



City of Creedmoor



BICYCLE AND PEDESTRIAN TRANSPORTATION PLAN

Adopted by the City of Creedmoor Board of Commissioners on November 14, 2011

Prepared for the City of Creedmoor, North Carolina
Prepared by Alta/Greenways

PART 2: BICYCLE TRANSPORTATION PLAN

This Bicycle Plan was prepared for the City of Creedmoor
by Alta/Greenways



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2011-R-20

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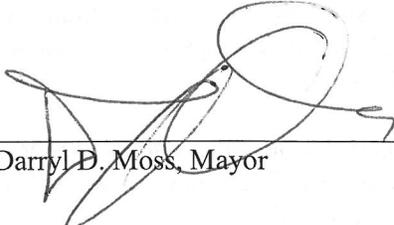
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RESOLUTION TO ADOPT THE CITY OF CREEDMOOR PEDESTRIAN TRANSPORTATION PLAN

- WHEREAS, the City of Creedmoor and the North Carolina Department of Transportation - Division of Bicycle and Pedestrian Transportation (NCDOT-DBPT) have worked cooperatively with a project Steering Committee of multiple stakeholders, holding multiple planning meetings and Public Involvement opportunities to develop a Pedestrian Transportation Plan for the City of Creedmoor; and
- WHEREAS, the Steering Committee included representatives from the local community, City Government, local business, Creedmoor Schools, Capital Area MPO, Granville County Planning, Granville Greenways; and
- WHEREAS, the local NCDOT Division and District offices and City departments are prepared to work together to implement this plan over time; and
- WHEREAS, the Pedestrian Plan takes into account related recommendations from other plans, such as Creedmoor's 2009 Strategic Plan, the NC 50 Corridor Study, the 2009 Creedmoor Bicycle, Pedestrian, and Greenway Plan, the CAMPO 2035 Long Range Transportation Plan, the 2008 Granville County Comprehensive Transportation Plan, the Granville County Greenway Master Plan, and the Capital Area MPO/Creedmoor Intersection Analysis Report; and
- WHEREAS, most major intersections within Creedmoor currently do not have crosswalks or other safety measures for pedestrians; and
- WHEREAS, Creedmoor currently has no trails and only a limited amount of sidewalk, primarily on Main Street and a small number of subdivision streets; and
- WHEREAS, the comments received during the Stakeholder and Public Involvement Process indicate support for improving conditions for walking in Creedmoor, and
- WHEREAS, this plan promotes streets that are safe and convenient for all users, including pedestrians; and
- WHEREAS, streets constitute a large portion of the public space and should be corridors for all modes of transportation, including pedestrians; and
- WHEREAS, trends in public health, energy and transportation costs, and air quality necessitate a more comprehensive approach to mobility within communities to offer a greater variety of mobility choices that are not strictly automobile based; and
- WHEREAS, the Federal Highway Administration has confirmed that designing streets with pedestrians in mind significantly reduces pedestrian risk (about one-third of Americans do not drive, including low-wealth Americans who cannot afford cars, school-age children, and an increasing number of older adults—whether they walk or bicycle directly to their destinations, these individuals require safe access to get to work, school, shops and medical visits, and to take part in social,

- WHEREAS, the Capital Area MPO and its member communities desire a multi-modal transportation network that is compatible with expected growth, sensitive to the environment, improves quality of life and is safe and accessible for all; and
- WHEREAS, it is recognized that the recommendations outlined in the Bicycle Plan, when implemented, will help achieve multi-modal transportation and increased recreation opportunities in Creedmoor; and
- WHEREAS, this Plan is to be used to guide decision-making and to assist the City in making the necessary improvements that support improved conditions for bicycling; and
- WHEREAS, providers of grants and other sources of project funding look more favorably upon projects submitted as part of an adopted plan,

NOW THEREFORE, BE IT RESOLVED, that on this 14 th day of November 2011, the Creedmoor Board of Commissioners adopts the Bicycle Transportation Plan.



Darryl B. Moss, Mayor

ATTEST:



Korena L. Weichel, City Clerk



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www.pedbikeimages.org / Dan Burden

OVERVIEW

In 2011, the City of Creedmoor commissioned planning and design consultants, Alta/Greenways, to conduct bicycle planning services, building upon work completed for the City's Pedestrian Plan. This Bicycle Plan provides an overall vision and strategy for the City of Creedmoor to grow into a bicycle-friendly community. This Plan's Steering Committee met in August 2011 to confirm project visions and goals, identify desired outcomes of the Plan, and determine areas of need for bicyclists. The vision statement is as follows:

"The City of Creedmoor will become a bicycle-friendly community by developing a combination of infrastructure, education programs, and policies that support and encourage bicycling."

This Plan outlines a purpose (Chapter 1), an assessment of where things stand today (Chapter 2), recommendations for bicycle facilities (Chapter 3), and implementation strategies (Chapter 4). Also included in this plan is an appendix with design guidelines for bicycle facilities. For more implementation resources, such as funding sources and State & Federal policies, please refer to the City of Creedmoor's Pedestrian Plan.

THE PLANNING PROCESS

The planning process was led by consultants Alta/Greenways with direction from the City's planning and transportation staff, as well as a project Steering Committee. Steering Committee members were selected by the City of Creedmoor, representing multiple city departments, regional partners, local business interests, and citizen advocates. They are listed in the Acknowledgements section of this Plan on page ii.

PUBLIC INVOLVEMENT

Citizen representatives served on this Plan's Steering Committee, providing guidance during the Kick-Off meeting, draft plan review, and the final plan's presentation. The draft for this plan was announced in official press releases by the City, and was available and on display for comment during the Creedmoor Music Festival in September 2011. The final plan was also presented at a public hearing in October 2011.

DATA COLLECTION AND ANALYSIS

Baseline information about the study area was collected during the planning process for the Pedestrian Plan in Spring 2011, including the review of existing plans, preliminary field analysis, and study-area base maps. In Summer 2011, project consultants held a second round of fieldwork to confirm current conditions for bicycle transportation. Consultants also used aerial photography and geographic information systems (GIS) data, to further identify opportunities and constraints for bicycle facility development.



Above: The Bicycle Plan Steering Committee identifies opportunities and constraints for bicycling in Creedmoor.

“Individuals must choose to exercise, but communities can make that choice easier.”
-Rails-to-Trails Conservancy

“The CDC determined that creating and improving places to be active could result in a 25 percent increase in the number of people who exercise at least three times a week.”

***-U.S. Department of Health and Human Services,
Centers for Disease Control and Prevention***

BENEFITS OF A BICYCLE-FRIENDLY COMMUNITY

A bicycle-friendly Creedmoor will help to improve the health and fitness of residents, enhance environmental conditions, decrease traffic congestion, and contribute to a greater sense of community. Scores of studies from experts in the fields of public health, urban planning, urban ecology, real estate, transportation, and economics consistently back-up such claims and affirm the value of supporting bicycling as it relates to active living and alternative transportation. Communities across the United States and throughout the world are implementing strategies for serving the bicycle needs of their residents, and have been doing so for many years. They do this because of their obligations to promote health, safety and welfare, and also because of the growing awareness of the many benefits of bicycling.

INCREASED HEALTH AND PHYSICAL ACTIVITY

A growing number of studies show that the design of our communities—including neighborhoods, towns, transportation systems, parks, trails and other public recreational facilities—affects people’s ability to reach the recommended daily 30 minutes of moderately intense physical activity (60 minutes for youth). According to the Centers for Disease Control and Prevention (CDC), “physical inactivity causes numerous physical and mental health problems, is responsible for an estimated 200,000 deaths per year, and contributes to the obesity epidemic.”

¹ The increased rate of disease associated with inactivity reduces quality of life for individuals and increases medical costs for families, companies, and local governments.

The CDC determined that creating and improving places to be active could result in a 25% increase in the number of people who exercise at least three times a week.² This is significant considering that for people who are inactive, even small increases in physical activity can bring measurable health benefits. Establishing a safe and reliable bicycle network in Creedmoor will positively impact the health of local residents. The Rails-to-Trails Conservancy puts it simply: “Individuals must choose to exercise, but communities can make that choice easier.”³

ECONOMIC BENEFITS

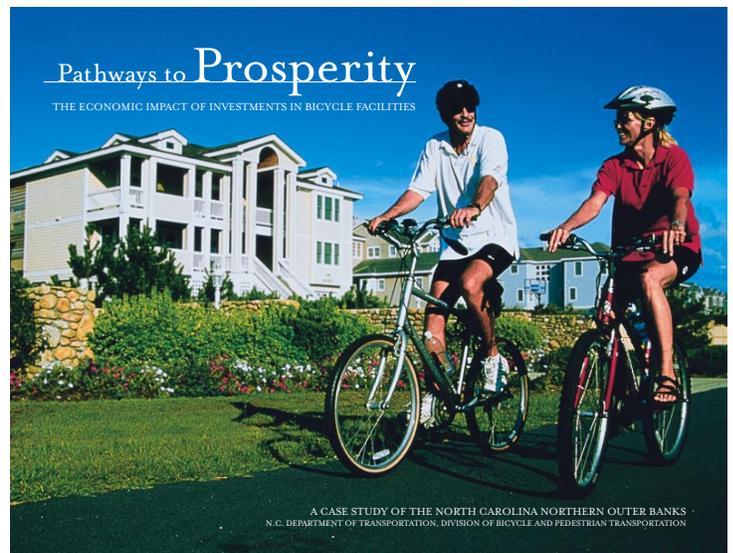
Bicycling is an affordable form of transportation. According to the Pedestrian and Bicycle Information Center (PBIC), of Chapel Hill, NC, the cost of operating a bicycle for a year is approximately \$120, compared to \$7,800 for operating a car over the same time period.⁴ Bicycling becomes even more attractive from an economic standpoint when the unstable price of oil is factored into the equation (e.g., in spring 2010, gasoline prices approached \$4 a gallon).⁵ The fluctuating cost of fuel reinforces the idea that local communities should be built to accommodate people-powered transportation, such as walking and biking. Creedmoor’ current mixed-use downtown area and surrounding land development patterns, combined with new strategies for improving bicycle transportation, could facilitate a substantial local reduction in auto- and oil-dependency.

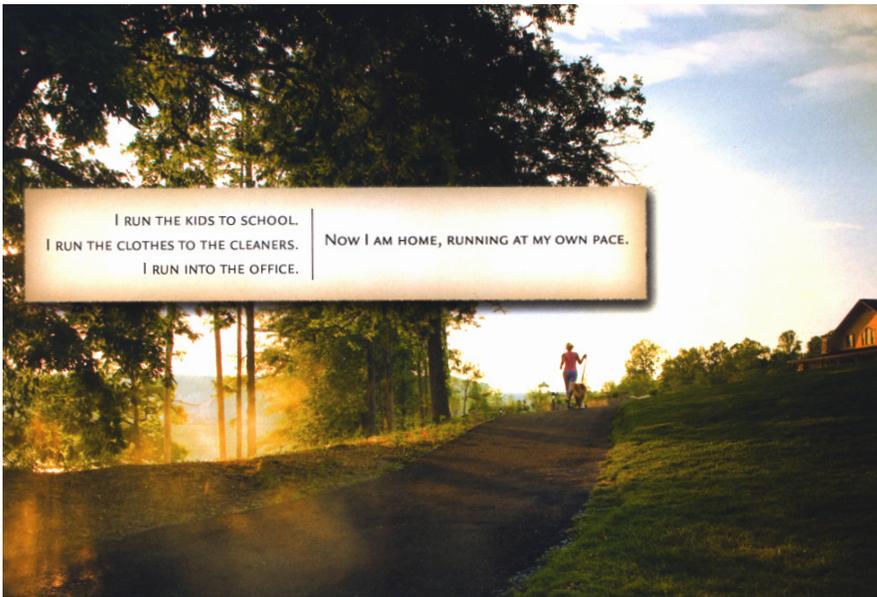
From a real estate standpoint, consider the positive impact of trails and greenways, which are essential components of a complete bicycle network. According to a 2002 survey of homebuyers by the National Association of Home Realtors and the National Association of Home Builders, trails ranked as the second most important community amenity out of a list of 18 choices.⁶ Additionally, the study found that ‘trail availability’ outranked 16 other options including security, ball fields, golf courses, parks, and access to shopping or business centers. Findings from the American Planning Association (How Cities Use Parks for Economic Development, 2002), the Rails-to-Trails Conservancy (Economic Benefits of Trails and Greenways, 2005), and the Trust for Public Land (Economic Benefits of Parks and Open Space, 1999) further substantiate the positive connection between trails and property values across the country.

Right: Apex, NC:
A residential development added \$5,000 to the price of 40 homes adjacent to the greenway – and those homes were still the first to sell. (Rails to Trails Conservancy, 2005)

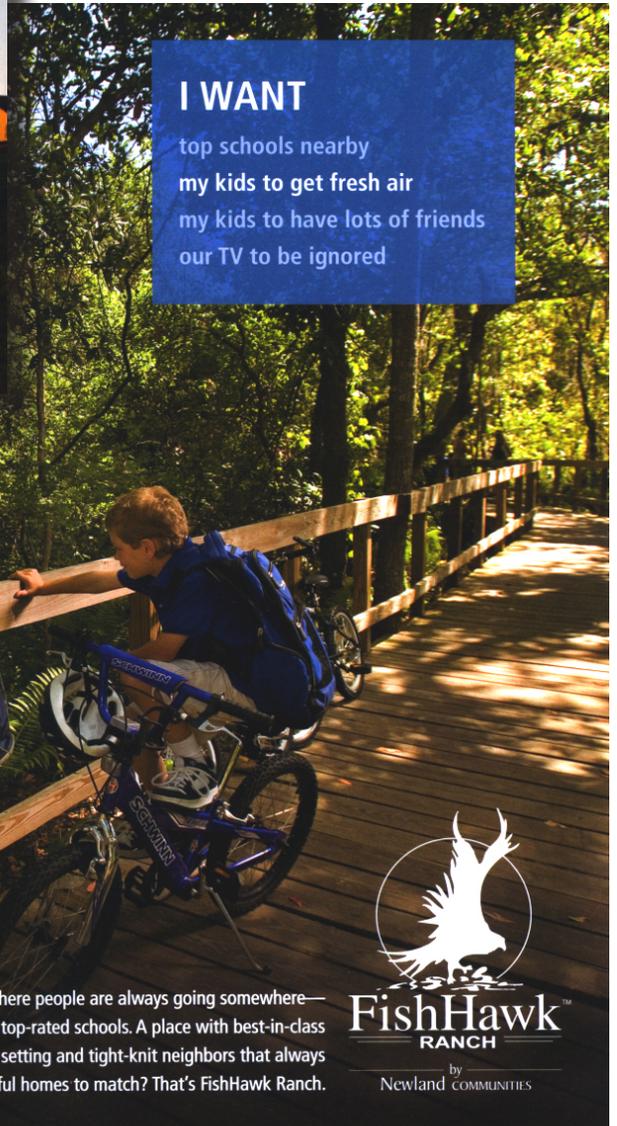


Far right: Download
“Pathways to Prosperity”
www.ncdot.gov/bikeped/researchreports





Developers are taking advantage of the positive impact of trails on property values by marketing their greenways; left and below are examples of two magazine advertisements from developers that focus their marketing on greenways.



A place where video games get lonely from lack of use. A place where people are always going somewhere—families hiking on the miles of trails, or kids biking to our onsite top-rated schools. A place with best-in-class amenities, including a huge Aquatic Club. A place with a natural setting and tight-knit neighbors that always seem to be doing something together. All this and beautiful homes to match? That's FishHawk Ranch.

Finally, from a tourism perspective, cyclists can add real value to local economies. For example, in the Outer Banks, NC, bicycling is estimated to have an annual economic impact of \$60 million; 1,407 jobs are supported by the 40,800 visitors for whom bicycling was an important reason for choosing to vacation in the area. The annual return on bicycle facility development in the Outer Banks is approximately nine times higher than the initial investment.⁷ Similarly, Damascus, VA, the self-proclaimed 'Friendliest Trail Town', features 34-miles of trail where approximately \$2.5 million is spent annually related to recreation visits. Of this amount, non-local visitors spend about \$1.2 million directly into the economies of Washington and Grayson counties.⁸ While these examples feature beach and mountain destinations, the City of Creedmoor also has key advantages, such as Lake Rogers and its proximity to Falls Lake, Raleigh, and RTP.

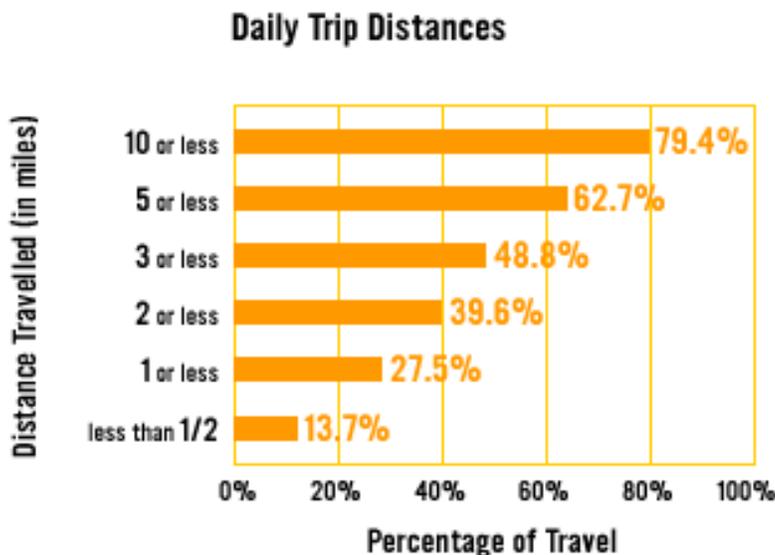
ENVIRONMENTAL IMPROVEMENTS

As demonstrated by the Southern Resource Center of the Federal Highway Administration, when people get out of their cars and onto their bicycles, they reduce measurable volumes of pollutants.⁹ Other environmental impacts include a reduction in overall neighborhood noise levels and improvements in local water quality as fewer automobile-related discharges wind up in the local rivers, streams, and lakes.

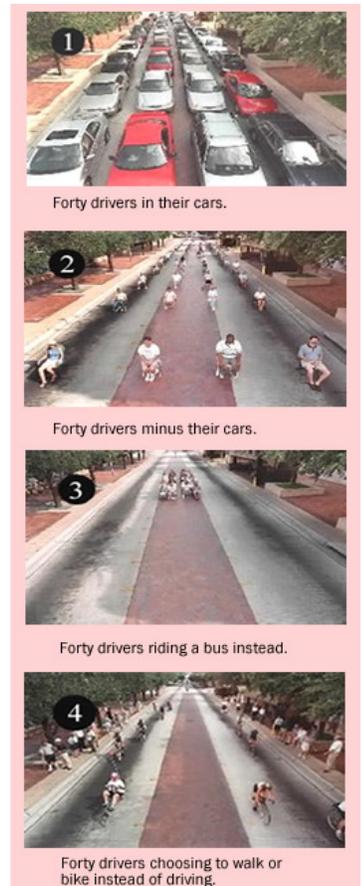
Trails and greenways are also part of any bicycle network, conveying unique environmental benefits. Greenways protect and link fragmented habitat and provide opportunities for protecting plant and animal species. Aside from connecting places without the use of air-polluting automobiles, trails and greenways also reduce air pollution by protecting large areas of plants that create oxygen and filter air pollutants such as ozone, sulfur dioxide, carbon monoxide and airborne particles of heavy metal. Finally, greenways improve water quality by creating a natural buffer zone that protects streams, rivers and lakes, preventing soil erosion and filtering pollution caused by agricultural and road runoff.

