Mercer County Bicycle Master Plan

Adopted February ___, 2020

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Mercer County Bicycle Master Plan

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The original of this plan has been signed and sealed in accordance with the New Jersey Professional Planners Licensing Act.

Adopted by the Mercer County Planning Board,
February __, 2020.

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This plan is a sub-element of the Mercer County Master Plan Mobility Element and serves to enhance the County road network, as directed in the Mercer County Complete Streets Resolution (Resolution No. 2012-249) adopted April 26, 2012. With this Resolution, the Mercer County Board of Chosen Freeholders expressed support for the County Executive’s "Complete Streets" policy for the planning, design, construction, maintenance, and operation of new and retrofitted transportation facilities to enable safe access and mobility, not only for motorists, but also for pedestrians, bicyclists, and transit users of all ages and abilities. This Plan offers guidance to project development in the County's capital program. Its goal is to enhance the safety and convenience of bicycle travel on the County's road network and thereby improve the quality of life for everyone who lives and works in Mercer County.

**GENERAL PROJECT INFORMATION**

Mercer County’s strategy for improving the cycling network focuses on improvements for safety and accommodation along approximately 180 centerline miles of roadway under County jurisdiction. These roads serve as critical corridors for intra-county (600 routes) and inter-county (500 routes) mobility. By addressing bicycle mobility on these routes, the County hopes to provide strategies that complement municipal plans and forge new connections. The plan builds upon roughly 15 years of work of the County Planning Department, the Mercer County Bicycle and Pedestrian Task Force (MCBPTF), and careful review of municipal plans and studies.

The Mercer County Bicycle Master Plan provides recommendations for bicycle facilities to be considered for every County route segment. Based on a wide-ranging review of best practices nationwide, and on facility standards developing within the State of New Jersey, particular recommendations for specific segments were deemed most practical given cartway and right-of-way limits, posted speeds, traffic volumes, truck and bus routes, adjacent land use, and more. Recommended facilities are not proposed projects nor are they final recommendations. County Planning and Engineering staff will study locations in greater detail and consider location-specific design alternatives as scheduled capital projects advance, and may propose new projects to close critical gaps or create longer corridors. Final facility designs and implementation schedules will be determined case by case, at the final discretion of the County Engineer.
Goals

In order to achieve this vision, the County of Mercer has outlined a C5 strategy, similar to that in NJDOTs Complete Streets Design Guide, for developing and integrating bike facilities throughout the County. These 5 goals will guide the County's efforts:

Continuous: Create a network of continuous facilities that do not require bicyclists to walk their bikes or weave in and out of vehicular traffic.

Complete: Create a complete and thorough network of on and off-road bike facilities.

Connected: Provide bicycle access to destinations such as schools, employment centers, neighborhoods, shopping centers, trails, parks and other major attractors.

Comfortable: Create a safe ride where people do not have to fear riding on our facilities.

Convenient: Create facilities that are easy to use by all age groups.

Bicycle Master Plan Objectives

In order to advance these goals, this study has achieved four objectives:

Consider roadway conditions of all County Routes, including: Posted Speeds, Traffic Volumes, Existing Cartway Widths, Adjacent Land Use, Environmental Conditions, Constraints and Pinch Points, Truck Routes, Bus Routes, and Street Activity.

Demonstrate conceptual designs and identify opportunities, constraints and costs associated with implementation.

Identify and separate road segments into short term, medium term and long term project horizons based on necessary infrastructure, right-of-way considerations, and fiscal constraints.

Specific Goal Targets

- Build at least 30 miles of bike facilities by end of 2025.
- Double the bicycle commuting mode share in Mercer County by 2030.
- Improve safety for pedestrians and bicyclists by reducing bicycle & pedestrian crashes on County roads by 50% by 2030.
- Encourage biking and walking events to promote healthy, active living and to enjoy the associated economic and environmental benefits.
- Enhance the connectivity of adjacent off-road and on-road bikeways and walking trails.
- Achieve a minimum of Level of Traffic Stress 3 rating on improvement projects, targeting LTS 1 & 2.
- Establish a working relationship with local planners, engineers and officials as well as with NJDOT staff for efficient project advancement and coordination.
BICYCLE MASTER PLAN PURPOSE AND NEED

The main purpose of this project is to assist in the implementation of our Complete Streets Policy, which aims to accommodate all modes of transportation and users of all ages, abilities and incomes. At this time, every municipality in the County, as well as the State of New Jersey has adopted similar Complete Street Policies.

Cycling is an important mode for County residents. For many, cycling is an enjoyable recreational activity. For others it is a primary travel mode for commuting and errands. The Princeton area in particular has a high concentration of commuters who exclusively ride their bicycles to work and school. In other parts of the County, cycling is less a choice than a necessity. For households living below the poverty line or households with only a single vehicle, the option of cycling may be critical. And walking or cycling may be the only way for young people with working parents to get to extracurricular activities.

To support the case for implementing bicycle facilities, Chapter 2 of the Bicycle Master Plan cites numerous positive impacts on real estate, retail, tourism, and economic development activity. That chapter also describes benefits to public health, social equity, environmental justice, the environment, and how cycling may contribute to pavement preservation, crash reduction, and congestion reduction.

BICYCLE MASTER PLAN ANALYSIS

Anticipating an aging population, this Plan takes an ‘8 to 80 design’ approach, which is based on the premise that if a community is accommodating for eight year olds and 80 year olds, then that community is accommodating to everyone. To do so, Planning staff adopted a facility selection method similar to that in the NJDOT 2017 Complete Streets Design Guide. This method is primarily driven by traffic speeds and volumes, as are most best practices today in the United States. The premise is that, as volumes and speeds increase, the level of “traffic stress” for cyclists increases. More than just a feeling, crashes at higher speeds result in exponentially higher fatality rates for cyclists. This means that high speed and high volume roads need greater separation from traffic, with wider bike lanes and buffers, or physical separation on a side path.

Chapter 3 applies this method to every segment of roadway under the jurisdiction of the County to assign a facility type, and assigns codes to indicate planning-level estimates of design and construction costs. Types and costs are indicated in maps and tables.
While Chapter 3 provides a facility recommendation based on the County Bicycle Facility Selection Table and road characteristics, Chapter 4 recommends design considerations for the various facility types. The designs and recommendations to be considered are derived from design and policy manuals from both local agencies and national organizations, including the Federal Highway Administration. These manuals offer guidance on standards, best practices, and strategies for design and construction of bicycle facilities.

It is important to note that there is significant room for flexibility in highway and roadway design. In particular, the often used AASHTO Policy on Geometric Design of Highways and Streets (the ‘Green Book’) is not a detailed design manual but a guidance document to be used to make better-informed decisions. There is a significant range of roadway conditions within Mercer County so a “one size fits all” approach will not work. Context sensitive solutions must be used to reflect the location and community. As a result, a range of design reference and guidance documents will be used to design and implement bicycle facilities throughout the County.

Despite flexibility in geometric design, the County must comply with the Federal Highway Administration’s Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD is adopted by reference in accordance with Title 23, United States Code, Section 109(d) and Title 23, Code of Federal Regulations, Part 655.603, and is approved as the national standard for designing, applying, and planning traffic control devices, including roadway striping and signage. As the MUTCD and other federal guidance changes, design recommendations may vary during the life of this plan.
Mercer County’s bicycle facility selections in Chapter 3 were based on a careful analysis of the roadway conditions and surrounding land use in order to provide context sensitive recommendations. To support this analysis, 21 different environmental, land use, and transportation data sets, and three aerial imagery sources were compiled within a geographic information system (GIS), which is a framework for gathering, managing, and analyzing spatial data. With frequent reference to Google Streetview imagery, these data allowed staff to visualize each segment of road and nearby infrastructure, as well as nearby environmental assets and constraints. Measurements in GIS were compared to field samples and found to be within six inches, plus or minus. With these data, staff was able to make a good faith determination of what facility to recommend for each segment and to estimate implementation costs. In total, approximately 931,957 feet or 176.5 miles of roadway were analyzed, in 50'-250' segments.

GIS ANALYSIS

Above: Simplified visualization of overlapping GIS data.

