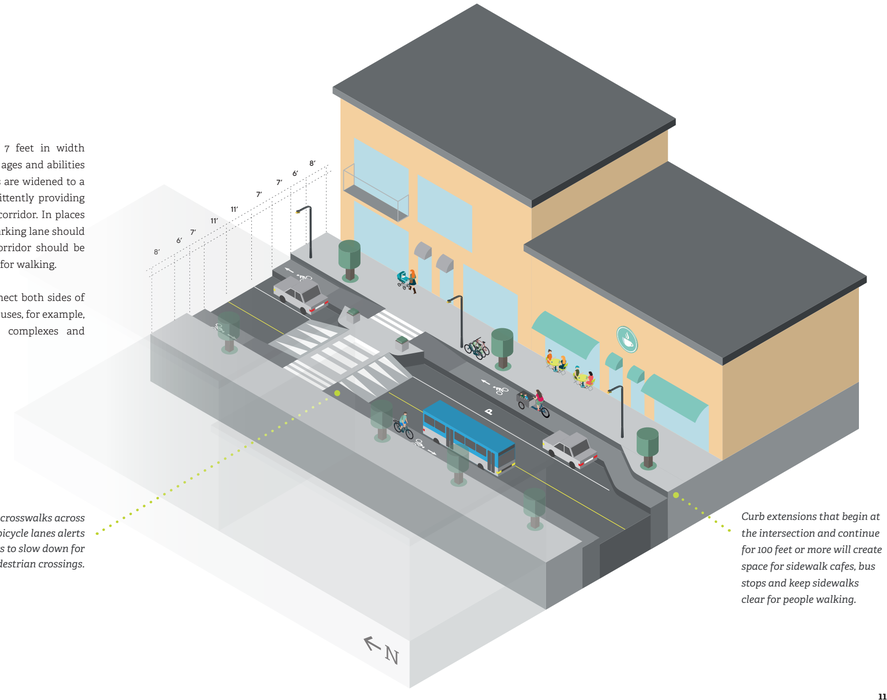
The southern segment of Hamilton Road is similar to Maxwell Road, a dense mixed-use corridor that connects the Glen Lennox neighborhood to the village center. Given the anticipated density and the function of this corridor the mixed use lanes proposed in the Development Design Guidelines will be far too wide, 12 feet. At that width people bicycling will be nudged into the dooring zone alongside parked cars when drivers try to pass at relatively unregulated speeds. A bicycle lane, with full protection for people bicycling, will ensure safety and provide the best access to the village center.

Additionally, the 12 to 20 foot setbacks include areas for landscaping and street furniture, sidewalks and storefront amenities like sidewalk cafes. This is a lot of programming and will likely lead to cramped sidewalks, with clear zones far too narrow for people walking to the village center. The opportunity to create active frontages for shops and restaurants should be prioritized over on-street parking. Most parking can be accomodated off-street in shared parking facilities, opening up the feel of the street to promote active mobility and a vibrant street life.

Proposed Design

Raised unidirectional bicycle lanes of 7 feet in width create a protected and safe space for all ages and abilities bicycling in the village center. Sidewalks are widened to a width between 8 and 10 feet by intermittently providing on-street parking along one side of the corridor. In places where sidewalk cafes are planned, the parking lane should be dropped and sidewalks along the corridor should be widened to ensure a clear zone of 10 feet for walking.

Mid-block pedestrian crossings can connect both sides of the corridor where there is a mix of land uses, for example, connecting people leaving apartment complexes and offices to storefronts and restaurants.



Painting crosswalks across raised bicycle lanes alerts bicycle users to slow down for mid-block pedestrian crossings.

Curb extensions that begin at the intersection and continue for 100 feet or more will create space for sidewalk cafes, bus stops and keep sidewalks clear for people walking.



HAMILTON ROAD
NORTH OF GLEN LENNOX DR

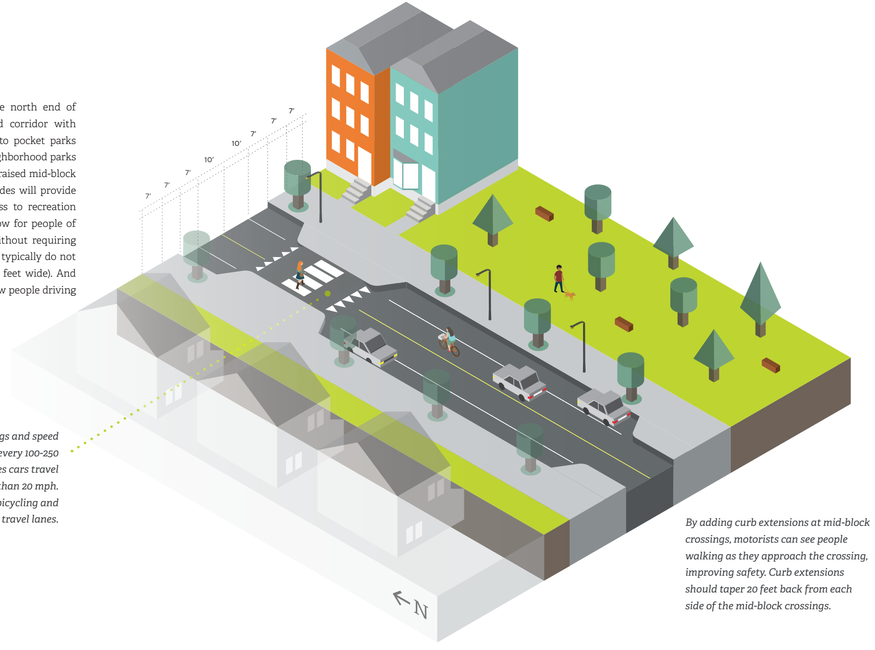
Opportunities

Currently residents park on-street, yet cars often park close to existing crossings leading to poor visibility for people walking as they step into the street. Sidewalks of 5 feet are currently far too narrow for people to walk comfortably and pass one-another with strollers or wheelchairs, and are only widened by a foot in the **Development Design Guidelines**. With 11 foot drive lanes and 7 foot parking on both sides of the street Hamilton Road is not safe for people of all ages and abilities to ride a bike without dedicated bicycle lanes or significant traffic calming. There is currently no major incentive in the street design for cars to slow down to a speed that improves safety outcomes and perceptions alike.

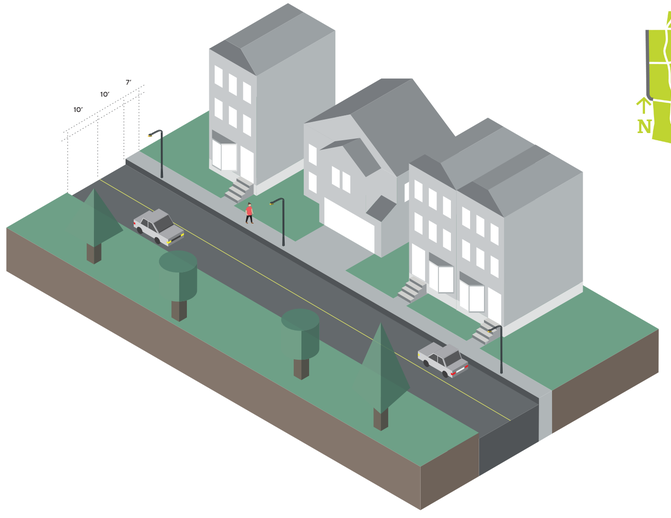
Proposed Design

To create a safe neighborhood street the north end of Hamilton Road becomes a traffic-calmed corridor with midblock crossings connecting residents to pocket parks throughout the neighborhood. Several neighborhood parks are planned along Hamilton Road, adding raised mid-block crossings with curb extensions on both sides will provide residents, particularly children, safe access to recreation in the neighborhood. Raised crossings allow for people of all ages and abilities to cross the road without requiring oversized ADA-compliant curb ramps that typically do not fit within narrower sidewalks (less than 7 feet wide). And raised crossings act as a speed hump to slow people driving through residential areas.

Raised mid-block crossings and speed humps should be spaced every 100-250 feet, this spacing makes cars travel at slower speeds, less than 20 mph. At this speed people bicycling and driving can share travel lanes.



By adding curb extensions at mid-block crossings, motorists can see people walking as they approach the crossing, improving safety. Curb extensions should taper 20 feet back from each side of the mid-block crossings.





HAYES ROAD

Opportunities

Hayes Road is a narrow two-way street on the western edge of the Glen Lennox site. There are are no plans to significantly widen the corridor, which is only 20 feet wide with an existing 6' sidewalk on one side. To discourage drivers from using the street as a by-pass route for the nearby highway or other streets, Hayes Road should be significantly traffic calmed. Currently cars parked on-street serve as informal traffic calming by narrowing the roadway to a single lane of 12-13 feet wide depending on the size of the parked vehicle. Formalizing the traffic calming by utilizing chokers and diverters will keep traffic volumes low and slow traffic. At slower speeds bicycles can travel in shared lanes with automobiles along the corridor.

Proposed Design

People bicycling share narrow 10 foot wide lanes with cars along most of Hayes Road but chokers narrow the travel lanes from one lane to two lanes every 200-250 feet. A single six foot bicycle pass-through with two foot chokers on each side of the street will narrow the two travel lanes to one 10 foot lane, requiring drivers to yield to oncoming traffic but prioritize cyclists traveling in one direction. The prioritized direction of bicycle travel can alternate between southbound and northbound at specific points along the corridor. For example southbound bicycle travel can be prioritized north of Glen Lennox Drive and northbound travel prioritized at chokers south of that east-west route.

At the approach to intersecting east-west streets like Glen Lennox Drive and Brandon Road, diverters with bicycle only cut-throughs can force drivers to turn but still allow people bicycling to continue straight. Strategically employing diverters can create the desired circulation patterns for automobiles through the Glen Lennox neighborhood and ensure drivers do not use Hayes Road as a bypass route.



Building setbacks should be changed by a foot or two to expand the sidewalk width to a minimum of 7 feet in width but preferably 8 feet wide.

A single 6 foot bicycle cut-through prioritizes cycling in one direction through the choker point, and forces cars to decelerate and pass one at a time.

EAST-WEST STREETS

As the site itself stretches further along a north-south axis, it is of utmost importance to implement a sufficient number of safe, comfortable and connected bicycle and pedestrian corridors from east to west. This is compounded by the need to easily connect users into the adjacent community of Oakwood and across the major barrier of Fordham Boulevard. The primary east-west corridors that are key to the bicycle network are Brandon Road, Glen Lennox Drive, and the Berkley Road corridor. Secondary east-west connections can be made through Douglas Road and a future road or connector just south of Glen Lennox Drive. The three primary corridors and Douglas Road will need cut-throughs to connect people to the Greenway (to be discussed further in the last section of this chapter).

For any additional east-west corridors, traffic calming strategies like those proposed for Douglas Road should be the guiding design standards.

4.2

Source: Adam Fukushima



The diverter with a bicycle cut-through forces cars to turn but allows for people bicycling to continue straight through at this intersection in San Luis Obispo, California.

Source: Mikael Colville-Andersen

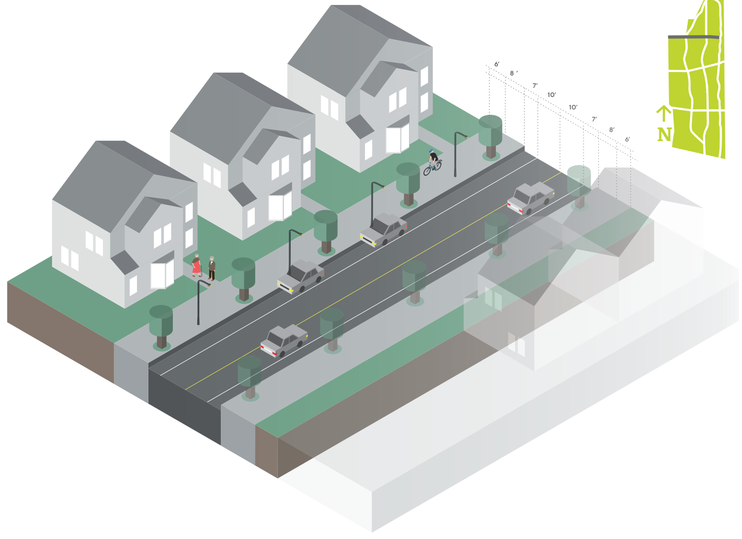


Separated by planted medians this raised bicycle lane in suburban Copenhagen connects people to the city center. Car lanes were narrowed from 13' to 10' creating more space for trees and for a wider bicycle lane with no changes to the travel patterns for motor vehicles.

Source: Mikael Colville-Andersen



A choker with a uni-directional bicycle pass-through slow traffic on a residential Copenhagen street. Greening is placed in these chokers to narrow the field of view, serving multiple functions; slowing traffic and preserving sidewalk space for pedestrians.



BRANDON ROAD

Opportunities

Brandon Road is the primary east-west connection though the most northern residential area of Glen Lennox and passes through the new Brandon Road Park, the new clubhouse and two additional neighborhood parks. The existing design proposals in the Development Design Guidelines do not change the character of the roadway, it is still very auto-oriented with parking on both sides and narrow 6 foot wide sidewalks. The narrower right-of-way of Brandon Road, 50 feet, is ideal for traffic calming. This corridor should discourage cars from simply passing through and instead slow cars though the neighborhood, making the street safe for people walking and biking. Traffic calming the corridor will ensure children and people of all ages and abilities can access neighborhood parks and recreation, easily and safely by foot or on a bike.