TRANSPORTATION BENEFITS

In 2001, the National Household Travel Survey found that roughly 40% of all trips taken by car are less than 2 miles (see chart below). By taking these short trips on a bicycle, rather than in a car, citizens can substantially impact local traffic and congestion. Traffic congestion reduces mobility, increases auto-operating costs, adds to air pollution, and causes stress. Bicycle users can help alleviate overall congestion because each cyclist is one less car on the road. Incidentally, cyclists take up significantly less space on the road (see image at right).



Above: 'Daily Trip Distances' chart from the Bicycle and Pedestrian Information Center website, www.pedbikeinfo.org



Source: *The Association for the Advancement of Sustainability in Higher Education, 2007.*

Additionally, many people do not have access to a vehicle or are not able to drive. According to the National Household Travel Survey (NHTS), one in 12 U.S. households does not own an automobile and approximately 12 percent of persons 15 or older do not drive.¹⁰ An improved bicycle network provides greater and safer mobility for these residents.

QUALITY OF LIFE

Many factors go into determining quality of life for the citizens of a community: the local education system, prevalence of quality employment opportunities, and affordability of housing are all items that are commonly cited. Increasingly though, citizens claim that access to alternative means of transportation and access to quality recreational opportunities such as parks, trails, greenways, and bicycle routes, are important factors for them in determining their overall pleasure within their community. Communities with such amenities can attract new businesses, industries, and in turn, new residents. Furthermore, quality of life is positively impacted by bicycling through the increased social connections that take place by residents being active, talking to one another and spending more time outdoors and in their communities.

According to the Brookings Institution, the number of older Americans is expected to double over the next 25 years.¹¹ All but the most fortunate seniors will confront an array of medical and other constraints on their mobility even as they continue to seek both an active community life, and the ability to age in place. Trails built as part of the bicycle transportation network generally do not allow for motor vehicles; however, they do accommodate motorized wheelchairs, which is an important asset for the growing number of senior citizens who deserve access to independent mobility.

Children under 16 are another important subset of our society who deserve access to safe mobility and a higher quality of life. According to the U.S. Environmental Protection Agency, fewer children walk or bicycle to school than did so a generation ago. In 1969, 48% of students walked or bicycled to school, but by 2001, less than 16% of students between 5 and 15 walked or bicycled to or from school.¹²

*Utility bicycle for everyday trips, like grocery shopping
(image from
www.yubabike.com)*



According to the National Center for Safe Routes to School, “Walking or biking to school gives children time for physical activity and a sense of responsibility and independence; allows them to enjoy being outside; and provides them with time to socialize with their parents and friends and to get to know their neighborhoods.”¹³ In a 2004 CDC survey, 1,588 adults answered questions about barriers to walking to school for their youngest child aged 5 to 18 years.¹⁴ The main reasons cited by parents included distance to school, at 62%, and traffic-related danger, at 30%. Strategic additions to Creedmoor’ bicycle and trail system could shorten the distance from homes to schools, and overall bicycle improvements can improve the safety of our roadways.

Footnotes from, “The Value of Bicycle Transportation”:

1. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. (1996). *Physical Activity and Health: A Report of the Surgeon General*.

2. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. (2002). *Guide to Community Preventive Services*.

3. Rails-to-Trails Conservancy. (2006) *Health and Wellness Benefits*.

4. Pedestrian and Bicycle Information Center. (2008). *Economic Benefits: Money Facts*. Retrieved 8/8/2008 from www.bicyclinginfo.org/why/benefits_economic.cfm

5. King, Neil. *The Wall Street Journal: Another Peek at the Plateau*. (2/27/08): In February 2008, the *Wall Street Journal* quoted industry experts, stating, “supply constraints could push the price of oil to \$150 a barrel by 2010”.

6. National Association of Realtors and National Association of Home Builders. (2002). *Consumer’s Survey on Smart Choices for Home Buyers*.

7. NCDOT and ITRE. (2006). *Bikeways to Prosperity: Assessing the Economic Impact of Bicycle Facilities*.

8. Virginia Department of Conservation. (2004). *The Virginia Creeper Trail: An Assessment of User Demographics, Preferences, and Economics*.

9. Federal Highway Administration, Southern Resource Center. (1999). *Off-Mode Air Quality Analysis: A Compendium of Practice*. To calculate air quality benefits of bicycling, first calculate the Daily VMT reduction. $VMT\ Reduction = PD * Area * L * BMS$, where PD = Population density, persons/mile; Area = Project length * 1 mile radius, mile; L = Round trip length, one-half of the project length times 2 daily trips, miles; BMS = Bike mode share, %. Last, calculate the Daily Emission reductions for a pollutant. $Ed = Efx * VMT\ Reduction$, where Ed = Daily Emissions, grams/day; Efx = Emission factor for pollutant x, grams/mile; VMT = vehicle mile/day.

10. U.S. Department of Transportation (DOT), Bureau of Transportation Statistics (BTS) and the Federal Highway Administration (FHWA). (2002). *National Household Travel Survey*.

11. Brookings Institution. 2003. *The Mobility Needs of Older Americans: Implications for Transportation Reauthorization*.

12. US EPA. (2003). *Travel and Environmental Implications of School Siting*.

13. National Center for Safe Routes to School. (2006). National Center for Safe Routes to School Talking Points.

14. Centers for Disease Control and Prevention. The Importance of Regular Physical Activity for Children. Accessed 9/16/05 at http://www.cdc.gov/nccdphp/dnpa/kidswalk/health_benefits.htm.



OVERVIEW

In order to propose a comprehensive bicycle system for Creedmoor, it is critical to examine the existing environment. The area's geographic characteristics, existing roadway configurations, and existing bicycle facilities significantly affect bicycle transportation and the everyday decisions by bicyclists and motorists. This chapter covers the following:

- Field Inventory and Observations
- Geographic Information Systems (GIS) Analysis
- Summary of Existing Plans

FIELD INVENTORY AND OBSERVATIONS

The consultant team conducted a field analysis of area roads and potential greenway corridors. The analysis focused on existing strengths and deficiencies of the current roadway network as related to bicycling and the potential for bicycle facilities. According to the Creedmoor Police Department, roadways with observed higher numbers of bicyclists include Church St, Lake Rd, Stem Rd, and NC 56 E. A summary of other key field observations is provided below:

STRENGTHS OF EXISTING BICYCLE FACILITIES:

- *Narrow paved shoulder:* Existing 1-2 foot paved shoulder on several two-lane roadways throughout is a starting point for separated space (4 feet is the desired minimum standard).
- *Neighborhood roads:* Some neighborhood roads have low speed limits and low traffic volumes allowing for recreational riding.

DEFICIENCIES OF EXISTING BICYCLE FACILITIES:

- *Lack of connectivity:* There are no on-road or off-road bicycle facilities within Creedmoor.
- *No bicycle parking:* There are no bicycle racks at public locations, shopping centers, or schools.
- *Bicyclist behavior:* Recreational bicyclists observed were not wearing bicycle helmets but were bicycling on the correct side of the road.

Committee members noted that some bicyclists ride in the wrong direction and do not wear helmets.

STRENGTHS OF EXISTING ROAD NETWORK:

- *Residential street network:* Many collector roadways generally connect to destinations and to more than one arterial roadway.
- *Main Street:* Main Street features wider lanes and on-street parking with marked crosswalks. Traffic moves through this portion of Downtown relatively slowly (though some speeding was noted by Committee Members). There is opportunity for on-road bicycle facilities here.
- *Shoulders:* Several roadways throughout the City have clear and level shoulders offering opportunity to add bicycle lanes, paved shoulders, or multi-use trails.

DEFICIENCIES OF EXISTING ROAD NETWORK:

- *Connectivity issues:* There is a lack of grid connectivity in most of the City's overall street network.
- *High-volume, high-speed roadways:* There are several high-volume roadways with heavy vehicles and rural two-lane roadways throughout with higher speeds and/or little shoulder where bicyclists are not safe. Some of these roads include NC 56, US 15, and parts of NC 50.
- *Narrow roadways and lanes:* There are also many roadways that are too narrow for bicyclists to travel safely. These roads have little or no shoulder and have relatively high vehicle travel speeds which pose multiple hazards for bicyclists (such as Church, Brassfield, Hawley School, NC 56, US 15, Hillsboro, and Joe Peed). With the existing roadway widths, there is very little opportunity for restriping to fit bicycle lanes or paved shoulders.
- *Lack of curb and gutter:* Most roadways through Creedmoor have a rural two-lane configuration lacking curb and gutter (including neighborhood roadways). Curb and guttered roadways offer greater opportunity for bicycle lanes and shared-lane markings.
- *Roadways currently designed for automobiles only:* Many roads were designed around the automobile and need to be redesigned to become more bicycle friendly. Narrowing existing lanes and adding planted medians, sidewalks, and shade trees could also help reduce speeding and the hazards that speeding presents to cyclists, pedestrians, and drivers.

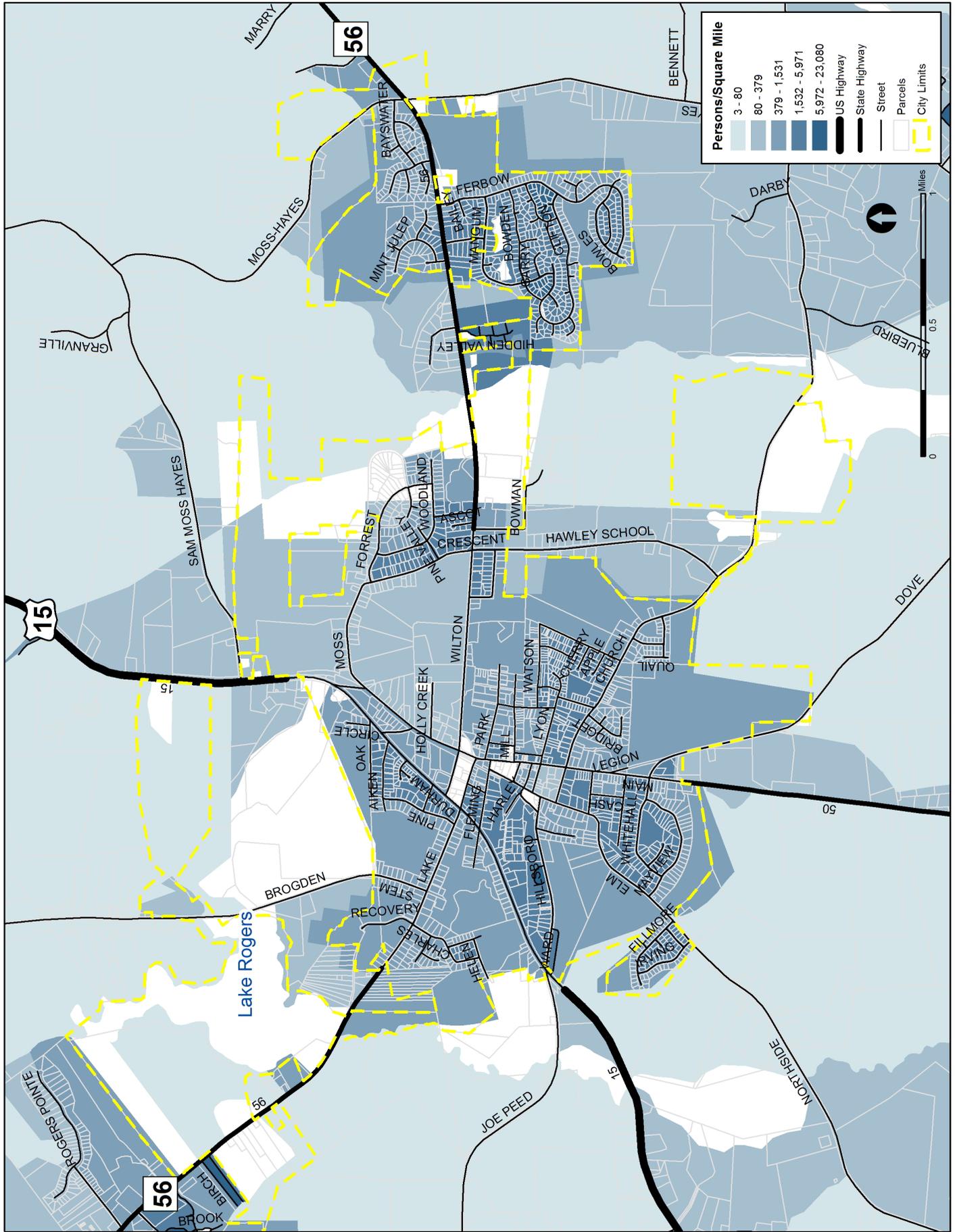


Hawley School Road, like many two-lane roadways, features narrow paved shoulders, not enough space for bicyclists.

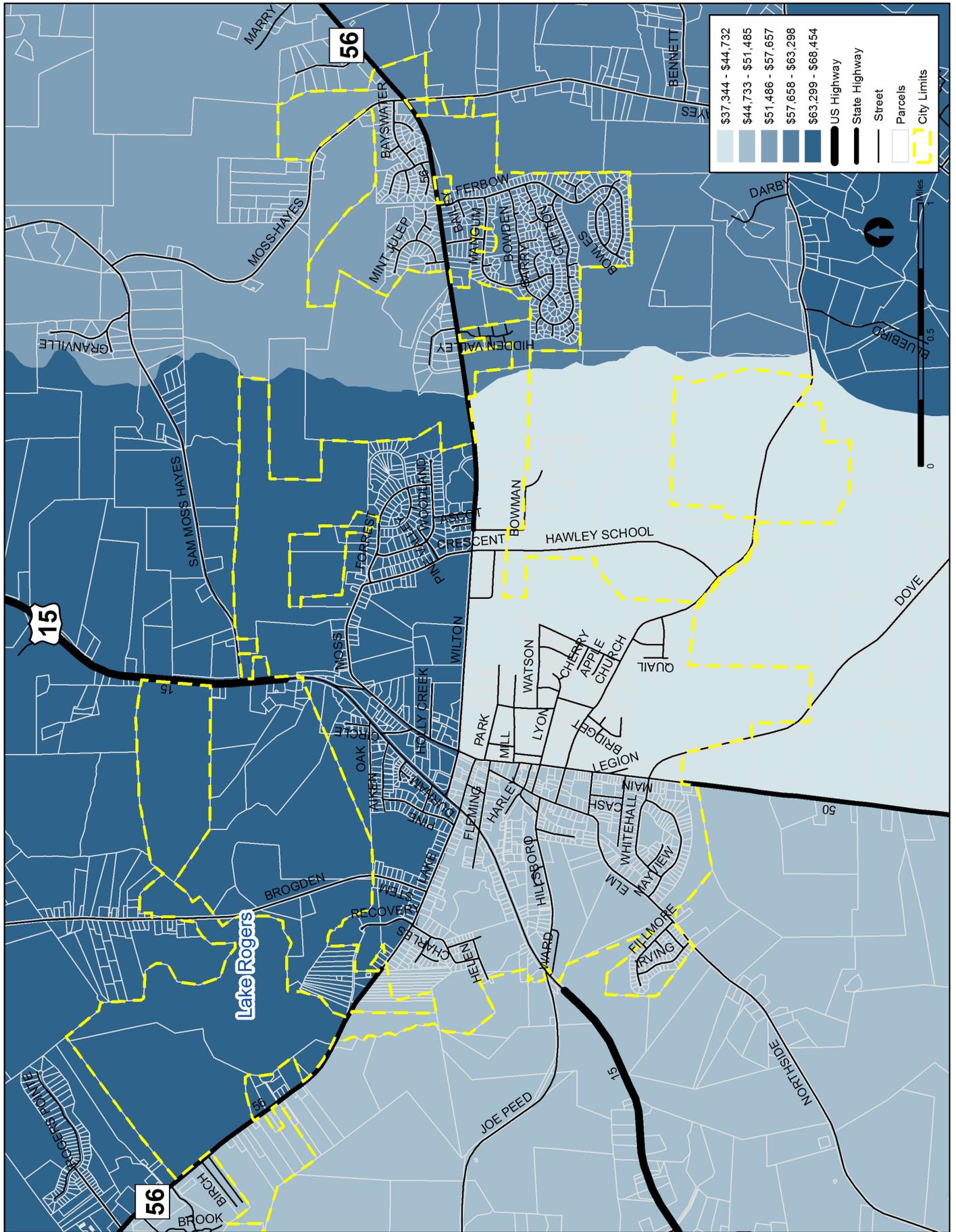
GEOGRAPHIC INFORMATION SYSTEMS (GIS) ANALYSIS

Geographic Information Systems (GIS) data was received from the City of Creedmoor and Granville County during the development of this Plan. The analysis included information about popular destinations, land use, and demographic patterns that may be useful in assessing need for future bicycle facilities.

MAP 2.2 POPULATION DENSITY Map based on data from 2010 US Census



MAP 2.3 MEDIAN HOUSEHOLD INCOME
 Map based on 2005-2009 American Community Survey (ACS) 5-year estimates



TRIP ATTRACTORS (MAP 2.1)

People currently drive, walk, or bicycle to a variety of destinations across Creedmoor for various purposes. These potential destinations and points of origin for bicyclists are referred to as 'trip attractors'. Examples include:

- Downtown
- Lake Rogers
- Schools
- Shopping locations (Food Lion, CVS Pharmacy, etc.)
- Places of worship
- Places of employment
- Senior Center

Each of these categories of bicycle trip attractors will be considered when determining locations for recommended bicycle improvements. They represent important starting and ending points for bicycle travel and provide a good basis for planning ideal routes.

DEMOGRAPHIC ANALYSIS (MAPS 2.2-2.3)

Needs and demands related to bicycling can be better understood through an analyses of demographic information. US Census demographic data provide geographic information such as the means of transportation to work and median family income, however the latest data available regarding mode to work (2000) showed zero people bicycling for transportation to work in Creedmoor.

Since 2000, the population of Creedmoor has increased by 84.8%, or approximately 6% per year, bringing the certified population of Creedmoor to 4,124. The City's median age 36.6, compared to 36.2 for Granville County, and 35.3 for North Carolina. Much of the growth that has occurred are younger or urban professionals, many of whom have active, and healthy lifestyles.

Map 2.2 shows population density (persons per square mile) throughout the City. The most densely populated areas in Creedmoor surround the downtown core and the cluster of subdivisions east on NC 56. Incidentally, as shown on Map 2.3, part of this more densely populated area (east of Main and south of NC 56) also has a lower median income than the rest of Creedmoor. The need for greater bicycle and pedestrian access and mobility may be greater for lower-income communities and high-density areas, where more people would be impacted.

SUMMARY OF EXISTING PLANS

2009 STRATEGIC PLAN

One idea that came out of this comprehensive growth strategy was to develop a policy or plan to address bicycle and pedestrian needs for the areas near the downtown, schools, and commercial, residential and employment centers. The following represents some goals of the Strategic Plan that relate to bicycle planning:

- Encourage development that protects the natural and built environment, and provides for the appropriate location of land uses;
- Develop a comprehensive transportation system that will enhance the mobility of all citizens;
- Provide community facilities and public services that meet the physical, social, and cultural needs of the population and that are available to all residents;
- Develop a mechanism and process that will assure diverse recreational activities and opportunities are available for all residents through new and expanded public parks, new Trails or Greenways (Linear Parks), and within new development projects.
- Develop a long-range plan for the Lake Rogers Park areas. The plan should include a pedestrian connection between the north and south properties that is separated by the lake.
- Continue to pursue the acquisition of the Fontaine development property for a major city park and recreational area.
- Develop a comprehensive Recreation Master plan. This plan would complement the City's Greenway and Pedestrian Plan, identifying future recreational needs and ways to provide a range of recreational opportunities for Creedmoor's citizens.

