

Proposed Network

Input from the public engagement efforts and Steering Committee exercises, combined with criteria for the use of pedestrian and bicycle facilities taken from various technical resources, was used to develop a desired network of bicycle and pedestrian facilities across the urbanized portion of Pender County. Recommendations focused on providing a connected and safe network for all users as top priorities, with emphasis on safe access to commercial areas along US 17, including safe crossings of US 17, access to the Rocky Point area, and access to schools and parks.

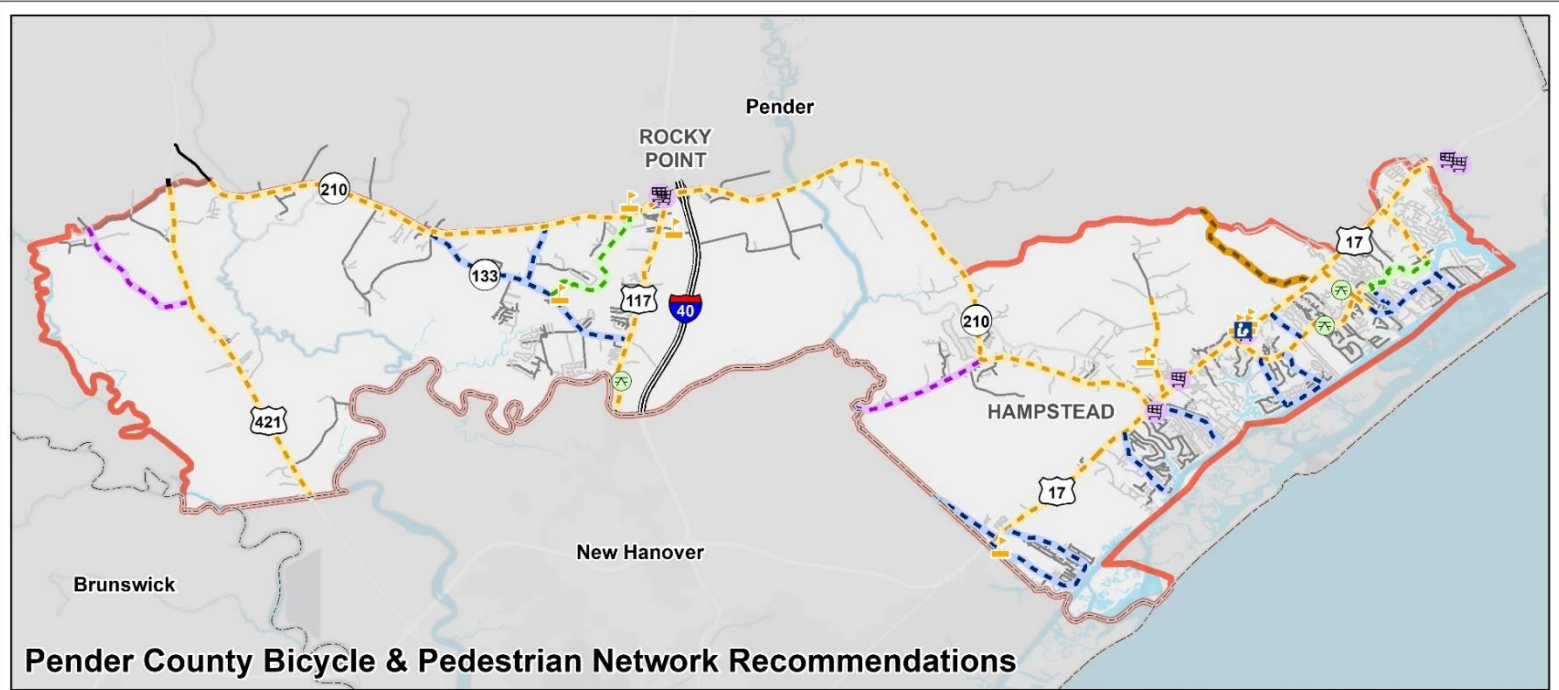
The public input results and Steering Committee discussion emphasized that a bicycle and pedestrian network would not only provide needed mobility options for residents, but the ability to connect residential areas within a mile of US 17 would offer an opportunity for those wanting to access commercial areas to walk or bike, thus helping to reduce the vehicle traffic on US 17.

Facility type was determined using local input, as well as context considerations such as roadway speed and volume, network connectivity, and adjacent land use. Technical resources that were considered in the development of the network include:

- NCDOT Highway Typical Sections for Use in SPOT Online, 2019
- NCDOT Complete Streets Policy, 2019
- NCDOT Roadway Design Manual, 2018
- FHWA Guidance on Bicycle and Pedestrian Accommodation, 2011

Bicycle and Pedestrian Network Recommendations

Figure 1 and Figure 2 on the following pages show the bicycle and pedestrian network recommendations for the study area. Table 1 lists the bicycle and pedestrian network recommendations for the study area. These recommendations are considerate of the fiscal constraint associated with constructing and maintaining a network of bicycle and pedestrian facilities, the general rural character of many roadways in the study area, the right-of-way constraints associated with several roadways, and the rate of population growth across the study area.



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|--|---|--|
|  Study Area | Network Recommendations | Places of Interest |
|  County Boundary |  Bike Lane |  Library |
|  Interstate |  Greenway |  School |
|  US Highways |  Sidepath |  Recreation |
|  NC Highways |  Sidewalk |  Shopping |
|  Secondary Road |  Unpaved Trail | |
|  Private Roads | | |