Above: Within our geographic information system (GIS), we utilized NJDOT 2014 centerline information to break up each route into segments based on identified AADT, speeds, pavement cartway, pinch points, and other relevant information. The entire Mercer County Bikability network is as a result based on the 2014 Standard Route Identifier (SRI) and Linear Referencing Systems (LRS). Each segment as a result can be looked at individually, which is much more helpful when determining costs and improvements. In addition to the improvement and design codes provided for each segment, a field for additional comments was included to provide more detail.
IMPLEMENTATION AND MAINTENANCE

The final Chapter of the Bicycle Master Plan focuses on implementation and maintenance. This chapter outlines how the County can incorporate bicycle facilities that do not require changes to geometry or motor vehicle operations into our resurfacing projects. Initially a bicycle facility may appear simply as a wider shoulder. The County will consider formally designating bicycle routes when practical extents are achieved, such as when longer continuous segments and connections are possible. For larger projects on longer timeframes, which may require traffic signal alterations, right-of-way, or geometric changes, the County may either design facilities in-house or work with outside contractors to develop design plans for construction.

Long-term maintenance must also be considered. Just like regular vehicle lanes, bike lanes must be kept clear of debris, free of hanging vegetation, free of standing water, free of parked vehicles and free of snow and ice in winter. The County will also need to work with towns to educate residents and pass parking and debris ordinances, where necessary to keep bicycle lanes clear. When adding bicycle facilities, it is important to understand that, as the network is built out, maintenance may require additional machinery and manpower to keep lanes in a good state of repair.

PLANNING BOARD & LAND DEVELOPMENT

Chapter 5 also discusses how Complete Streets, and bicycle facilities in particular, should be incorporated into the County’s Land Development process. The New Jersey County Planning Act (N.J.S.A 47:20-1, et seq.) authorizes counties to balance the desires of private developers with the general welfare and safety of the traveling public. Through the County Land Development process, the Planning Board may require the installation of bicycle and pedestrian facilities on County highways or require that accommodations to be made for future projects. Where municipal streets provide potentially desirable bicycle access to the County network, the Planning Board may recommend consideration of bicycle improvements on those streets.

The parent document of this element, the Mobility Element of the County Master Plan, identifies five roadway types or ‘access levels’ for Mercer County highways, with desirable typical sections (DTS) that define right of way requirements to accommodate travel by motor vehicle, bicycle, foot, and wheelchair, with elements that include shoulders or on-street parking, bicycle lanes, sidewalks, roadside buffers, as well as vehicular travel lanes and medians or center left two way turn lanes. These DTS assignments define right-of-way dedications required for approval of subdivision and site plans. In most cases, the Master Plan DTS will accommodate bicycle facilities as recommended in this sub-element. However, where high-speed, high-volume roads result in the recommendation of a side path or shared use path, the Planning Board may require its inclusion in a subdivision or site plan. While this plan provides specific, data-driven facility-type recommendations for every County Highway, based on current best practices and standards, final design decisions and implementation schedules are at the discretion of the County Engineer.
PROJECT CONTEXT & BACKGROUND
Mercer County, prides itself as a center of commerce, education, healthcare and culture. Located in central New Jersey, roughly equidistant between New York City and Philadelphia, the County is home to nearly 400,000 residents within 226 square miles. Our County sits within one of the most densely developed regions in the nation with approximately 10% of the US population living within 75 miles.

The County is home to the State Capital and many state offices as well as numerous fortune 500 corporations and prestigious medical and educational institutions. Along with its many assets, it is also blessed with a rich cultural history that dates back to Native American inhabitation and encompasses sites of original European settlements, vital Revolutionary War locations, industrial revolution factories, and more. The County is also home to a vast amount of preserved farmland and open space, home to numerous parks and a growing trail network.

As Mercer County evolved from a rural agricultural community to a mixed-economy with vast manufacturing in the City of Trenton, the County continued to grow organically. Starting in the post WWII era, we witnessed the first large scale suburban developments, which now form the backbone of our many communities and neighborhoods. During this time, our region witnessed a massive expansion of our highway networks. This network has been evolving to meet our community’s needs and to make the County a strong, economically successful and socially vibrant area. Today, our transportation infrastructure is the skeleton on which our modern society is built upon. Without it, our modern society would grind to a halt. Moving forward, the County will continue to improve our highways to accommodate all users and community needs.

With nearly 400,000 residents and thousands of local businesses located within the County, it is crucial to work together to promote a more economically viable, environmentally sustainable and livable area. Transportation planning at the regional scale is critical to our economic vitality, environmental health and community cohesion. To meaningfully influence economic and environmental impacts associated with development, land use, and transportation, officials must act at a level where central cities and suburbs can be considered together. At the County level, our transportation system connects towns to each other and to connect towns to other surrounding counties.
This plan in a sub-element of the Mercer County Mobility Element and serves to enhance our County road network as directed per the Mercer County Complete Streets Resolution (Resolution No. 2012-249), adopted on April 26, 2012. Under this resolution, the Mercer County Board of Chosen Freeholders wish to support the County Executive’s "Complete Streets" policy through the planning, design, construction, maintenance and operation of new and retrofitted transportation facilities, enabling safe access and mobility of pedestrians, bicyclists, and transit users of all ages and abilities. This Mercer County Bike Plan serves as a guidance document for the County in developing bicycle facilities along County roadways and, to enhance travel for pedestrians and bicyclists of all abilities. It also serves to improve the quality of our transportation network as well as the quality of life for everyone who lives and works in the County.
through adoption of Complete Streets policies at the State, County, and Municipal levels, Mercer County is committed to accommodating and encouraging transportation by all modes on our public roadways. An important element of this complete streets initiative in turn is the pursuit of a safe and comprehensive network for cyclists. Over the past decade, bicycling has become increasingly recognized as a key element of everything from reducing traffic congestion to improving air quality to reducing obesity and is a critical factor in creating healthy and vibrant communities. Within the county, existing and proposed investments for bicycling are seen in dedicated on-street facilities as well as several off-road multi-use trails, such as the Lawrence-Hopewell Trail, Delaware and Raritan (D&R) Canal Trail and others.

Individually, these projects reflect improved safety for cyclists, but their sum is a network that lacks connectivity - both between bicycle facilities and between key destinations. Obstacles such as highways and large intersections pose additional challenges to improving the connectivity of the network.

Mercer County’s strategy for improving the network begins by focusing on improvements for safety and accommodation along our jurisdiction of approximately 180 centerline miles of County Routes. These roadways are owned and maintained by the County, and serve as critical intra-county and inter-county corridors for all users. By addressing bicycle access on these routes, the County hopes to provide strategies that bridge disparate municipal plans and resolve existing obstacles.

The Mercer County Master Bike Plan provides a comprehensive analysis and bicycle facility design recommendations for all County routes. As part of the Mercer County Master Plan, this sub-element of the Mercer County Mobility Element, complements local initiatives and programs; and builds upon the work of the County Planning Department, the Mercer County Bicycle and Pedestrian Task Force (MCBPTF), and local municipalities’ plans and studies. This analysis can be used for future planning efforts by County staff as well as by the County Engineer and Planning Board during the Land Development review process, especially when determining DTS, ROW dedications, and conditions of approval such as sidepaths.

Staff from the Delaware Valley Regional Planning Commission (DVRPC), our regional Metropolitan Planning Organization, assisted with this study to assess opportunities, constraints, and strategies towards enhancing bicycle facilities and connections on County Routes within Mercer County, with emphasis on improving safety and mobility for all users.

In addition to the recommendations included in the report, this study provides a replicable framework for identifying, assessing, and designing facilities to be used in future phases of MCPD’s bicycle network development. The following pages discuss our County Vision, Goals and Objectives which served as the guide to developing our plan and facility recommendations as well as to help guide future conceptual designs and implementation.
Bicycling and walking are integral components of an efficient transportation network. Appropriate bicycle and pedestrian accommodations provide the public, including the disabled community, with access to the transportation network, connectivity with other modes of transportation, and independent mobility regardless of age, physical constraint, or income. It is the objective of Mercer County to create a bicycle facility network that encompasses the entire County of Mercer and connects neighborhoods to parks, schools, open space, retail, employment centers, public facilities and anywhere else people may need to go. Our vision is to create the most bike friendly community in the State of New Jersey.

**Goals**

In order to achieve this vision, the County of Mercer has outlined a C5 strategy, similar to that in NJDOTs *Complete Streets Design Guide*, towards developing and integrating bike facilities throughout the County. These 5 goals will guide the County’s efforts of establishing

**Continuous:** Create a network of continuous facilities that do not require bicyclists to walk their bikes or ride in and out of vehicular traffic.

**Complete:** Create a complete and thorough network of on and off-road bike facilities.

**Connected:** Provide bicycle access to destinations such as schools, employment centers, neighborhoods, shopping centers, trails, parks and other major attractors.