NC 50 CORRIDOR STUDY

This 2011 study by the Capital Area Metropolitan Planning Organization analyzes the 15-mile segment of NC 50 between I-540 and NC 56. The Study evaluates the efficiency and effectiveness of the existing NC 50 roadway, determines the long-term vision for the corridor, assesses the impact of the new Falls Lake Watershed requirements on future growth patterns and roadway design, investigates other transportation choices that may be available to reduce reliance on the NC 50 corridor and discusses how proposed improvements to NC 50 could enhance the overall quality of life and economic vitality of the region.

The study contains a Pedestrian Recommendations chapter which recommends the following (south to north along the corridor):

- A 10' wide multi-use path along the eastern side of NC 50, between NC 98 and Old Weaver Trail.
- Paved shoulders along NC 50, from Old Weaver Trail north to the future Creedmoor Connector (bottom image below).
- Multi-use path alternative to NC 50, from Old Weaver Trail north into

Creedmoor (along a power line easement that roughly parallels NC 50 to the east).

- Sidewalks on both sides of the road from the future Creedmoor Connector to existing sidewalks in downtown Creedmoor (see top image below). The study states, *“To enhance the pedestrian experience, these sidewalks should be buffered from traffic by a planting strip.”*
- Regarding the streetscape along NC 50 in Downtown Creedmoor: *“Intersection level improvements, aesthetic enhancements, and sidewalk maintenance will enhance pedestrian travel in this area. Mid-block crossings and treatments should also be considered at appropriate locations.”*

PEDESTRIAN–BICYCLE–GREEN SPACE PLAN, 2009

This Plan was developed by six local governments and four partner organizations in the center of the Triangle Region to help them create a linked network of pedestrian, bicycle, and green space facilities. By coordinating across jurisdictional lines, the plan provides a way for the project partners and other funders to make these investments in an efficient and cost-effective manner, specifically recommending that the NCDOT make suitable accommodations for bicyclists and pedestrians whenever making improvements along the corridors considered as being CORE-wide priorities. Recommendations from the CORE plan were used as one of several starting points for identifying planned trails in this Bicycle Plan.

2035 JOINT LONG RANGE TRANSPORTATION PLAN

This document contains the 2035 Long-Range Transportation Plans (LRTP) for the two organizations charged with transportation decision-making in the Research Triangle Region: the Capital Area Metropolitan Planning Organization (CAMPO) and the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO). The LRTPs are the guiding documents for future investments in roads, transit services, bicycle and pedestrian facilities and related transportation activities and services to match the growth expected in the Research Triangle Region. Projects identified for Creedmoor in the next 15-25 years include the future Creedmoor Connector (connecting US 15 with Brassfield Rd, south of Downtown) and NC 50 (see NC 50 Corridor Study). The LRTP also contains goals and objectives that directly promote pedestrian-friendly and sustainable development. Additionally, sidewalk facilities are programmatically included in the LRTP to enable local governments to access federal funding for their construction.

GRANVILLE COUNTY COMPREHENSIVE TRANSPORTATION PLAN, 2008

The main goal was to examine present and future transportation needs of the county and develop a Comprehensive Transportation Plan to meet these needs. Recommendations were made for each mode of transportation, including these related to bicycle and pedestrian transportation in Creedmoor:

- Develop north-south rail with trail route connecting Oxford to Butner through Creedmoor along Norfolk Southern RR Line. At southwest corner of County (at Falls of Neuse Lake), branch the trail to connect with planned Durham County trails.
- Develop east-west route connecting Creedmoor to central Butner accessing residential, commercial, and industrial developments.
- Widen NC 56 and provide bicycle/pedestrian accommodations as part of this project.
- Widen US 15 from 2-lane facility to a 3-lane urban section or 4-lane divided boulevard facility with raised median and Ancillary bicycle routes via on-road or off-road accommodations are recommended along US 15 to enhance the county-wide bicycle network.
- NC 50: Widening the current 2-lane facility to a 4-lane divided boulevard facility with median from the Wake County line to the proposed Creedmoor Connector. An ancillary bicycle route accommodation is recommended along NC 50 to enhance the county-wide bicycle network.
- NC 96: Widening the current 2-lane facility to a 4-lane divided boulevard facility with median from I-85 in southern Granville County to Franklin County. Ancillary bicycle routes via on-road or off-road accommodations are recommended along NC 56 to enhance the county-wide bicycle network.
- Brassfield Road: Widening the current 2-lane facility to a 4-lane divided boulevard facility with raised median and bicycle accommodations from the proposed Creedmoor Connector to NC 96. Ancillary bicycle routes via on-road or off-road accommodations are recommended along Brassfield Road to enhance the countywide bicycle network.
- Create a greenway system that connects Creedmoor's parks with other City greenways.
- In addition, the Plan recommends that the city require new developments to connect to the parks and trail system. Local trails should also be connected with surrounding communities and the All American Trail.

CAPITOL AREA METROPOLITAN PLANNING ORGANIZATION (CAMPO) TRANSPORTATION IMPROVEMENT PROGRAM (TIP) RECOMMENDATIONS

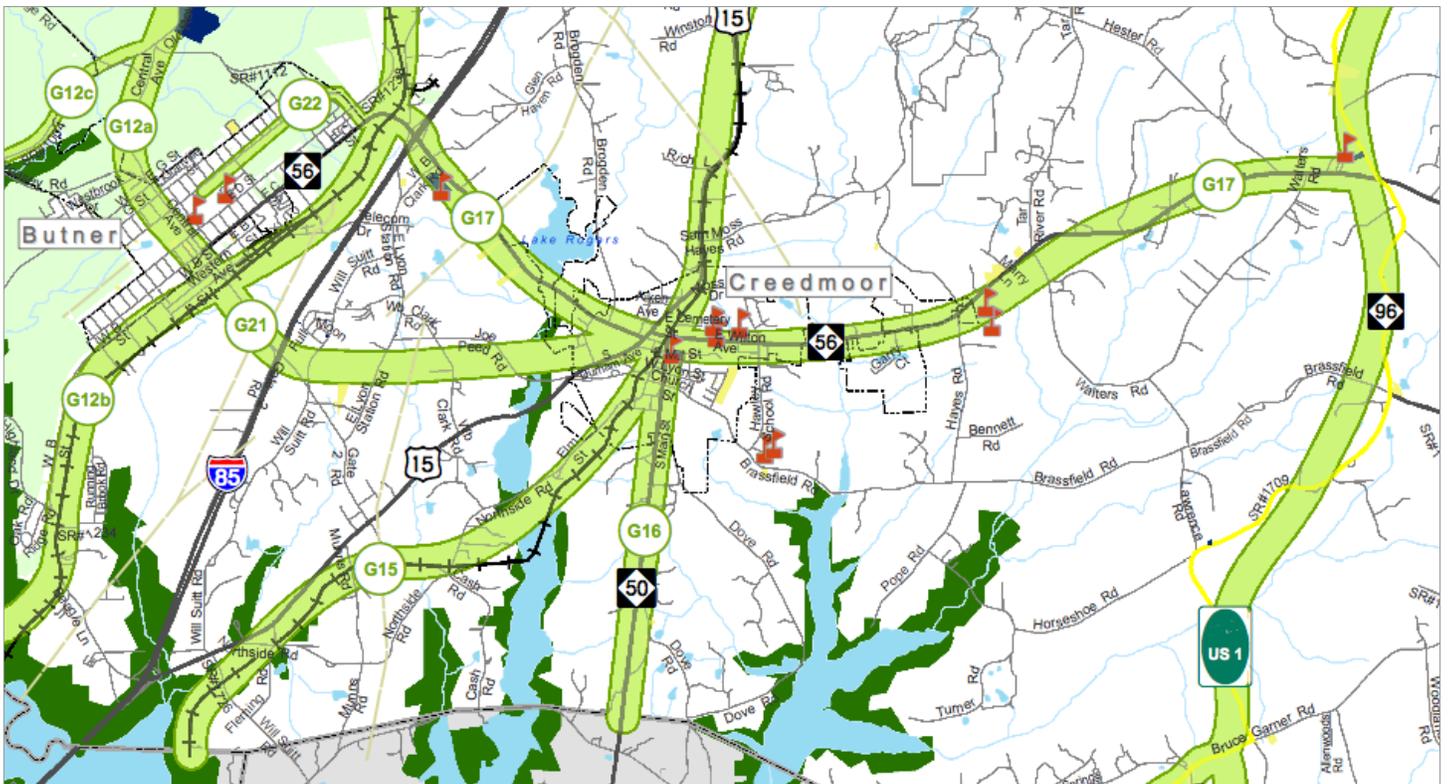
The recommendations from CAMPO's TIP list of projects in the Creedmoor area are listed below (and in Chapter 3). These include:

- US 15 (Hillsboro Street to NC 56) - Sidewalks and bicycle lanes
- Hawley School Rd - Sidewalks and bicycle lanes
- NC 56 E (Wilton) (US 15 to NC 50; NC 50 to Creedmoor Elementary; Creedmoor Elementary to Darden) - Sidewalks and bicycle lanes
- Creedmoor Connector - Bike lanes or wide outside shoulders
- Cash/Gate 2 Roads - Bike accommodations.

GRANVILLE COUNTY GREENWAY MASTER PLAN, 2006

The Granville County Board of Commissioners and the county's municipalities adopted this plan which proposes a total of 22 trails. Key greenway recommended routes that affect Creedmoor are the OxMoore Run, Creedmoor Connection, and Seaboard Trail (G15), On road (NC 50) utility easements (G16), NC 56 greenway (G17), and connection across I-85 from Creedmoor to the Town of Butner (G21).

Below: Part of the Granville County Greenway Master Plan.



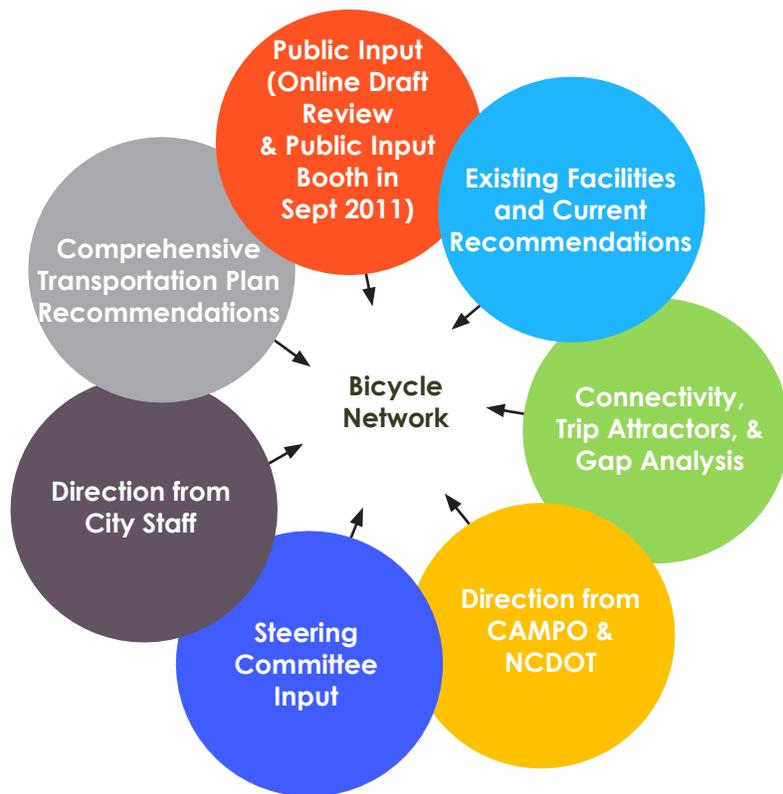


Example of a greenway trail.

OVERVIEW & METHODOLOGY

The recommended bicycle network (page 3-3) represents a connected system that will allow transportation and recreation-based bicycle travel throughout Creedmoor. The recommended network is composed of numerous types of on-street and off-street bicycle facilities that serve to connect people and neighborhoods to local destinations. This chapter contains an overall map of key recommendations and descriptions of the bicycle facility types.

This diagram illustrates the many inputs and levels of analysis used to design the Bicycle Facility Network.



The recommended bicycle network builds on a key principle that bicyclists (both current bicyclists and potential future bicyclists) have a range of skill levels. Type “C” bicyclists are beginners, often seniors and children. Type “B” bicyclists are intermediate level, typically occasional commuters and recreational cyclists. Type “A” bicyclists are experienced, regular commuters and recreational cyclists who are comfortable sharing the road with motor vehicles. These groups are not always exclusive – some elite level athletes still like to ride on shared-use paths with their families, and recreational bicyclists will sometimes use their bicycles for utilitarian travel. Most importantly, the majority of the population falls in the “Type B” or “Type C” category. This Plan seeks to accommodate all current and future users of the system.



Type "A" bicyclists are experienced, regular commuters and recreational cyclists who are comfortable sharing the road with motor vehicles.

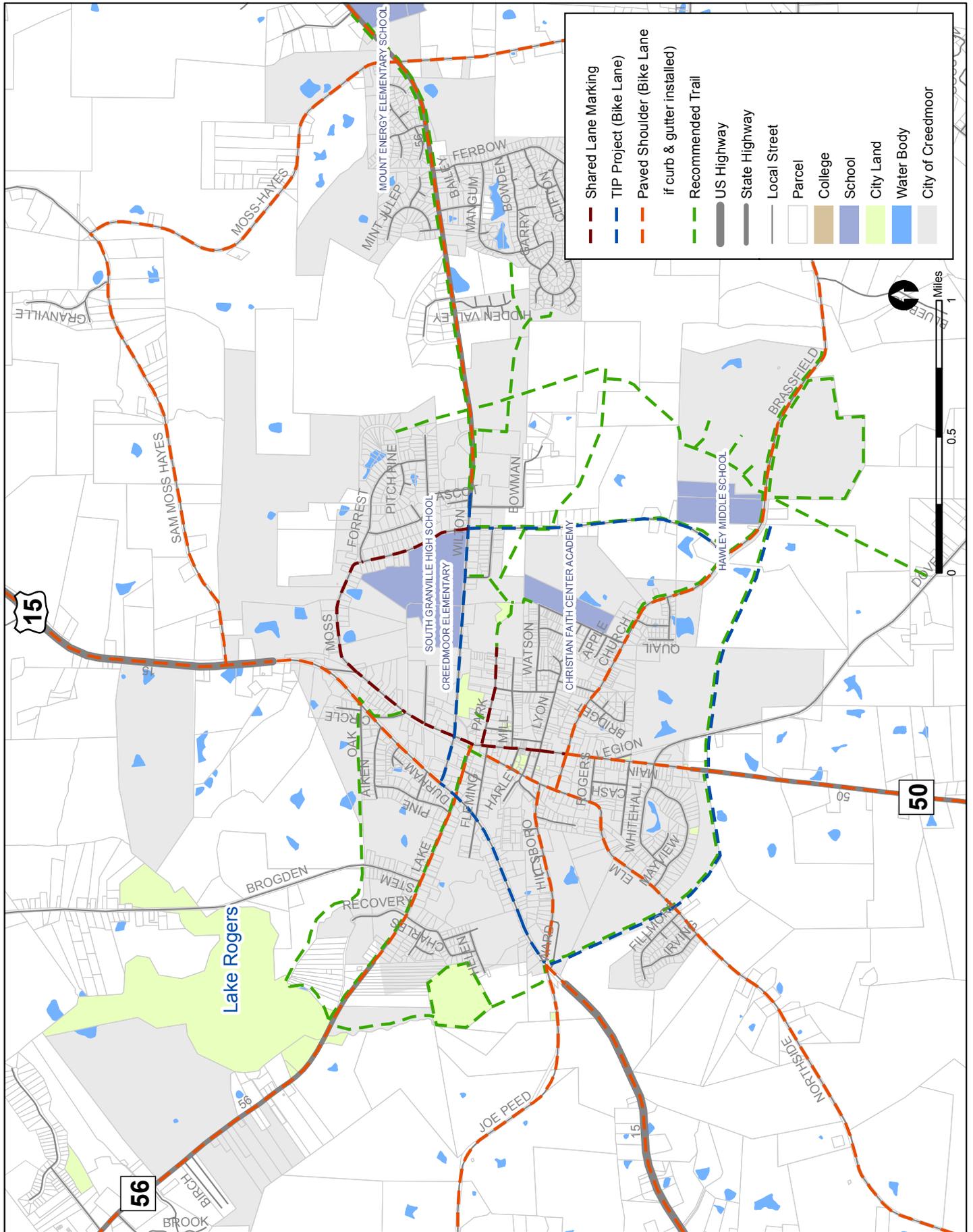


Type "B" bicyclists are intermediate level, typically occasional commuters and recreational cyclists.



Type "C" bicyclists are beginners, often seniors and children.

MAP 3.1 RECOMMENDED BICYCLE FACILITY NETWORK



RECOMMENDED BICYCLE FACILITY TYPES

Bicyclists have the same rights and responsibilities as motorists and are allowed to ride on all roads in Creedmoor. Modifications to roadways in Creedmoor, as well as the addition of off-street pathways, will make bicycling a safer and more viable form of transportation. The key facility types for this plan are shared-lane markings (sharrows), bicycle lanes (with new construction of curb & gutter), paved shoulders, multi-use trails, and bicycle parking. These facilities should be included in all new roadway design in the City of Creedmoor, especially as they are recommended in the Map 3.1 of this Plan. Below are brief descriptions of six types of bicycle facilities recommended in Creedmoor (for more about bicycle facility design, see Appendix A).



Color corresponds to Map 3.1

Bicycle Shared-Lane Markings (Sharrows)

Shared lane markings, or “sharrows,” are placed in a linear pattern along a corridor, typically every 100-250 feet and after intersections. They function in several important ways:

- They make motorists more aware of the potential presence of cyclists;
- Direct cyclists to ride in the proper direction; and
- Remind cyclists to ride further from parked cars to avoid ‘dooring’ collisions.

(see A-3 for more on Sharrows)



Color corresponds to Map 3.1

Bicycle Lanes

A bicycle lane is a portion of the roadway that has been designated by striping, signing, and pavement markings for the preferential and exclusive use of bicyclists. The minimum width for a bicycle lane is four feet; five- and six-foot bicycle lanes are typical for collector and arterial roads. There are some opportunities for bicycle lanes in Creedmoor in the long term when roadways are widened and curb and gutter are added. As a general practice, any local roadway that is widened should incorporate bicycle lanes, with consideration for speed limit reductions.

A key factor in recommending bicycle lanes in this plan was the inclusion of recommendations from the Capitol Area Metropolitan Planning Organization (CAMPO) Transportation Improvement Program (TIP), which specifically calls for bicycle lanes on several roadways in Creedmoor. As noted in Chapter 2, these include:

- US 15 (Hillsboro Street to NC 56) - Sidewalks and bicycle lanes
- Hawley School Rd - Sidewalks and bicycle lanes
- NC 56 E (Wilton) (US 15 to NC 50; NC 50 to Creedmoor Elementary; Creedmoor Elementary to Darden) - Sidewalks and bicycle lanes
- Creedmoor Connector - Bike lanes or wide outside shoulders
- Cash/Gate 2 Roads - Bike accommodations.