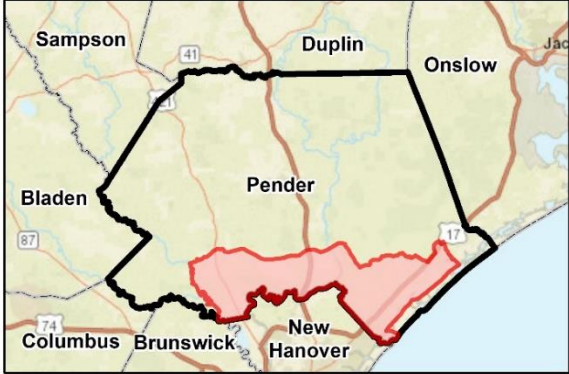


Figure 1: Network Recommendations

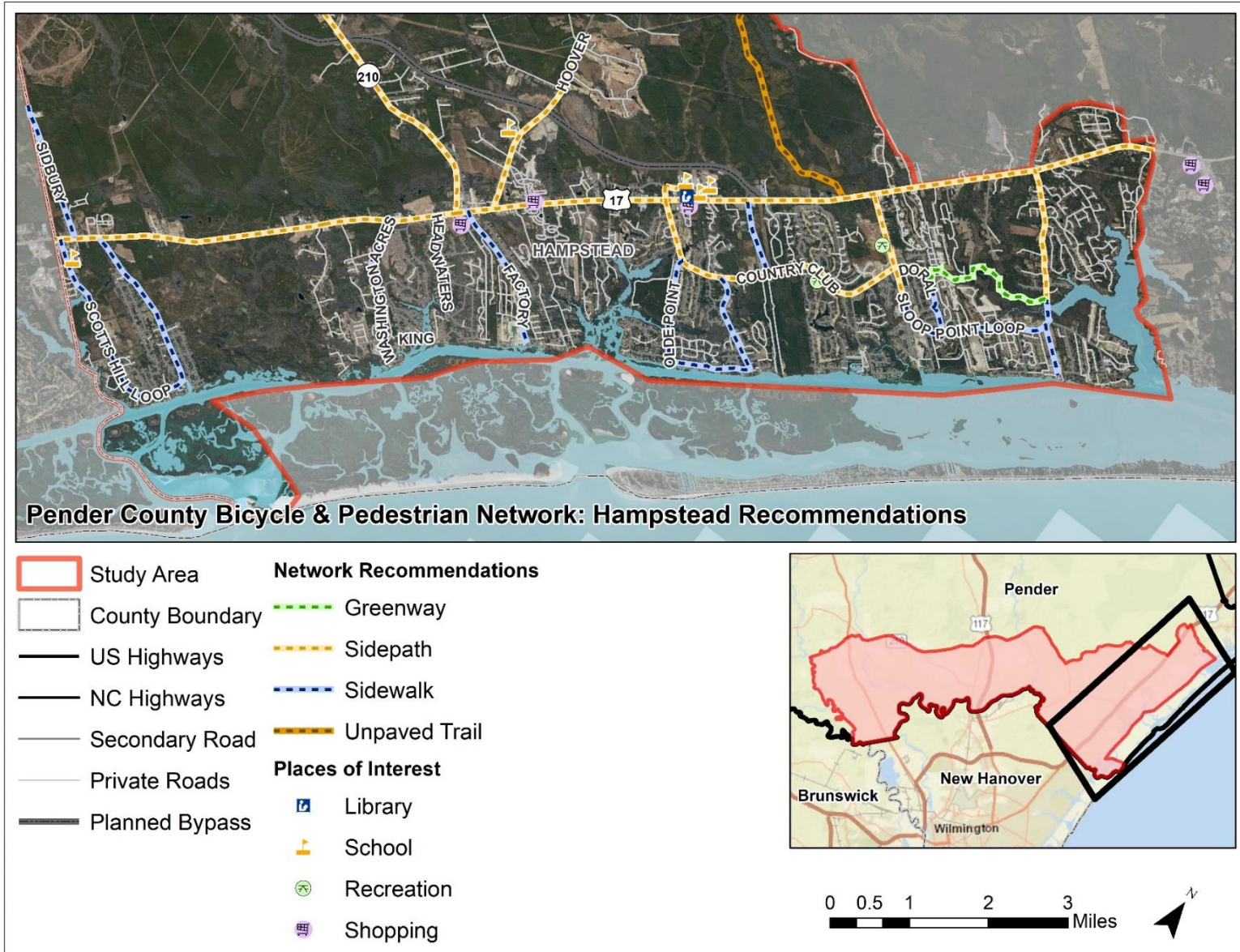


Figure 2: Network Recommendations for Hampstead

Table 1: List of Bicycle and Pedestrian Network Recommendations

Corridor	From	To	Facility Recommendation
Avila Drive Extension	US-17	Country Club Road	Sidewalk
Blueberry Road	US-421	Montague Road	Bike lane
Cheshire Road	NC-133	NC-210	Sidewalk
Country Club Road	US-17	Sloop Point Loop Road	Sidewalk
Doral Drive	Sloop Point Loop Road	East Coast Greenway	Sidewalk
Doral Drive	East Coast Greenway	Masters Lane	Sidewalk
East Coast Greenway	Doral Drive	Sloop Point Road	Greenway
Factory Road	US-17	Waterfront Circle	Sidewalk
Holly Shelter Road/Island Creek Road	New Hanover County line	NC-210	Bike lane
Hoover Road	Highlands Drive	Godfrey Creek Road	Sidewalk
Hoover Road	Godfrey Creek Road	US-17	Sidewalk
Jenkins Road	US-17	N St Johns Church Road	Sidewalk
Kings Landing Road	Country Club Road	Olde Point Road	Sidewalk
Lewis Road	Sloop Point Loop Road	Sloop Point	Sidewalk
Lodge Road	US-17	Study area limits	Unpaved Trail
Masters Lane	Doral Drive	Sloop Point Loop Road	Sidewalk
N St Johns Church Road	Jenkins Road	Topsail Middle School	Sidewalk
NC-133	NC-210	US-117	Sidewalk
NC-210	Shaw Highway	Royal Oak Drive	Sidewalk
NC-210	Dallie Futch Road	US-17	Sidewalk
NC-210	NC-133	Shaw Highway	Sidewalk
NC-210	Montague Road	NC-133	Sidewalk
Olde Point Road	Country Club Road	Kings Landing Road	Sidewalk
Scotts Hill Loop Road	US-17	US-17	Sidewalk
Shaw Highway	Study area limits	NC-210	Sidewalk
Sidbury Road	US-17	Study area limits	Sidewalk
Sloop Point Loop Road	Doral Drive	North Topsail Elementary School	Sidewalk
Sloop Point Loop Road	US-17	Doral Drive	Sidewalk
Sloop Point Loop Road, Sloop Point Road	North Topsail ES	Tidewater Court	Sidewalk
Sloop Point Road	US-17	Tidewater Court	Sidewalk
Turkey Creek Greenway	NC-210	NC-133	Greenway
US-117	New Hanover County line/Northeast Cape Fear River	NC-210	Sidewalk
US-17	Whitebridge Road	NC-210	Sidewalk
US-17	NC-210	Country Club Road	Sidewalk
US-17	Sloop Point Road	Cornel Lane	Sidewalk

Corridor	From	To	Facility Recommendation
US-17	New Hanover County line	Whitebridge Road	Sidepath
US-17	Lodge Road	Sloop Point Road	Sidepath
US-17	Country Club Road	Lodge Road	Sidepath
US-421	New Hanover County line	Blueberry Road	Sidepath
US-421	Blueberry Road	Montague Road	Sidepath
Washington Acres Road	US-17	End of roadway	Sidewalk