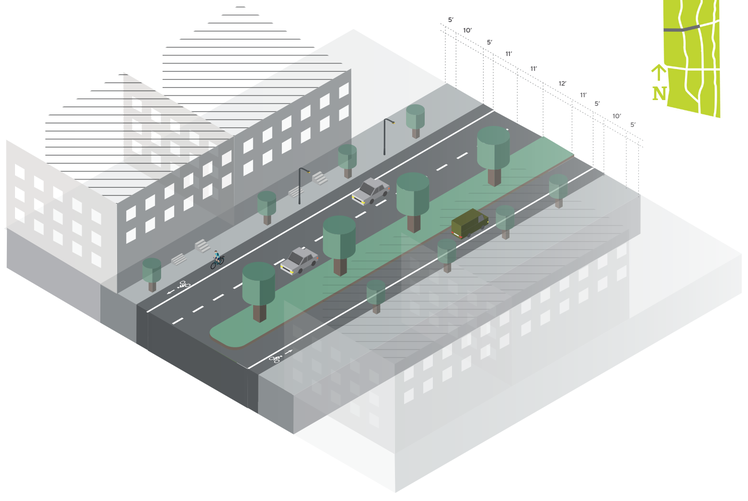


Chokers should be placed every 250-330 feet, this spacing will ensure that cars travel at slower speeds of 20-25 mph on average.

Chokers 2 feet in width will narrow the drive aisle to 18 feet wide, allowing for smaller vehicles to pass each other slowly. Signage can indicate to drivers that they will need to yield to larger vehicles or buses first before continuing through the choker.

Proposed Design

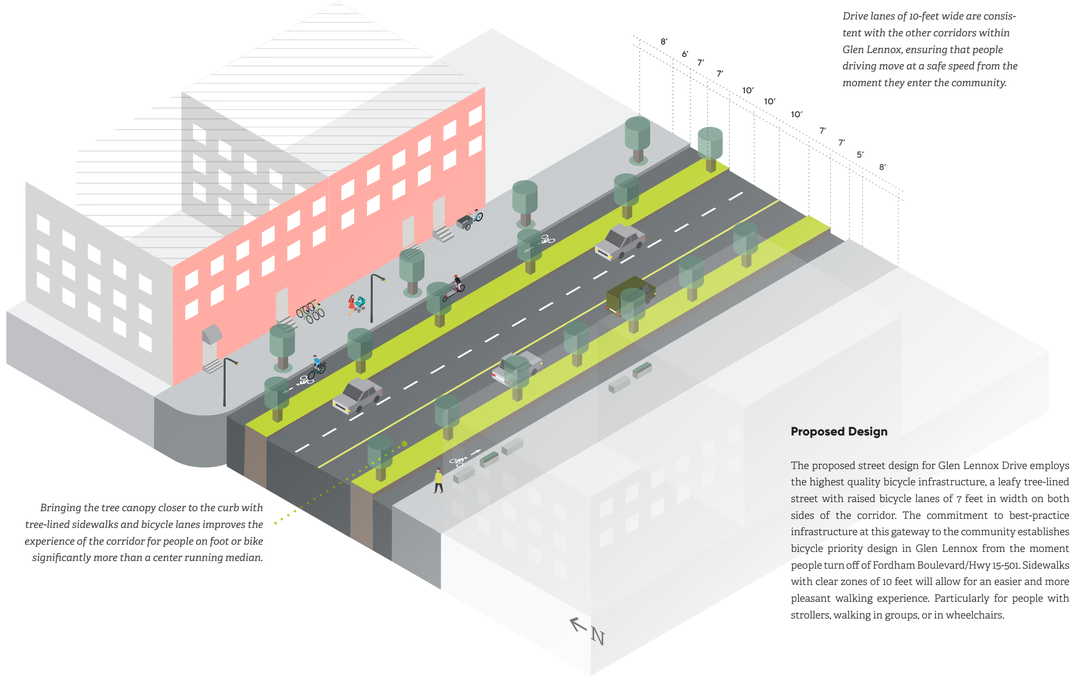
In the north end of the Glen Lennox neighborhood Brandon Road serves as a bikeable traffic calmed street connecting residents and neighborhood parks. Given the development of a five-story car garage adjacent to this street, on-street parking can be removed to create 6 foot wide painted unidirectional bicycle lanes on both sides of the street. Traffic calming is achieved through the use of road chokers along the corridor. A road choker narrows the drive lanes at one specific point in the roadway to allow two cars to pass each other, while separating them from bicycle users. Bicycle lanes are are raised for a short distance of 30-40 feet through chokers. Chokers used in conjunction with speed humps can further slow vehicles.



GLEN LENNOX DRIVE

Opportunities

Glen Lennox Drive is the gateway from Fordham Boulevard/ Hwy 15-501 into the Glen Lennox neighborhood, and thus setting the tone for bicycle-friendly design is key to the street layout strategy employed on this corridor. The wide 80 to 100-foot right-of-way presents ample opportunity to create best practice bicycle infrastructure and develop a pleasant walking environment with greening and landscaping. Phase 1 development plans will greatly increase the number of people living and working in the area, with over 200 new residential units and new office spaces. As a brand new corridor, Glen Lennox Drive should make it seamless for people to walk and bike as they enter the community. Current design guidance constraints people walking to 5 foot wide sidewalks, barely enough room for someone to push a stroller. And the bicycle lane width, 5 feet, is below the minimum Danish-standard of 6 feet for users of all ages and abilities. Additionally the 11 foot wide drive lanes create inconsistencies in lane widths throughout the development, elsewhere drive lanes are 10 feet wide.

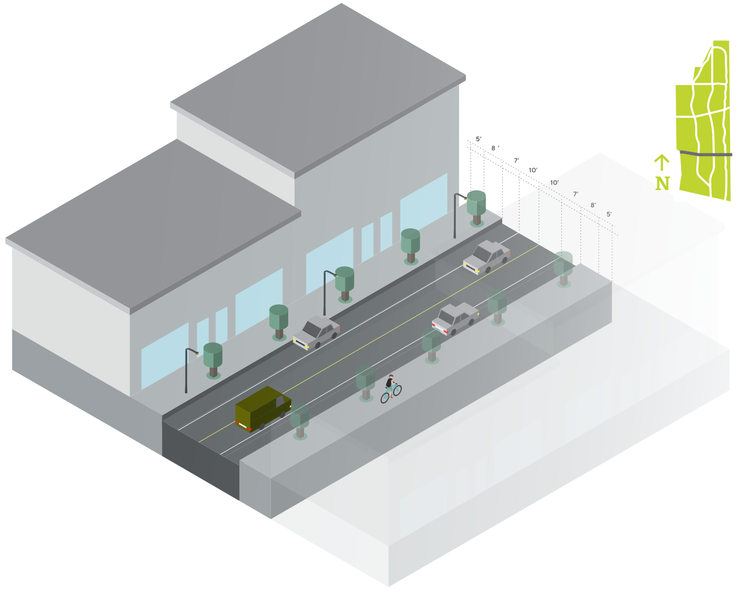


Drive lanes of 10-feet wide are consistent with the other corridors within Glen Lennox, ensuring that people driving move at a safe speed from the moment they enter the community.

Bringing the tree canopy closer to the curb with tree-lined sidewalks and bicycle lanes improves the experience of the corridor for people on foot or bike significantly more than a center running median.

Proposed Design

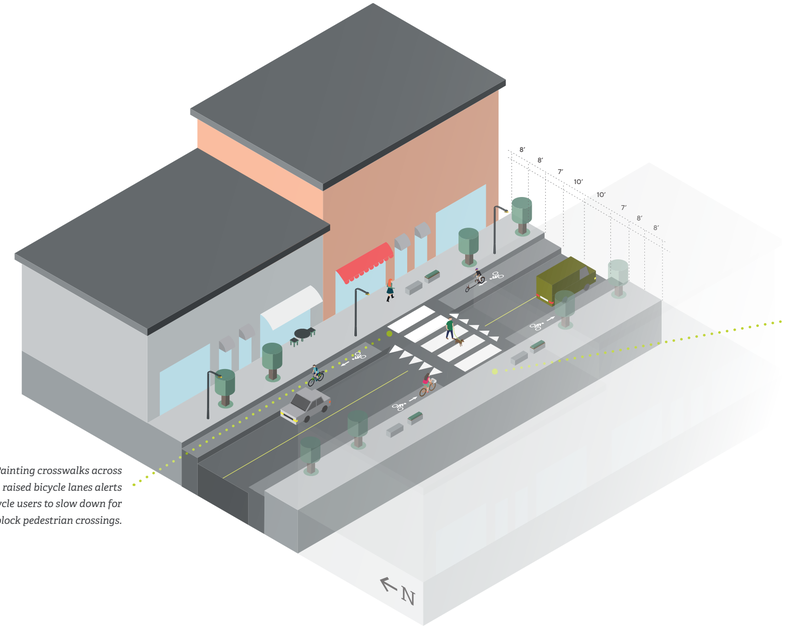
The proposed street design for Glen Lennox Drive employs the highest quality bicycle infrastructure, a leafy tree-lined street with raised bicycle lanes of 7 feet in width on both sides of the corridor. The commitment to best-practice infrastructure at this gateway to the community establishes bicycle priority design in Glen Lennox from the moment people turn off of Fordham Boulevard/Hwy 15-501. Sidewalks with clear zones of 10 feet will allow for an easier and more pleasant walking experience. Particularly for people with strollers, walking in groups, or in wheelchairs.



LANARK/BERKLEY ROAD

Opportunities

The primary east-west bicycle connection in the southern end of the Glen Lennox community is Lanark/Berkley Road. It is the longest east-west corridor in Glen Lennox and the community connection to the nearby Oakwood neighborhood. As the only east-west corridor in the village center, the street should be designed to provide protected and safe bicycle infrastructure. And given the mix of land-uses, residential, commercial, and retail, there is a need for sidewalks wider than the existing 6 feet.

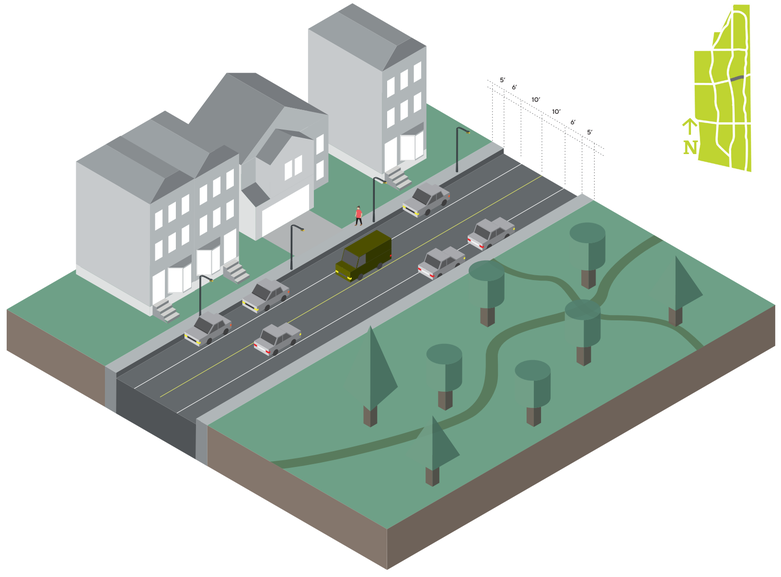


Painting crosswalks across raised bicycle lanes alerts bicycle users to slow down for mid-block pedestrian crossings.

Mid-block pedestrian crossings create more pedestrian permeability along this mixed-use corridor.

Proposed Design

Unidirectional bicycle lanes (7 feet wide) connect people biking from Hayes Road to the Greenway. Raised mid-block crossings along the corridor will create ample opportunities for people to cross between shops, offices and residences on both sides of the corridor. Raised crossings also slow vehicles to safer speeds along this higher density corridor. Sidewalks with 8 foot clear zones will be the most comfortable for people walking. Further east, at the Greenway, a raised crossing for the sidewalk and two-way bicycle path prioritizes people walking and biking along the Greenway.



DOUGLAS ROAD

Opportunities

As deed holders change and the development of Glen Lennox progresses, the existing dead-end of Douglas Road should be connected to Douglas Road in the Oakwood neighborhood using the existing public right-of-way. Traffic calming this corridor will slow cars to safe neighborhood speeds and create space to expand existing narrow sidewalks and buffer sidewalks with landscaping. Off street parking at residences and along residential alleys throughout Glen Lennox means less on-street parking needs to be provided for residents along local roads.



The chicane and lane shift is created by curb extensions that taper to 10 feet wide, an additional 3 feet, before tapering back to 7 feet wide as the parking lane begins again.

On-street parking lanes alternate between each side of the street before and after the chicane.

Proposed Design

A traffic-calmed Douglas Road would have parking on one-side of the corridor only and chicanes that shift the roadway centerline at approximately 200-250 feet from the start of the corridor. This spacing of chicanes slows moving vehicles to speeds of 20 mph or less, which is safe for travel lanes shared between cars and bicycles. Additionally the chicaned street corridor creates wider sidewalks in segments and space for landscaping with additional trees or shrubs. A bicycle cut-through at the end of the cul-de-sac will connect people walking and biking to the north-south Greenway. Cut-through design is described in the final section of this chapter.

OFF-STREET CORRIDORS

Greenways and bicycle cut-throughs serve as off-street corridors for people walking and bicycling, supplementing on-street connections. Greenways often serve recreational purposes in the U.S. but in Denmark they are direct connections for people to reach village and town centers between cities and suburbs. Frequent pedestrian and bicycle cut-throughs will make Glen Lennox's Greenway a usable transportation option for everyday trips.

For optimal bikeability, the Glen Lennox site plan can be improved with three bicycle-focused cut-throughs; the street end of Hamilton Road, a dead-end of Douglas Road continuing west from Glen Lennox Drive, and a connection on the north end of the site. The following best practice examples from Copenhagen's neighborhoods and other cities showcase design solutions for the off-street corridors in Glen Lennox.