**Comfortable:** Create a safe ride that is comfortable where people do not have to fear riding on our facilities.

**Convenient:** Create facilities that are easy to use by all age groups.

**Objectives**

In order to achieve these goals, this study accomplishes 4 objectives:

1. Consider roadway conditions of all County Routes including the following:
   - Posted Speeds, AADT, Existing Cartway Widths, Land Use, Environmental Conditions, Constraints and Pinch Points, Truck Routes, Bus Routes, and Street Activity.
2. Demonstrate conceptual designs and identify opportunities, constraints and costs associated with implementation.
3. Identify and separate road segments into short term, medium term and long term project horizons based on necessary infrastructure needed, right-of-way considerations and fiscal constraints.
4. Prioritize bicycle capital program improvements (maintenance, operational or major capital projects), especially for resurfacing projects.
The steering committee assembled for this project included staff from the Mercer County Planning Department and the Mercer County Engineering Division. The steering committee also included the Greater Mercer Transportation Management Association (GMTMA) which includes advocates and staff from the Mercer County Bicycle and Pedestrian Task Force (MCBPTF), the Greater Philadelphia Bicycle Coalition, as well as and municipal representatives. The steering committee met during this County Bicycle Master Plan process and the GMTMA Trail Plan process. Committee members and the general public were involved during 5 public meetings and 2 pop-up events held in May, June and July. Photos from those meetings are on the following pages.

Mercer County Planning Department staff also worked closely with the Engineering Division to discuss implications and overall feasibility of bicycle infrastructure. With the help of the Engineering Division, a variety of issues were discussed. Items such as setting speed limits and utilizing USLIMITS2, reducing cartway widths, road diets, intersection improvements, crosswalk types and locations, curb radii, incorporating bike infrastructure during resurfacing projects and more were discussed. The County Highway Division was also consulted with to determine feasibility of improvements at a series of locations. Moving forward the Department of Planning with Engineering and Highway Divisions will work to implement these facilities where feasible.

Steering Committee Meetings

The project team and steering committee first convened at a MCPBTF meeting in September 2016. After introducing the project scope and goals, the committee participated in a map based workshop of prioritizing routes in order to establish a study area for the project. This exercise helped to reduce the number of potential routes from forty to thirteen. An overview of these prioritized routes was provided in January 2017, during the second steering committee meeting. The project team briefly presented the existing conditions of the study area, and outlined the process of collecting, assessing, and mapping street characteristic data.

Feedback from the first two steering committee meetings informed the process by which the project team assembled additional data and conducted analyses. Next, a series of design proposals for each of the priority routes were developed and provided to the steering committee for review at the third meeting in April 2017. The committee shared their priorities and feedback related to the proposed designs, and discussed the potential outcomes of each proposal.
Five Public Meeting & Two Pop-Up Events

2019 Princeton Communiversity Day Celebration with GMTMA

2019 Cultural Heritage Festival at Mercer County Park

Above: Public Bike Plan meeting at the Hightstown Public Library
Above: Public Bike Plan meeting at the Ewing Senior Center across from NJDOT HQ.

Above: Public Bike Plan meeting at the Princeton Country Club in West Windsor.

Above: Public Bike Plan meeting at the Princeton University Carl Fields Center
Above: Final Public Bike Plan meeting at Trenton City Hall coordinated with the GMTMA Trail Plan and Trenton Cycling Revolution, a local Trenton area bicycle advocacy group.
Through the months of May, June and July, a total of 5 public “open-house” style meetings were held throughout the County. These meetings were advertised on County and town websites and social media pages as well as through social media pages of various nonprofits and bicycle advocacy groups. In addition to these public meetings, Mercer County staff ran stands at the Princeton Communiversity Day Festival and the Mercer County Cultural Heritage Festival to reach out to bypass residents who do not or cannot typically attend public meetings. Over these 7 public outreach events, staff interacted with hundreds of residents. During these meetings, staff asked residents to provide feedback on the County Bicycle Master Plan Element and cycling in general around the County.

Three major forms of public participation were utilized. The County began its efforts with an online survey which the County website and social media linked to. Physical paper links with scannable QR codes were also handed out in person during live meetings. The link led to a short 5 minute survey (average response time 4.2 minutes) with 10 questions. The survey saw 144 individual respondents answer the survey. When asked how often they ride their bike, a majority of our respondents (41%) rode a few times a week, followed by 17% who said they rode a few times a year and 12% who rode a few times a year. Approximately 10% of our respondents ride their bikes every single day.

Which of the following destinations do you ride to?

Above: A majority (77%) respondents ride their bike to get to parks, trails or other open space opportunities in and around Mercer County. Due to lack of school reach out, school age children may have been underrepresented.
When asked about what impediments riders faced and factors that made it difficult to ride, 58% of respondents cited high speed traffic, 55% said there was too much traffic, and 57% cited that the road was too narrow. Other major problems facing riders include difficult intersections (37% of respondents) as well as unpredictable drivers (34% of respondents) and uneven roads (33% of respondents). When asked what they would like to see most to make their biking experience better, 59% said that a complete bicycle network connecting Local, County and State bike facilities was important. Respondents also wanted wide bike lanes (51% of respondents), bike lanes with 1.5’ or 3’ buffers (52% of respondents), and safer intersections, interchanges or bridge crossings (42% of respondents).

Approximately 75% of respondents, indicated that the primary reason that they bike was for health or exercise. Most also ride for recreation or for fun (69% of respondents). Only some 20% of respondents indicated that they ride primarily for commuting to school or work reasons. Of our respondents, approximately 65% of people indicated that their average bicycle trip is one hour or less with 35% indicating that their average trip is 30 minutes or less. Of the respondents, approximately 45% of respondents rode their bikes from 1.5 hours to 2 hours in a single trip. Two enthusiastic respondents indicated that they typically ride 4-5 hours in one trip.
The survey also asked the public to agree or disagree with a variety of statements. Respondents answered that they strongly agreed, agreed, had no opinion, disagreed, or strongly disagreed with the statements shown above. Most people would like to live in a community in which they can bike to many destinations and that they would ride their bike more if the bicycle network was improved. Some 89% of respondents agreed or strongly agreed that improving bicycling will have a positive benefit on Mercer County's attractiveness as a community.
The second form of public participation included paper handouts of the County map with County routes emphasized by cost of improvement by linear foot. Participants at the 7 public meetings were asked to circle, highlight or point out locations where they currently ride, wish they could ride and specific things that obstruct their ride or prevent their ride. Respondents mostly selected out local routes near their homes but a significant portion of responses indicated a desire for improved bicycle facilities along County Route 571 between Hightstown Borough and downtown Princeton. There were also several participants who wanted to see more facilities improved in the inner I-295 ring of Mercer County, specifically the inner ring areas of Ewing-Trenton-Lawrence-Hamilton. Those sheets can be found in the appendix.

The third form of public participation includes 4 36” x 24” boards asking the public various questions. During this process, participants were asked questions very similar to our survey questions such as what was the biggest obstacle to their ride and what is the most important to their ride. This was done to get responses from visitors who would not take the time to do the survey. The following page shows the four boards while a high resolution photo of the responses can be found in the appendix.
These four boards were used to gather public input on bicycle facilities asking basic questions such as where do people ride and where they wish they could ride. During this process, participants were asked what was the biggest obstacle to their ride and what is the most important to their ride.
The 2019 Mercer County Bike Plan builds upon years of various planning objectives and initiatives to develop cycling facilities throughout the County. Over the past decade, there has been an increasing amount of effort to reincorporate bicycle traffic within our right-of-way. The following efforts show previous initiatives and projects that have paved the way and influenced our Mercer County Bike Plan.

**2007 Mercer County Bike-Ped Task Force Created**

In 2009, the Mercer County Bike-Pedestrian Task Force (MCBPTF) was created with the support of Mercer County Executive, Brian M. Hughes, and hosted by the Greater Mercer Transportation Management Association (GMTMA). The MCBPTF consists of municipal representatives designated by town mayors as well as various advocates and residents. The primary purpose of the organization is to help advocate for non-motorized infrastructure throughout Mercer County, including sidewalk improvements, bicycle improvements, intersection improvements, trail improvements, and many others. The group also acts as a forum to coordinate municipal efforts and keep each other informed of activities happening around the County.