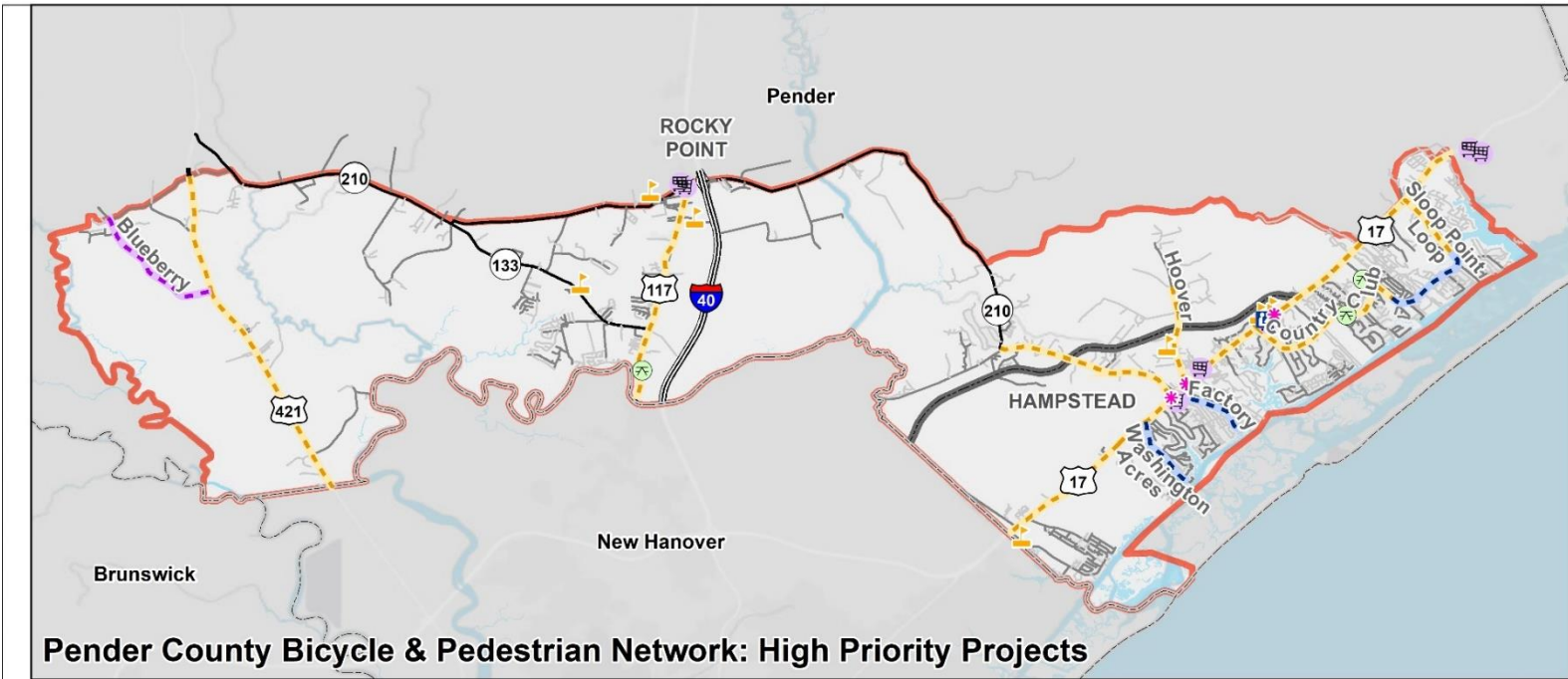
Facilities on US 17 are recommended on both sides of the roadway. Other roadways should be evaluated on a case-by-case basis to determine if facilities on one or both sides are recommended during project planning.

Network Priorities

The Steering Committee used input from the public engagement efforts along with project values to prioritize bicycle and pedestrian facilities that should be at the forefront of planning in Pender County. Figure 3 and Figure 4 show the high priority bicycle and pedestrian projects for the study area. Understanding that there are limited financial resources, these are projects that the Steering Committee felt have the highest desire and need and would result in the greatest impact.

Highly desirable destinations, like grocery stores, restaurants, businesses, medical offices, and schools, are concentrated along and near US 17. Residential developments both west and east of US 17 are growing and residents have a desire to access these destinations along US 17 by bike and walking. These high priority projects were selected because they would prioritize safe bicycle and pedestrian access between these locations while helping to reduce vehicle trips on US 17.

Table 2 lists these high priority projects. Three intersection projects were identified as part of these high priorities. These improvements would improve safety and accessibility across US 17 near active commercial areas and Topsail schools. The intersection near Lowes Food and Topsail Elementary, Topsail Middle, and Topsail High schools was especially identified as a safety concern. Improvements could come in the form of high visibility crosswalks, improved ADA accessibility, median pedestrian islands, curb extensions, lighting, and improved bicycle and pedestrian signalization such as countdown timers, Rectangular Rapid-Flashing Beacons (RRFB), and High-Intensity Activated (HAWK) crosswalk.



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|-----------------|-------------------------------|
| Study Area | High Priority Projects |
| County Boundary | Sidewalk |
| Interstate | Sidepath |
| US Highways | Bike Lane |
| NC Highways | Intersection Improvements |
| Secondary Road | Places of Interest |
| Private Roads | Library |
| Planned Bypass | School |
| | Recreation |
| | Shopping |