4.3

Source: Cycle Superhighways, Capital Region of Denmark



As part of Copenhagen's Cycling Superhighway, this greenway connects the communities of Værløse and Ballerup on the outskirts of Copenhagen with a direct off-street path.

Source: Wikimedia

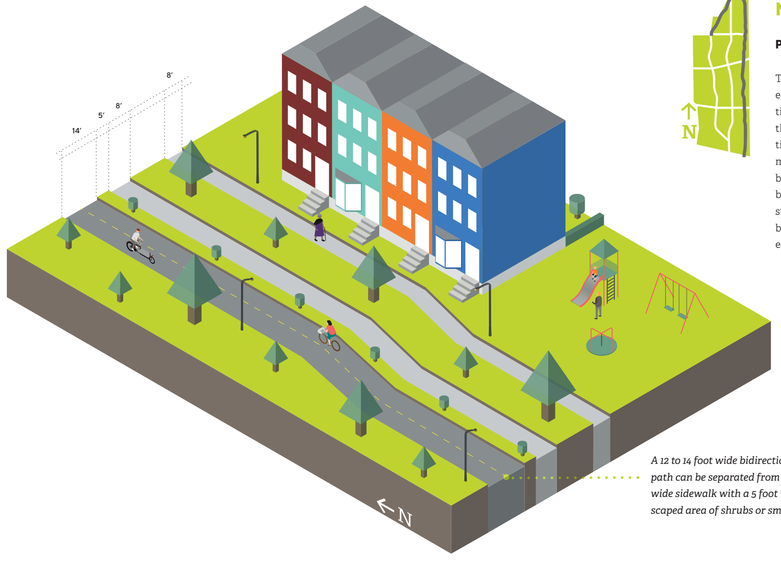


In Copenhagen, a cul-de-sac on Krakas Plads ends in a bicycle cut-through that connects people bicycling to an off-street connector that passes through a playground and onto main thoroughfare on the other side.

Source: CamCycle.org



In Cambridge, England this bicycle cut-through gives people bicycling priority access and prevents cars from crossing the corridor using a planted concrete median.



A 12 to 14 foot wide bidirectional bicycle path can be separated from an 8 foot wide sidewalk with a 5 foot wide landscaped area of shrubs or smaller trees.

NORTH-SOUTH GREENWAY

Proposed Design

The Greenway on Glen Lennox's eastern edge will be most effective as a primary bicycle connection with a bidirectional bicycle path and a separate sidewalk. This ensures that people walking and those bicycling have clear indications of where to go based in intuitive design. In contrast, multi-use bidirectional paths that are shared between bicycles and pedestrians can foster additional conflict between users, those walking are anticipating a leisurely stroll, perhaps with a stroller or dog on a leash and people bicycling are faster moving than pedestrians, in search of an easier A-to-B direct connection.



BICYCLE CUT-THROUGHS

Proposed Design

Bicycle cut-throughs connect people bicycling to greenway paths via short off-street links. These connections also serve people walking when sidewalks are integrated into the design. A cut-through is a formalized entrance, with signage and physical barriers, often a simple bollard, that prevents vehicles from traveling on an off-street path. Applying the same standard treatment, 8 foot wide two-way bicycle paths paired with sidewalks on both sides, and by employing uniform signage and wayfinding ensures users can find and identify cut-throughs. For example, signage at the cut-through entrance should note the travel distance to the Greenway and wayfinding signage on the Greenway should note which corridor the cut-through connects to. These cut-throughs can be short in length and serve to help people reach the Greenway at multiple points throughout the Glen Lennox site.

The design example here shows how a cul-de-sac of the traffic calmed Douglas Road can become a bicycle and pedestrian cut-through, leading to the north-south greenway. Connecting people to the Glen Lennox Greenway and the Oakwood neighborhood.





FIVE



Safe and pleasant connections to destinations beyond Glen Lennox is key to creating a bicycle friendly community.

INTRODUCTION

This final chapter is structured as an idea catalog to thread together innovative, imaginative and practical design solutions to address the unmet needs of bicycle users in Glen Lennox. It looks at how to celebrate the bicycle as an efficient and enjoyable way to travel not only within Glen Lennox but beyond the neighborhood itself. Glen Lennox sits at a crossroads between greater Chapel Hill to the west and Durham to the northeast. This is an opportunity to both introduce best practices in bicycle infrastructure and visual language to Glen Lennox while connecting the greater region by bicycle.

At a core level there is a need to communicate how to get to, through and within Glen Lennox using the bicycle network introduced in Chapter 4 and simultaneously ensure the network is connected to greater Chapel Hill's existing and planned transportation networks. Taking inspiration from the Danish Cycle Superhighway concept – linking villages, towns and cities throughout Denmark by bicycle, Glen Lennox can be the important connector within a larger regional transportation network. Glen Lennox can showcase cutting-edge bicycle best practices that inspire the region and beyond.

TAKEAWAYS

1. ***With bicycle-friendly best practice design, Glen Lennox can help inspire and connect the greater Chapel Hill region through another means of transportation.***
2. ***Bicycle and pedestrian wayfinding in Glen Lennox can offer an iconic visual language to direct people to where they want to go, and better understand their location within the region.***
3. ***Intersections on Glen Lennox's periphery must be redesigned to limit pedestrian and bicyclists' interactions with turning vehicles, improving traffic safety for all roadway users.***
4. ***A bold design solution for crossing the interchange of Highways 15-501 and 54 – the greatest barrier to mobility in the area – is the way forward for a bicycle and pedestrian-friendly region.***
5. ***Glen Lennox and North Carolina specific micro design objects offer a way to introduce comfort and fun to current and prospective bicycle users within a truly bicycle-friendly community.***

GLEN LENNOX: CONNECTING THE REGION

By laying a foundation for bicycle-friendly best practice design in the Carolinas, Glen Lennox can inspire and help connect the greater Chapel Hill region. Bringing the concept of the Danish cycle superhighways to a scale that works for Glen Lennox does not mean compromising on the core design ideas of the community. By applying these design principles to the context of Glen Lennox, convenient and easy travel by bicycle beyond the neighborhood's boundaries would become possible for a large demographic base. The design ideas presented in this chapter are not only for Glen Lennox but can be implementable in the greater Chapel Hill region.

5.1

WHAT IS THE DANISH CYCLE SUPERHIGHWAY?

Starting in 2012, Denmark began to connect urban, suburban and rural bicycle infrastructure into a set of coordinated long distance travel routes. The core design elements of the cycle superhighway include a network of clear, direct and off-street bicycle routes that connect to the region's primary centers. Visual communication is clear and uniform so bicycle users know they are en route to their destination. Physical design guides bicycle users safely through transition points like intersections or highway and railway interchanges. The overall concept also includes signalling systems that prioritize bicycle users along these routes. The cycle superhighway also has a uniformity of high quality infrastructure design and other physical features that increase comfort when cycling, such as bicycle repair stations and high quality lighting.

Scaling the concept of a cycle superhighway to the region of Chapel Hill into implementable strategies in Glen Lennox identifies four key areas of development:

1. A network of bicycle routes connecting to potential bike & public transport travel routes.
2. Cohesive visual communication of bicycle routes within the network.
3. Best practice design of transition points on Glen Lennox's periphery.
4. Micro-design for comfortable, engaging and fun cycling.

Source: Supercykelstier



GLEN LENNOX AS THE LINK IN A REGIONAL NETWORK

The foundation of any travel network – whether roads, highways, railways or trails – is a clear identification of routes that lead to key destinations. Synthesizing the existing trail network, the proposed bicycle network within Glen Lennox, and proposals in the the Chapel Hill Bike Plan, the Chapel Hill Mobility & Connectivity Plan, and the Durham Bike+Walk Implementation Plan, there are key bike routes that connect Glen Lennox and the larger region.

The map on the right shows the connections through Glen Lennox for longer trips beyond the neighborhood. The route in blue shows a longer travel route of 20 to 30 minutes from Glen Lennox to either Downtown/Carrboro in the west or southwest to UNC-Chapel Hill's Medical Campus. This route hits most of the major destinations within Chapel Hill and links proposed bicycle connections in both of the city's Bike Plan and Mobility & Connectivity Plan.

The route in green is a long distance bicycle route towards Duke University and Durham to the northeast and Research Triangle Park to the east through Meadowmont. This route would end in Durham and Research Triangle Park, respectively, using existing and proposed greenway networks from the Chapel Hill Bike Network Plan and Durham's Bike+Walk Implementation Plan. Travel times to destinations in Durham and Research Triangle from Glen Lennox would be longer, an estimated 45 to 60 minutes by bicycle on protected lanes and greenways. Bike to bus travel could shorten travel times to these destinations, connections at Hamilton & Raleigh Roads and on East Franklin Street are shown on the green route.

REGIONAL CONNECTIONS BY BIKE

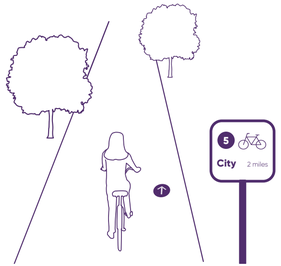
Existing & Glen Lennox Proposals

Proposed in Chapel Hill Transportaiton Plans

Superstop Connection Bike to Bus

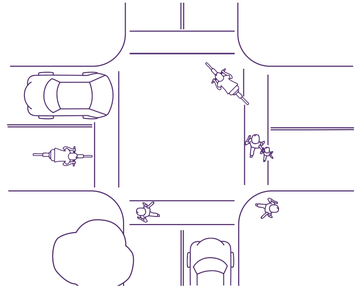


BICYCLE NETWORK DESIGN ELEMENTS



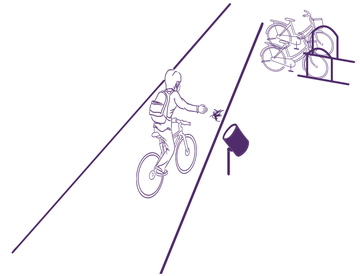
COHESIVE VISUAL COMMUNICATION

Beyond the bicycle network itself, creating clear visual communication is needed so bicycle users and pedestrians know where they are along the routes to, from and within Glen Lennox. This can be achieved through wayfinding – a comprehensive system of signs, graphics, and environmental information that people use to orient themselves and simplifies navigation by making destinations easy to locate. Bicycle and pedestrian wayfinding in Glen Lennox should extend beyond basic road signage and offer a visual language of symbology and color to direct people to where they want to go.



PHYSICAL DESIGN OF TRANSITION POINTS

Glen Lennox's periphery has several entrance points where intersections often act as barriers to cycling or walking, these intersections can be improved to link a regional bicycle network through Glen Lennox. Peripheral intersections are currently designed with an enormous amount of space given to wide and fast turning cars, which leads to higher crash rates. For people cycling, there is a need to connect seamlessly and safely through these junctions – limiting interactions with turning vehicles – and easily navigating changes between different types of bicycle facilities to continue en route to their destination. Similarly, pedestrian movements need to be safe and intuitive, protected as much as possible from interactions with fast moving cars.



MICRO DESIGN FOR COMFORTABLE AND FUN CYCLING

Clear wayfinding and connectivity through better intersection design will make biking to, from and within Glen Lennox seamless – but to make it truly enjoyable there are elements of play and comfort that can be created through micro-design. Micro design encompasses the design of bicycle user-focused objects – street furniture, parking, and conveniences – that create a bicycle-friendly atmosphere. Micro design objects are the little things that often matter to the end user and can blend cohesively with wayfinding design elements. Given the climate of the Carolinas and Grubb Properties' goals to create an inviting and neighborly community, the final section of this chapter features playful micro design concepts crafted uniquely for Glen Lennox and Chapel Hill.

BICYCLE AND PEDESTRIAN WAYFINDING

Developing a wayfinding strategy for any community is key to helping people orient themselves and get them to where they want to go. With a new street grid being developed in Glen Lennox, both future and current residents of the area will need to be able to easily navigate the neighborhood. In order to achieve the goal of half of all trips to and from Glen Lennox by walking, biking and transit, wayfinding solutions should be focused on those users who are not in a motor vehicle. Wayfinding in Glen Lennox that goes beyond basic road signage and offers a visual language of symbology and color to direct people to where they want to go on foot, by bicycle or transit is of the utmost importance.

5.2

WHAT IS WAYFINDING?

Wayfinding is a system of signs, graphics, and environmental information that people use to orient themselves and navigate within a geographic context. Wayfinding systems allow both newcomers and locals to understand their location within a city, simplifying navigation by making destinations easy to locate.

Wayfinding for pedestrians and bicycle users differs from directional road signage, which is focused on automobile users. Pedestrian wayfinding systems point users in the direction of desirable locations in a smaller geographic area – one that is generally walkable. Since automobiles are moving at higher speeds, the design of a typical large roadway sign is designed to point out destinations at distances miles ahead. These routes that are often not walkable or beyond a comfortable walking distance (greater than 20 minutes by foot). Wayfinding for bicycles takes a similar approach to pedestrians, but since bicycle users are essentially fast-moving pedestrians, they require a wayfinding system that combines the needs of people traveling at slower and faster speeds. A system for bicycle users should provide directions to farther destinations, within 20 to 30 minutes travel by bicycle, along with noteworthy local attractions.

When done properly, wayfinding improves transportation habits, supports local businesses, encourages tourism, and assists city marketing campaigns. Wayfinding should be consistent, coherent, and memorable to help users develop mental maps and deepen a person's connection with the community, city and greater region.

Core Elements of a Wayfinding Strategy

The best wayfinding strategies emphasize a few key elements:

1. The first objective of wayfinding is orienting the user. In order to determine the location of important destinations, you must first know where you are. The user's orientation in space should be immediately comprehensible to users.