**2009 Mercer County Bicycle Level of Service Online Tool**

The Mercer County Bicycle Level of Service Project was the first project to attempt to identify the bikability (on-road) of Mercer County Highways. Bikability is an estimate of how comfortable it is to bike along a roadway, and considers many factors, including traffic volumes, traffic speeds, pavement widths, and whether there is a usable shoulder. This online tool derived bikability using the Bicycle Level of Service (BLOS) model, which references physical characteristics such as shoulders and widths as well as functional characteristics including traffic volumes to determine a letter grade (A-F) for each segment. The study incorporated an interactive map to facilitate data sharing and solicit feedback stakeholder from agencies and with the community. This site was and currently is also intended to be a resource for Mercer County residents and bicyclists to help them plan bicycle-friendly routes to ride and to help planners identify priority bicycle corridors and facilities to be considered in the future.
**2010 Mercer County Mobility Master Plan (Amended 2016)**

In September of 2010, the County adopted a new Master Plan, replacing the traditional highway element with a Mobility Element that addressed all modes at a policy level. This was our complete streets policy, among other more general policies. This mobility plan presented a vision for the future of mobility in Mercer County that was conservative about recommending new roads and increased vehicular capacity. Instead the plan looked at existing conditions and making realistic improvements to our existing network. It also addressed for the first time the need to consider all modes, including transit, bicycle infrastructure and pedestrian scale walkability improvements.

**2010 Mercer County Multi-Jurisdictional Bike Plan**

A predecessor of the current study, the Multi-Jurisdictional Bicycle Plan, was intended to create a database of roadway conditions from which the County could select segments or intersections for improvements. This plan was not adopted into the County Master Plan due to its focus on all jurisdictions. The County does not have jurisdiction over municipal or state facilities and as such cannot adopt a Master Plan stating where those improvements should take place. Instead, the MCBPTF decided to informally adopt this plan as their guide in advocating for improvements. Prior to this document, the last Countywide bicycle plan effort County staff could track down was a 1975 Mercer County Bikeway Map, 35 years prior.

**2010 County Route 546 Bikeway Study**

The County Route 546 Bikeway Planning and Development Study was prepared in July of 2010 by Michael Baker, Jr., Inc. The primary purpose of the plan was to develop a concept for bikeway infrastructure between Washington Crossing State Park in Hopewell and the Johnson Trolley Line in Lawrence Township. The proposed bikeway would also include a possible connection to the Borough of Pennington via CR 631, CR 640 and CR 632. This study analyzed existing conditions and compiled data on the roadway and proposed improvement alternatives including a preferred alternative.
2012 Mercer County Complete Streets Policy
In 2012, the Mercer County Freeholders adopted a Complete Streets Policy and became the first County in New Jersey in which every single jurisdiction had adopted a Complete Streets Policy. Twelve Borough, Township and City policies now complement Complete Streets policies at the County and State levels. Adopting these Complete Street Policies orients roadway owners to improve transportation options, access to opportunities, safety, physical health, environmental quality, and community and economic vitality. Implementation of Complete Streets policies ensures that all users of the roadway are routinely considered in transportation projects and provided with safe, convenient, affordable, and equitable transportation options. With the adoption of the Complete Streets Policy, Mercer intends to incorporate complete streets facilities on all new roadways and during resurfacing projects when time and budgets allow.

2016 Cranbury Road Area Bicycle and Pedestrian Study
The Cranbury Road Area Bicycle and Pedestrian Alternatives Study was released in 2016. Prompted by a lack of pedestrian and bicycle connections, West Windsor Township commissioned a study of five alternatives for a two-mile stretch of Cranbury Road (Route 615), from Route 571 to the County line. Proposed Alternatives include options for bicycle lanes and sidewalks and options centered on off-road facilities. The study ultimately recommends a hybrid alternative: a four-foot sidewalk along the north side of the road before transitioning to the south side of the road to avoid relocation of utility poles.

2016 New Jersey Bicycle & Pedestrian Master Plan
An update to the New Jersey Bicycle and Pedestrian Master Plan was released in December of 2016, renewing NJ’s commitment to creating a bicycle and pedestrian-friendly state. This document at the State level lays out a series of goals and proposes measurable actions to reach them. The plan also aims to integrate the NJDOT Complete Streets Policy and design frameworks into a long-term vision for New Jersey.
**2017 NJDOT Complete Street Design Guide**

In 2017, The State of New Jersey Complete Street Design Guide was released and serves as a reference for strategies and designs to achieve the goals of each municipality’s adopted policy. Our 12 municipal complete streets policies as well as the County and State policies vary in their implementation approach and intensity, but each references and promotes the NJDOT vision of providing “safe access for all users by designing and operating a comprehensive, integrated, connected, multi-modal network of transportation options” (NJDOT Complete Streets Policy). The design guide helps move municipalities as well as the State from policy to action with design recommendations.

**2018-2019 Mercer County Priority Route Process Memo**

Mercer County most recently worked with DVRPC to prepare a technical memorandum to regarding the process and methodology for analyzing our County roadways and execute that process for thirteen routes. These routes were selected with input of the Mercer County Bike and Pedestrian Task Force (MCBPPTF) and determined to be of the highest priority. During this process, the County Planning Department and Engineering Division worked very closely to establish a methodology which would produce recommendations to be considered which could actually work out in the field in accordance with MUTCD, AASHTO and local regulations.

**2019 Greater Mercer Trails Plan**

During the creation of the 2018 Mercer County Bike Plan, Mercer County transportation staff was also involved with the Greater Mercer Transportation Management Association’s (GMTMA) 2019 Mercer County Trail Plan. The GMTMA is preparing a trail network plan which will serve as a guide to further developing a trail network that will connect users of all ages and abilities to the many opportunities, services, and destinations in the region. This plan is due to be released in 2019 and compliments this plan by looking at trail and multi-use paths outside of Mercer County right-of-way. As some on-road facilities may be too expensive or difficult to construct throughout Mercer County, these networks will serve as secondary or “Plan B” routes to connect the rest of our network. See more on page ___.

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See more on page ___.
2019 Repaving Program & Bike Facility Implementation Coordination

Prior to the 2019 repaving program, several roadways were identified in need of milling and resurfacing throughout the County. During this process, the roadway is typically restriped to the existing traffic conditions.

Following a FHWA’s 2016 report titled, “Incorporating On-Road Bicycle Networks into Resurfacing Projects”, conversations within the County Engineering and Highway Divisions took place about feasibility. Staff identified several roads within the scheduled 2019 paving program which could accommodate bicycle lanes with simple restriping. These projects include no geometric changes and only make improvements to the existing cartway with epoxy paint/thermoplastic and signage. Moving forward, Planning Department staff will work on a Bicycle Implementation Repaving program alongside the County Engineering Department and Highway Division. This will be the County’s primary method of increasing the number of bicycle facilities around the County.

2020 DVRPC UPWP Assistance

In fiscal year 2020, DVRPC has scheduled to set aside staff time and resources to assist Mercer County with a pilot project on selected Mercer County roadways scheduled to be re-paved with bicycle lanes. This project will determine feasibility of bicycle improvements in circumstances where travel lanes would need to be moved, eliminated or added. DVRPC staff will work with the County in identifying specific locations and will conduct technical work to assist with planning-level design concepts. Concept refinement may require capacity analysis to assess the impacts of lane configuration changes on traffic movements and if bicycle facilities are feasible in those select locations.
As this study area comprises all of Mercer County’s municipalities, the plan aims to synthesize disparate municipal plans and local studies related to bicycle facilities and policy. The resources reviewed include local complete street policies, which serve as the foundation for the current project, as well as municipal master plans and elements. In determining appropriate bicycle improvement on County facilities, it was imperative to look at municipal proposals and priorities in determining how best to link the different jurisdictional networks. Below is a list of municipal documents reviewed for this purpose.

2004 West Windsor Bicycle/ Pedestrian Plan
NJDOT provided technical assistance to West Windsor Township by assessing 28 miles of roads and 14 miles of trails. The study finds over 60 percent of segments as ‘not optimal’ for accommodating bicyclists and pedestrians. For more feasible areas, the plan provides short- and long term recommendations for increasing the network; a few of the assessed routes are included in the current study as well. West Windsor is also home to a few corridor improvement projects such as the CR 571 Princeton Junction Project and others.

2006 Hopewell Circulation Plan Element
Hopewell Township has identified the bicycle as a low-cost and effective means of transportation that is quiet, nonpolluting, extremely energy-efficient, versatile, healthy and fun. Bicycles also provide low-cost mobility to the non-driving public, including the young. In addition, pedestrian and bicycle routes can be designed to accommodate both forms of transportation. The intent in recommending both pedestrian and bikeway plans are to ensure that the dual function is accommodated.