(see A-4 for more on Bicycle Lanes)

Color corresponds to Map 3.1



Paved Shoulders Paved shoulders are the part of a roadway which is contiguous and on the same level as the regularly traveled portion of the roadway. There is no minimum width for paved shoulders; however a width of at least four feet is preferred. Ideally, paved shoulders should be included in the construction of new roadways and/or the upgrade of existing roadways, especially where there is a need to more safely accommodate bicycles. Recreational bicycling is very common across this region of the Triangle.

Most rural roadways in their existing configuration, either feature no shoulder or only a 1-2 foot paved shoulder which is not adequate for bicyclists. Roadways in which paved shoulders should be added or widened to a minimum of four feet are shown on Map 3.1. In cases where curb and gutter is added to roadways where paved shoulders are recommended, bicycle lanes should replace paved shoulders. Current two-lane roads that would still benefit from short-term paved shoulder widening include: Joe Peed Road, Church Street, NC 56, US 15, Brassfield Road, NC 50, and Crescent/Moss.
(see A-7 for more on Paved Shoulders)

Color corresponds to Map 3.1



Multi-Use Trails (a.k.a. Greenways) A greenway is defined as a linear corridor of land that can be either natural, such as rivers and streams, or man-made, such as utility corridors or abandoned railroad beds. Many greenways contain trails that can be designed to accommodate a variety of trail users, including bicyclists, walkers, hikers, joggers, skaters, horseback riders, and those confined to wheelchairs (hence, the term 'multi-use trail'). Greenway corridors can also serve environmental purposes, protecting forests and water quality, and offering ample opportunities for environmental education. Greenway trails in Creedmoor should be integrated with and serve as an off-road extension of the on-road bicycle network.



however, for trails that serve the purpose of bicycle transportation, hard surfaces such as asphalt or concrete are recommended. Each trail project will also require close coordination with nearby property owners. Design features such as landscaped screening, fencing, and other treatments should be considered to help ensure privacy where desired.

In order to best serve different types of bicyclists (see page 3-2) multi-use trails located adjacent to roadways (bottom photo above) should not prohibit the provision of adequate on-road bicycle facilities (such as paved shoulders or bicycle lanes). Furthermore, multi-use trails next to roadways are most appropriate in corridors with few driveways and intersections and should be at least 10' wide.

Multi-use trails are the most highly desired facility types identified during this planning process and the pedestrian planning process (2011). This is common across the State of North Carolina and the United

States as a whole, since families and novice bicyclists are most comfortable in an off-road situation. (see Chapter 6 of the City of Creedmoor's Pedestrian Plan for more on Multi-Use Trail Design)



BICYCLE PARKING

This plan recommends adding bicycle racks to destinations throughout the city, including Downtown Creedmoor, at parks, schools, the library, post office, grocery stores, shopping/employment centers, and multi-family housing communities.

Bicycle parking is recommended at the following locations in Creedmoor:

- Downtown (near Southern States and at Main/Church)
- Food Lion shopping center
- South Granville High School
- Hawley Middle School
- Creedmoor Elementary
- Lake Rogers
- Family Fun Center
- Christian Faith Center Academy
- Future development (especially multi-family residential and commercial)

(see A-18 for more on Bicycle Parking)



INVERTED "U"

One rack element supports two bikes.



POST AND LOOP

One rack element supports two bikes.



OVERVIEW

This chapter outlines the implementation priorities, staffing, evaluation, facility development methods, implementation resources, and specific action steps. Table 4.1 summarizes the action steps, along with all other recommendations made throughout the plan, and defines recommended actions, lead & support agencies, and action step phasing.

IMPLEMENTATION PRIORITIES

ADOPT THIS PLAN

Through adoption, this Plan becomes an official planning document of the City. Adoption shows that the City of Creedmoor has undergone a successful, supported planning process. The City can then use this document to improve its chances in receiving funding through NCDOT and other outside resources. The City BOC and Planning Board should become knowledgeable of this Plan and support bicycle-related projects and policies. Finally, this Plan's recommendations should also be integrated into future City of Creedmoor planning documents.

BEGIN BUILDING PROJECTS

Steering Committee input, public input, existing plans, connectivity, and other factors were used to develop the recommended bicycle network (see Chapter 3). These projects should be supported by a combination of grants, local funding, and state funding, and should be constructed in coordination with local development and state transportation projects (see Funding Appendix in Creedmoor's Pedestrian Plan and refer to page 4-5 and 4-6 for facility development methods).

IMPROVE AND ENFORCE BICYCLE-RELATED REGULATIONS.

Regulations should be enforced to ensure that future development provides for bicycle facilities on adopted plans. Some bicycle & pedestrian policy recommendations are provided in detail in Chapter 4 and Appendix D of Creedmoor's Pedestrian Plan. For state roadways (which comprise most of Creedmoor's recommended bicycle network) see the "Complete Streets" policy that was adopted by NCDOT in 2009. The policy directs the Department to consider and incorporate several modes of transportation when building new

projects or making improvements to existing infrastructure. Under the new policy, the Department will collaborate with cities, towns and communities during the planning and design phases of projects. Together, they will decide how to provide the transportation options needed to serve the community and complement the context of the area. The guidance in the updated cross sections establishes design elements that emphasize safety, mobility, and accessibility for multiple modes of travel. For more information, contact the State Roadway Design Engineer, or visit: www.nccompletestreets.org

CREATE A BICYCLE AND PEDESTRIAN ADVOCACY GROUP.

Many communities across the State have committees or groups who advocate for the needs of local bicyclists and pedestrians. The City of Creedmoor should create an advocacy group committee to embrace an advocacy role for bicycle and pedestrian issues. The committee should help coordinate the implementation of this Plan, develop programs, listen to community needs, promote the pedestrian network, and keep positive momentum going. Consider planning board members, City staff, Steering Committee members, and Granville County representatives for advocacy group members.

There are a few optional structures for this group:

- A City-appointed group/committee that reports to the City BOC
- A standalone advocacy group that provides support to the City and community
- A subcommittee of the City Planning Board

The committee can also help monitor the progress of the City and NCDOT as they develop new facilities and programs. This group can assist in researching and applying for trail and bicycle-related construction grants. Coordination with NCDOT, specifically the Division of Bicycle and Pedestrian Transportation and the local Division 5 office, will prove critical if this plan is to be implemented successfully.

TAKE ADVANTAGE OF ALL OPPORTUNITIES.

Some of the most cost-effective opportunities to provide bicycle facilities are during routine roadway construction, reconstruction, and repaving projects. A new commercial development or a roadway widening project, for instance, would provide a good opportunity to add shoulder width or paint shared lane markings as part of an existing effort, potentially saving costs.

SEEK MULTIPLE FUNDING SOURCES AND FACILITY DEVELOPMENT OPTIONS.

Multiple approaches should be taken to support bicycle facility development and programming. It is important to secure the funding necessary to undertake short-term projects but also to develop a long term funding strategy to allow continued development of the overall system. Capital and Powell Bill funds for bicycle facility and greenway construction should be set aside every year, even if only for a small amount (small amounts of local funding can be matched to outside

funding sources). A variety of local, state, and federal options and sources exist and should be pursued. These funding options are described in Appendix B of Creedmoor's Pedestrian Plan. Other methods of bicycle facility development that are efficient and cost-effective are described later in this chapter.

DEVELOP BICYCLE PROGRAMMING.

Programs such as Safe Routes to School can help educate and encourage users. Safe Routes to School offers a number of school workshop opportunities and construction funding for improvements around schools. Public events and media involvement should occur when announcing new walkways and projects. Refer to Chapter 4 of Creedmoor's Pedestrian Plan for a comprehensive list of program ideas.

ENSURE PLANNING EFFORTS ARE INTEGRATED REGIONALLY.

Combining resources and efforts for bicycle planning and trail planning with surrounding municipalities, regional entities, and stakeholders is mutually beneficial to all parties involved. Regional, long-distance trails often spark the most excitement, use, and tourism. The City should remain coordinated with Granville County and neighboring municipalities on regional trail initiatives. It is important to stay aware and communicative with other municipal, county, state, and NCDOT efforts to ensure the City takes advantage of funding opportunities and support. A BPAC member, for example, could have the responsibility of staying in tune and updating the City on regional trail initiatives.

After adoption by the City, the City should ensure that this document is recognized by regional transportation planning agencies, such as NCDOT Division 5, and the MPO. The plan's recommendations should be programmed into the official work schedule and planning of these organizations.

BECOME DESIGNATED AS A BICYCLE FRIENDLY COMMUNITY.

This Bicycle Plan should help to transform Creedmoor into a "Bicycle Friendly Community" (BFC). The Bicycle Friendly Community Campaign is an awards program that recognizes municipalities that actively support bicycling. A Bicycle Friendly Community provides safe accommodation for cycling and encourages its residents to bike for transportation and recreation. The League of American Bicyclists (LAB) administers the Bicycle Friendly Community Campaign and a committee of the LAB reviews and scores the BFC application. An award of platinum, gold, silver or bronze status is designated for a period of four years. The LAB and technical assistance staff continue to work with awardees and those communities that do not yet meet the criteria to encourage continual improvements.

The development and implementation of this Plan is an essential first step in eventually becoming a Bicycle Friendly Community. Having a citizen's board officially dedicated to these issues also helps tremendously. For example, the City of Durham has had a BPAC in place for many years (<http://www.bikewalkdurham.org/>) and they recently received BFC status from the LAB. Even smaller communities,

such as Davidson, NC, and Carrboro, NC, also have BPACs and are among the few communities in NC that are designated as “Bicycle Friendly”. Creedmoor should make progress in accomplishing the goals of this Plan, and then apply for BFC status.

STAFFING

CITY OF CREEDMOOR

The City's Transportation Projects Manager, Planning Director, and City Manager are responsible for leading the implementation of this plan. The City will continue to spearhead initiatives to manifest tangible, on the ground results, based on the recommendations of this plan.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

NCDOT Division 5 maintains the state-owned roads in Creedmoor, affecting the bicycle facilities (or lack thereof) on much of Creedmoor's roadway environment. Recommendations for bicycle facilities on NCDOT roads will have to be carried out through a coordinated effort between the City of Creedmoor and NCDOT Division 5. Some technical assistance could also be provided through NCDOT's Division of Bicycle and Pedestrian Transportation (the City should be proactive in seeking such assistance, and should refer the departments back to this plan whenever possible).

POLICE DEPARTMENT

The Creedmoor Police Department plays a vital role in bicycle safety. All local police officers should be knowledgeable about North Carolina's bicycle laws to promote positive interactions between bicyclists and motorists. The Guide to North Carolina Bicycle and Pedestrian Laws, written by the NCDOT Division of Bicycle and Pedestrian Transportation, should be distributed to local law enforcement. The Police Department should continue to specifically target any know areas of bicycle use and speeding, such as along Main Street.

VOLUNTEERS

For trail development, services from volunteers, students, and seniors, or donations of material and equipment may be provided in-kind, to offset construction and maintenance costs. Formalized maintenance agreements, such as adopt-a-trail/greenway or adopt-a-highway can be used to provide a regulated service agreement with volunteers. Other efforts and projects can be coordinated as needed with senior class projects, scout projects, interested organizations, clubs or a neighborhood's community service to provide for many of the program ideas outlined in Chapter 4 of Creedmoor's Pedestrian Plan. Advantages of utilizing volunteers include reduced or donated planning and construction costs, community pride and personal connections to the City's greenway and pedestrian networks.

PERFORMANCE MEASURES (EVALUATION AND MONITORING)

The City of Creedmoor should establish performance measures to benchmark progress towards implementing this plan. These performance measures should be stated in an official report within two years after the Plan is adopted. Performance measures could address the following aspects of bicycle transportation and recreation in Creedmoor:

- *Safety.* Measures of bicycle crashes and injuries or speeding in the City.
- *Facilities.* Measures of how many bicycle facilities have been funded and constructed since the Plan's adoption.
- *Maintenance.* Measures of existing bicycle facility deficiency or maintenance needs.
- *Education, Encouragement and Enforcement.* Measures of the number of people who have participated in part of a bicycle program since the Plan's adoption.

BICYCLE FACILITY DEVELOPMENT METHODS

This section describes various construction methods for the proposed bicycle facilities outlined in Chapter 3. Note that many types of transportation facility construction and maintenance projects can be used to create new bicycle facilities. It is much more cost-effective to provide bicycle facilities during roadway construction and re-construction projects than to initiate the improvements later as "retrofit" projects.

To take advantage of upcoming opportunities and to incorporate bicycle facilities into routine transportation and utility projects, the City should keep track of NCDOT's projects and any other local transportation improvements. While doing this, staff should be aware of the different procedures for state and local roads and interstates.

NCDOT TRANSPORTATION IMPROVEMENT PROGRAM (TIP)

The Transportation Improvement Program (TIP) is an ongoing program at NCDOT which includes a process asking localities to present their transportation needs to state government. Bicycle facility and safety needs are an important part of this process. Every other year, a series of TIP meetings are scheduled around the state. Following the conclusion of these meetings, all requests are evaluated. Bicycle transportation improvement requests, which meet project selection criteria, are then scheduled into a four-year program as part of the state's long-term transportation program.

There are two types of projects in the TIP: incidental and independent. Incidental projects are those that can be incorporated into a scheduled roadway improvement project. Independent are those that can stand alone such as a greenway, not related to a particular roadway.

The City of Creedmoor, guided by the priority projects within this Plan, should present bicycle projects along State roads to the MPO and State. Local requests for small bicycle projects, such as shared lane markings or signage, can be directed to the MPO or the local NCDOT Division 5 office. Further information, including the criteria evaluated can be found at: www.ncdot.org/transit/bicycle/funding/funding_TIP.html

LOCAL ROADWAY CONSTRUCTION AND RECONSTRUCTION

Bicyclists should be accommodated when a new road is constructed or an existing road is reconstructed. All new roads with moderate to heavy motor vehicle traffic should have bicycle facilities and safe intersections. The City of Creedmoor should take advantage of any upcoming construction projects, including roadway projects outlined in local comprehensive and transportation plans.

RESIDENTIAL AND COMMERCIAL DEVELOPMENT

Construction of bicycle facilities that corresponds with site construction is more cost-effective than retro-fitting, and should be required during development. In commercial development, emphasis should also be focused on bicycle parking and safe bicycle access into, within, and through large parking lots. This ensures the future growth of the bicycle network and the development of safe communities.

RETROFIT ROADWAYS WITH NEW BICYCLE FACILITIES

It may be necessary to add new facilities before a roadway is scheduled to be reconstructed, especially on roadways that are not expected to be modified or improved in the foreseeable future. In some places, it may be relatively easy to add facilities to fill gaps, but other segments may require removing trees, relocating landscaping or fences, re-grading ditches or cut and fill sections.

SIGNAGE AND WAYFINDING PROJECTS

When more bicycle facilities are constructed, the City should consider adding to the current wayfinding signage in Downtown Creedmoor (signage still in design-phase as of summer 2011). A comprehensive style policy and procedure, should be applied throughout the entire community, to make it easier for people to find destinations and to provide consistency for users. For a step-by-step guide to help non-professionals participate in the process of developing and designing a signage system, as well as information on the range of signage types, visit the Project for Public Places website: www.pps.org/info/amenities_bb/signage_guide

EXISTING CITY EASEMENTS

The City may have several existing easements offering an opportunity for greenway facilities. Sewer easements are very commonly used for this purpose; offering cleared and graded corridors that easily accommodate trails. This approach avoids some of the difficulties associated with acquiring land, and it utilizes the City's existing resources. Refer to Appendix C of the Creedmoor Pedestrian Plan for an example sewer-greenway trail easement that could be adapted for Creedmoor to use when pursuing updates to older easements.

GREENWAY ACQUISITION

Since not all greenways can be built on existing City easements, land acquisition is an important component of greenway development. It will be necessary to work with landowners and future development projects. For more on this topic please refer to the City of Creedmoor's Pedestrian Transportation Plan (Chapter 5: Implementation and Appendix C).

IMPLEMENTATION RESOURCES

BICYCLE PLAN APPENDIX A: DESIGN RESOURCES

This toolbox provides design guidelines for bicycle facilities that are used in various locations across the United States. These guidelines can be used to determine a comprehensive bike network throughout Creedmoor, while still providing for flexibility on a project by-project basis. For pedestrian and trail-related facilities, please refer to Chapter 6 of Creedmoor's 2011 Pedestrian Transportation Plan.

PROGRAM, POLICY, TRAIL DEVELOPMENT, AND FUNDING RESOURCES

See the appendices included in Creedmoor's 2011 Pedestrian Transportation Plan for more on related programs and policies, as well as strategies for land acquisition in trail development and potential funding resources for bicycle, pedestrian, and trail development.

PLANNING-LEVEL BUDGET ESTIMATES FOR BICYCLE FACILITIES

The following per-costs can be used to develop planning-level budget estimates for individual projects:

- *Shared-Lane Markings*: \$300/Shared Lane Sign and \$155/Sharrow Marking - typically placed after intersections and about every 250 feet between intersections.
- *Bicycle Lanes*: \$0.70/LF for single thermoplastic white lines (\$0.07/LF for painted lines). \$300/Bicycle Lane Sign and \$155/Bicycle Lane Marking - typically placed after major intersections and incrementally between intersections, based on engineering judgement. If roadway width needs to be added to create the bicycle lanes, add shoulder costs below.
- *Paved Shoulders*: \$75/LF for adding paved shoulders to an existing roadway.
- *Multi-Use Trails (Greenway)*: \$55/LF for typical 10-foot wide paved multi-use trails.

Budget estimates for shared-lane markings, bicycle lanes, and paved shoulders were provided by NCDOT. The multi-use trail cost of \$55/LF is based on 2011 project examples from communities in North Carolina.