2. Route planning should be addressed by pedestrian wayfinding strategies in particular. Some people may not consider walking as a viable mode of transportation unless a safe and pleasurable route is provided for them. Making route planning easy encourages people to walk.

3. Route guidance and choice selection are closely related to route planning, yet need to be optimized for people riding bicycles. Because bicycle users are fast-moving pedestrians, a wayfinding system that provides directions quickly with visual cues allows them to continue on their journey without requiring frequent stops. Wayfinding strategies like trail markers or posts can help accommodate their specific needs.

Source: Legible London (London, United Kingdom)



London's "Legible London" established a citywide strategy for simplified and standardized wayfinding. The system features totems with maps of "walking circles" to place the user in the context of his or her surroundings. The maps are oriented in the direction that the reader is facing, rather than with north at the top, helping users make sense of their placement.

Source: (New York City, USA)



WalkNYC, New York's wayfinding strategy, took note from Legible London by implementing a similar "heads-up" map that facilitated user orientation and highlighted the physical structure of landmarks in 3D form, making the urban environment more identifiable to users.

A WAYFINDING STRATEGY FOR GLEN LENNOX

Glen Lennox sits at a crossroads within Chapel Hill and as such there is a need to both communicate how to get around the new street network and beyond the community to destinations such as the University of North Carolina, downtown Chapel Hill and Durham. Working within the larger framework of the regional bicycle routes and utilizing best practices in wayfinding, the following elements are essential to wayfinding:

1. Orient bicycle users and people walking in the physical environment;
2. Provide confirmation that they have arrived or are en route to a destination; and
3. Help them navigate which direction they are headed through route guidance.

We've employed a language of color and pattern based on the visual identity that Grubb Properties has developed for Glen Lennox to address these core elements of wayfinding. Color orients users where they are within the region and where they are headed on routes to farther destinations beyond the Glen Lennox community. Patterns provide confirmation that users are en route or have arrived at a destination. Color and pattern combined are directional, simple combinations help users navigate towards their destination.

ORIENTATION

For orientation, the color palette of each object is defined by where it sits within or on the peripheral edge of Glen Lennox and from the viewer's perspective. To break it down further:

The deep navy of Glen Lennox's logo denotes objects within Glen Lennox or when the viewer is facing towards Glen Lennox from the periphery.

Light blue denotes travel towards Chapel Hill, both UNC's main campus and downtown. From the viewer's perspective, when facing these directions, objects are colored in light blue.

Bright green denotes travel north and east toward Durham, when viewers are facing these directions, wayfinding objects are colored in bright green.

CONFIRMATION AND DIRECTION

A concentric circle pattern is used on maps to show where users are, or they are applied to pavement and other surfaces to confirm that users have arrived at a destination, for example on park signage.

The chevron pattern is employed in the design of arrows, when applied as colored stamps on greenways or paths it helps users confirm they are on a specific route. Additionally, the chevron pattern as an arrow indicates directionality on wayfinding markers in conjunction with the color palette defined above for directionality, allowing users to see markers and easily navigate towards their destination.

Totems are the largest objects in the wayfinding system, easily identifiable as information booths. Totems are designed with a heads-up map for users to orient themselves within Glen Lennox, plan their route and navigate to nearby destinations.

The nearest destination is at the top of the totem and bolded, followed by other nearby destinations with the number of arrows to infer the relative proximity of destinations, near (fewer arrows) or farther away (more arrows).

Totems are designed with a "heads-up map" that users can use to orient themselves within Glen Lennox and navigate to nearby destinations or be directed to further destinations.

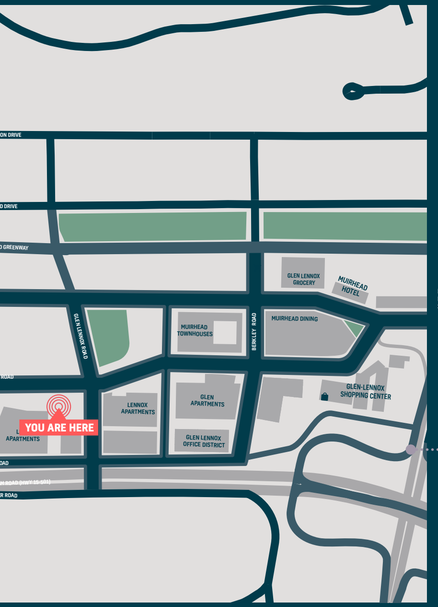
Confirmational patterns of the concentic circles are associated with destinations and "You Are Here" markers.



Typical two sided totems can be used at gateways at Glen Lennox Drive and Hamilton Road but a central totem in the town plaza should be three sided. The street grid is atypical at this location and the three sides allows for maps that face the three directions in view; Maxwell Road (northwest), Hamilton Road (northeast), and Hamilton Road (south).

Totems are colored in the dark navy of Glen Lennox's logo, visually reinforcing the idea that this blue "means" Glen Lennox.





This heads-up wayfinding map employs best practice design for wayfinding maps. Heads-up refers to the rotation of the map. While most maps have north as the upward direction a heads-up map is rotated so that the upward-direction or top of the map is the direction the user is facing. Once a user lifts their head up or eyes off the map they're facing the direction that aligns with the top of the map.

In addition to the totems, there are smaller wayfinding objects that let users know where they are, help them navigate their route and ensures bicycle users continue on the quickest path to key destinations. These objects are a combination of directional and confirming design elements. Small bollards and pavement stamps are color-coded by the main routes to farther-off destinations, while wooden posts and larger bollards can be used to communicate distances to both nearby and farther destinations.

The regional routes for transit and bicycling are shown with directional arrows and basic symbology, extending off the edges on the map.

The line weight of streets reflects their size and importance for walking and bicycling connectivity. Auto-only routes fade into the background are faintly visible.

Smaller bollards can be used as regional route confirmation markers or at decision points on bicycle routes, located at the turn or entrance to a regional route. Their smaller profile is ideal for narrow median or smaller entrances at multi-use paths. Large bollards call-out the distance to destinations within Glen Lennox.



WAYFINDING OBJECTS IN CONTEXT

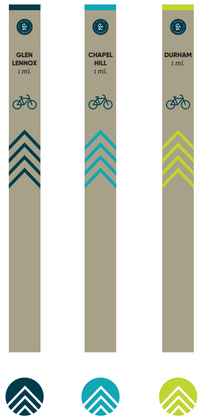


These design concept drawings show how wayfinding objects work within the context of the streetscape. A two-sided totem for wayfinding is visible to both people in the bicycle lane and people on the sidewalk when placed near the sidewalks' edge.



A large bollard informs bicycle users of how far they are from local destinations within Glen Lennox. The bollard also serves to divert auto traffic at this bicycle only cut-through.

Wayfinding markers can be used on roads, greenways and bicycle paths for two purposes: direction and confirmation. For greenways and trails, posts indicate direction and conformational arrow symbols on the path's surface provides visual cues to bicycle users they are en route to specific destinations.





The colors employed in the post design are used to indicate directionality. This post faces toward Glen Lennox, with a deep navy as the marking elements. The reverse side would be in green, to match the route marker for travel towards Durham. In other locations the reverse side could be light blue for travel towards Chapel Hill. The post also informs users that they are heading toward a specific destination and how far away they are.

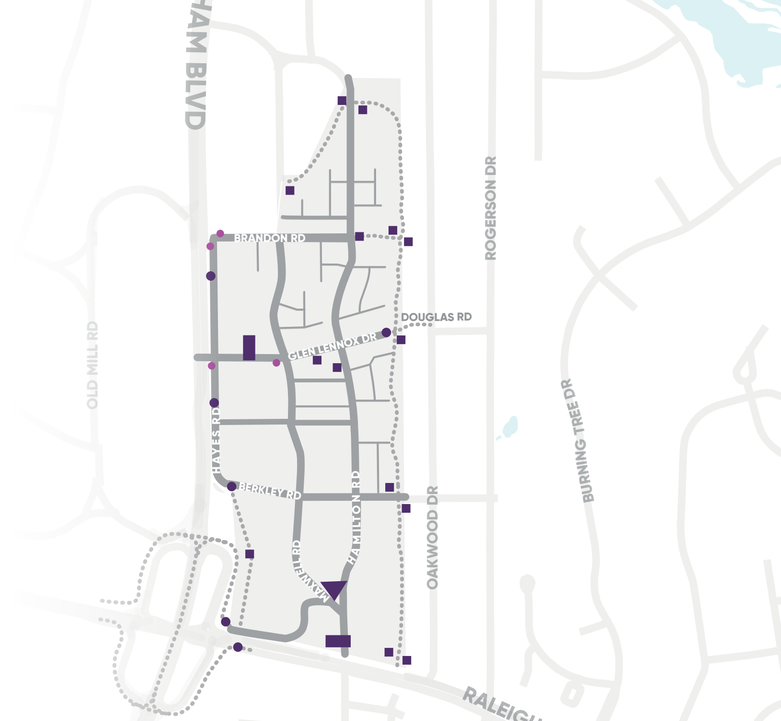
The map at right shows where wayfinding objects are recommended to be placed in Glen Lennox in order to help people walking and bicycling navigate towards their destinations.

Gateways to the community at Glen Lennox Drive, Hamilton and Raleigh Roads, and the community plaza at the three way intersection of Hamilton and Maxwell Roads are all ideal locations for totems.

Smaller directional posts or bollards should be placed at the entrances to the greenway, secondary entrances into Glen Lennox along Brandon Road, within parks, bicycle cut-throughs and along the pedestrian and bicycle bridge.

Confirmation bollards for the regional routes should be placed within Glen Lennox where bollards are used to divert auto traffic but maintain bicycle travel through an intersection or segment of the street.

Stamps for directionality can be used on protected bicycle lanes, calm shared streets, the pedestrian and bicycle bridge, and on the greenway.



WAYFINDING IN GLEN LENNOX

- **Wayfinding Totem – 2 sided**
- **Wayfinding Totem at Main Plaza**
- **Directional Posts**
- **Directional Bollards**
- **Confirmation Small Bollards**

INNOVATIVE INTERSECTION DESIGN

Like many communities in Chapel Hill, the highways and wide arterials that surround Glen Lennox are significant barriers for people bicycling, walking and using transit. Connectivity for Glen Lennox to the Chapel Hill and greater Durham-Raleigh region can be ameliorated through better design at key nodes of transportation; major street intersections and transit stops. Key intersections need to be redesigned in order to ensure safe all ages and abilities bicycling and walking, both to and from Glen Lennox. Greater integration between cycling and transit – creating a seamless transition from riding a bike to hopping on a bus – will enable residents to connect to destinations beyond the neighborhood as well as bring visitors and commuters to destinations within Glen Lennox.

CONNECTING GLEN LENNOX

Part 1 of the Network Strategy highlighted key intersections where a disproportionate amount of space is allocated to automobiles today, creating barriers that negatively affect other modes of transportation and the ability of people to move safely beyond the neighborhood by foot, bike or transit. On the western edge of Glen Lennox these barriers are Fordham Boulevard (Highway 15-501) at both Brandon Road and the new intersection with Glen Lennox Drive. On the southern and western edges, the most significant barrier to mobility is the cloverleaf interchange between Fordham Boulevard (Highway 15-501) and Raleigh Road (Highway 54). The interchange completely lacks any safe crossings for people walking or biking into downtown Chapel Hill, on the most direct connection of Raleigh Road.

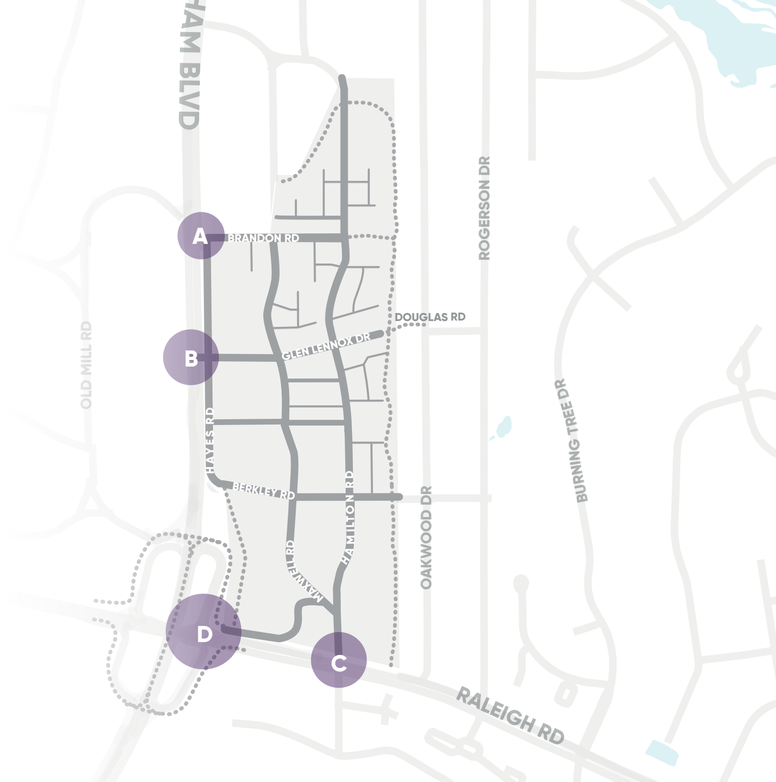
Building on the analyses of earlier chapters as well as the design strategies for the corridors within Glen Lennox, the following map showcases a primary local biking and walking network beyond the neighborhood to connect to key destinations and transit transfer points. To achieve seamless bicycle trips that extend beyond Glen Lennox and easy transfers to transit requires the following barriers to be redesigned for all ages and abilities bicycling and walking.

A The intersection of Brandon Road at Hayes Road and Fordham Boulevard. This intersection connects northward to the greenway along UNC-Chapel Hill's East Campus and links people to transit hubs that serve the existing Chapel Hill-Durham connection at Estes Drive and E Franklin Street, as well as future greenway connections east toward to Duke University and Durham.