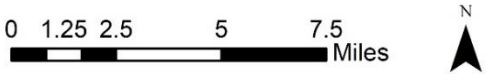
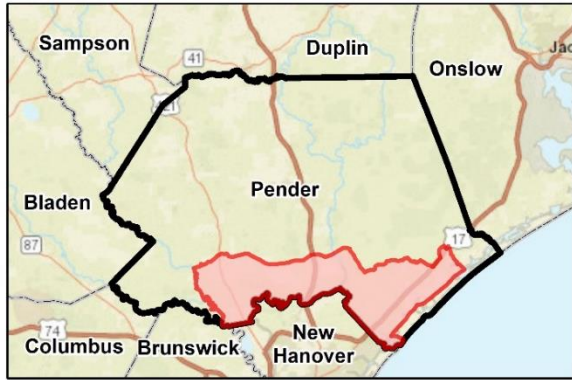
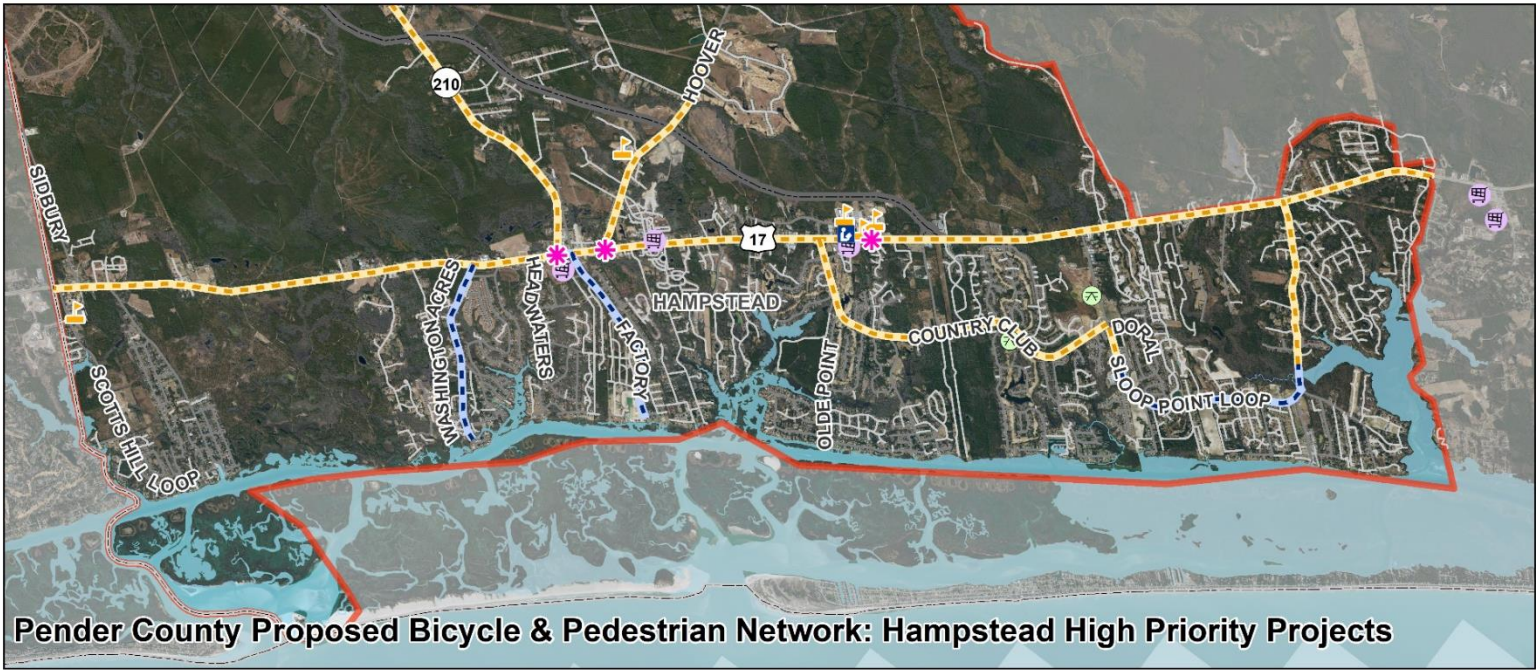


Figure 3: High Priority Projects



Pender County Proposed Bicycle & Pedestrian Network: Hampstead High Priority Projects

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|---|-----------------|---|---------------------------|
|  | Study Area | High Priority Projects | |
|  | County Boundary |  | Sidewalk |
|  | US Highways |  | Sidepath |
|  | NC Highways |  | Intersection Improvements |
|  | Secondary Road | Places of Interest | |
|  | Private Roads |  | Library |
|  | Planned Bypass |  | School |
| | |  | Recreation |
| | |  | Shopping |

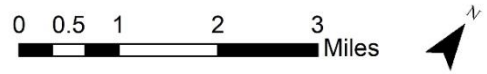
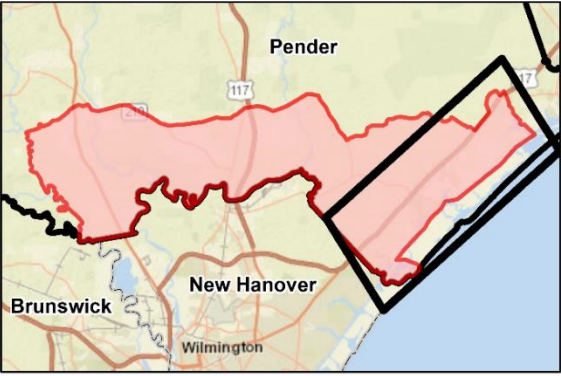


Figure 4: High Priority Projects for Hampstead

Table 2: Priority Bicycle and Pedestrian Projects

Corridor	From	To	Priority Recommendation
Blueberry Road	US-421	Montague Road	Bike Lane
Country Club Road	US-17	Sloop Point Loop Road	Sidepath
Factory Road	US-17	Waterfront Circle	Sidewalk
Hoover Road	Godfrey Creek Road	US-17	Sidepath
NC-210	Dallie Futch Road	US-17	Sidepath
Sloop Point Loop Road	Doral Drive	North Topsail Elementary School	Sidepath
Sloop Point Loop Road, Sloop Point Road	North Topsail ES	Tidewater Court	Bike Lane
Sloop Point Road	US-17	Tidewater Court	Sidepath
US-117	New Hanover County line/Northeast Cape Fear River	NC-210	Sidepath
US-17	Whitebridge Road	NC-210	Sidepath
US-17	NC-210	Country Club Road	Sidepath
US-17	Sloop Point Road	Cornel Lane	Sidepath
US-17	New Hanover County line	Whitebridge Road	Sidepath
US-17	Lodge Road	Sloop Point Road	Sidepath
US-17	Country Club Road	Lodge Road	Sidepath
US-421	New Hanover County line	Blueberry Road	Sidepath
US-421	Blueberry Road	Montague Road	Sidepath
Washington Acres Road	US-17	End of roadway	Sidewalk
NC 210/US 17 Intersection	--	--	Intersection improvements
Hoover Road/US 17 Intersection	--	--	Intersection improvements
Lowes Food/Topsail Schools Intersection	--	--	Intersection improvements

Bicycle and Pedestrian Network Recommended Facility Types

Greenway / Shared Use Path

A greenway, or shared use path, provides a travel area separate from motorized traffic for bicyclists, pedestrians, wheelchair users, skaters, joggers, and other users. Greenways offer network connectivity opportunities beyond the roadway network, as they are often located along streams, in utility corridors and parks.



Figure 5: Sample greenway graphics

Context Considerations:

Greenways operate independently of roadway corridors and are fully separated from traffic and can even become their own corridors, following features such as waterways or utility easements. However, when selecting bicycle and pedestrian facilities, greenways and shared use paths should be considered as multi-modal alternatives for roadway corridors that exceed traffic volumes of 6,000 vehicles per day and speed limits higher than 35 miles per hour. Greenways may provide network alternatives to arterial and collector roadway connections and are appropriate in low-density areas as well as high-density areas to serve as a corridor connection.