ACTION STEPS TABLE

TABLE 4.1 POLICY, PROGRAM, AND ADMINISTRATIVE ACTION STEPS TABLE

Task	Lead Agency	Support	Details	Phase
Present Plan to City BOC	Project Consultants	Planning & Transportation Staff	Presentation to City BOC in Fall 2011	Fall 2011
Adopt this plan	City BOC	Planning & Transportation Staff, Project Consultants	Through adoption, the Plan becomes an official planning document of the City. Adoption shows that the City of Creedmoor has undergone a successful, supported planning process.	Fall 2011
Designate Staff	City BOC & City Manager	Leadership of City Departments	Designate staff to oversee the implementation of this plan and the proper maintenance of the facilities that are developed. It is recommended that a combination of existing Planning, Transportation, and Engineering Staff oversee the day-to-day implementation of this plan.	Fall 2011
Create a Bicycle and Pedestrian Advisory Committee (BPAC)	City BOC	Planning & Transportation Staff	The committee should help coordinate the implementation of this Plan, develop programs, listen to community needs, promote the pedestrian network, and keep positive momentum going.	Fall 2011
Begin Semi-annual Meeting With Key Project Partners	Planning & Transportation Staff	City Departments, NCDOT, BPAC, and local & regional stakeholders	Key project partners should meet on a semi-annual basis to evaluate the implementation of this Plan. Meetings could also occasionally include on-site tours of locations where facilities are recommended. CAMPO meetings could also serve as an opportunity to coordinate.	Ongoing/ Beginning Winter 2011- 2012
Seek Multiple Funding Sources and Begin Facility Development	Planning & Transportation Staff	Finance Director, BPAC	Chapter 3 contains recommended projects. See 4-1 and 4-5 for facility development options. See Appendix B of the Creedmoor Pedestrian Plan for potential funding opportunities.	Ongoing/ Beginning Winter 2011- 2012
Develop Bicycle Facility and Trail Specifications	Engineering Staff	Planning & Transportation Staff	City staff could prepare these in-house to save resources using the design resources of this plan as a starting point. Specifically, the resources listed on A-20 will be very useful in drafting such documents.	Ongoing/ Beginning Winter 2011- 2012
Launch Programs as New Projects are Built	BPAC	Planning & Transportation Staff	Assist in the coordination of education and encouragement programs, such as Bicycle Rodeos.	Short-Term (2012)
Provide police officers with educational material to hand out with warnings	Police Department	NCDOT Bike/Ped Division	Provide officers with an informational handout to be used during bicycle and pedestrian-related citations and warnings.	Short-Term (2012)
Present this Plan to other local and regional bodies and agencies.	Planning & Transportation Staff	BPAC	This Plan should be presented to other local and regional bodies and agencies. Possible groups to receive a presentation might include: the regional transportation and greenway planners, health clubs and fitness facilities, schools and youth organizations, environmental clubs, civic organizations, chambers of commerce, and large neighborhood groups.	Short-Term (2012)
Develop a long term funding strategy	City Manager & Finance Director	Planning & Transportation Staff & City BOC	To allow continued development of the overall system, capital and Powell Bill funds for bicycle facility construction should be set aside every year, even if only for a small amount (small amounts of local funding can be matched to outside funding sources). Funding for an ongoing maintenance program should also be included in the City's operating budget.	Short-Term (2012)

Task	Lead Agency	Support	Details	Phase
Notify City Planning & Transportation staff of all upcoming roadway reconstruction or resurfacing/restriping projects, no later than the design phase.	Public Works Director, and NCDOT Division 5	Planning & Transportation Staff, NCDOT Bike/Ped Division, NCDOT Granville County Maintenance Engineer,	Provide sufficient time for comments; Incorporate pedestrian recommendations from this Plan. If a compromise to the original recommendation is needed, then contact NCDOT Division of Bicycle and Pedestrian Transportation for guidance on appropriate alternatives. Also, coordinate with the NCDOT Granville County Maintenance Engineer, on the Annual Resurfacing Plan’s 3-year project list.	Ongoing/ Beginning Fall 2011
Explore possibility of a regional multi-modal coordinator	City Manager	Planning & Transportation Staff, BPAC, regional planning organizations, and neighboring municipalities	Explore the possibility of partnership with neighboring municipalities in hiring a regional Multi-Modal Transportation Coordinator	Short-Term (2012)
Ensure planning efforts are being integrated regionally	Planning & Transportation Staff	Regional planning organizations, neighboring municipalities, BPAC	Combining resources and efforts with surrounding municipalities, regional entities, and stakeholders is mutually beneficial, especially with trail development. Communicate and coordinate with the regional partners on regional trails and bicycle facilities; partner for joint-funding opportunities. After adoption by the City, this document should also be recognized in regional transportation plans.	Short-Term (2012)
Apply for further Safe Routes to School Grants and Infrastructure Funding	Planning & Transportation Staff	NCDOT Division 5 & BPAC	Establish ‘bike-to-school’ groups, ‘walking school buses’ or other similar activities for children through the Safe Routes to School Program. Inquire about pedestrian infrastructure funding for projects within 1.5 miles of schools through NCDOT Division 5.	Short-Term (2012)
Policy Orientation	All Stakeholders	NCDOT Bike/Ped Division	Become familiar with State and Federal bicycle and pedestrian policies (refer to Appendix D of Creedmoor’s Pedestrian Plan, which also contains bicycle policies).	Short-Term (2012)
Design Orientation	Public Works and NCDOT Division 5	NCDOT Bike/Ped Division	Become familiar with the guidelines featured in Appendix A of this Plan, as well as state and national standards for bicycle facility design.	Short-Term (2012)
Become familiar with the bicycle facility recommendations for NCDOT roadways in this Plan (Chapter 3); take initiative in incorporating this plan’s recommendations into the Division’s schedule of improvements.	NCDOT Division 5	Planning & Transportation Staff, NCDOT Bike/Ped Division	Construct and maintain pedestrian facilities using the highest standards allowed by the State (including the possibility of using innovative treatments on a trial-basis). Seek guidance and direction from the NCDOT Division of Bicycle and Pedestrian Transportation on issues related to this Plan and its implementation.	Ongoing

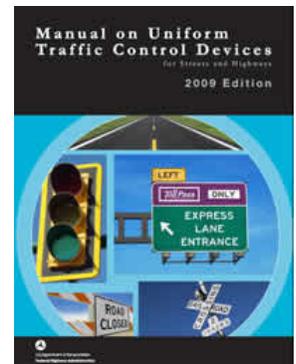
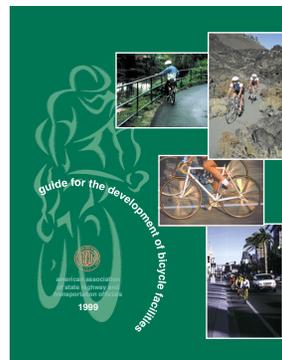
Task	Lead Agency	Support	Details	Phase
If the City determines that there are streets where speeds need to be lowered for safety purposes, contact NCDOT to lower them.	City BOC	Planning & Transportation Staff, NCDOT Division 5, NCDOT Bike/Ped Division, BPAC	The authority to lower speeds is set out in NC General Statute 20-141(f) - Whenever local authorities within their respective jurisdictions determine upon the basis of an engineering and traffic investigation that a higher maximum speed than those set forth in subsection (b) is reasonable and safe, or that any speed hereinbefore set forth is greater than is reasonable and safe, under the conditions found to exist upon any part of a street within the corporate limits of a municipality and which street is a part of the State highway system (except those highways designated as part of the interstate highway system or other controlled access highway) said local authorities shall determine and declare a safe and reasonable speed limit. A speed limit set pursuant to this subsection may not exceed 55 miles per hour. Limits set pursuant to this subsection shall become effective when the Department of Transportation has passed a concurring ordinance and signs are erected giving notice of the authorized speed limit.	Ongoing
Create a user-friendly walking and bicycling map for the City of Creedmoor	GIS/ Planning & Transportation Staff	BPAC, local businesses (to sponsor design & printing costs)	Once more facilities are in place, produce and distribute the user-friendly walking and bicycling map of Creedmoor. Provide basic safety information, commuting information, trail etiquette, transit information (if and when transit is available), and a list of local resources on the back side of the map.	Mid-Term (2013)
Offer Training for Enforcement	Police Department	BPAC, National Highway Traffic Safety Administration (NHTSA) or Association of Pedestrian and Bicycle Professionals (APBP)	Training for Creedmoor's officers could be done through free online resources, such as APBP webinars. If the City is able to find and secure grants for education, they could also seek instructor-led courses offered by the NHTSA or groups such as the League of American Bicyclists (LAB).	Mid-Term (2013)
Become Designated as a Bicycle Friendly Community	Planning & Transportation Staff	BPAC	Creedmoor should make progress in accomplishing the goals of this Plan, and then apply for Bicycle Friendly Community status. See www.bikeleague.org/programs/bicyclefriendlyamerica/communities/ for more information.	Long-Term (2014)
Attend a bicycle planning and design training session	Planning, Transportation, and/or Engineering Staff	BPAC	Sponsor at least one city staff member to attend a bicycle and pedestrian planning and design training session. NCDOT, in partnership with the Institute for Transportation Research and Education (ITRE), offers pedestrian planning and design workshops for practicing professionals. Free or inexpensive webinars are also available online through such groups as the Association of Pedestrian and Bicycle Professionals (APBP).	Opportunity-Based



OVERVIEW

This appendix provides design guidelines for bicycle-related facilities that are used in various locations across the United States. The guidelines should be used with the understanding that design adjustments will be necessary in certain situations in order to achieve the best results. Facility installation and improvements should be evaluated on a case-by-case basis, in consultation with local or state bicycle coordinators, and/or a qualified engineer and landscape architect. Some new treatments may require formal applications to the North Carolina Department of Transportation (NCDOT) and the Federal Highway Administration (FHWA) for approval as experimental uses. On facilities maintained by NCDOT, the State's design guidelines will apply. Creedmoor has the potential to exceed minimum guidelines where conditions warrant (within their jurisdiction).

These resources (and those listed on A-20) can be consulted for more information on design standards.

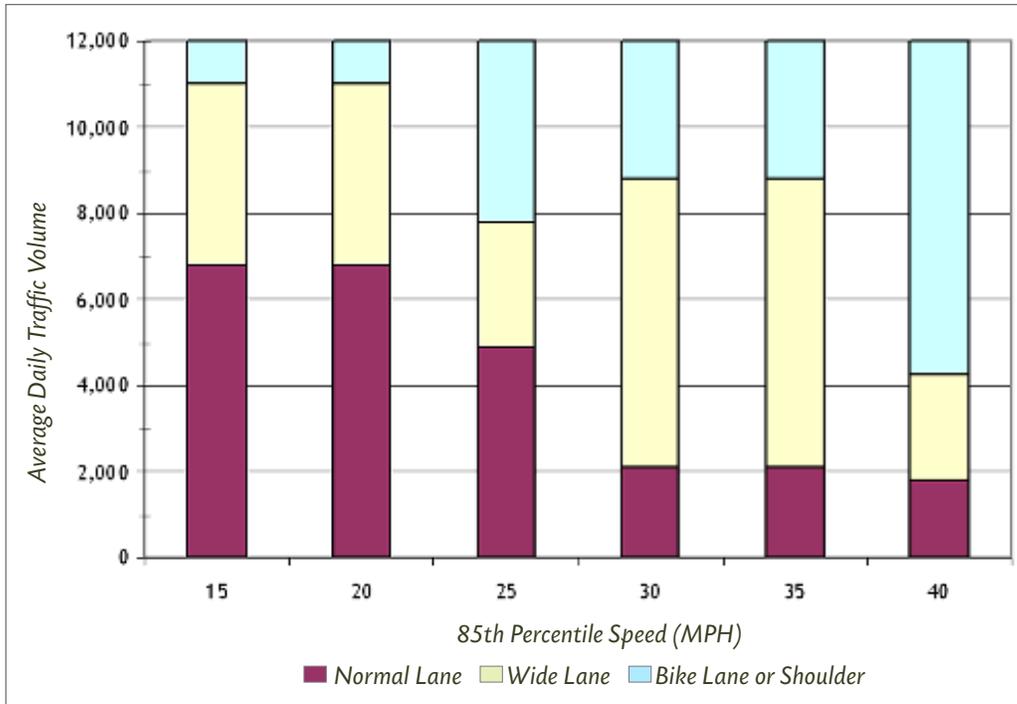


Pedestrian and Bicycle Information Center

BICYCLE FACILITIES AND RELATED STREETScape IMPROVEMENTS

A wide variety of on-road bicycle facilities are recommended to meet different transportation needs in different roadway situations. The appropriate bicycle facility for any particular roadway, whether new or existing, should be dictated primarily by vehicle volume and speed of the roadway. The figure below provides a matrix for evaluating bicycle facilities. The speed of the travel lane is shown along the x-axis and total traffic volumes per day are shown along the y-axis. The different colors represent the type of bikeway facility prescribed given the volume and speed of the travel lane. This chart represents a broad guideline, rather than a hard standard.

NORTH AMERICAN SPEED-VOLUME CHART



Source: M. King: *Bicycle Facility Selection: A Comparison of Approaches*

NEIGHBORHOOD STREETS

Many bicyclists can safely share the road with vehicles on low volume (less than 3,000 cars per day), low speed roadways (e.g., a residential or neighborhood street).



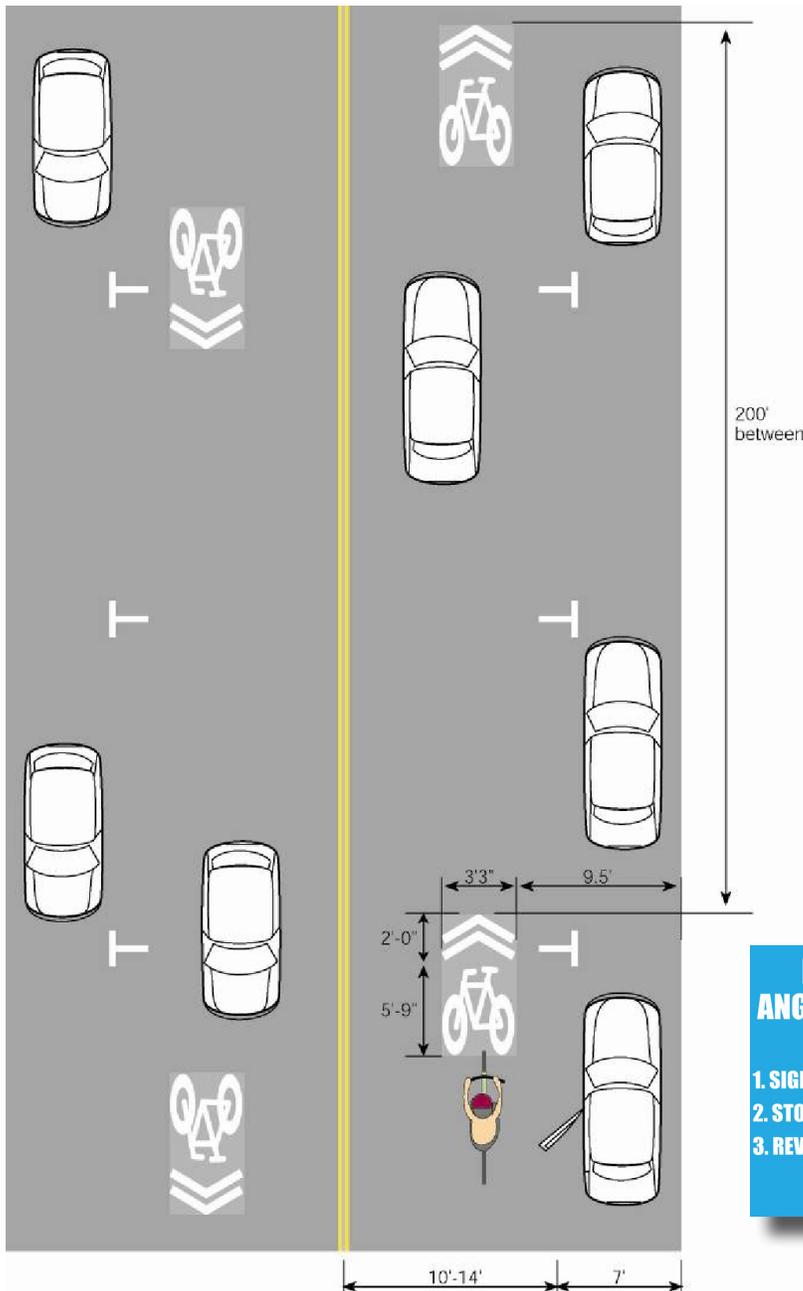
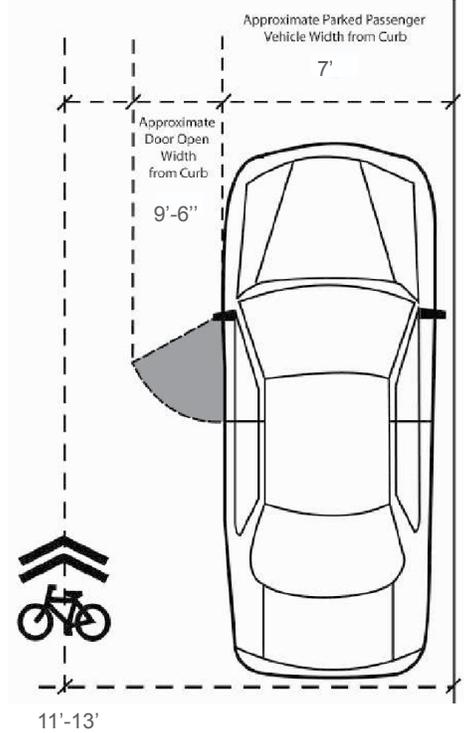
Left: Neighborhood street examples.

SHARED LANE MARKING

A bicycle shared lane marking (or 'sharrow') can serve a number of purposes, such as making motorists aware of bicycles potentially traveling in their lane, showing bicyclists the appropriate direction of travel, and, with proper placement, reminding bicyclists to bike further from parked cars to prevent "dooring" collisions. The shared lane marking stencil is used:

- Where lanes are too narrow for striping bike lanes
- Where the speed limit does not exceed 35 MPH
- With or without on-street parking (with on-street parking, the center of the sharrow should be placed a minimum of 11 feet from the curb face; without on-street parking, the center of the sharrow shall be placed 4 feet from the curb face or edge of pavement)

Cities throughout the United States have effectively used this treatment for many years; it is now officially part of the 2009 Manual for Uniform Traffic Control Devices (MUTCD). Additional guidance will also be available in the update of the AASHTO Bike Guide.



SHARROWS WITH BACK-IN ANGLE PARKING

Back-in/head-out diagonal parking and conventional head-in/back-out diagonal parking have common dimensions, but the back-in/headout is superior for safety reasons due to better visibility when leaving. This is particularly important on busy streets or where drivers find their views blocked by large vehicles, tinted windows, etc. (drivers do not back blindly into an active traffic lane). Furthermore, with back-in/head-out parking, drivers can see bicyclists as they prepare to pull out.