B The intersection of Glen Lennox Drive at Hayes Road and Fordham Boulevard. From here people can connect via calm residential streets - Christopher Road, Greenwood Road, Shepard Lane and small off-street trail links - north to University Place, North Chapel Hill and the Bolin Creek greenway network leading into Downtown Chapel Hill. Additionally this crossing is a link in the Chapel Hill Mobility & Connectivity Plan's Cross Cities Corridor.

C The intersection of Hamilton Road at Raleigh Road connects people to existing and planned high frequency transit on Raleigh Road and is the crossing to the planned Hamilton Road Light Rail station. This intersection can also provide safe east and westbound bicycle connections to the existing and planned protected paths on both sides of Raleigh Road. This corridor is slated for bicycle infrastructure improvements with dedicated paths westbound to Downtown Chapel Hill as part of the Chapel Hill Bicycle Plan.

D Safe pedestrian and bicycle travel under or over the interchange of Fordham Road (Highway 15-501) and Raleigh Road (Highway 54) is needed. This is the single greatest barrier to safe travel for people walking and biking and limits their ability to connect to the rest of Chapel Hill. This interchange is also highlighted as a key issue in Chapel Hill's Mobility & Connectivity Plan, where safe low-stress crossings are needed for people walking and bicycling.



DANISH INTERSECTION DESIGN

CORNER CURB RADIUS



Reducing the radius of the corner curbs at an intersection slows down cars completing a turn. By slowing turning vehicles, crash rates at bicycle and pedestrian crossings are reduced.

Throughout Copenhagen most corner curb radii are 10 to 15 feet at intersections, which is significantly smaller than 20 to 40 foot corner radii in Glen Lennox currently. And dramatically less than the 50 foot or larger curb radii in use at highways and arterials along the edges of the Glen Lennox, where turning is more akin to traveling on a high speed slip lane for cars.

PAINTED CROSSINGS



In Copenhagen, bright blue painted crossings alert motorists to the highest bicycle traffic crossings. These crossings are a visual cue to drivers that they are entering a space where they need to be alert and extra cautious to prevent harming other roadway users. These bright strips of paint are inspired by high visibility crossings for pedestrians. While only the highest risk areas are painted for intersections in Copenhagen, Glen Lennox can employ this type of pavement striping at large intersections in conjunction with high visibility pedestrian crossings. To conform to traffic standards in the U.S. these crossings should be painted in bright green.

PROTECTED BICYCLE TURNS



Protected bicycle turns significantly reduce the risk of people bicycling being hit by a right-turning motorist. Preventing "right hook" crashes can greatly improve overall traffic safety, as it is the most common crash type at intersections. Bicycle users are protected by by physical curbs and can complete their own right turn without the risk of motorists crossing their path.

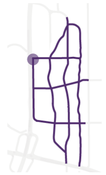
BICYCLE ONLY SIGNALS



Improvements beyond physical design include signal phasing and timing. Bicycle only signals are installed with a dedicated priority phase, as shown here people cycling get a head start through the intersection before automobile traffic.

If a dedicated bike signal cannot be installed, signage should state that bicycle users can also use the pedestrian priority phase to cross. This phase is called a Leading Pedestrian Interval, where people walking are given a head start to cross the intersection before the light goes green for motorists.





BRANDON ROAD AT FORDHAM BOULEVARD

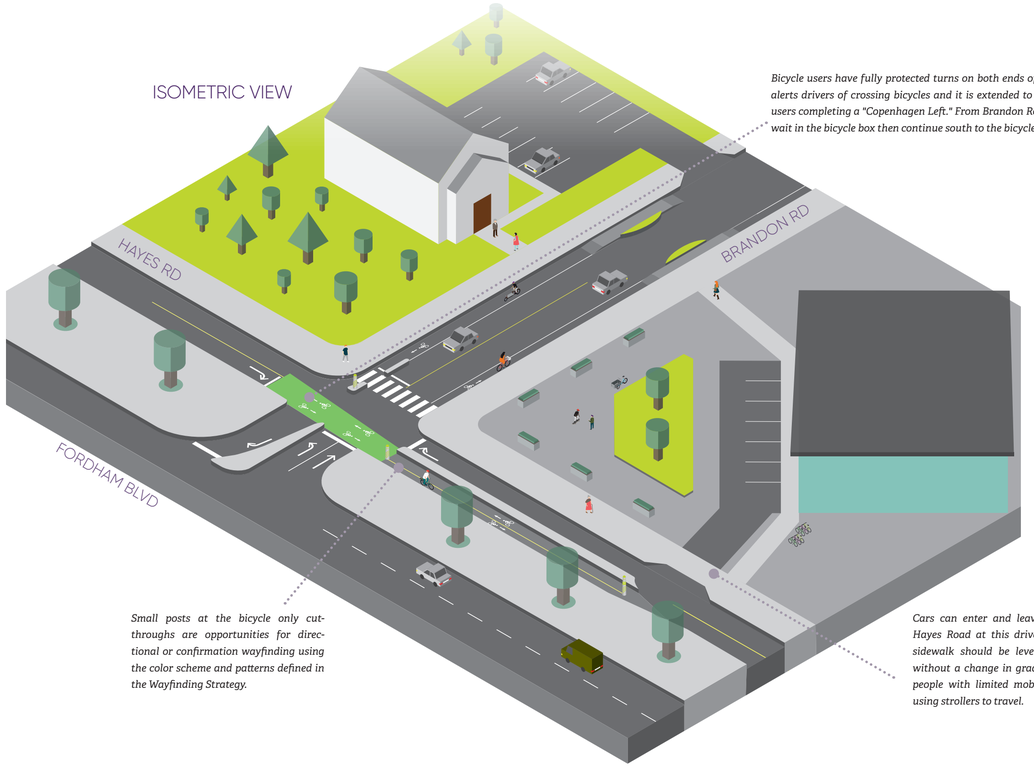
Brandon Road is anticipated to remain an unsignalized intersection at Fordham Boulevard (Hwy 15-501) for the foreseeable future. Without the addition of signals, the safest option for people bicycling or walking is to reduce the intersection curb radii thereby reducing the speeds of vehicles turning onto either Brandon or Hayes Roads from Fordham Boulevard and further reduce the risk of crashes. Additionally, it will be necessary to direct people towards westbound crossings at Glen Lennox Drive to the south or Estes Drive to the North. For people bicycling, this intersection would be optimal as a pseudo T-shaped design, with Fordham Boulevard as the barrier preventing travel further westbound. The intersection design should provide safe southbound connections to the traffic calmed Hayes Road and northbound travel to the greenway at UNC's East Campus.

In the photo at right it is obvious that the current design does nothing to slow vehicles turning from Fordham Boulevard onto Brandon Road. The large curb radius appear to create slip lanes rather than corners for a stop-controlled turn.



View of the Brandon Road intersection from Hayes Road looking northward.

ISOMETRIC VIEW



Bicycle users have fully protected turns on both ends of the intersection. Green paint alerts drivers of crossing bicycles and it is extended to provide a bike box for bicycle users completing a "Copenhagen Left." From Brandon Road, users cross Hayes Road to wait in the bicycle box then continue south to the bicycle only cut through.

Small posts at the bicycle only cut-throughs are opportunities for directional or confirmation wayfinding using the color scheme and patterns defined in the Wayfinding Strategy.

Cars can enter and leave the Clubhouse from Hayes Road at this driveway entrance but the sidewalk should be level across the curb cut, without a change in grade. Making it easier for people with limited mobility, in wheelchairs or using strollers to travel.

PLAN VIEW

Building upon preliminary designs for this intersection, the proposed design increases pedestrian and bicyclist safety by reducing corner curb radii, creating protected turning movements for bicycle users and painting the primary bicycle crossing. These design interventions reduce motorists' turning speeds, further reducing the risk of crashes. And the creation of highly visible crossings of Brandon Road ensure the safety of people walking or bicycling as they continue north or south to safer signalized intersections crossing Fordham Boulevard.

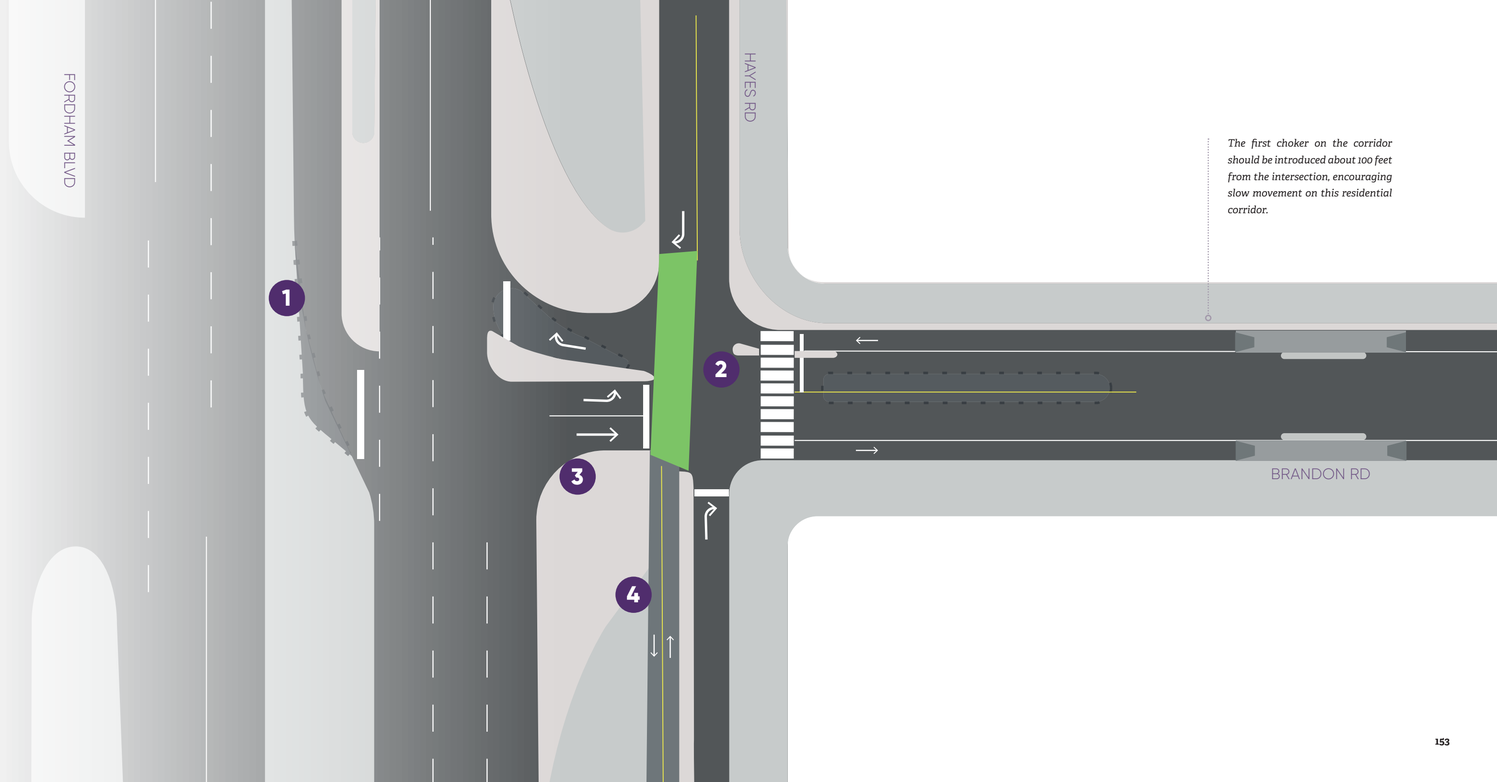
With any future design changes to Fordham Boulevard this intersection should become signalized, connecting people by all modes of travel to Christopher Road on the westside of Fordham Boulevard.