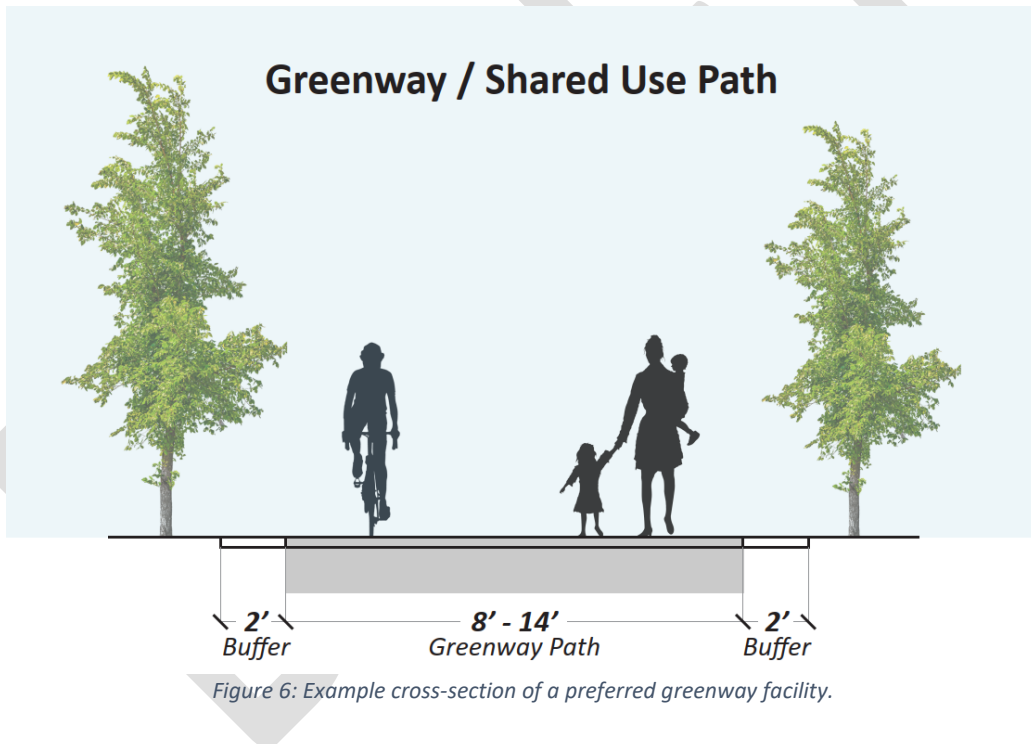
Design Considerations:

Greenways should be designed to a width of 10-12 feet in most locations, with a 2-foot shoulder on either side. In areas where low volumes are expected or the corridor is constrained, an 8-10-foot greenway may be adequate. Areas where usage is expected to be very high may be built to a width of 12-14 feet.

A variety of surface treatments are available for greenways depending on expected use, context, and budget. Paved trails are often constructed with asphalt or concrete. Asphalt tends to be more popular and cost-effective than concrete, but concrete is more durable. A less expensive option is an unpaved or

natural surface trail, with compacted aggregates and compacted native soil being popular and durable alternatives. Compacted aggregates often consist of granite fines which are readily available in many locations. Natural surface trails, while less expensive to construct, require proper drainage and more careful maintenance to ensure that materials remain sufficiently compacted. In areas where floodplains or wetlands are present, boardwalk structure is often required for trail construction. Boardwalk is typically more expensive to construct but has a lower maintenance cost. Two main surface options for boardwalk include timber and concrete, with timber being less expensive but more maintenance-intensive than concrete.

Greenways typically do not require pavement marking except in certain locations and contexts. Where greenway traffic is heavy, a 4-inch dashed yellow center line stripe and 4-inch solid white edge line may be used. Solid center lines may be employed in locations where sightlines are poor or the greenway approaches a roadway crossing, and edge lines may be employed in locations where evening use is expected. Signage such as the Bikes Yield to Peds (R9-6) specified in the Manual on Uniform Traffic Control Devices (MUTCD) may be used at the entrance of a greenway segment as a reminder of user etiquette, and many communities use customized wayfinding signs to provide navigation to destinations and other greenways. Figure 6 provides an example cross-section of a preferred greenway facility.



Sidepath

A sidepath is a bi-directional shared use path adjacent to and parallel to a roadway. Sidepaths offer a low-stress experience for bicycle and pedestrians along network routes with high-speed or high-volume traffic.



Figure 7: Sample sidepath graphics

Context Considerations:

Sidepaths are used along roads with high volumes that exceed 6,000 vehicles per day and moderate to high speeds over 35 miles per hour. Sidepaths are used along arterial and collector roadways and are generally recommended in high-density areas to provide dedicated space for bicyclists and pedestrians.

Design Considerations:

Sidepaths should be designed to a width of 10-12 feet in most locations, with 2 feet of clearance on either side. In areas where low volumes are expected or the corridor is constrained, an 8-10-foot trail may be adequate. Areas where usage is expected to be very high may be built to a width of 12-14 feet. The sidepath should be separated from the roadway by at least 5 feet, with additional separation up to 20 feet recommended along high-speed roadways.

Sidepaths are commonly constructed with asphalt or concrete. Asphalt pavement tends to be the most popular and cost effective for paved trails. Concrete pavement is more durable, but costs more than asphalt pavement. As such, concrete trails are typically more common in urban settings (where projected user volumes are high or the trail may be subject to vehicular loading more often) or in areas subject to heavy flooding forces that may cause damage to the trail.

Sidepaths typically do not require pavement marking except in certain locations and contexts. Where sidepath traffic is heavy, a 4-inch dashed yellow center line stripe may be used. Edge lines may be employed in locations where evening use is expected. Signage such as the Bikes Yield to Peds (R9-6) specified in the MUTCD may be used at the entrance of a sidepath segment as a reminder of user etiquette, and many communities use customized wayfinding signs to provide navigation to destinations and other greenways. Other signs may be used to indicate the bidirectional nature of the facility, taking care that any signage is positioned such that it will not be interpreted as guidance for drivers on the adjacent roadway. Figure 8 provides an example cross-section of a preferred sidepath facility.