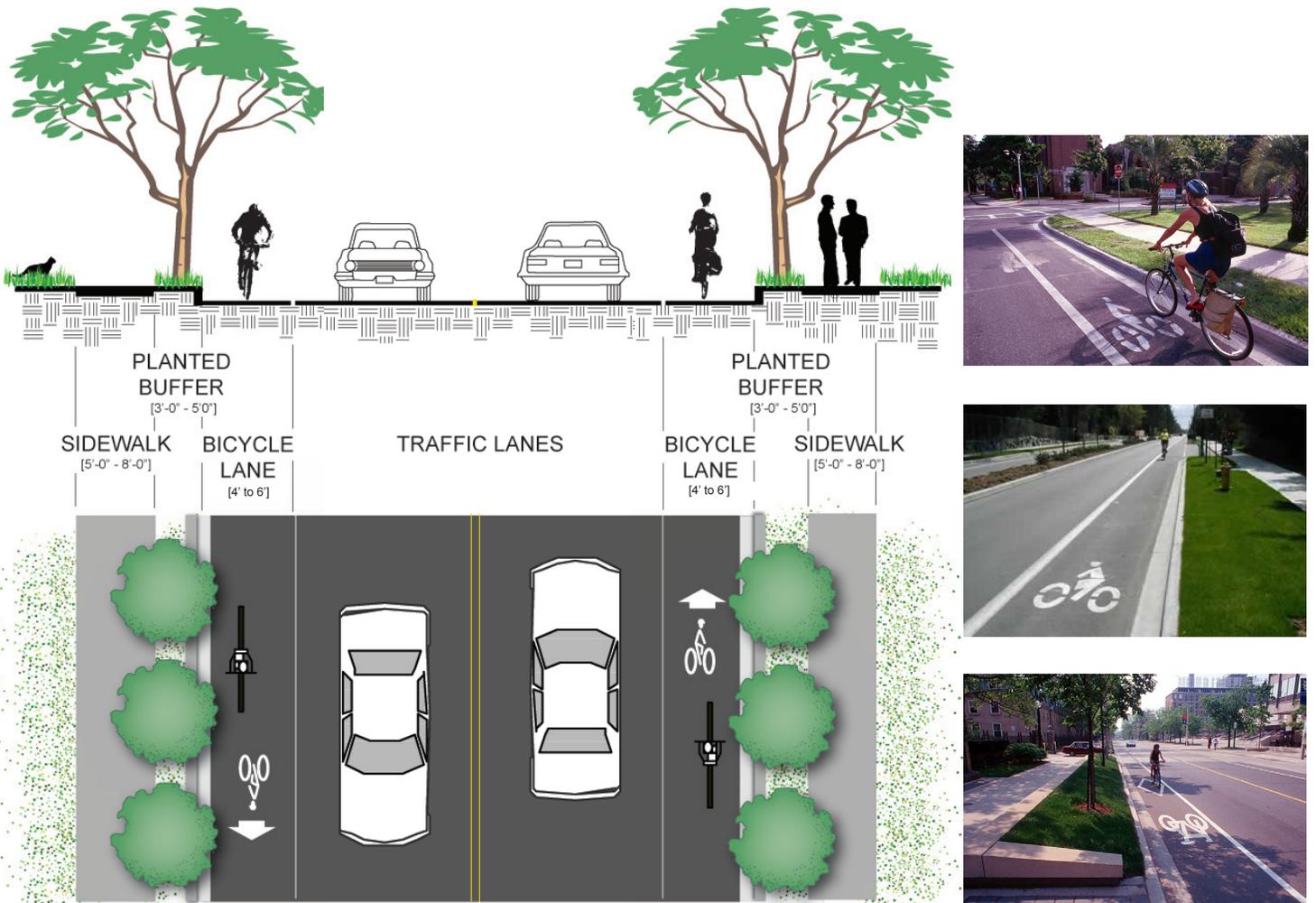
See the "Back-in/Head-out Angle Parking" study by Nelson\Nygaard Consulting Associates for more information: www.bicyclinginfo.org/library/details.cfm?id=4413



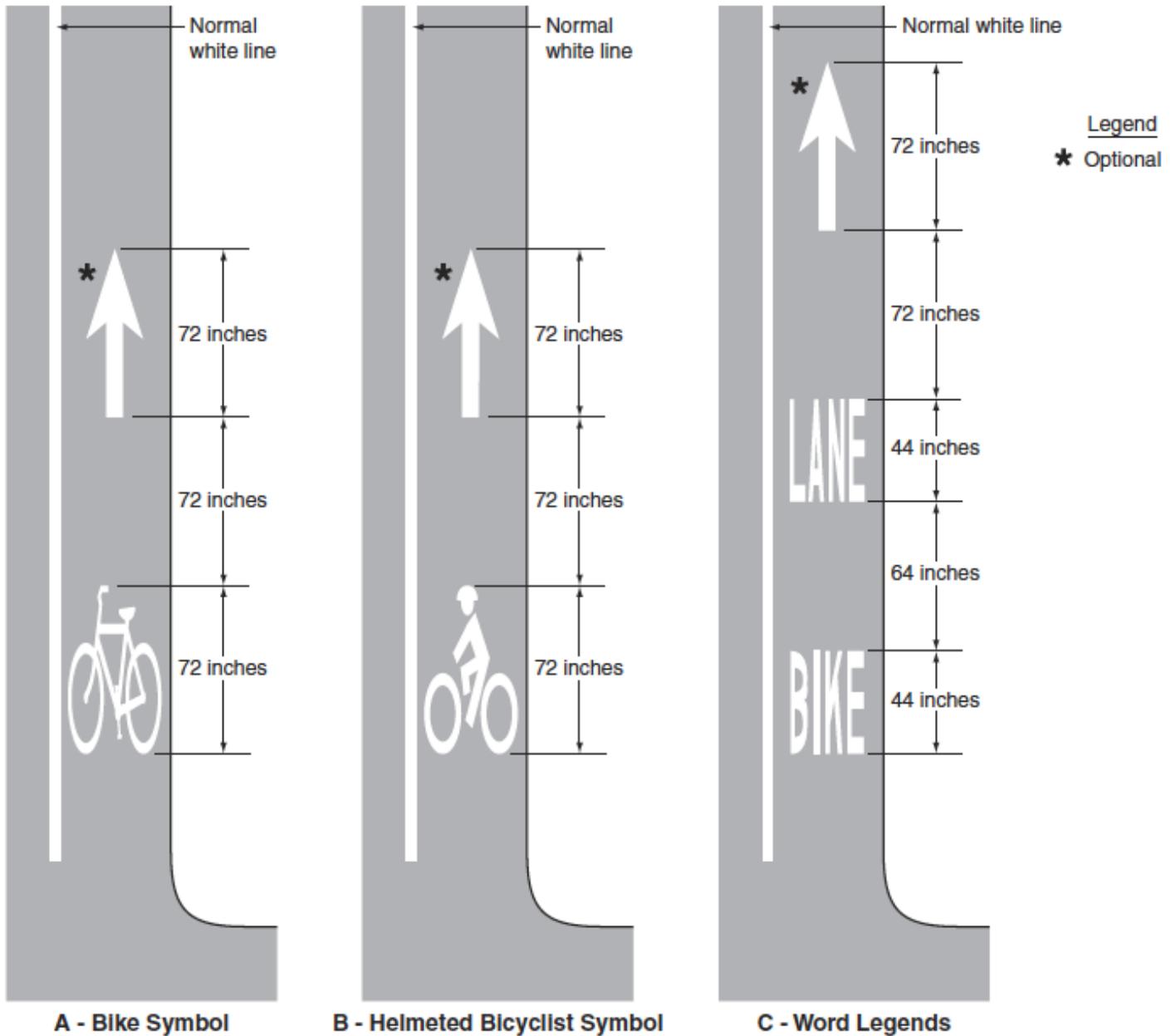
BICYCLE LANES

A bicycle lane is a portion of the roadway that has been designated by striping, signing, and pavement markings for the preferential and exclusive use of bicyclists. Bicycle lanes are located on both sides of the road, except one way streets, and carry bicyclists in the same direction as adjacent motor vehicle traffic. In some communities, local cyclists may prefer to use striped shoulders as an alternative to bicycle lanes (see guidelines for 'Striped/Paved Shoulders').

- Recommended bicycle lane width: 6' from the curb face when a gutter pan is present (or 4' from the edge of the gutter pan); 4' from the curb face when no gutter pan is present.
- As speed and volume increase, greater width is preferred. Per the AASHTO Guidebook, page 23, a width of 5 feet or greater is preferable and additional widths as desirable where substantive truck traffic is present, or where motor vehicle speeds exceed 50 mph.
- Should be used on roadways with average daily traffic (ADT) counts of 3,000 or more
- Not suitable where there are a high number of commercial driveways
- Suitable for 2-lane facilities and 4-lane divided facilities



Below: 2009 MUTCD examples of word, symbol, and pavement markings for bicycle lanes.



COLORIZED BIKE LANES

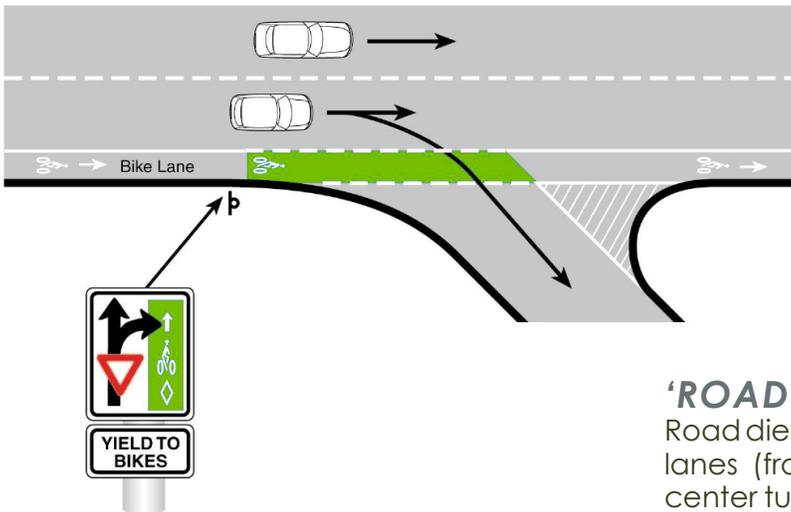
In addition to markings presented in the MUTCD, the following experimental pavement markings may be considered. Colored pavement is used for bicycle lanes in areas that tend to have a higher likelihood for vehicle conflicts. Examples of such locations are freeway on- and off-ramps and where a motorist may cross a bicycle lane to move into a right turn pocket. In the United States, the City of Portland and New York City have colorized bike lanes and supportive signing with favorable results. Studies after implementation showed more motorists slowing or stopping at colored lanes and more motorists using their turn signals near colored lanes. Green is the recommended color (some cities that have used blue are changing to green, since blue is associated with handicapped facilities).

Below: Henry Street in Brooklyn, NY.



Consideration:

- Colorized bike lanes are not currently included in the MUTCD but there are provisions for jurisdictions to request permission to experiment with innovative treatments (and thus with successful application, future inclusion of colorized bike lanes in the MUTCD could occur).



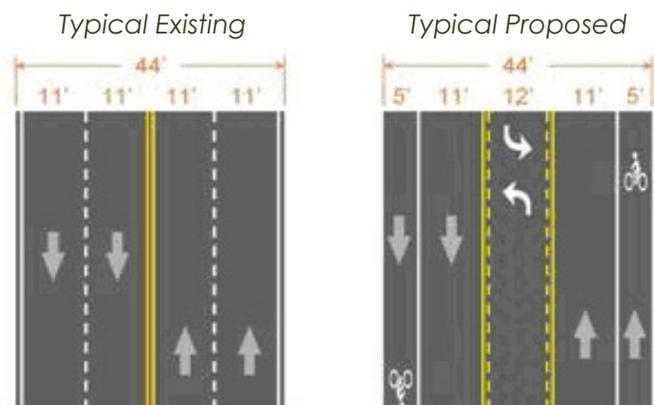
Left: colorized bicycle lane application at a potential conflict area.

BIKE LANES WITH ON-STREET PARKING

Where on-street parking is permitted, and a bike lane is provided, the bike lane must be between parking and the travel lane. Appropriate space must be allocated to allow passing cyclists room to avoid open car doors. The distance between the curb face and the outer marking of the bicycle lane is typically 13 to 15 feet (parking stall of 8 to 10 feet and bike lane of 5 feet).

'ROAD DIETS' FOR BICYCLE LANES

Road diets typically involve reducing the number of travel lanes (from a four-lane road to a two-lane road with center turn lane, for example) allowing adequate space for bicycle lanes. These are generally recommended only in situations where the vehicular traffic count can be safely and efficiently accommodated with a reduced number of travel lanes. Study may be necessary for recommended road diets to ensure that capacity and level-of-service needs are balanced against bicycle level of service needs.



STRIPED/PAVED SHOULDER

Paved shoulders are the part of a roadway which is contiguous and on the same level as the regularly traveled portion of the roadway. There is no minimum width for paved shoulders, however a width of at least four feet is preferred. Ideally, paved shoulders should be included in the construction of new roadways and/or the upgrade of existing roadways, especially where there is a need to more safely accommodate bicycles.

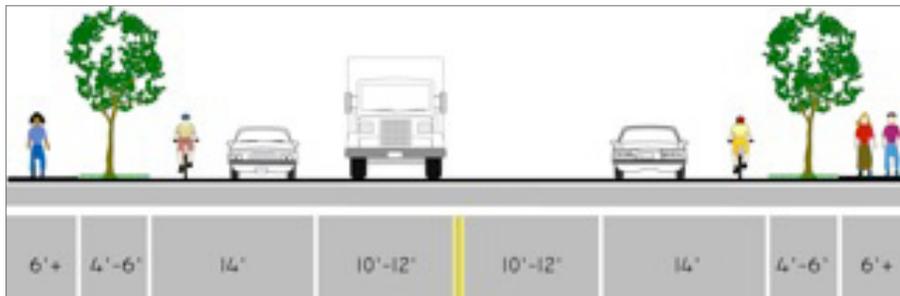
- Most often used in rural environments, although not confined to any particular setting
- Should be delineated by a solid white line, and provided on both sides of the road
- Should be contiguous and on the same level as the regularly traveled portion of the roadway
- 4' minimum width; however, if site conditions are constrained, then the option of a smaller shoulder should be weighed against simply having a wider outside lane.
- For roads with speeds higher than 40 MPH with high ADT, a shoulder width of more than 4' is recommended.
- Rumble strips should be avoided, but if used, then a width of more than 4' is needed.
- Paved shoulders should not be so wide as to be confused with a full automobile travel lane.



WIDE OUTSIDE LANES

Even without a bicycle facility or marking, the conditions for bicycling are improved when the outside travel lane in either direction is widened to provide enough roadway space so that bicyclists and motor vehicles can share the roadway without putting either in danger (e.g., higher volume roadways with wide (14') outside lanes). For outside lanes wider than 14', striping a bicycle lane should be considered.

Below: Wide Outside Lane on a Typical Two Lane Roadway



BICYCLE BOULEVARDS

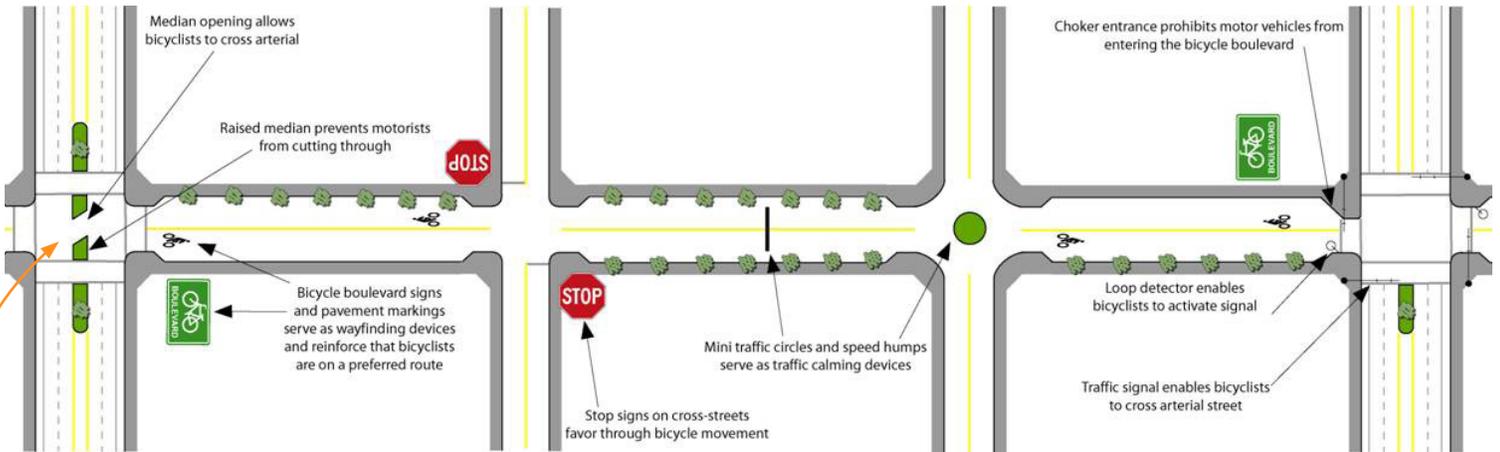
To further identify preferred routes for bicyclists, the operation of lower volume roadways may be modified to function as a through street for bicycles while maintaining local access for automobiles. Traffic calming devices reduce traffic speeds and through trips while limiting conflicts between motorists and bicyclists, as well as give priority to through bicycle movement.

For a complete overview, see www.ibpi.usp.pdx.edu/guidebook.php



Above: Bike boulevard pavement markings and choker entrance.

Below: A bicycle boulevard.



Bikeway planners and engineers may pick and choose the appropriate mix of design elements needed for bicycle boulevard development along a particular corridor. Mix and match design elements to:

- Reduce or maintain low motor vehicle volumes;
- Reduce or maintain low motor vehicle speeds;
- Create a logical, direct, and continuous route;
- Create access to desired destinations ;
- Create comfortable and safe intersection crossings;
- Reduce cyclist delay.

Image and text source: *Fundamentals of Bicycle Boulevard Planning and Design*, www.ibpi.usp.pdx.edu/guidebook.php

BICYCLE FACILITIES AT INTERSECTIONS

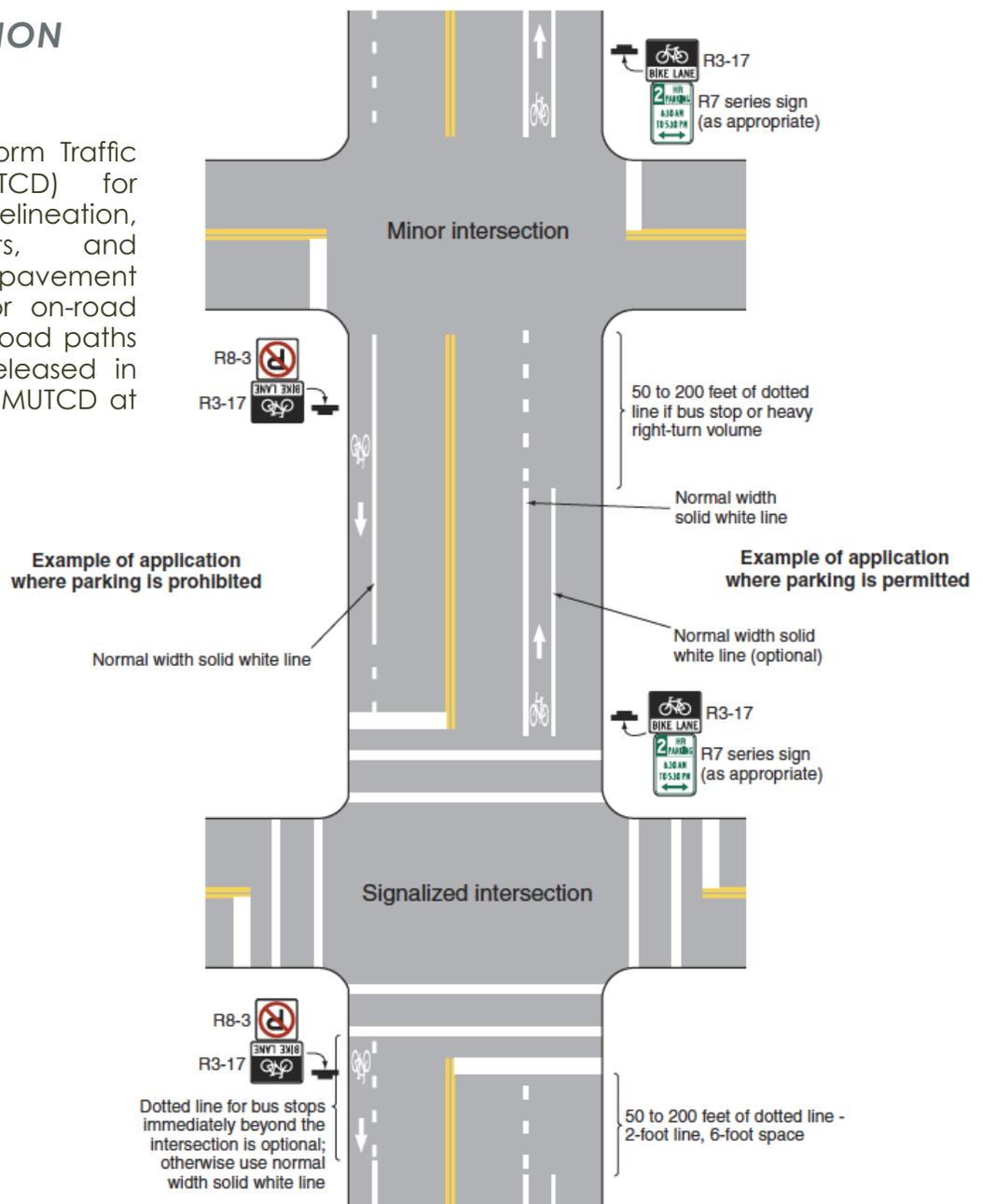
Intersections represent one of the primary collision points for bicyclists, with many factors involved:

- Larger intersections are more difficult for bicyclists to cross.
- On-coming vehicles from multiple directions and increased turning movements make it more difficult for motorists to notice non-motorized travelers.
- Most intersections do not provide a designated place for bicyclists.
- Loop and other traffic signal detectors, such as video, often do not detect bicycles.
- Bicyclists making a left turn must either cross travel lanes to a left-turn lane, or dismount and cross as a pedestrian.
- Bicyclists traveling straight may have difficulty maneuvering from the far right lane, across a right turn lane, to a through lane of travel.