2011 Lawrence Township Study
The stated goal of the Lawrence Township Bike and Ped Planning Assistance Study was to develop and implement a comprehensive bicycle and pedestrian plan that includes improvements in the three (3) E’s (Engineering, Education and Enforcement), to enhance safety and mobility. The outcome of this planning study is a two-part Action Plan, The Planning Resource Manual as well as an Implementation Workbook.
Relevant Municipal Documents

2011 Hamilton Bicycle and Pedestrian Circulation Study
The Hamilton Bicycle and Pedestrian Circulation Study is envisioned as a component of the overall circulation element and will serve to support planning and implementation of bicycle and pedestrian improvements across the Township. This study was undertaken as part of the NJDOT’s Local Bicycle/Pedestrian Planning Assistance Program, which seeks to foster the development of non-motorized transportation modes in accordance with statewide goals and local needs.

2015 East Windsor Bicycle and Pedestrian Circulation Study
East Windsor Township sought to develop a plan for bicycle and pedestrian circulation that accommodates access and provides connections to key generators of non-motorized traffic. The plan is anticipated as a framework plan to guide the development of improvement concepts and policies, and to support planning and implementation of bicycle and pedestrian improvements for the township. East Windsor has indicated their commitment to improving conditions for non-motorized traffic through their Complete Streets Policy, passed in May 2014.

2016 Downtown Trenton Bicycle and Pedestrian Plan
This plan was prepared by DVRPC in 2016. This plan suggests that Trenton, the capital city and major city of Mercer County, can become a more walkable, bikable and safer city through a robust cycling and walking network and through dedicated infrastructure. The plan compiles existing conditions and provides strategies and designs ranging from standard bicycle lanes to Bicycle Boulevards, and also addresses off-road trails and pedestrian infrastructure.

2017 Princeton Bicycle Master Plan
This is the most recent municipal bike plan finished in 2017. Princeton earned recognition as Bronze Level Bicycle Friendly Community in 2013, and hopes to achieve silver status through implementation of its 2017 Bicycle Master Plan. The data for the plan incorporates a crowd-sourced webmap, an analysis of Level of Traffic Stress (LTS), and a Bicycle Penalty Metric which calculates the percentage of the street network that is fully-accessible to vehicles but falls above LTS 2 for bicyclists. The plan concludes with guidance and proposals to improve Princeton’s bicycling infrastructure and facilities.
New and Upcoming Municipal Documents

2019 Lawrence Township Master Plan Element Effort
This plan serves as Lawrence Township’s guiding document for guiding bicycle and pedestrian improvements. With approximately one-third of the town’s population unable to drive for reasons such as age, disability, or income, it is important that this significant segment of the population be able to safely access destinations. The town also recently updated their Complete Streets Policy, Complete Streets, Implementation Policy and Complete Streets Checklist.

This document is intended to further advance the Township’s vision for complete streets and related open space and recreation goals by providing goals and objectives, recommendations and implementation strategies specifically intended to enhance bicycle and pedestrian safety, access, and mobility throughout Lawrence Township.

2020 Ewing Township Rec and Open Space Master Plan
Ewing Township’s Open Space and Recreation Plan will serve as a “blueprint” for the future of its parks and recreation system. As an element of the Township Master Plan, the document will communicate the Township’s vision for current and future park facilities and make recommendations to guide Township policies, capital expenditures, and decisions by the Planning Board and Zoning Board. Through the plan, Ewing will continue to form an integrated system of open space that is sufficiently diverse and comprehensive to protect natural areas and provide sources of recreation for all residents. The ultimate goal is to deliver an adequate supply of park and recreation facilities that is connected to schools, public transit, bicycle and pedestrian routes, surrounding neighborhoods, and economic activity.

2020 Hightstown Borough Mobility Plan
The Hightstown Borough Mobility plan, funded through NJDOT, will aim to establish a long-term plan to improve the bicycling and walking environment for residents and visitors to Hightstown. The Borough has been proactive in incorporating new sidewalks and crosswalks in new public works projects and would like for this plan to build upon those efforts with private owners as well as County and State agencies.
One of Mercer County’s signature projects currently underway is a major long distance bicycle corridor along County Route 546. This County Route essentially runs from the D&R Canal next to the Delaware River in Hopewell Township through to the D&R Canal and Route 1 in Lawrence Township and covers a massive western section of Mercer County. Once completed, the Great Western Bikeway will establish 17.5 miles of bikable shoulders, bike lanes and signed bikeways on CR 546 and Scotch Road. In 2009, Mercer County requested local planning assistance from NJDOT for the project’s CR 546 segment, resulting in a plan and conceptual alignment.

With this alignment, we can create a “bicycle spine” that will allow us to connect future bike facilities and trails from Ewing, Pennington, Hopewell and Lawrence. Building off this spine will allow us to create a safe, comprehensive, connected and continuous network for residents and visitors to Mercer County. Much of this route was originally intended to be a 4-lane highway, though only ever striped to carry one lane in each direction. With such wide pavement extents, most of this road can be converted to bicycle lanes relatively easily, converting existing 8 foot shoulders to 5 foot bike lanes with 3 foot rumble and painted buffers. There are however certain segments which will require minor widening to accommodate a safe and continuous facility from the Delaware River to Route 1 and from Upper Ferry Road to CR 546. Though no ROW acquisition is anticipated, items such as utility poles, landscaping and mailboxes may need to be moved in certain cases for road widening. In 2017, Mercer County submitted a Regional Transportation Alternatives application which was awarded in 2019 in the sum of $2,365,900.
Existing Conditions on CR 546 Lawrenceville-Pennington Road

Conceptual Alternative 1 Great Western Bikeway

Connecting Bicycle Lane Facility on Federal City Road

Conceptual Bike Lanes and/or Multi-Use Path Franklin Corner Road (BMS Trail to Route 206)
Concurrently, as the Mercer County Department of Planning has been developing our Bicycle Plan, the Greater Mercer Transportation Management Association (GMTMA) has been working with their consultant, WSP, on a Greater Mercer Trail Plan. This trail plan aims to create an integrated network of multi-use trails and paths throughout the Greater Mercer region and is directly tied to the County’s on-road Bike Plan network. The combined on-road and off-road network will provide a variety of transportation needs and will connect users of all ages and all abilities to the many opportunities, services, and destinations in the region.

The effort involved inventorying existing and planned trails and paths for all jurisdictions in the Planning Area, and gained input from all relevant stakeholders. WSP is currently creating a plan for an interconnected network of multi-use paths that enable access to transit stations, education, retail and other employment locations and recreation. The vision is for the Planning Area to be home to a multiuse trail network that transforms public life by linking communities and the amenities within those communities with a safe, low stress option to motorized travel.

This plan alongside our Mercer County Bike Plan can be transformative for Mercer County in creating wholesome connections. Trails, bikeways and greenways are often seen narrowly when it comes to their benefits. People tend to focus on the recreational or environmental aspects of bikeways, trails and greenways, failing to see the big picture—the total package of benefits that a bikeway, trail or greenway can provide to communities, including public health, economic and transportation benefits, and even the effect on community pride and identity. See the benefits section for more information.
Vital Local Connections

Mercer County is lucky to be home to hundreds of recreational facilities (including parks, ball fields, trails, nature preserves, nature centers, etc.) that are dispersed throughout the County. In addition, the County has done an excellent job preserving farmland and open space. Today, approximately 28,000 acres of land in Mercer County is protected and preserved, accounting for over 20% of all developable land in Mercer County. The County also has a wealth of existing and planned trails. Among all of these recreational facilities, open space, trails, schools, neighborhoods, local businesses and other areas of interest, there are few connections for non-motorized traffic. Under current conditions, it is difficult for a pedestrian or cyclist to get from the Delaware and Raritan Canal State Park to Mercer County Park.

At the same time, it is difficult for workers and students to get from their homes to employment centers or schools. Where a short bike ride should be possible to get to school, current road conditions make it difficult and oftentimes dangerous to ride to school with on-road traffic. Though State Law in New Jersey grants bicycles the same rights and subjects them to the same duties as a motor vehicle driver, it is oftentimes impractical for the average rider to utilize existing right-of-way.

The Mercer County Bike Plan strives to utilize the County Road System to create as many connections as possible so our residents can travel without a motor vehicle. With some of the best natural and institutional assets in New Jersey, Mercer County will strive to connect these for the general public. The following pages illustrate a few of the many incredible assets within the County that could ultimately be connected with a full bicycle network.

Over 28,000 acres of land in Mercer County are protected and preserved, accounting for over 20% of all developable land in the County. Of the land preserved for recreation and public use, most land isn’t interconnected in a way that residents can access without an automobile.
The 70-mile trail is one of central New Jersey’s most popular recreational corridors for canoeing, jogging, hiking, bicycling, fishing and horseback riding. The canal and the park are part of the National Recreation Trail System, Circuit Trails and East Coast Greenway. This linear park is also a valuable wildlife corridor connecting fields and forests.