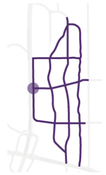
1 *A preliminary design of the median created a slip lane style turn. By removing some on the south end (dashed) and extending the north median tip (in pale grey) motorists turning left onto Brandon Road have a clearer line of sight of traffic flowing northbound on Fordham Boulevard.*

2 *Bicycle users turning north from Brandon Road can turn onto Hayes Road from the bicycle lane where a small curb discourages encroachment by motorists into the bicycle lane, providing protection for turning bicyclists.*

3 *Shown in pale grey the curb is expanded to create smaller corner curb radii that slow vehicles making a turn from Fordham Boulevard.*

4 *On the south end of the intersection there is a bicycle only cut-through, preventing automobile travel southbound onto Hayes Road but preserving travel by bicycle.*





CROSSING FORDHAM BOULEVARD AT GLEN LENNOX DRIVE

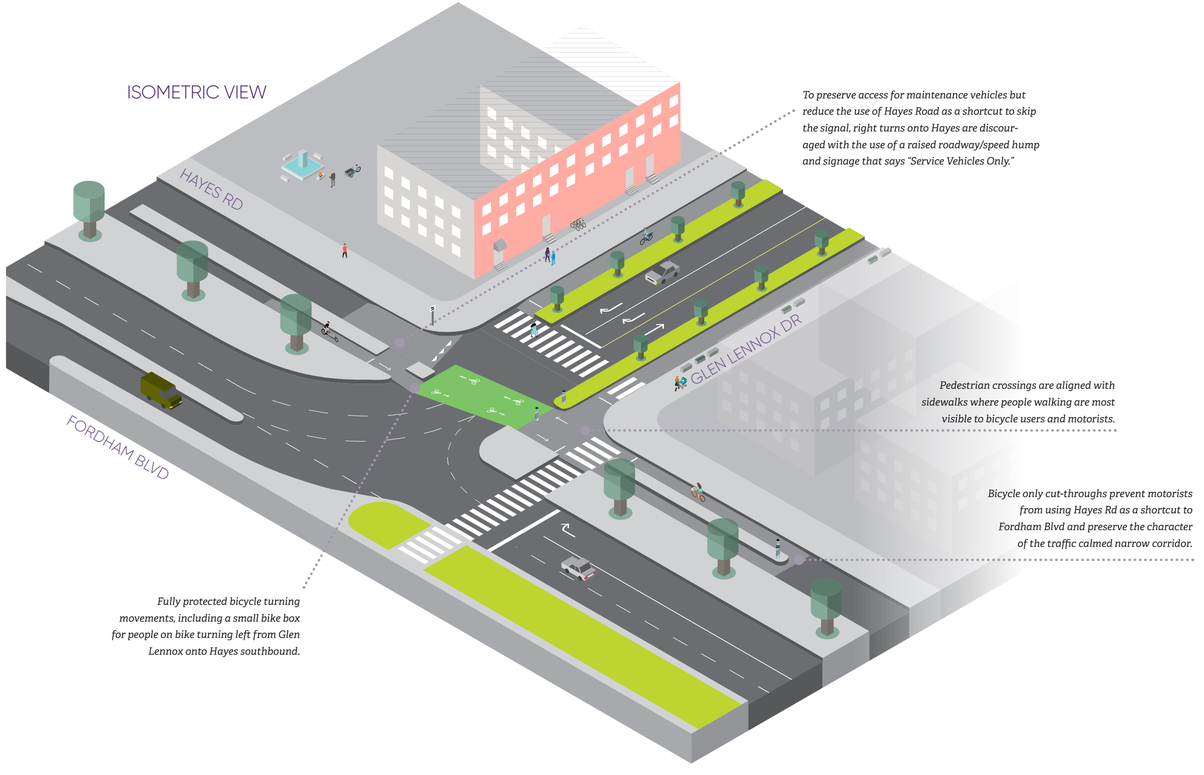
Glen Lennox Drive is the gateway to the community on the neighborhood's western edge at Fordham Boulevard. It is the only signalized intersection to be added and served by a pedestrian crossing over Fordham Boulevard. This intersection is also a part the city's Mobility & Connectivity Plan's Cross Cities Connector corridor, a key non-motorized corridor that better connects Chapel Hill, from east to west.

As a new intersection, Glen Lennox Drive at Fordham Boulevard is an opportunity to reset the design standard for intersections on Fordham Boulevard. Taking a bicycle and pedestrian user perspective to designing this intersection increases safety and pivots away from the typical highway design employed on collectors and arterials that connect to Fordham Boulevard today.



Rendering of Phase 1 development adjacent to the new Glen Lennox Drive.

ISOMETRIC VIEW



To preserve access for maintenance vehicles but reduce the use of Hayes Road as a shortcut to skip the signal, right turns onto Hayes are discouraged with the use of a raised roadway/speed hump and signage that says "Service Vehicles Only."

Pedestrian crossings are aligned with sidewalks where people walking are most visible to bicycle users and motorists.

Bicycle only cut-throughs prevent motorists from using Hayes Rd as a shortcut to Fordham Blvd and preserve the character of the traffic calmed narrow corridor.

Fully protected bicycle turning movements, including a small bike box for people on bike turning left from Glen Lennox onto Hayes southbound.

PLAN VIEW

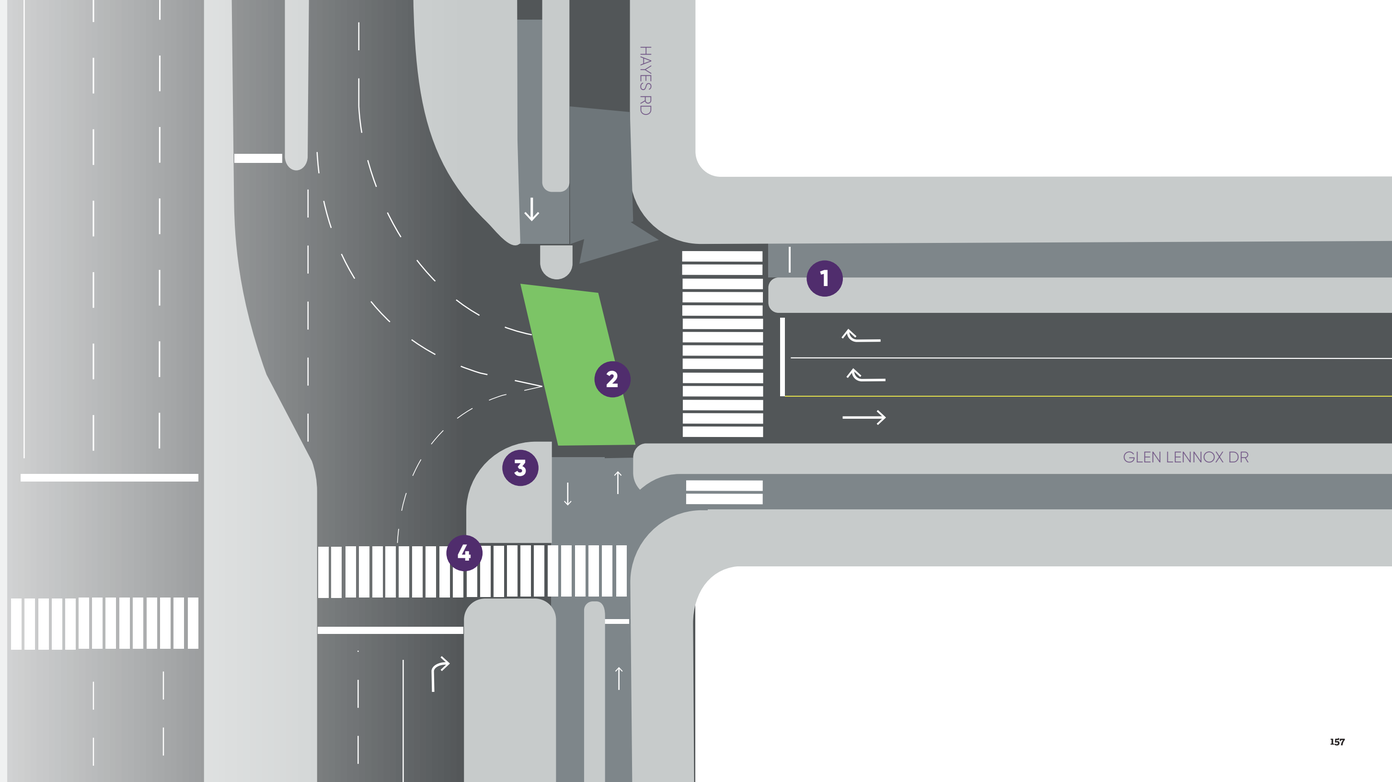
Adhering to best practice design the new intersection of Glen Lennox Drive at Fordham Boulevard and Hayes Road give bicycle users protected movements, prevents turning conflicts at curbside bicycle lanes and aligns pedestrian crossing with the flow of travel for people walking. The priority of the design is safety and ensuring that people moving on foot or by bicycle are able to move through the intersection intuitively while minimizing the risk of crashes by turning vehicles.

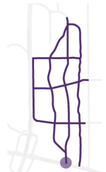
1. *Conflicts with people biking are eliminated, drivers do not cross or move into the bicycle lanes.*

2. *Green paint highlights north-south bicycle crossings and heightens drivers attention when turning off of Fordham Boulevard crossing conflict zones where bicycle users are likely to be.*

3. *Curb radii are designed to slow high speed vehicles from Fordham Boulevard, drivers can see pedestrians clearly in crossings, rather than taking turns at high speeds.*

4. *The new signal should be optimized for pedestrian priority and include bicycle only phases for crossing both Glen Lennox Drive and Fordham Boulevard.*





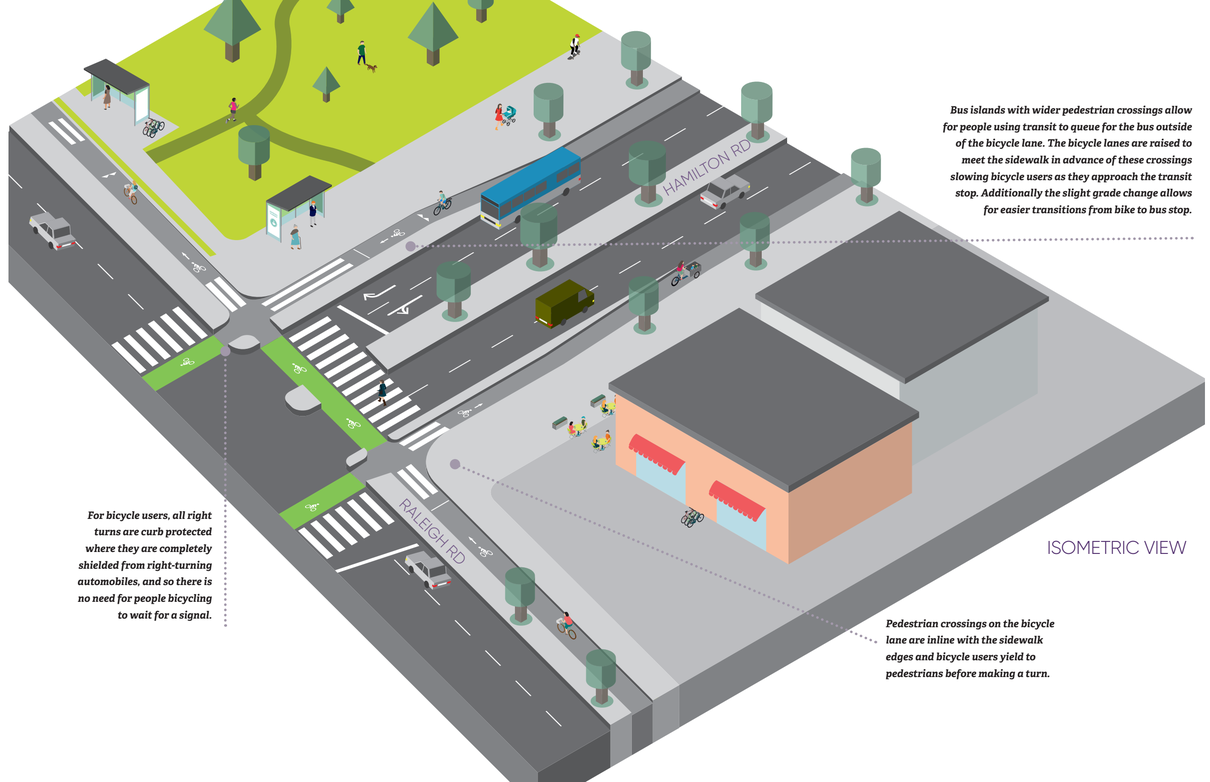
THE HAMILTON ROAD GATEWAY TO GLEN LENNOX

The Hamilton Road Gateway to the Glen Lennox community is at the intersection of Hamilton and Raleigh Roads. This intersection is anticipated to receive several new transportation improvements beyond the designs in Glen Lennox. Just south of the intersection is the connection to a new light rail train station. Additionally, both the City of Chapel Hill's Bike Plan and the Mobility & Connectivity Plan show the extension of the Meadowmont trails westward toward downtown Chapel Hill. These investments will grow the demand for non-motorized travel and increase the need for safe bicycle and walking connections at this intersection.

As can be seen in the photo at right, this large intersection has only a narrow two stripe crosswalk and no markings to indicate people bicycling would cross to connect to the existing two-way trail just out of view. Heavy traffic has worn away the crosswalk markings and the crossing is so long that people walking rarely have enough time to cross given the signal timing. The pedestrian priority phase only adds a few seconds to a very short crossing phase.



View of the Hamilton and Raleigh Road intersection from the southwest corner, facing north towards the Glen Lennox entrance.



Bus islands with wider pedestrian crossings allow for people using transit to queue for the bus outside of the bicycle lane. The bicycle lanes are raised to meet the sidewalk in advance of these crossings slowing bicycle users as they approach the transit stop. Additionally the slight grade change allows for easier transitions from bike to bus stop.

For bicycle users, all right turns are curb protected where they are completely shielded from right-turning automobiles, and so there is no need for people bicycling to wait for a signal.

ISOMETRIC VIEW

Pedestrian crossings on the bicycle lane are inline with the sidewalk edges and bicycle users yield to pedestrians before making a turn.

PLAN VIEW

The design solutions for a safe protected intersection at Hamilton and Raleigh Roads include the build out of curb protected bicycle lanes along both sides of Raleigh Road. On the northside, the lanes would extend the multi-use trail from the east, and protected lanes on the southside of Raleigh Road would connect to the existing two-way trail. These new protected lanes would be unidirectional, matching best practice infrastructure in Glen Lennox, and integrate into the two-way trail on the southeastern corner of the intersection.