Solutions to some these issues are illustrated below and in the following pages, including intersection configurations for bicycle lanes, pega-tracking, signage, and bicycle-activated detector loops.

TYPICAL INTERSECTION CONFIGURATION FOR BIKE LANES

See the Manual on Uniform Traffic Control Devices (MUTCD) for guidance on lane delineation, intersection treatments, and general application of pavement wording and symbols for on-road bicycle facilities and off-road paths (updated version was released in 2009); example from the MUTCD at right.



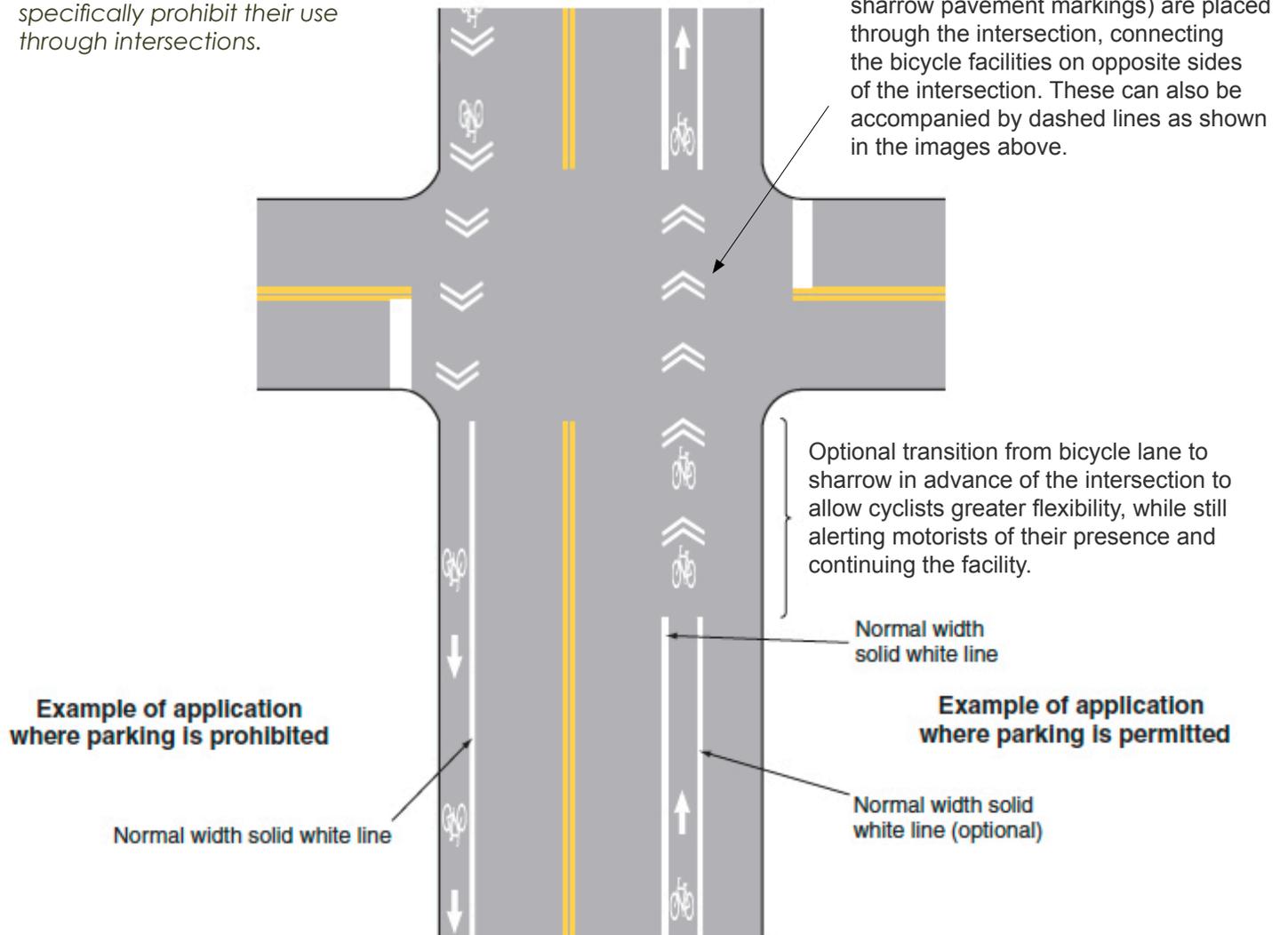
PEGA-TRACKING FOR BIKE LANES & SHARROWS AT INTERSECTIONS

Pega-tracking is a type of pavement marking that connects bicycle facilities on opposite sides of the intersection, placed along the desired path for bicyclists. This use of the sharrow marking carries the bicycle facility through the intersection, rather than entirely 'dropping' the facility before the intersection. This treatment is being used in major cities throughout North America.



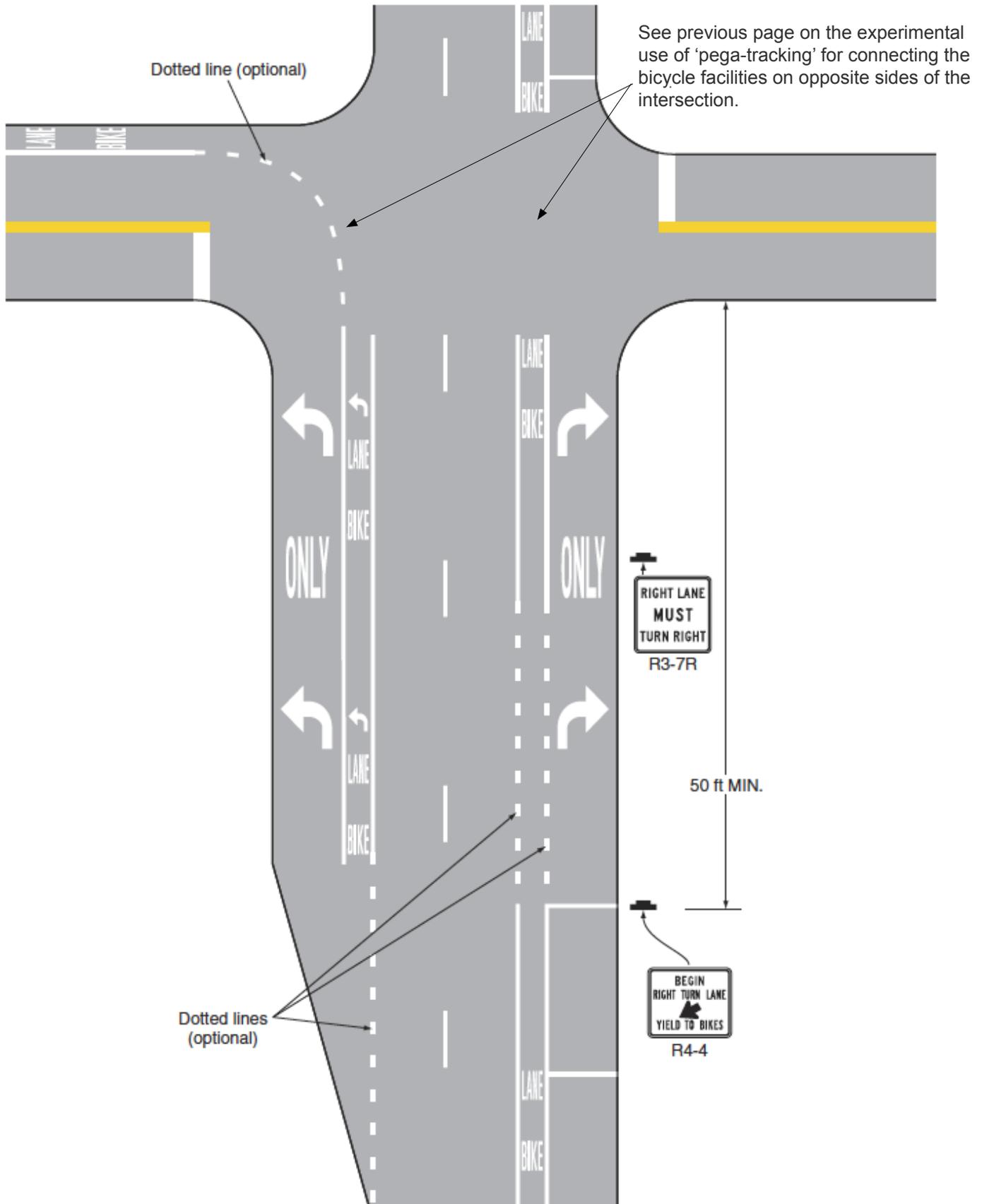
Sharrows are included in 2009 MUTCD, which does not specifically prohibit their use through intersections.

Chevrons (similar to those used in sharrow pavement markings) are placed through the intersection, connecting the bicycle facilities on opposite sides of the intersection. These can also be accompanied by dashed lines as shown in the images above.



EXAMPLE OF INTERSECTION PAVEMENT MARKING - DESIGNATED BICYCLE LANE WITH LEFT-TURN AREA, HEAVY TURN VOLUMES, PARKING, ONE-WAY TRAFFIC, OR DIVIDED HIGHWAY

(Image below from the 2009 MUTCD, Figure 9C-1).

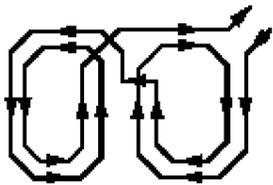
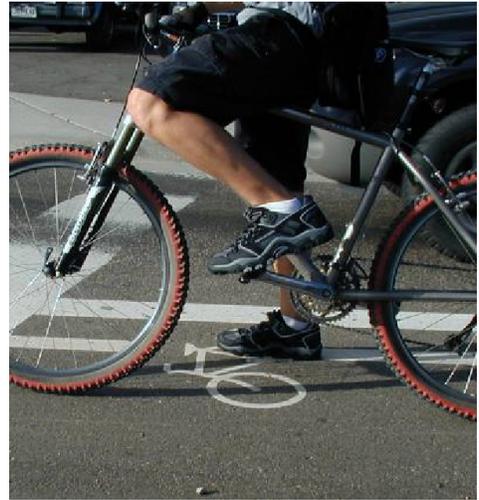


See previous page on the experimental use of 'pega-tracking' for connecting the bicycle facilities on opposite sides of the intersection.

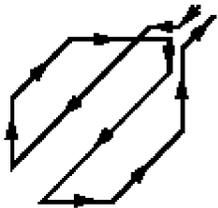
BICYCLE-ACTIVATED DETECTOR LOOP

Changing how intersections operate can help make them more “friendly” to bicyclists. Improved traffic signal timing for bicyclists, bicycle-activated loop detectors, and camera detection make it easier and safer for cyclists to cross intersections. Bicycle-activated loop detectors are installed within the roadway to allow the weight of a bicycle to trigger a change in the traffic signal. This allows the cyclist to stay within the lane of travel and avoid maneuvering to the side of the road to trigger a push button, which ultimately provides extra green time before the light turns yellow to make it through the light. Current and future loops that are sensitive enough to detect bicycles should have pavement markings to instruct cyclists on how to trip them. These common loop detector types are recommended:

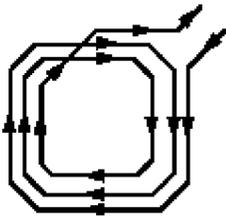
Use pavement marking to aid bicyclists in locating loop detectors at intersections.



- Quadruple Loop**
(Recommended for bike lanes)
- Detects most strongly in center
 - Sharp cut-off sensitivity

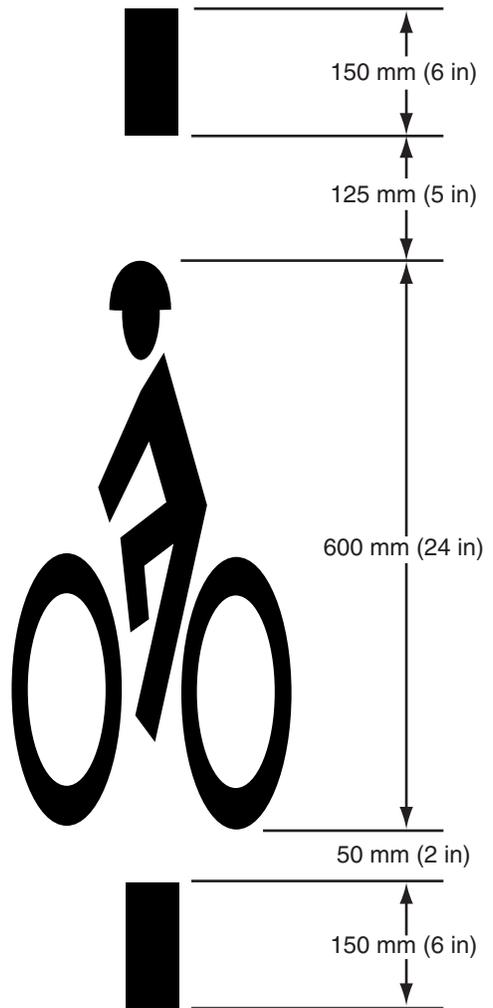


- Diagonal Quadruple Loop**
(Recommended for shared lanes)
- Sensitive over whole area
 - Sharp cut-off sensitivity



- Standard Loop**
(Recommended for advanced detection)
- Detects most strongly over wires
 - Gradual cut-off

(See: Implementing Bicycle Improvements at the Local Level, FHWA, 1998, p. 70)



BIKE BOX / ADVANCE STOP LINE

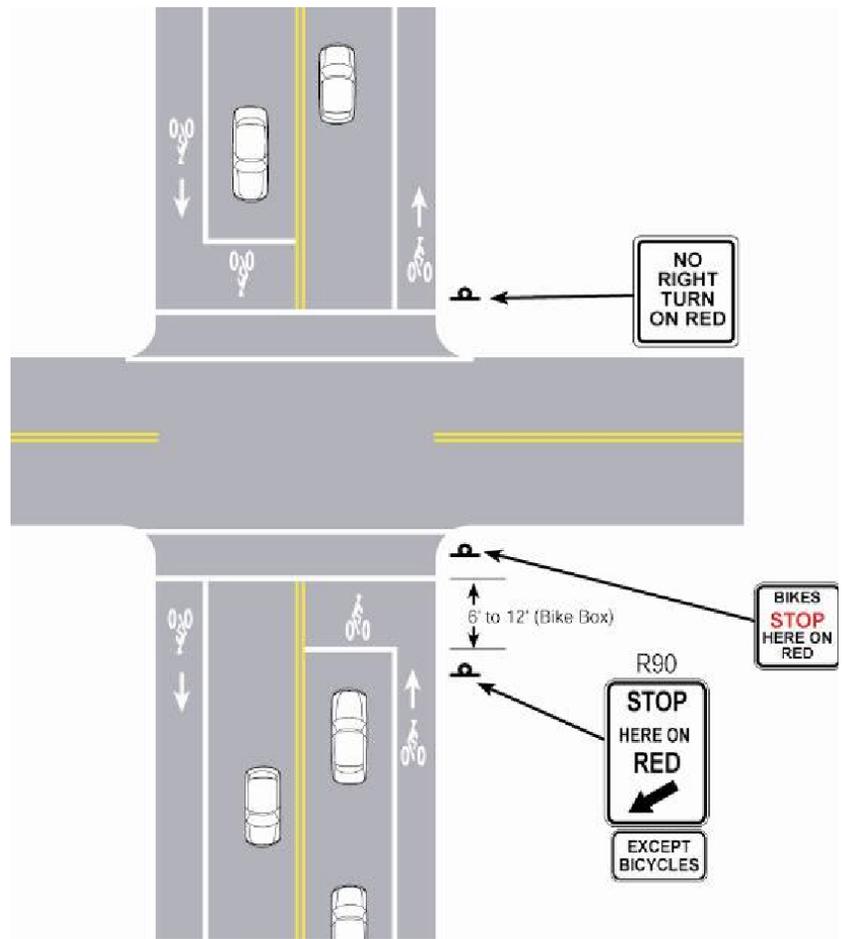
A bike box is a relatively simple innovation to improve turning movements for bicyclists without requiring cyclists to merge into traffic to reach the turn lane or use crosswalks as a pedestrian. The bike box is formed by pulling the stop line for vehicles back from the intersection, and adding a stop line for bicyclists immediately behind the crosswalk. When a traffic signal is red, bicyclists can move into this “box” ahead of the cars to make themselves more visible, or to move into a more comfortable position to make a turn. Bike boxes have been used in Cambridge, MA; Eugene, OR; and European cities.

Potential Applications:

- At intersections with a high volume of bicycles and motor vehicles
- Where there are frequent turning conflict and/or intersections with a high percentage of turning movements by both bicyclists and motorists
- At intersections with no right turn on red (RTOR)
- At intersections with high bicycle crash rates
- On roads with bicycle lanes
- Can be combined with a bicycle signal (optional)

Considerations:

- Bike boxes are not currently included in the MUTCD but there are provisions for jurisdictions to request permission to experiment with innovative treatments (and thus with successful application, future inclusion of bike boxes in the MUTCD could occur).
- If a signal turns green as a cyclist is approaching an intersection, they should not use the bike box.
- Motorists will need to be educated to not encroach into the bike box.



Plan view of a bike box.



Above and below: Bike boxes filled in with color to emphasize allocation of space to bicycle traffic.