The LHT is a 18.7 mile trail that traverses public and private lands in Lawrence and Hopewell Townships including Mercer Meadows, the Stony Brook Millstone Watershed Association, Mt. Rose Preserve, Maidenhead Meadows Park and more. The trail is complete and open to the public for all but 3.3 miles which planned. The trail offers safe, off-road access for all who want to enjoy the great outdoors.

The Delaware River Heritage Trail’s goal is to ultimately link 24 towns in the hopes of highlighting the cultural and natural resources along the river. The Delaware River Heritage Trail will follow the east bank of the Delaware River from D&R Canal in downtown Trenton to the Ben Franklin Bridge in Camden and will loop to Pennsylvania to connect from Morrisville to Philadelphia’s Tacony neighborhood in Pennsylvania.

Following the corridor of the former Johnson Trolley Line in Lawrence Township, the Johnson Trolley Line trail is a 1.9 mile route that is divided by Interstate 95. The Johnson Trolley Line South is also a linear park that runs from the Shabakunk Creek in the south to Rider University in the north. At just under one mile in length, the southern route connects the future Heritage Park, the Loveless Nature Preserve, Central Park, and Rider University’s nature trail.
Mercer Meadows consists of more than 1,600 acres, divided among five separate districts (Rosedale Park, Mercer County Equestrian Center, Mercer County Park Northwest and Curls Woods). Miles of mowed and gravel trails provide visitors and their families with scenic walking and biking routes through the meadows and woodland. Fishing and kayaking is also popular activity at the park’s four water bodies.

Baldpate Mountain is located adjacent to the Delaware River, on the border of Mercer and Hunterdon Counties, just south of Lambertville. The woods at Baldpate Mountain have over 12 miles of marked trails for hiking, horseback riding, mountain biking, and trail running. A walk to the grassy summit of Baldpate, the highest point in Mercer County, offers a spectacular view of the Delaware River and the City of Trenton.

Mercer County Park is 2,500 acre park primarily within West Windsor Township and includes a tennis center with indoor and outdoor courts, an ice skating center, a boat marina, a lake used for rowing with local and national events, picnic and playground areas, soccer, baseball, and cricket playing fields, basketball, bocce and volleyball courts, dog parks, paved paths and nature/bike dirt trails. Mercer County Community College is on the southern border.

The Abbott Marshlands contain a number of different habitats, including tidal and non-tidal freshwater marsh, streams, upland forest, and forested swamps. These habitats support a huge array of plant and animal life, making the Marshlands an excellent destination for nature enthusiasts. The marshland also has 4 trails for hikers and cyclists that allow visitors to explore the park.
Veteran’s Park is a large park in Hamilton Township that has walking and bike paths, as well as many other facilities. The recreation facilities include a playground, picnic areas, formal gardens, a shallow lake, and numerous memorials, baseball fields, tennis, bocce, croquet, badminton, and shuffleboard courts as well as two dog parks. The historic area near the entrance includes a Civil War and Native American Museum.

Washington Crossing State Park is a 3,575-acre park in Hopewell Township and is the location of General George Washington’s Delaware River crossing on December 25, 1776 prior to the attack on Trenton, NJ. The park offers miles of hiking and cycling trails, numerous historic artifacts, a nature center, observatory, overlook, and contains a variety of wildlife and plant species.

The South Riverwalk Park sits above the Route 29 tunnel in the City of Trenton and hosts many festivals throughout the year. It also hosts weddings, walk-a-thons, community events and offers picturesque views of the river and waterfront. Within the park sits, bicycle and pedestrian walkways, lawn areas, pavilions, a children’s playground, an historic interpretive area and an urban streetscape along Lamberton Street.

The Stony Brook-Millstone Watershed Reserve in Hopewell Township was created with an initial gift of 400 acres from Dr. Muriel Gardiner Buttinger in 1969, the Reserve now spans nearly 1,000 acres of forest, wetlands, meadows and farmland. More than 10 miles of hiking trails wind through these habitats and pass by two historic farmsteads that date back to the 18th and 19th centuries.
Located between two of the nation's most important cities, in an important corridor for the Mid Atlantic region, the Camden & Amboy Railway was the third railroad to be constructed in the nation. Today the line is no longer used but right-of-way is retained by Conrail. In the future, this could be a great location for a Rails to Trails project, creating walking, cycling, and commuting connections for residents and visitors alike.

The Capital to Coast Trail is a 55-mile (89 km) cross-state multi-use trail network that is designed to span the state of New Jersey (west to east) from the Delaware River in Trenton through much of Eastern Mercer County, including Miry Run Ponds (Dam Site 21), to the beach front town of Manasquan on the Atlantic Ocean. When finished the trail will be the third longest in the state, behind the Delaware and Raritan Canal Trail and the Appalachian Trail.

The Union Transportation Trail is a 9 mile rail trail on the former Pemberton & Hightstown Railroad in Monmouth County. The trail now accommodates equestrians, hikers, walkers, joggers and bicyclists and will ultimately be extended into Mercer County from Old York Road in East Windsor Township to downtown Hightstown. The new extension will continue to follow the Jersey Central Power and Light right-of-way.

The East Coast Greenway is the nation’s longest connected biking and walking route and will ultimately connect 15 states as well as 450 cities and towns. The approximately 3,000-mile protected biking and walking routes will allow bicyclists, walkers, runners, inline skaters, horseback riders, wheelchair users, cross-country skiers and more — of all ages and abilities — feel safe, for commuting and recreation.
Greater Philadelphia is the proud home of the Circuit Trails, a vast regional network of hundreds of miles of multi-use trails that is growing in size each year. The Circuit connects Greater Philadelphia communities, and provides endless opportunities for recreating and commuting. Governments, non-profits, and foundations have collaborated to complete over 300 miles of the envisioned 750-mile regional network.

The September 11th National Memorial Trail is a 1,300 mile system of trails and roadways that are a symbol of resiliency and character that links the World Trade Center in New York, the Pentagon in Washington D.C and the Flight 93 Memorial in Shanksville, Pennsylvania. It serves as a tribute to the fallen men and women who perished on September 11, 2001.

The Wellness Loop has been designed to provide connectivity between Battle Monument and the Assunpink Creek using Broad and Warren Streets. This loop operates on a pair of one-way streets. The wellness loop provides bike compatible roadways between the Battle Monument and the heart of downtown, with additional connections to the Assunpink Creek at Mill Hill Park.

In addition to many regional, state-wide and national trail systems running through Mercer County, we have hundreds of miles of smaller local trails. These trails are the capillaries to main arterial trail systems, oftentimes more remote and secluded. They are great places to walk, run and enjoy within each town in Mercer County.
Educational Institutions

PRINCETON UNIVERSITY

RIDER UNIVERSITY

THE COLLEGE OF NEW JERSEY

MERCER COUNTY COMMUNITY COLLEGE

THOMAS EDISON STATE UNIVERSITY

PRINCETON THEOLOGICAL SEMINARY

INSTITUTE FOR ADVANCED STUDY

107 PUBLIC AND 65 PRIVATESCHOOLS

OLD BARRACKS MUSEUM

GROUND FOR SCULPTURE

NJ STATE MUSEUM AND PLANETARIUM

MORVEN MUSEUM & GARDEN
This study considers the context of county-wide networks and amenities. Under this study every single County Roadway (approximately 180 miles) was analyzed for existing conditions and has a recommendation for future consideration. Only those routes under direct ownership and jurisdiction of Mercer County were observed unlike the 2010 Multi-Jurisdictional Bike Plan which examined both Municipal and County roadways.

It was determined that every County Route should be examined for a variety of reasons. Foremost, it was determined that choosing a select number of routes would limit the County in building out a network based on a Complete Streets Policy. By analyzing all routes at once, we can utilize a data-driven methodology to rank each route, or route sub-segments, by improvement cost and effort. In doing so, Mercer County can prioritize the low cost "low hanging fruit" for capital improvements while beginning work to design larger, more costly and more problematic routes. In doing so, we have also identified pinch points and determined future road conditions to be considered. This means that whenever Mercer County reconstructs a bridge or culvert, reconstructs a roadway or works on a County facility, projects can be programmed with design recommendations for future bicycle facilities.