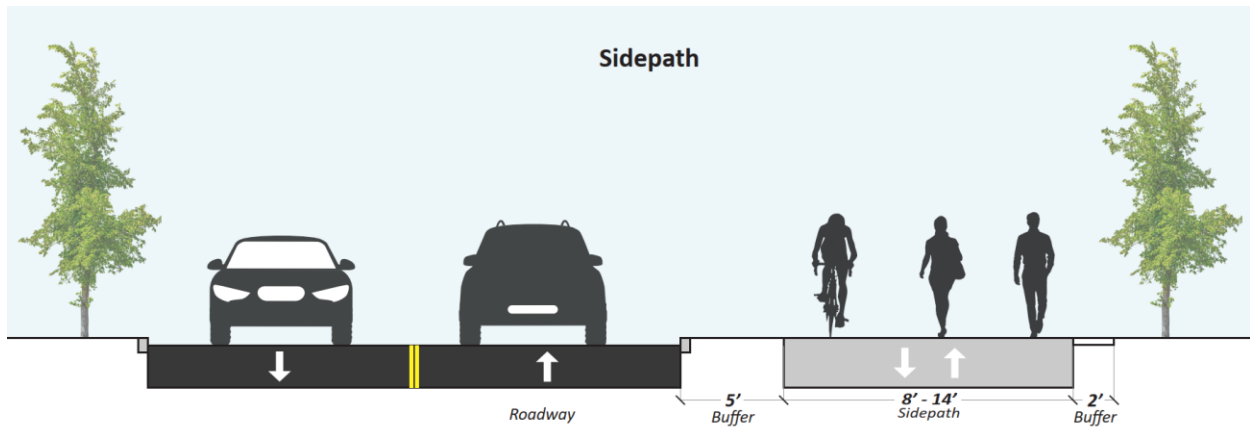


Figure 8: Example cross-section of a preferred sidepath facility

On-Road Facilities

On-road facilities consist of bicycle and pedestrian accommodations provided directly within the roadway. These facilities can be separate or buffered from traffic, or simply striped as dedicated facilities along the outside of the road. The following provides a discussion of various bicycle lane facilities that can be considered for the roadways identified in the bicycle and pedestrian network as desiring bike lanes. When a project opportunity to implement a bike lane facility comes to fruition, the County can work with NCDOT to identify a preferred facility type based on how the character of the corridor has evolved.

Separated Bicycle Lane

A separated bicycle lane is a facility for exclusive use by bicyclists that is located within or directly adjacent to the roadway and is physically separated from motor vehicle traffic by a buffered space with a vertical separation element. Separated bicycle lanes can be designed to accommodate one-way and bi-directional travel.



Figure 9: Sample separated bike lane graphics

Context Considerations:

Separated bicycle lanes are recommended along roadways with high volumes that exceed 6,000 vehicles per day and moderate to high speeds over 35 miles per hour. Separated bicycle lanes are recommended along major roadways and collectors that serve as primary connections to destinations. Separated bicycle lanes are appropriate in areas with moderate to high volumes of bicycle and pedestrian activity. In high-density areas, design treatments should consider potential conflicts with transit stops and driveway crossings to mitigate safety concerns for bicyclists.

Design Considerations:

Separated bike lanes should be designed to a minimum width of 5 feet for one-way facilities, with 7-foot lanes preferred. The bicycle lane should be separated from the roadway by at least 3 feet to provide clearance, or by a minimum of 1 foot where curb is present. Bicycle lanes can be separated from the roadway by a variety of methods, including by installing flexible delineator posts, armadillos, or placing it behind the curb. Separation from pedestrians may be required when the bike lane is immediately adjacent to and at the same level as a sidewalk.

Separated bicycle lanes should be marked with the standard bicycle lane symbol (MUTCD marking 9C-3) to clearly indicate their intended use. Where separated bicycle lanes are adjacent to a sidewalk, additional signage such as MUTCD signs D11-1a (Bicycle) and D11-2 (Pedestrian) may be necessary to indicate which users belong on which facility. Figure 10 provides an example cross-section of a preferred separated bike lane facility.

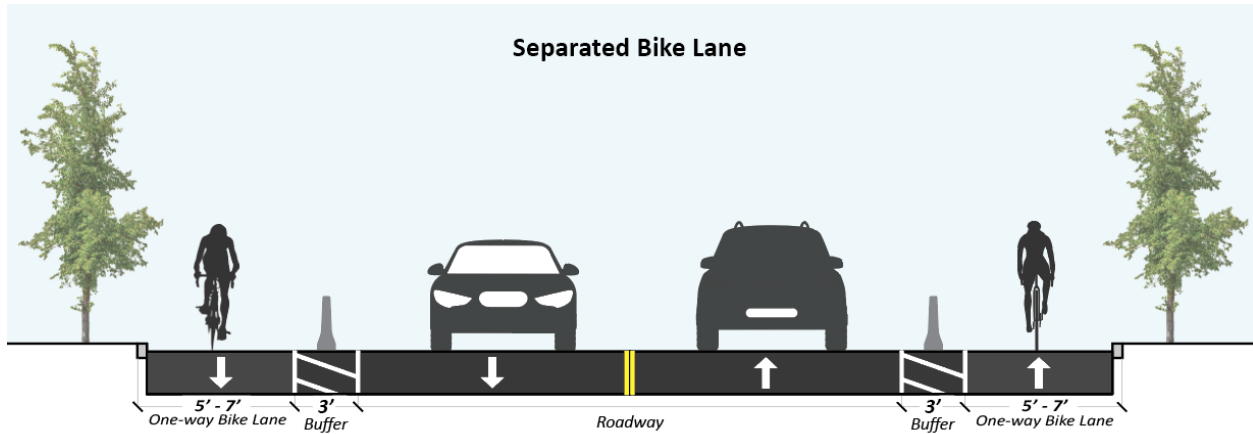


Figure 10: Example cross-section of a preferred separated bike lane facility

Buffered Bicycle Lane

A buffered bicycle lane designates a travel space for bicyclists within the roadway corridor through use of pavement markings, optional signage, and a buffer space separating the bicycle lane from the adjacent travel lane.



Figure 11: Sample buffered bike lane graphics

Context Considerations:

Buffered bicycle lanes are recommended along roads with moderate volumes and speeds. Buffered bicycle lanes are appropriate treatments for roadways with traffic volumes between 3,000 and 6,000 vehicles per day and moderate speeds between 25 and 35 miles per hour. Buffered bicycle lanes are appropriate treatments along arterial and collector roadways that connect local bikeway routes to

regional corridors. Buffered bicycle lanes are recommended in areas with increased bicycle and pedestrian activity.

Design Considerations:

Buffered bike lanes should be designed to a minimum width of 5 feet, with 6 feet preferred. The bicycle lane should be buffered from other traffic by at least 18 inches by a painted double white line. If the buffer is 3 feet or more, it should be marked with diagonal stripes or chevron markings to increase visibility and motorist compliance. Markings should be between 30 to 45 degrees and striped at intervals between 10 and 40 feet.

Buffered bicycle lanes should be marked with the standard bicycle lane symbol (MUTCD marking 9C-3) to clearly indicate their intended use. Where right turns are made across the buffered bicycle lane, the turn lane should be placed to the right of the bicycle lane, or a combined bicycle lane/turn lane can be used when space is limited. MUTCD sign R4-4, Begin Right Turn Lane Yield to Bikes, should be used at the start of the turn lane to alert drivers to the potential conflict with bicyclists when entering or crossing the buffered bicycle lane. Lines should be dashed where cars are expected to cross the bike lane to access turn lanes. The bike lane may be painted to increase visibility and minimize confusion with other facilities. Green is the standard paint color for bicycle lane markings, which may be applied throughout the bicycle lane, at intersections, or in conflict areas. Figure 12 provides an example cross-section of a preferred buffered bike lane facility.