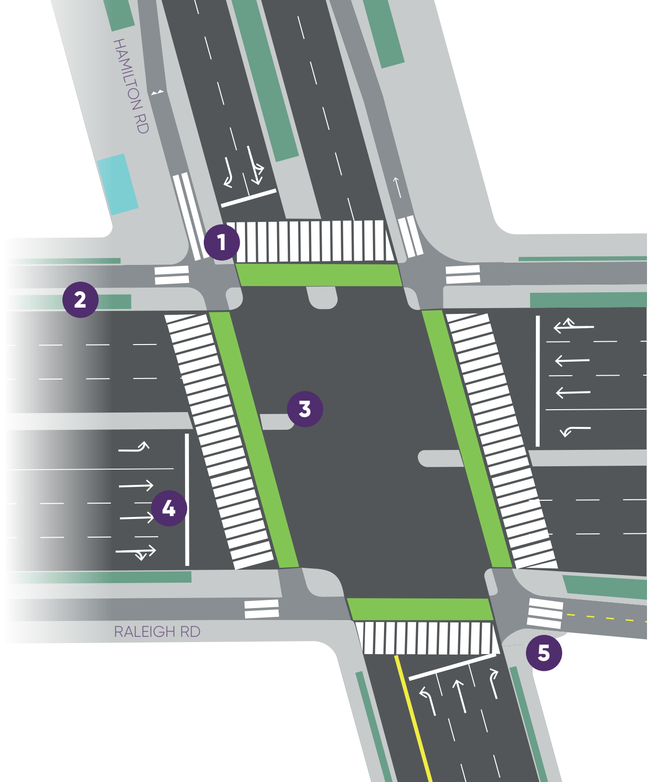
1. *Bus stops are placed so that buses do not pull out of traffic, they stop in the lane, reducing transit delays from pulling in and out of traffic at each stop.*

2. *Extending the existing Meadowmont trails on the northside of Raleigh Road, should adhere to best practice design on this a higher speed busy arterial, with the creation of curb-separated unidirectional bicycle lanes and separate sidewalks.*

3. *Median extensions into the intersection can reiterate right-turn only movements onto Raleigh Road and create pedestrian refuges in the event a person walking has insufficient time to cross Raleigh Road.*

4. *Stop bars for cars are perpendicular to the lane. Left-turning drivers have increased visibility of people on foot or bike approaching the intersection because vehicles on the opposite side of the intersection are not blocking the view of the sidewalks and bicycle lanes.*

5. *Curb protected areas encourage bicycle users to wait, and they can wait comfortably outside of the flow of moving cars. This zone of transition from two way multi-use path to curb separated dedicated bicycle lanes and separate sidewalks is larger to accommodate bicycle users turns and provide a waiting space for the traffic signal.*

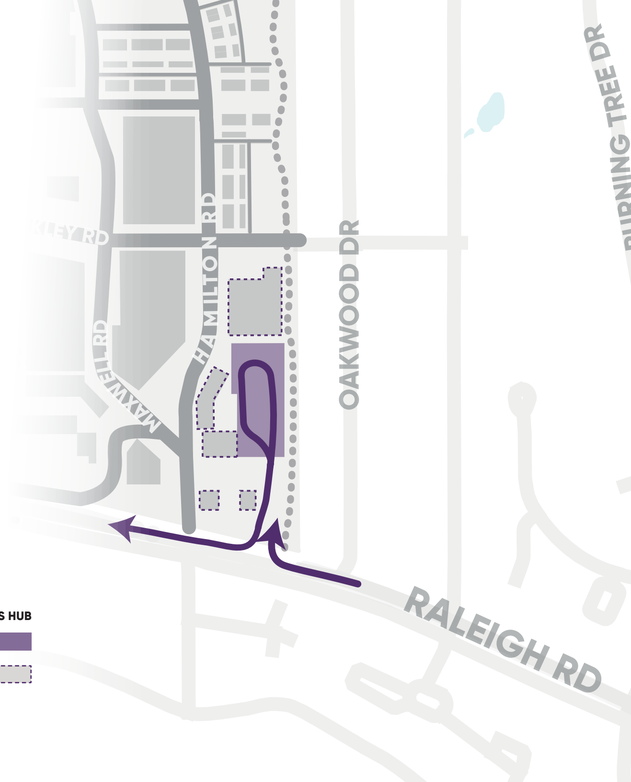


LARGE TRUCKS AND CARGO LOGISTICS

To ensure large trucks can be accomodated and loading access is available to the hotel, retail and grocer to be located on Hamilton Road, providing a truck loading access point off of Raleigh Road into the parking structure is desirable. This will preserve pedestrian oriented frontages along Hamilton Road, making window shopping more pleasant. And the lower level(s) of the parking structure can serve as a small logistics hub for surrounding retail and commercial buildings.

International best-practices in cargo logistics support the use of Urban Consolidation Centers, which are collective receiving points strategically located near city centers where trucks drop off goods rather than going to each store. From these centers, electric vans and cargo cycles can be used for the last mile delivery; reducing congestion, emissions and noise, and improving safety for pedestrians and bicyclists.[1]

Scaling Urban Consolidation Center practices to the Glen Lennox context is achievable on a block level, particularly within the block adjacent to the grocer, hotel and retail uses on the southern site. Freight elevators and large truck loading docks within the parking structure will minimize the need to build large cargo facilities within every building on this block. Additionally, the layout of the grocer's refrigeration and inventory and hotel's kitchen storage areas, can be oriented to face the parking structure, minimizing time for transporting perishable goods from the loading area. Smaller vehicles and cargo cycles could be used to move goods into surrounding buildings or even beyond this block depending on the size of logistics facility.



1 Volvo Research and Education Foundation. "Why Goods Movement Matters." http://goodsmovementmatters.org/



THE CLOVERLEAF AT NC 15-501

The prior intersection interventions will address barriers to connectivity for bicycle users and pedestrians in the near-term but the single greatest barrier to connecting people in Glen Lennox to greater Chapel Hill is the interchange of Fordham Boulevard (Highway 15-501) and Raleigh Road (Highway 54). To truly connect the Glen Lennox community to the city and greatly improve the mobility of people traveling by bicycle or on foot requires a safe solution to this highway crossing. Long-range transportation proposals such as the Bike Network Plan and Mobility & Connectivity Plan, call for greater pedestrian and bicycle access including multi-use paths or trails along both sides of Fordham Boulevard and bicycle lanes and wider sidewalks on Raleigh Road. But neither plan envisions a high quality safe crossing for people biking or walking at the crossroads of these two highways. Looking globally at the world's best bicycle cities and suburbs, Glen Lennox can embrace macro design for bicycle users. Macro design is larger scale bicycle infrastructure that inspires and creates seamless bicycle access across large barriers. In Denmark, the Netherlands, and even in US cities, urban planners and politicians are embracing macro design strategies to address connectivity across highways and large infrastructural barriers.

BICYCLE TUNNELS

Bicycle tunnels and underpasses allow people bicycling or walking to safely cross infrastructural barriers, be they railroads or highways. The Meadowmont Trails just east of Glen Lennox include an underpass under Raleigh Road that helps people safely cross the highway. Tunnels and underpasses are often built when changes in grade or topography of structures can accommodate them. For example, railways and some highways, often require very small grade changes and are built on berms, which can accomodate bicycle tunnels and trail underpasses.

BICYCLE BRIDGES

Bicycle bridges take an elevated approach to crossing large barriers. Bridges and flyovers are used when tunneling or underpasses may not be structurally possible and where grade changes make slopes un-bikeable. Copenhagen has used bicycle bridges to cross highways, rivers, harbor basins and even pedestrianized parts of the city. The bridges have grades that are less than 5% for bikeable slopes, and some are even completely flat for the length of the structure - ensuring people can cycle with ease.

Source: Copenhagenize



Copenhagen's Cykelslangen or Bicycle Snake is a bicycle bridge that connects people cycling from downtown Copenhagen over a highway and the harbor to the Havneholmen waterfront commercial district.



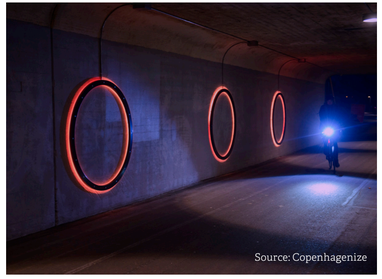
Source: Gizmodo

In the Netherlands, the Hovenring is a steel tensioned deck where bicycle users ride above a busy multi-lane highway interchange in Eindhoven. People bicycling do not ever cross the highway interchanges, significantly reducing the risk of crashes between bicycle users and motorists.



Source: Davis Wiki

Davis, California has used bicycle tunnels and underpasses for it's growing bicycle network over the past 25 years to address barriers like railways, highways and interstates. The city has over 18 tunnels and underpasses for pedestrians and bicycle users. Shown here, the I-80 underpass ensures bicycle users can safely pass under Interstate 80 and avoid highway interchanges.



Source: Copenhagenize

The Farumruten from Copenhagen to Skovbrynet has several tunnels under highways. Shown here bicycle themed lighting was installed after comments from bicycle commuters on how dark the tunnel was previously. Bicycle tunnels require significant lighting for bicycle users to feel comfortable using the infrastructure.



Source: NewsOK

Oklahoma City built the nearly 400-foot long Skydance Bridge to connect people walking and biking from Riderside into Midtown (the city's central business district) over Interstate 40. The bridge is a feature in the city's skyline. The structure features a large sculptural scissor-tailed flycatcher, celebrating the Oklahoma state bird.



Given the complexity of the interchange of Fordham Boulevard and Raleigh Road, as well as the grade changes, the possibility of tunnels, underpasses, bridges or a combination of the three, were explored as solutions to this difficult crossing. To maximize the connections to existing and planned bicycle and pedestrian routes, a **bicycle and pedestrian bridge** that ensures people do not cross dangerous highway entry/exit ramps and is designed to minimize grade changes is showcased at left.

This bicycle and pedestrian bridge can serve as central feature in **Chapel Hill's future non-motorized travel network**, linking the city east and west and also north and south by a span placed in the center.

The bicycle bridge's ramps fly over the existing highway ramps, sloping down to connect with bicycle lanes on both sides of the interchange. Bikeable slopes of **less than a five-percent grade** should be part of the bridge design. The central span in the middle could be slightly raised above the existing Fordham Boulevard overpass if it reduces changes in grade for people bicycling or walking. While shown here alongside the existing overpass, this design concept can be applied to a widened Fordham Boulevard or as deck above a central bus rapid transit link on this portion of the corridor, as was proposed in the Chapel Hill Mobility & Connectivity Plan. Ultimately the goal of this bridge structure is ensuring pedestrians and bicycle users never need to cross highway ramps, the places where deadly crashes happen most often.

INNOVATIVE BIKE PARKING + MICRO DESIGN

To make bicycling truly enjoyable there are elements of play and comfort that can be created through micro design. Micro design encompasses the design of bicycle user-focused objects - street furniture, parking, and conveniences – that create a bicycle friendly atmosphere. Creative and playful micro design objects can express the uniqueness of Glen Lennox and greater Chapel Hill. Enticing people to ride a bike and piquing the curiosity of visitors.

5.4

BIKE PARKING

In all of the most bicycle-friendly communities around the world, people use bicycles because they're supremely functional in accommodating their travel needs – the quickest and easiest option from A to B. To increase ridership, bicycle parking caters to bicycle users' habits and needs the way that a state-of-the-art car parking facility would cater to drivers: by making it easy, safe, and convenient to leave your means of transportation at a new location for a short or long term duration. The Glen Lennox community can accommodate people who ride bicycles best with innovative rack design, protected outdoor parking, and easy-to-access indoor parking.

Bicycle racks should be both secure and simple to use – without requiring any previous know-how or a guide to use it. Protected outdoor parking, which keeps bicycles covered from the elements, as well as indoor bicycle parking should be available. Sheltered parking should adequately prevent bicycles from being rained on, structures that cover three sides and include a roof are preferred. And bicycle parking within the structure should be placed far enough towards the back to prevent the heaviest rains from reaching bicycles.

Stairs and ramps with tight turns, and heavy doors are some of the biggest impediment to indoor bike parking, forcing people to physically carry their bicycles and push through difficult barriers to find proper parking. Additionally, indoor parking systems should avoid hooks or complicated pulley systems so people can easily park without having to lift their bike or decipher a complex gadget. Storage rooms should be locked and accessible by residents only but if the secure parking is "too much work" for residents to get their bicycle out of storage rooms, they will chose not to ride regularly or perhaps very little at all.

For all types of bicycle parking solutions, good location and placement is an absolute priority. Bicycle racks at the wrong location, too far from their destinations will not be well used. Bike parking should be located:

- Near the access routes to destinations: "in the flow" of the access routes.
- Near building or transit entrances (at minimum of 25 feet from the station/stop location with 100 feet as an absolute maximum).
- Within view of local residents and commerce (to feel safer about potential theft and ensure a larger number of eyes on the street – leading to a sense of collective security).
- On ground floor level, not in a basement, and easily accessible for people of different physical abilities, with different bicycle types.

BIKE PARKING BEST PRACTICES

Bicycle parking should be intuitively designed and simple. Complex bicycle parking systems, a lack of sheltered and indoor parking, and parking in inaccessible locations that require lifting or raising a bicycle are barriers to people using the bike for everyday travel. Bike parking best practices showcased here empower people to spend less time figuring out how to lock up and more time riding.



Copenhagen-style butterfly racks combine safety and simplicity by allowing users to easily roll their bicycle securely in place, making them ideal for interior parking. These roll-in racks minimize wasted space and are simpler to use than other designs.



Single hoop racks are also safe and require minimal effort. These racks are especially good for exterior use, as they allow users to lock their bicycle directly to the frame itself.



Indoor parking should be situated on the ground floor and with simple butterfly racks, allowing people to roll their bike in or out and be on their way, with mechanical aid to hold doors open while they roll out of the room.



It is important for outdoor bicycle parking facilities to provide shelter from the elements, particularly at shopping destinations or transit connections like bus stops or train stations. Protected outdoor parking design ensures that bicycles don't accumulate rust or other weather damage so they remain useful for extended periods of time.

BICYCLE PARKING SUPPLY

It is important to create high-quality bicycle parking spaces that take into account the growth of population and bicycle use in Glen Lennox over the coming decade. To determine effective recommendations for Glen Lennox's bicycle parking strategy, a methodology was created based on requirements from LEED-ND standards and Danish parking standards.

Ensuring successful adoption of the bicycle in Glen Lennox community can be ameliorated by using the LEED for Neighborhood Development (LEED-ND) and Danish bicycle parking supply standards as a guide, striving towards greater capacity as demand is increased through access to facilities. In general, the LEED-ND's standards for bicycle parking provision are about one third to one fifth of Danish parking standards. The quantity of bicycle parking spaces at different locations is outlined in the table at right.