Another benefit to analyzing the entire road network is that it provides an equitable way of reviewing our County network for improvements. By reviewing the entire County, underrepresented and overrepresented neighborhoods and corridors are treated equally. Below is a quadrant map of the County Road network, divided into 9 quadrants to make for legibility:
<table>
<thead>
<tr>
<th>CR #</th>
<th>Name(s)</th>
<th>Length</th>
<th>Maps</th>
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<tbody>
<tr>
<td>518</td>
<td>Lambertville-Hopewell Road/ Louellen Street/ Hopewell-Rocky Hill Road / Georgetown Franklin Turnpike</td>
<td>7.35 miles</td>
<td>A1, A2</td>
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<tr>
<td>524</td>
<td>Broad Street</td>
<td>5.79 miles</td>
<td>B3, C3</td>
</tr>
<tr>
<td>526</td>
<td>Edinburg Road/ South Mill Road</td>
<td>3.84 miles</td>
<td>B1, C1</td>
</tr>
<tr>
<td>533</td>
<td>Quaker Road/ Quaker Bridge Road/ Mercerville-Quakerbridge Rd / White Horse Ave / Whitehorse-Mercerville Rd</td>
<td>8.65 miles</td>
<td>B1, B2, B3</td>
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<tr>
<td>535</td>
<td>East State Street/ East State Street Extension/Nottingham Way / Edinburg Rd./ Mercerville Edinburg Rd./Old Trenton Rd.</td>
<td>11.70 miles</td>
<td>B1, B2, B3</td>
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<td>C1, C2</td>
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<td>A2, A3, B2</td>
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<td>Sam Weinroth Road</td>
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<td>A3, B3</td>
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<td>Spruce Street</td>
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<td>B3</td>
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<td>Nottingham Way</td>
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<td>Nottingham Way</td>
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<td>Pennington-Rocky Hill Road</td>
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<td>Arctic Parkway</td>
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<td>Nursery Road</td>
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<td>Sloan Ave/ Sweet Briar Ave/ Flock Road</td>
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<td>672</td>
<td>Broad Street</td>
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</tr>
</tbody>
</table>
Mercer County Map Panel Index

Somerset
- Hopewell Borough
- Pennington Borough

Hunterdon
- Hopewell Township
- Lawrence Township

Mercer
- Princeton
- Hamilton Township

Middlesex
- East Windsor Township
- Robbinsville Township

Monmouth
- Hightstown Borough

Burlington
- Ewing Township
- Trenton

Bucks

Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Sharrow
These are the simplest proposed facilities and require the least amount of infrastructure and improvements. They are also ranked as the least comfortable and safe as cyclists and drivers must share the roadway. As a result, these facilities are only recommended for roads posted for 25 mph or slower and with an AADT less than 10,000.

Standard Bicycle Lanes
A standard bicycle lane offers a basic travel way, separated by a solid white line, for bicyclists adjacent to vehicle travel lanes. These are separated facilities that are safer than a mixed travel way and offer a more comfortable ride. These are recommended for locations where cartway is wide enough for these lanes but too narrow for buffered bicycle lanes.

Buffered Bicycle Lanes
A buffered bicycle lane offers more separation between vehicle lanes and bicycle lanes. Buffers also help create a much more comfortable riding environment for younger and older riders. A standard Mercer County double white line buffer will range from 1.5’ to 4’, and may include raised pavement markers to help alert drivers of cyclists at night or under adverse weather conditions. In rural areas away from significant residential development, rumble strips may be considered to provide drivers with an additional auditory and sensory notification.

Off-Road Facilities
This grouping includes facilities such as physically protected bicycle lanes, sidepaths, and multi-use paths, all of which are located outside of the road travel lanes, road cartway or outside of the County right-of-way. These facilities offer the most protection and comfort for bicycles but are the most difficult and expensive to construct and maintain. Careful design and engineering is required as well as geometric changes to the roadway. In many cases, the County would need to work with towns and property owners to secure the necessary travel way.

Existing “Trails”
These are “trails” known and verified to exist. “Trails” include sidepaths, multi-use paths, or minimally improved hiking paths. They may include hard paths such as asphalt and concrete, or be of soft materials such as stone dust, turf or dirt. These may include bikable and non-bikable trails.

Existing Bike Lanes
These are existing on-street bicycle facilities that were built and are maintained by either the municipality, County or State. Bike lanes may encompass either regular bicycle lanes or buffered bicycle lanes. They vary in size and design as per jurisdiction and year constructed.

Proposed Bike Lanes
These are bicycle lanes that are located on either a municipal or State plan or are proposed by a municipality or State. These facilities may at some point be contracted for the general public to use and show where additional connections can and should be made. Proposed bike lanes may encompass either regular bicycle lanes or buffered bicycle lanes.

Proposed Trails
These are trails known and verified to be either in, or entering, the concept development phase or preliminary/ final engineering phases and are actively moving forward to construction. Within a few months or years, these trails will be constructed for the general public to utilize.

Existing Sharrows
These are shared use roadways known and verified to exist. They include either signage, on-street sharrow markings or both. They show where existing connections exist and where additional connections can be made.

Municipal Boundary (1891)
These are municipal boundary lines separating different municipalities.
Panel C-3 Bike Facility Improvement Type To Be Considered
The WSP "Demand Score" in this map shows a combination of elements that look at a variety of factors that influence demand for bicycle travel ranging from socio-economic factors to environmental factors to demographic and population geography factors.

Demographic factors such as population density under 18 and over 64, zero car household density, slow walk transit to work density as well as an income-poverty ratio density were used. In addition, geographic factors such as population density, job density, school/university access, park access, commercial access, and bus/train access were used. [SEE CHART ABOVE FOR WEIGHTS]
Since Mercer County’s Complete Streets Policy adoption in 2012, the County has been striving to promote a multi-modal approach to transportation. The policy calls for County officials to promote walkability, pedestrian safety, increased bicycle use and alternative modes of transportation throughout the County in order to increase public safety, sustainability, efficiency, mobility and air quality, while decreasing overall traffic congestion. This policy initiative is driven by significant demographic changes as well as significant research quantifying the many economic, environmental, mobility and social benefits of complete streets.

Demographic Changes

According to Census Bureau population projections for the US, in 2015 individuals between the ages of 18 and 34 numbered 75.3 million, surpassing baby boomers (74.9 million) as the largest generational cohort in the United States. This generation is now entering a period in which their purchasing power is growing at an exponential rate and will soon take over the previous generation to become our nation’s dominant consumer base. Everyday decisions like housing and transportation choices that millennials will make will translate into hundreds of billions of dollars in economic activity.

According to DVRPC, approximately one-third of young adults (32.1%) currently live at home with their parents or other relatives. Many of these factors are a result of a sluggish economy during the recession, low starting wages out of college, student debt, high cost of housing and the fact that young adults are marrying and having children later. Despite these factors, the millennial generation represents the largest share of recent homebuyers according to a 2015 study conducted by the National Association of Realtors (NAR). That means that over 24 million millennials will likely move out on their own over the next several years as they enter the work force, marry, or save enough to purchase a home. According to the 2015 NAR study, the millennial generation already represents the largest share of recent homebuyers and will only grow larger over the next few years.

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In Mercer County, millennials make up a significant portion of certain municipalities’ populations. Ewing Township and Princeton rank #10 and #11 respectively out of 352 municipalities in the Greater Philadelphia DVRPC region (9 County Region) for millennials as a proportion of their total population. Lawrence Township, Hightstown and the City of Trenton also have significant population proportions of millennials. Where they choose to live will have momentous implications for communities not only in Mercer County but the region and state. Even a small percentage of this generation exhibiting any preference or behavior can translate into large investments. Clearly, this generation will shape our economy and drive our land use and transportation investments for decades to come. Communities unprepared or unwilling to accommodate this new generation will lose a large market segment and consumer class. Doing so will also impact existing residents and may have a cascading effect on the success of existing and future economic development as well as municipal budgets.

Existing Demographics

In addition to preparing for significant demographic changes, we must look at our current demographic profile in order to understand how to best serve our public. With an estimated population of 373,362 persons calling Mercer County home as of 2017, there are varying needs for different demographic segments of the County. Demographics subgroups will all have different priorities and as such, finding common ground in determining facility choices and improvements is critical.

Bicycle demand is influenced by a variety of factors, including the locations of population centers, jobs, key destinations, and demographic factors. In terms of bicycle planning, there are several key demographic indicators called out in this plan due to their interconnected role in determining demand and need. Factors such as percent of households living below poverty level, number of households with no vehicles, populations of persons over 62 and under 18, as well as commuting mode choice all play a significant role in determining need and demand for bicycle improvements. Though all County roads are considered for improvements, these demographics will help influence which roads require prioritization over others when funding is limited. Populations living in poverty and with no vehicles have a greater need for bicycle facilities over wealthy residents or those with multiple vehicles. Younger or older residents who cannot drive also have a greater need, as do people who commute via bicycles to work or school. The following pages discuss demographics as well as the various benefits of bicycle improvements on the County.