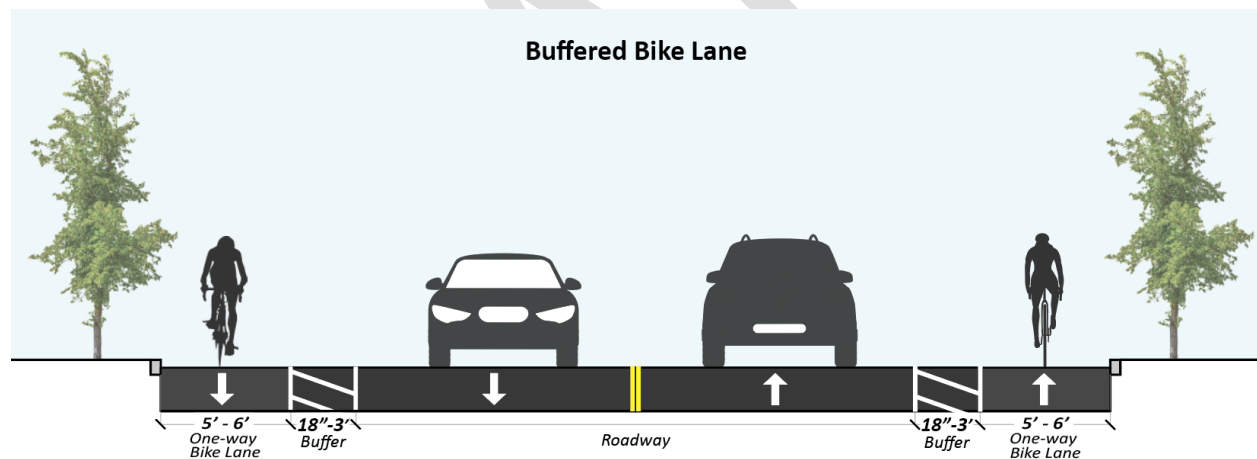


Figure 12: Example cross-section of a preferred buffered bike lane facility.

Bicycle Lane

A bicycle lane designates a travel space for bicyclists within the roadway corridor through use of pavement markings and optional signage to provide accommodations in the absence of more separated facilities.



Figure 13: Sample bicycle lane graphics

Context Considerations:

Bicycle lanes may be used along roads with moderate traffic volumes and speeds. Bicycle lanes are appropriate treatments along roads with traffic volumes between 3,000 and 6,000 vehicles per day and moderate speeds between 25 and 35 miles per hour. Bicycle lanes are appropriate treatments along arterial and collector roadways that connect local bikeway routes to regional corridors. Bicycle lanes are recommended in areas with increased bicycle and pedestrian activity and in areas where right-of-way constraints limit the ability to provide a higher quality facility.

Design Considerations:

Bicycle lanes should be designed to a minimum width of 5 feet, with 6 feet preferred. The bicycle lane should be marked with a solid white line and standard bike lane symbol. If the bicycle lane is more than 7 feet wide, there may be issues with drivers using the bike lane for driving or parking. The bike lane markings should not be dashed at driveway crossings, as the MUTCD does not recognize driveways as intersections.

Bicycle lanes should be marked with the standard bicycle lane symbol (MUTCD marking 9C-3) to clearly indicate their intended use. Where right turns are made across the bicycle lane, the turn lane should be placed to the right of the bicycle lane, or a combined bicycle lane/turn lane can be used when space is limited. MUTCD sign R4-4, Begin Right Turn Lane Yield to Bikes, should be used at the start of the turn lane to alert drivers to the potential conflict with bicyclists when entering or crossing the bicycle lane. Lines should be dashed where cars are expected to cross the bike lane to access turn lanes. The bike

lane may be painted to increase visibility and minimize confusion with other facilities. Green is the standard paint color for bicycle lane markings, which may be applied throughout the bicycle lane, at intersections, or in conflict areas. Figure 14 provides an example cross-section of a preferred bike lane facility.

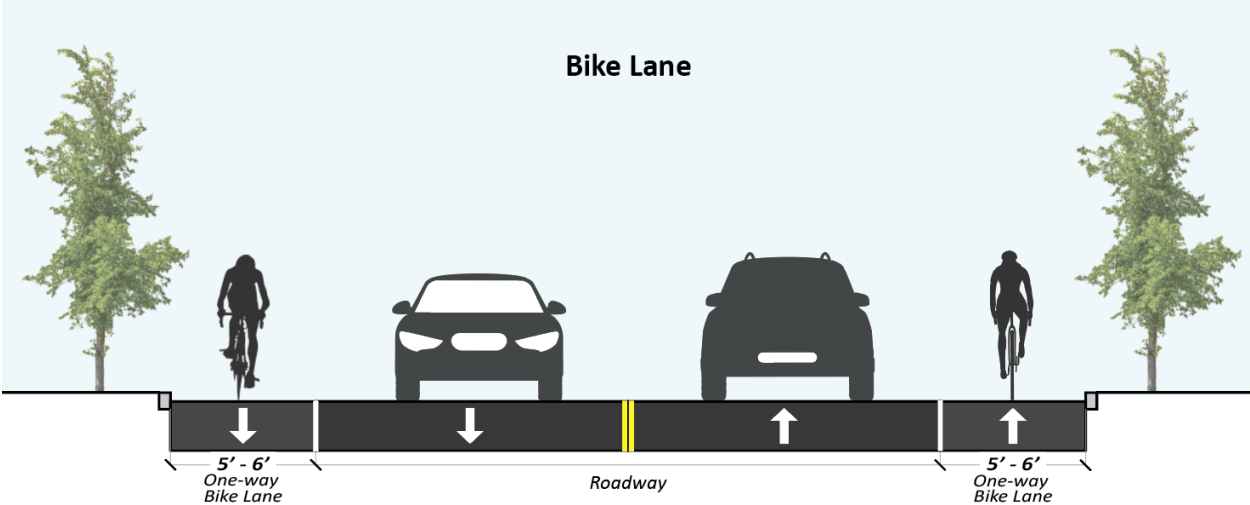


Figure 14: Example cross-section of a preferred bike lane facility

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Sidewalk

A sidewalk is a bidirectional path that provides a dedicated travel area for pedestrians in the transportation network. Sidewalks are physically separated from the roadway by a curb or unpaved buffer space.