To estimate the minimum bicycle parking supply, the Glen Lennox development agreements for residential units, square footage of retail and commercial uses were used. Transit ridership estimates are based on existing ridership with assumptions for future growth. Existing transit ridership numbers were sourced from the Chapel Hill Transit: Short-Range Transit Plan for the existing bus routes in and around Glen Lennox. Given increased bus frequencies, the growth in residential and worker populations, and Grubb Properties commitment to growing transit use in Glen Lennox, the existing transit ridership with the full build out of the development is assumed to double, growing from 315 daily riders to 630.

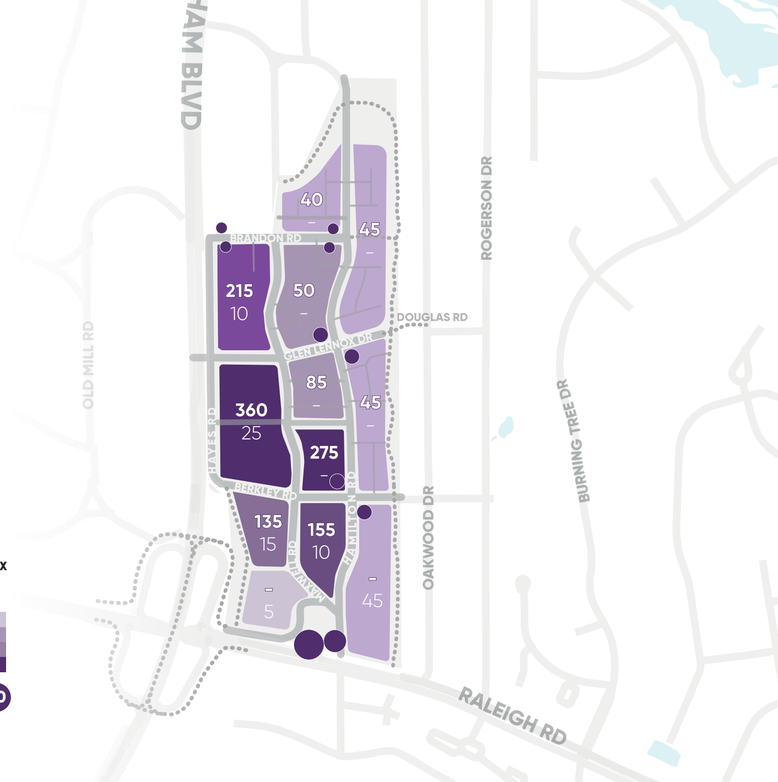
Bicycle Parking Supply Standards

Location	Danish Standard	LEED-ND Standard
Residential	2 - 2.5 spaces per 1075 sq. ft.	Enclosed secure parking spaces for 30% of the building's planned occupancy at a minimum of 1 space per unit AND Visitor Parking: Spaces for 2.5% of peak visitors
Commercial Office Space	2 spaces per 1075 sq.ft.	Enclosed secure parking spaces for 10% of the building's planned occupancy AND Visitor Parking: 1 space per 10,000 sq. ft.
Retail	2 spaces per 1075 sq.ft.	Enclosed secure parking spaces for 10% of the building's planned workers AND Visitor/Customer Parking: 1 space per 5,000 sq. ft.
Transit	Spaces equal to 10% of rush hour ridership at local bus stops. Up to 30% for larger bus hubs or transfer points and rail stations.	No standard outlined in LEED-ND

Given the development agreement, and existing and potential transit demand, the map at right reflects a minimum amount of bicycle parking throughout Glen Lennox using LEED-ND's standards and available projections of development levels.

Bicycle parking needs are highest in the south and east ends of Glen Lennox given the size of apartment and office/retail complexes. In **bold** are estimates for minimum indoor residential parking, below those figures are estimates for on-street parking for commercial and retail visitors. On blocks without two figures listed there is one land use not present, for example there was no commercial estimates for most blocks north of Glen Lennox Drive. Given the limitations of estimating residential visitors or employees per commercial/retail at this time, these parking figures are minimum levels that approach LEED-ND standards.

The Hamilton Road bus stop with the highest levels of transit frequency should have 30 bicycle parking spaces, this aligns with serving longer haul GoTriangle transit connections to employment centers beyond Glen Lennox.



BICYCLE SERVICES

Most people never question why a gas station or auto repair is located at nearly every highway interchange. But just like motorists, bicycle users need a place and the means to make a simple repair to their bicycle and be on their way. These services need to be offered to bicycle users without the hassle of carrying every imaginable tool and a tire pump when they just want to get from A to B. Bicycle repair stations seem to some like a nice-to-have, when they are in fact a necessity for bicycle-friendly communities. Of highest importance is the ability for bicycle users to quickly pump a tire and be on their way. Full service repair stations provide all the tools and a pump for people biking to inflate their tires, patch a flat, tighten up a loose bolt or adjust their seat, all of which matter for safe and comfortable cycling. Local examples of bicycle repair stations can be found on UNC-Chapel Hill's campus and in Carrboro. These "Fix-It" bike repair stations are located near bicycle parking. Repair stations at Greenlaw Hall and on the Libba Cotten Greenway are completely sheltered from the elements.

For successful and effective use, bicycle service stations should have at minimum:

1. A bicycle tire pump, the essential service, since most users are comfortable with pumping their tires and pumps should be placed more frequently along bicycle routes. Tire pumps can be a hand pump but compressed air pumps are prefered and can be integrated into buildings.

2. A set of tire levers, assorted wrenches, and allen keys for basic repairs such as tightening spokes, loose pedals, adjusting brakes, and making it easy to remove a wheel to repair a flat tire. These tools can be hung by cables so they cannot be easily stolen from the station.

3. A bicycle stand to hold the bicycle frame during repairs, which can be integrated into side of the repair station itself.

Bicycle stations can be combined with other micro design elements to create full service bicycle "rest stops." And smaller bicycle hubs can be created when stations are integrated with sheltered bicycle parking. Beyond the bicycle station itself there are opportunities to teach new bicycle users how to make simple repairs through community workshops. These workshops can be part of community programming at Glen Lennox's new Sports Center and can be an opportunity to introduce new residents to bicycling and introduce the surrounding communities to a bicycle-friendly Glen Lennox.

Source: Town of Carrboro



There are three bicycle repair stations throughout the the UNC-Chapel Hill campus and another is found in Carrboro's Wilson park.

Source: Copenhangeize



Candiac, Quebec is a small suburb of Montreal and every one of the village's parks has a bicycle repair station and compressed air pumps at public restrooms within their parks.

Source: Recyclery NC



Local organizations like Recyclery NC in nearby Carrboro hosts bi-weekly weekend workshops for bicycle repair. Partnering with local organizations like Recyclery NC for bicycle workshops in Glen Lennox presents an opportunity to connect to the surrounding communities.

MICRO DESIGN

Urban bicycle infrastructure design can be thought of in terms of a macro and micro scale. Macro design are the large elements of bicycle infrastructure that connect networks, like bicycle bridges. Micro design refers to the minute details on the urban landscape that makes biking through an urban context easier and more pleasurable. Elements of micro design are often found in street furniture or public messaging. In Copenhagen, micro design elements are strategically placed all over the city in the form of footrests, bicycle-friendly trash cans, bicycle counters, and gamified street lighting.

These footrests display short messages that provide riders with a playful connection to their city, or an opportunity for captive marketing.

COPENHAGEN'S FOOTREST

Waiting for traffic to pass at an intersection usually means bikers have to temporarily dismount from their saddles. This can become tiresome and interrupts a continuous journey. Copenhagen aimed at addressing this smaller inconvenience by developing and placing footrests for people to rest on so riders can stay on their saddles while waiting at a red light. And footrests are popping up in the US, from Chicago to Seattle.

Source: Copenhagenize



TILTED TRASH CANS

After riding to an appointment, school or an errand, bicycle users often accumulate some garbage, much like anyone else on foot or in a car. People can throw their garbage out in bins that are placed along bike paths in Copenhagen at an angle so getting rid of trash doesn't require a pit stop. These angled bins also reduce litter and curbside clutter, making biking along these routes more pleasant, and adding a new element of fun to a cyclist's daily commute.

Source: Copenhagenize



CELEBRATE CYCLING

In Copenhagen, 62% of citizens ride a bike daily to work or education in the city - only 9% drive cars. This may seem normal to them but it's higher than anywhere else in the world. To remind Copenhageners of their greatness, the city installed bicycle counter totems to indicate in real-time the number of riders who travel along that path at given time. Copenhagen installed this counter alongside a bike pump and bike service station.

Bike counters have been strategically placed in hundreds of cities around the world to date, allowing users to track their numbers and allowing communities to show that there are in fact growing numbers of two-wheeled commuters in their town.

Source: Copenhagenize



TARHEEL FOOTREST

So bicycle users can comfortably wait at a stop light and never need to dismount these ***Tarheel Footrests*** are designed to reflect the uniqueness of North Carolina. Footrests can be used where people need to wait for traffic signals, particularly ones with long light cycles. Employing the colors and symbols of wayfinding to the ***Tarheel Footrest*** reflects best practices in Denmark, where footrests on the Cycle Superhighway routes are colored orange and with route numbers.

The bicycle users never need to leave their seat while waiting at stop.

Markers on the handrail quickly communicate to bicycle users which direction to turn so they can continue on their route.



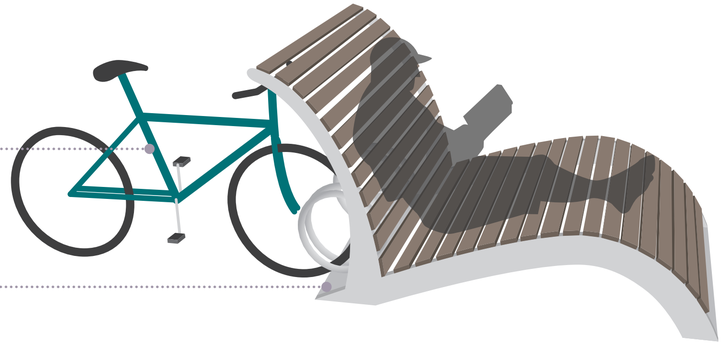
Wayfinding for regional bike routes is brightly printed as the background color of the footrest, in this example blue for a footrest on the Glen Lennox-Chapel Hill route. A play on words with the nickname of North Carolinians, the "Tar Heel" footrest introduces how to use a new type of bicycle infrastructure in a humorous way.

BIKE-A-LOUNGER

Sometimes a bicycle users' end destination or stop en route is just a place to relax. This design concept for street and public space furniture is a playful oversized lounge chair with short-term bike parking that users can easily roll their bike into. A welcoming oversized lounger is ideally sized to fit at least two people and their bikes. Either two friends can sit next to each other and chat or a single user can enjoy plenty of space for relaxing. Loungers could be placed in parks, the public square and along the Greenway. When integrated with bicycle service stations the lounger create a "rest stop" for bicycle users on longer rides, they can make a repair or pump a tire and rest in the lounger before continuing on their trip.

There is no need for people to lock up their bicycle frame because it's close by, right behind them. Some users may choose to lock their front wheel but the spaces are intended as short-term parking.

The Danish butterfly style rack is perfect for people resting in the lounger and it's shape nestles nicely into the space created by the curved back of the lounger.



COOLING STATION

Glen Lennox and the surrounding area have over 200 days of sunshine, perfect for sunny bike rides, but also humid summers, so staying cool and hydrated is important for comfortable cycling. Riffing off of the idea of being a kid and running through sprinklers in the summer, this cooling station takes that concept and applies it to high quality water fountain design. At the cooling station you can refill your water bottle and even give yourself a light mist to cool your face, similar to a misting fan, all without leaving the seat of your bike. It may seem a bit silly but that's also the point – creating opportunities for curious and playful exploration by bike even on the hottest days. People walking also have the chance to discover what the cooling station does since it functions as a standard water fountain and water bottle fill station.

A simple push button gives bicycle users a light mist of water on their face and upper body. So the user can decide how long the mister is engaged.



The water bottle refilling could be push operated but for easier operation while sitting a on a bike, a small sensor would trigger the flow of water when a bottle is placed in the cooling station. This is similar to other bottle refilling stations found in airports, corporate offices and college buildings in the U.S. The sensors operation could be powered by small solar panels on the top of the cooling station.

An integrated footrest allows bicycle users to stay on their bike as they use the cooling station.

The map at right shows where micro design objects could be located within Glen Lennox. Integrating bicycle service stations with other micro design elements can create cohesive spaces for bicycle users to rest, cool down, and repair their ride. On longer trips by bicycle the opportunity to have a "rest stop" where tires can be inflated and users can refill water bottles or have a relaxing moment are shown as two types of integrated hubs on the map. Service stations with cooling stations are located on the north end of the Greenway and at the intersection of the Greenway and Berkley Road, pairing well with wayfinding posts at these locations discussed before. The small park in the center of Glen Lennox on Glen Lennox Drive between Hamilton and Maxwell Roads is an opportunity for an service station with loungers. Loungers dot the other small parks, greenspaces along the greenway and the main plaza in Glen Lennox.

For cooling stations, shown as triangles, the highlighted side of the triangle is the direction the footrest and mister face to run parallel with bicycle paths and lanes. With this orientation the cooling station can be used by bicycle users who are making a quick stop. Likewise footrests, shown as rectangles, are oriented in the direction that is parallel with the bicycle lane. These locations are where bicycle users wait for long light cycles to cross arterial roadways.

MICRO DESIGN IN GLEN LENNOX

- **Bike Service & Cooling Station**
- **Bike Service Station with Loungers**
- **Cooling Station**
- **Loungers**
- **Footrest**