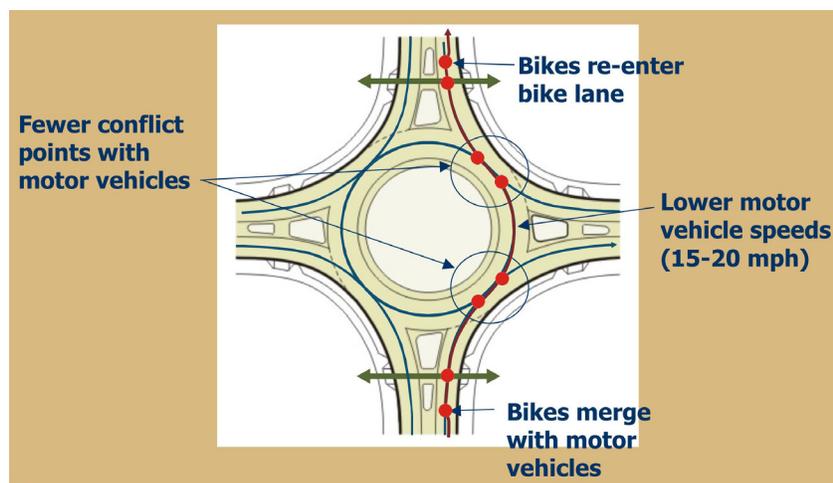
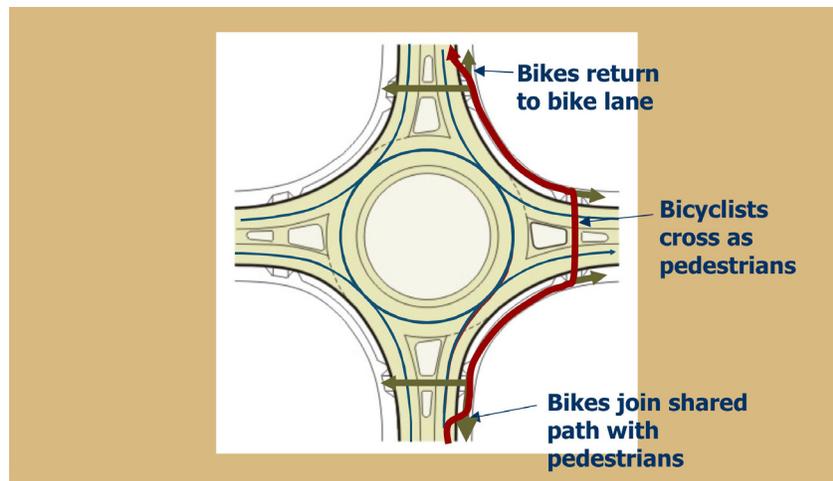
ROUNDBABOUTS/TRAFFIC CIRCLES

Roundabouts are one-way circular intersections in which traffic flows around a center island without stop signs or signals. Because roundabout traffic enters and exits through right turns only and speeds are reduced, the occurrence of severe crashes is substantially less than in many traditional four-way intersections. The lower speeds within roundabouts also allow entering traffic to access smaller gaps between circulating vehicles, increasing traffic volume and decreasing delays, congestion, fuel consumption and air pollution.

Modern roundabouts greatly reduce the potential for high-speed, right-angle, rear-end and left turn/head-on collisions. In traditional four-way traffic intersections, there are 32 points of conflict in which two vehicles may collide. Modern roundabouts have only eight conflict areas, greatly reducing potential crashes.

- Roundabouts with only one circulating lane are much safer to navigate than are multi-lane roundabouts, especially for bicyclists.
- The diagrams below show two ways for bicyclists to navigate roundabouts, depending on comfort and skill level.

Below: Circulating as a Pedestrian: If a cyclist is uncomfortable riding with traffic, a cyclist can choose to travel instead as a pedestrian.



Above: Circulating as a Vehicle: Bike lanes are not recommended within a roundabout. Instead, cyclists merge with traffic before entering the roundabout, circulate with traffic, and then re-enter the bike lane after exiting.

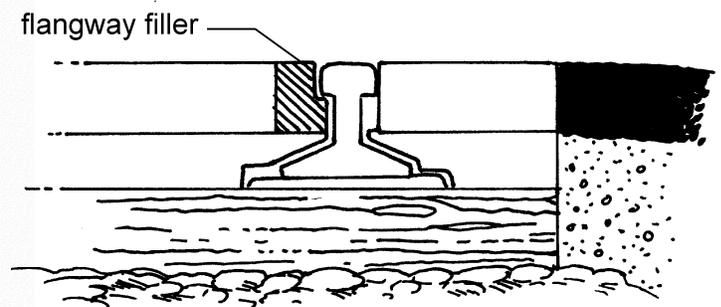
BICYCLE FACILITIES AT RAILROAD CROSSINGS

Railroad crossings are particularly hazardous to those who rely on wheeled devices for mobility (railroad crossings have flangeway gaps that allow passage of the wheels of the train, but also have the potential to catch wheelchair casters and bicycle tires). In addition, rails or ties that are not embedded in the travel surface create a tripping hazard. Recommendations:

- Make the Crossing Level: Raise approaches to the tracks and the area between the tracks to the level of the top of the rail.
- Bikes Should Cross RR at Right Angle
- When bikeways or roadways cross railroad tracks at grade, the roadway should ideally be at a right angle to the rails. When the angle of the roadway to the rails is increasingly severe, the approach recommended by Caltrans (Highway Design Manual, Section 1003.6) and AASHTO (Guide for the Development of Bicycle Facilities, 1999, p.60) is to widen the approach roadway shoulder or bicycle facility, allowing bicycles to cross the tracks at a right angle without veering into the path of passing motor vehicle traffic.
- Use Multiple Forms of Warning: Provide railroad crossing information in multiple formats, including signs, flashing lights, and audible sounds.
- Clear Debris Regularly: Perform regular maintenance to clear debris from shoulder areas at railroad crossings.
- Fill Flangeway with Rubberized Material or Concrete Slab: Normal use of rail facilities causes buckling of paved-and-timbered rail crossings. Pavement buckling can be reduced or eliminated by filling the flangeway with rubberized material, concrete slab, or other treatments. A beneficial effect of this is a decrease in long-term maintenance costs.



Installing a rubber surface rather than asphalt around railroad flangeways reduces changes in level and other maintenance problems.

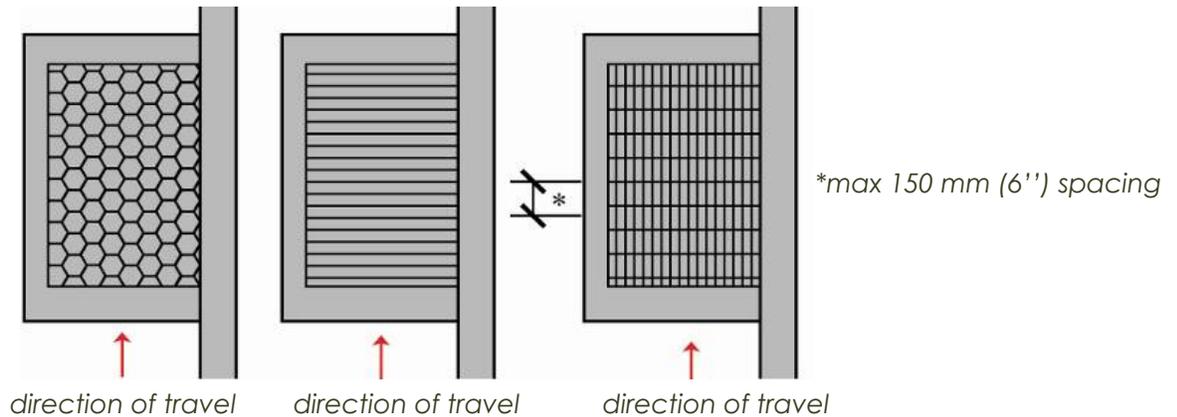


The “flangeway filler” eliminates the gap in the path of travel for pedestrians crossing railroad tracks. The filler, consisting of a rubber insert, will deflect downward with the weight of a train and does not affect railway function.

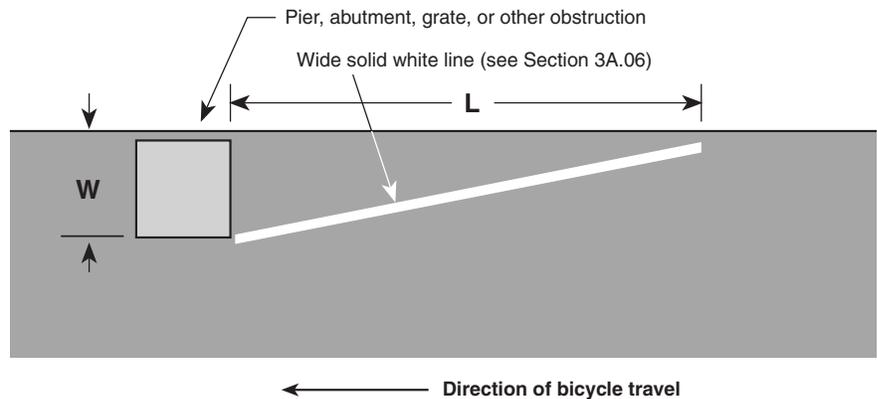
BICYCLE FRIENDLY DRAINAGE GRATES

Drainage grates usually occupy portions of roadways, such as bicycle lanes, where bicycles frequently travel. Often drainage grates are poorly maintained or are of a design that can damage a bicycle wheel or in severe circumstances, cause a bicyclist to crash. Improper drainage grates create an unfriendly obstacle a cyclist must navigate around, often forcing entrance into a motor vehicle lane in severe cases. Bicycle friendly drainage grates should be installed in all new roadway projects and problem grates should be identified and replaced.

Right: Bicycle Friendly Drainage Grate Designs



Right: MUTCD example of obstruction pavement marking; if dangerous drainage grates (or other obstructions) are not to be fixed in the short term, then this pavement marking should direct cyclists away from the obstruction.



Dangerous Drainage Grate Condition; this example is dangerous due to the grate running parallel to the roadway, creating a trap for bicycle tires.



Dangerous Drainage Grate Condition; this example is dangerous due to the surrounding paving condition (when the road was resurfaced the drainage grate remained at the same height).



Bicycle-Friendly Drainage Grate

BICYCLE ACCESS ON (FUTURE) TRANSIT

Integrating bicycle facilities with transit modes allows bicyclists to greatly expand the area accessible. Below are examples of bus services with customized facilities allowing for simple and secure storage of bicycles without hindering or impeding other passengers. The City of Creedmoor should advocate for the inclusion of bicycle-transit integration, if and when transit service becomes available. Future buses should be equipped with bicycle racks, and bus stops should accommodate bicycle parking with City-wide bicycling and walking maps available on the buses and at popular stops. Below is example guidance for mounting a bicycle on a typical bus rack.



- 1.** Have your bike ready to load—always approach the bus from the curbside. Remove water bottles or other loose items.
- 2.** Make eye contact with the driver to alert him/her to your presence.
- 3.** If the rack is empty, lift the metal handle and pull the folded bike rack down flat.



- 4.** Load the bike in the space nearest the bus.
If another bike is on the rack, load your bike in the open position. You are responsible for loading and securing your bike on the rack. Drivers are not allowed to load or unload bicycles.



- 5.** Lift the support arm and hook it over the front tire.
Make sure the support arm clamps the tire and not the fender or frame. Your bike now is securely fastened in the rack.



- 6.** Hop on and pay your fare.
- 7.** When you reach your stop, tell the driver before you exit the bus that you'll be removing your bike.
Raise the support arm, lower it into place and lift your bike off the rack.
Fold up the rack if it is empty, and step onto the sidewalk with your bike.
NEVER cross in front of the bus—wait until the bus has left the stop.

If the rack is full, please wait for the next bus.

Instructions on how to load a bicycle onto a bus equipped with a bicycle rack, developed for a bicycle user map by Fremont, CA

BICYCLE PARKING

BICYCLE PARKING

As more bikeways are constructed and bicycle usage grows, the need for bike parking will climb. Long-term bicycle parking at future transit stops and work sites, as well as short-term parking at shopping centers and similar sites, can support bicycling. When choosing bike racks, there are a number of things to keep in mind:

- The rack element (part of the rack that supports the bike) should keep the bike upright by supporting the frame in two places allowing one or both wheels to be secured.
- Install racks so there is enough room between adjacent parked bicycles. If it becomes too difficult for a bicyclist to easily lock their bicycle, they may park it elsewhere and the bicycle capacity is lowered. A row of inverted “U” racks should be installed with 15” minimum between racks.
- Empty racks should not pose a tripping hazard for visually impaired pedestrians. Position racks out of the walkway’s clear zone.
- When possible, racks should be in a covered area protected from the elements. Long-term parking should always be protected.

The table below provides basic guidelines on ideal locations for parking at several key activity centers as well as an optimum number of parking spaces.

BICYCLE PARKING LOCATIONS AND QUANTITIES

Use Category	Specific Use	Required Long-term Parking Spaces	Required Short-term Parking Spaces
Residential	Boarding houses	2, or 1 per ten sleeping rooms	None
	Hotels, motels	2, or 1 per 50 employees	None
Commercial / Industrial	Retail sales, service operations *	2, or 1 per 50,000 square feet of gross floor area	2, or 1 per 25,000 square feet of gross floor area
	Office buildings **	2, or 1 per 50,000 square feet of gross floor area	2, or 1 per 50,000 square feet of gross floor area
	Museums, libraries	2, or 1 per 50 employees	4, or 1 per 25,000 square feet of gross floor area
	Movie theaters	2, or 1 per 50 employees	4, or 1 per 50 seats
	Restaurants, ice cream shops, coffee shops	2, or 1 per 50 employees	4, or 1 per 50 seats
	Recreation centers	2, or 1 per 50 employees	4, or 1 per 25,000 square feet of gross floor area
	Major event entertainment (e.g., stadiums, arenas)	2, or 1 per 50 employees	8, or 1 per 500 seats
	Manufacturing	2, or 1 per 50 employees	None
	Warehousing	2, or 1 per 50 employees	None
Institutional	Medical centers	2, or 1 per 50 employees	2, or 1 per 25,000 square feet of gross floor area
	Transit park and ride lots	1 per 50 daily boardings	None

* Retail businesses below 3,000 square feet of gross floor area are exempt from bicycle parking requirements

** Office buildings below 10,000 square feet of gross floor area are exempt from bicycle parking requirements

BICYCLE RACK STANDARDS

The rack element should:

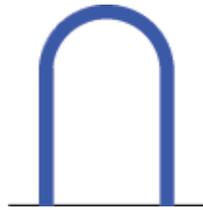
- Support the bicycle upright by its frame in two places
- Prevent the wheel of the bicycle from tipping over
- Enable the frame and one or both wheels to be secured
- Support bicycles without a diamond-shaped frame with a horizontal top tube (e.g. a mixte frame)
- Allow front-in parking: a U-lock should be able to lock the front wheel and the down tube of an upright bicycle
- Allow back-in parking: a U-lock should be able to lock the rear wheel and seat tube of the bicycle



Bicycle racks that incorporate advertising can be sponsored by local merchants.

Comb, toast, school-yard, and other wheel-bending racks that provide no support for the bicycle frame are NOT recommended.

The rack element should resist being cut or detached using common hand tools, especially those that can be concealed in a backpack. Such tools include bolt cutters, pipe cutters, wrenches, and pry bars.



INVERTED "U"
One rack element supports two bikes.



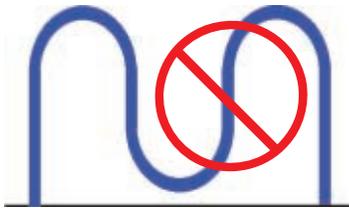
"A"
One rack element supports two bikes.



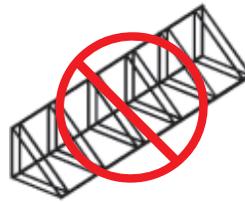
POST AND LOOP
One rack element supports two bikes.



COMB
One rack element is a vertical segment of the rack.



WAVE
One rack element is a vertical segment of the rack. (see additional discussion on page 3)



TOAST
One rack element holds one wheel of a bike.



Not recommended

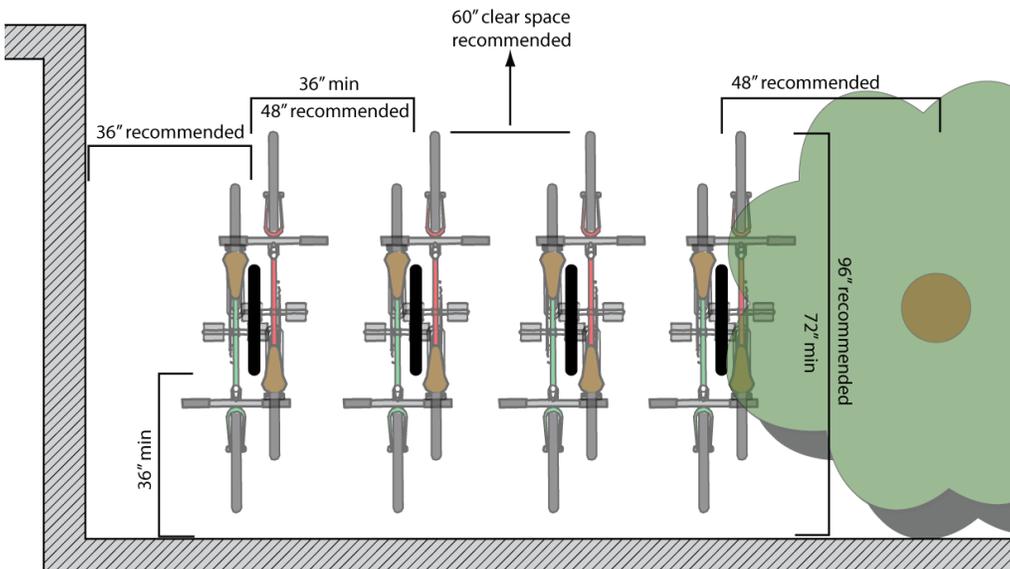


Provision of shelter from rain greatly increases usefulness of this bicycle parking facility during inclement weather.



A single inverted "U" rack can accommodate two bicycles.

Above: Recommended guidelines for bicycle parking from the Association of Pedestrian and Bicycle Professionals, 2002, www.apbp.org.



Left: Recommended guidelines for bicycle parking spacing dimensions.

DESIGN RESOURCES

NACTO URBAN BIKEWAY DESIGN GUIDE

The purpose of the NACTO Urban Bikeway Design Guide (part of the Cities for Cycling initiative) is to provide cities with state-of-the-practice solutions that can help create complete streets that are safe and enjoyable for bicyclists.

<http://nacto.org/cities-for-cycling/design-guide/>

PEDESTRIAN AND BICYCLE INFORMATION CENTER

Designers and engineers have a diverse array of design elements and ever-developing technologies at their disposal. Use this web site as a source for information on design and engineering tools that promote bikeability.

<http://www.bicyclinginfo.org/engineering/>

<http://www.bicyclinginfo.org/engineering/parking.cfm>

NCDOT "TYPICAL" HIGHWAY CROSS SECTIONS

The comprehensive planning and design "typical" highway cross sections have been updated to support the NCDOT's "Complete Streets" policy that was adopted in 2009. The guidance in the updated cross sections establishes design elements that emphasize safety, mobility, and accessibility for multiple modes of travel. For more information, contact the State Roadway Design Engineer, or visit:

<http://www.nccompletestreets.org>

GUIDE FOR THE DEVELOPMENT OF BICYCLE FACILITIES

American Association of State Highway Transportation Officials (1999). Once available, the updated AASHTO Bicycling Guide should be used; scheduled for release in 2011.

<http://www.transportation.org>

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD)

U. S. Department of Transportation, Washington, DC, 2009. The Manual on Uniform Traffic Control Devices, or MUTCD defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public traffic.

<http://mutcd.fhwa.dot.gov>

POLICY ON GEOMETRIC DESIGN OF STREETS AND HIGHWAYS

American Association of State Highway Transportation Officials, 2004. This fifth edition of AASHTO's "Green Book" contains the latest design practices in universal use as the standard for highway geometric design

<http://transportation.org>