Figure 15: Sample sidewalk graphics

Context Considerations:

Sidewalks are recommended on all but the most low-speed and low-volume roadways. Sidewalks should be considered for roadway corridors that exceed traffic volumes of 2,000 vehicles per day and speed limits higher than 10 miles per hour. Sidewalks are recommended for all types of roadways where pedestrian activity is likely. Sidewalks are also appropriate in areas with a variety of land uses and may best serve short-distance travel along roadways with pedestrian-generating development, such as neighborhoods, schools, shopping centers, and employment centers.

Design Considerations:

Sidewalks should be designed to a minimum width of 6 feet, with 5 feet recommended in constrained sections. A buffer of at least 5 feet between the sidewalk and curb roadway should be included wherever possible to provide physical separation from vehicle traffic.

Sideways are commonly constructed with asphalt or concrete. Asphalt pavement tends to be the most popular and cost effective for paved trails. Concrete pavement is more durable, but costs more than

asphalt pavement. As such, concrete trails are typically more common in urban settings (where projected user volumes are high or the trail may be subject to vehicular loading more often) or in areas subject to heavy flooding forces that may cause damage to the trail.

Sidewalks typically do not require markings except at intersections or midblock crossings, where marked crosswalks should be provided. Crosswalk markings should be designed to a minimum width of 6 feet, and the high-visibility “continental” design is recommended. At lower volume intersections or stop signs the standard, or “transverse” crosswalk marking may be acceptable. Signage such as the MUTCD R10-15 Turning Vehicles Yield to Pedestrians may be used to alert drivers to the presence of pedestrians at crosswalks. Figure 16 provides an example cross-section of a preferred sidewalk facility.

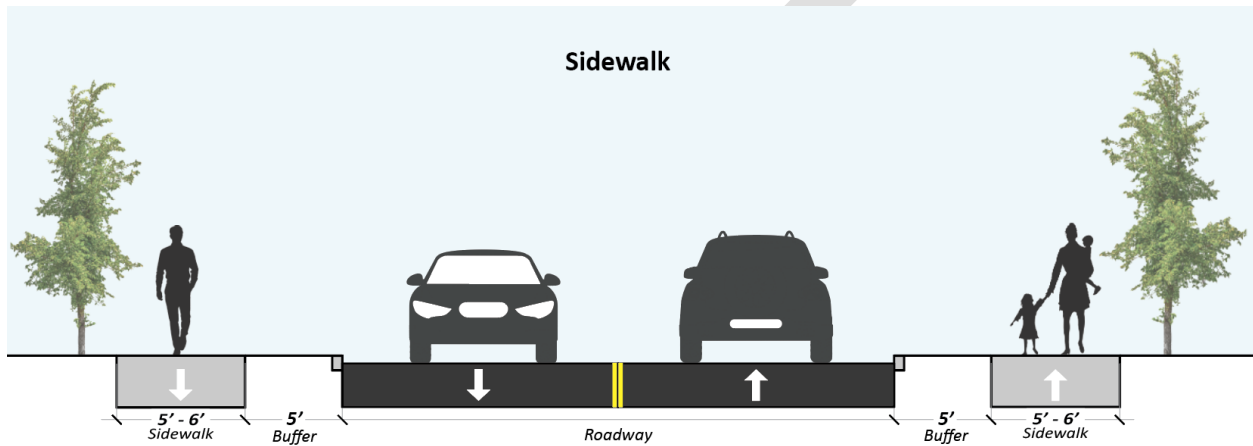


Figure 16: Example cross-section of a preferred sidewalk facility

Intersection Improvements

There are several locations along US 17 where improved bicycle and pedestrian crossings are desired to provide safer and more comfortable access to commercial areas and schools. Improvements could come in the form of high visibility crosswalks, improved ADA accessibility, median pedestrian islands, curb extensions, lighting, and improved bicycle and pedestrian signalization such as countdown timers, Rectangular Rapid-Flashing Beacons (RRFB), and High-Intensity Activated (HAWK) crosswalk. Intersection improvements should be discussed with NCDOT as part of ongoing planning and design work for upgrades to US 17.

To the right is an example of a RRFB that can be activated to alert motorists of a pedestrian or bicyclist crossing at a crosswalk. RRFB's are suitable for lower volume, lower speed roadways.



Figure 17: Rectangular Rapid Flashing Beacon

The following shows an example of a HAWK signal that can be activated to alert motorists of a pedestrian or bicyclists crossing at a crosswalk. These are used for corridors with high traffic volumes and high speeds where extra attention needs to be brought to a crossing.



Figure 18: HAWK Signal

The below shows an example of a median pedestrian island, high visibility crosswalk, and enhanced lighting.

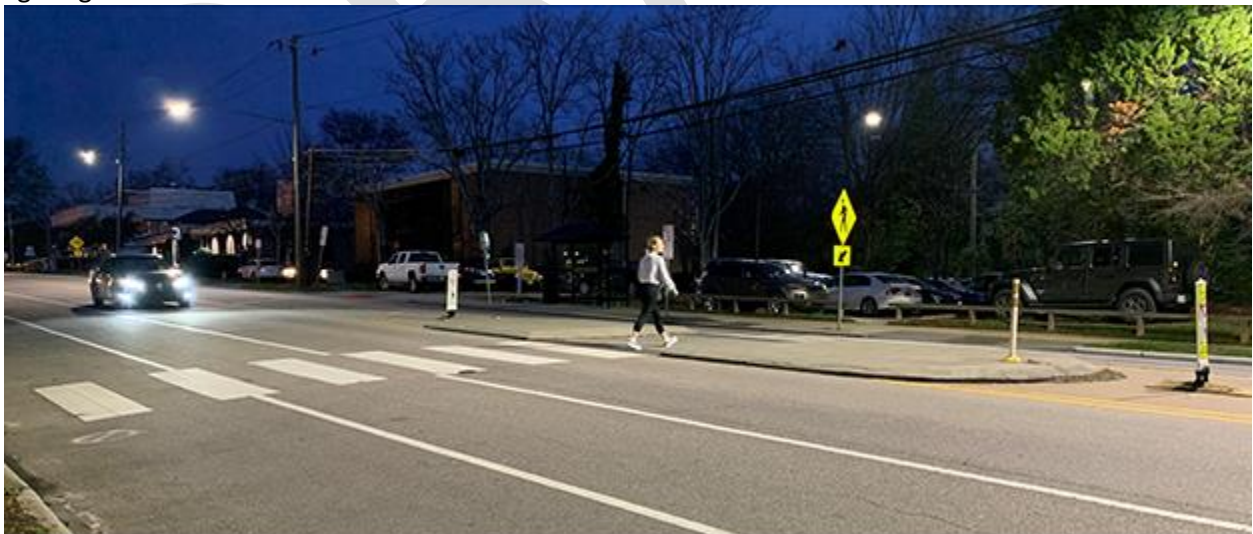


Figure 19: High visibility crosswalk with a median pedestrian island and enhanced lighting