3 AMERICAN COMMUNITY SURVEY 2013-2017 5-YEAR ESTIMATES
Cycling is an important alternative transportation choice for many low income households. Unlike high income households who typically choose to commute by bike for health or environmental reasons, low-income households often have no choice. Low income populations may often not be able to afford the costs associated with car ownership, and may rely more frequently on walking, bicycling, and transit options. Those that do own a vehicle may only have one, which is shared among many family members and not always available or may have broken down, and the costs of repair must compete with things like rent, mortgages, groceries or the electric bill. As a result, a majority of people walking and bicycling to work are of low-income backgrounds (with the second highest majority those of very high-income who do so out of choice).

While the median household income in Mercer County was approximately $77,650 in 2016, approximately 11.4% of people live below the poverty line. Much of the County’s poverty is concentrated in the City of Trenton but high percentages also exist in Princeton, Hightstown, Ewing, and Hamilton. With a little over 1 in 10 people living in poverty in Mercer County, having alternative travel modes is essential for prosperity and equity of all Mercer County residents.
Zero car households are becoming more common in the United States as we continue to urbanize and technology keeps advancing alternative options. According to the 2017 American Community Survey, approximately 5.2% of people in Mercer County had no vehicle available and nearly 22% had only one vehicle in their household. These are people who oftentimes either cannot afford to own and operate a vehicle or simply choose to live a car free lifestyle. Concentrations of zero car households can be found in the Trenton-Ewing-Hamilton area as well as parts of East Windsor, Princeton, and Hightstown. Many of these areas are of greater density and oftentimes can offer simple amenities such as sidewalk, bike lanes or sidepaths to allow people to walk or bike around.

In the City of Trenton, there are census tracts and neighborhoods where nearly half of all households own no car. These are households that contribute to municipal and County taxes, yet use a much smaller portion of the transportation network. It is important to ensure all constituents are given equitable access to safe and efficient mobility, whether it be walking, biking, using transit, or driving.
Mercer County residents have a median age of 38.6 years. Mercer County has approximately 80,409 persons under the age of 18 out of a total 373,362 persons or approximately 21.5% of our population. The County also has approximately 65,952 persons over the age of 62 which is approximately 17.7% of the population. These two groups represent a significant population of individuals who are significant users in need of safe bicycle and pedestrian facilities.

Young children and the elderly who need special assistance need safe crossings, ADA compliant wheelchair ramps, and dedicated facilities such as sidewalks, bike lanes or multi-use paths. Different subgroups of children also have different needs. Very young children and their parents need special facilities because they need a separation from vehicular traffic and dangerous and unpredictable conditions. Older children, though more aware of their surrounds, also need safer facilities and separations. As children enter adolescence and become young adults searching for freedom, walking or bicycling is oftentimes their only means of transportation. To these kids, who are too young to have a driver's permit or license but old enough to travel by themselves, these continuous, connected and safe facilities are critical to their growth and independence.

Multimodal facilities are just as critical for seniors entering retirement. In order to have a vibrant multi-generational society where our elderly can age in place, they need safe facilities to get them from place to place. As some seniors begin to abandon vehicles, out of choice or health necessities, alternative transportation such as walking, biking or taking public transit is the only method to move around. Additionally, some seniors may want to remain in their current neighborhoods and communities but would also like to engage in a more active lifestyle now that they have time. Simple things like walking to the store, senior center, friend or family member’s house is oftentimes impossible due to the lack of connections and facilities.

The maps on the following page show census tracts within Mercer County with the percentage of seniors and persons under 18 out of the total population. Within Mercer County, we have places of high senior concentrations in parts of Princeton, Lawrence and Hamilton. One census tract in Princeton has seniors consisting of 40.4% of the population and one in Hamilton has nearly 33.5% of its population consisting of seniors. We also have areas with very significant concentrations of young children under 18 in certain census tracts within Trenton where children under 18 comprise 35.8% and 34.2% of the population. Overall there are 20 tracts in Mercer County where children under 18 represent 25% of the population.
Within Mercer County, even though most people drive alone due to the nature of our built environment, there are several places within the County where people do commute via bicycle to work. In the Princeton and West Windsor area, there is a significant bicycle commuter population with a smaller commuter group in parts of Trenton, Ewing, Lawrence and Hamilton. Even though these numbers are small in relation to the entire population, they are not insignificant. These commuters are die hard cyclists who are often not riding in dedicated bike lanes but instead riding in travel lanes along with fast moving vehicles, trucks and busses. They represent a small percentage of the population who will ride regardless of facilities being available.

The rest of the population is more careful and will only ride if a bike lane or sidepath is present, regardless of how close they may be to their destination. Though not represented in this dataset and map, schoolchildren who live within a quarter mile of a school oftentimes cannot walk or bike to school because of a lack of sidewalk, bike lanes or crossings. The same issue exists for commuters who live near their job or nearest transit station but have to drive because no alternative exists.
Real Estate Impacts

With the construction of bike and trail facilities, real estate values oftentimes see positive gains. While the valuation of real estate is based on a multitude of factors, research shows that people positively value things such as parks, trails, bicycle facilities, farmland, walkable communities, wilderness areas, beaches, lakes and preserved open space. Neighborhoods that offer these amenities become more desirable and in turn increase the selling point of homes and the land they sit on.

A 2017 survey by the National Association of Realtors found that millennials and Gen Xers are more likely to live in at least somewhat walkable neighborhoods, and are more likely to have sidewalks, public transit, and parks nearby. Those characteristics were noted as being VERY important in determining where millennials and Gen Xers prefer to live. Of those surveyed, approximately 80% responded that they liked walking and about half like to ride their bikes. The number of people who responded that bike lanes or paths are very important or somewhat important in deciding where to live is nearby has been slightly increasing over the years. In the short time from the last 2015 survey to the 2017 survey, the number rose from 52% to 54% of respondents. Of all respondents who were asked what keeps them from walking, they mentioned that there are too few sidewalks or trails available to them.4

This preference for complete street communities translates indirectly to demand and real estate valuations. In our region, there are several examples of direct impact. In nearby Radnor Township, PA, a study found that properties within a quarter-mile (0.4 km) of the Radnor Trail, a 2.4-mile (3.9 km) trail which sees an estimated 200 to 600 users per day, were valued on average $69,000 higher than other area properties further away. Real estate listings in Radnor frequently mention trail access in their advertisements, and for-sale signs often appear on the trail side of properties. 5

Another 2009 nationwide study by CEOs for Cities, a cross-sector organization that develops ideas to make U.S. cities more economically successful, found that “houses located in areas with above-average walkability or bikability are worth up to $34,000 more than similar houses in areas with average walkability levels.”6 Nationally, residential developers have increasingly built properties with features that support use of trails with facilities such as bike parking, trail connections, bike repair stations and more. Overall, homes near walkable, and often bikable, trails enjoy premiums of between 5% to 10%, according to an analysis by

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Headwaters Economics, a research group focused on community development and land management issues. Other surveys have put that percentage even higher.

Within the region, residential developers have built properties with features that support use of trails with facilities such as bike parking, trail connections, bike repair stations and more. These facilities not only serve to promote good community relations but have a direct benefit to developers as their sites become more desirable to homebuyers and tenants. Just as community rooms, pools and gyms are amenities that multi-family developers can often include for residents, bicycle lanes and trails are oftentimes just as appealing if not more so.

In Philadelphia, Brandywine Realty Trust is developing trailside properties, including the FMC Tower, a 49-story, 730 foot tall mixed-use skyscraper recently completed. Access to the Schuylkill River Trail is touted in advertisements for the tower. Gerard H. Sweeney, Brandywine’s president and chief executive officer, expressed his company’s support for connecting regional trails in a 2013 letter to the city of Philadelphia, stating, “When fully complete, the Circuit Trails network will help connect people to jobs, recreational opportunities, public transportation, and other neighborhoods, and will serve as a gateway to open green space.”

New research from Portland State University finds that proximity to a network of high-quality bike facilities such as protected bike lanes, buffered bike lanes, and bike boulevards, is associated with an increase in property values. Through the separate estimation of ordinary least squares hedonic pricing models and spatial autoregressive hedonic models of single and multifamily properties, it was found that proximity to advanced bike facilities (measured by distance) had significant and positive effects on all property values, which highlighted household preferences for high-quality bike infrastructure. Furthermore, the study showed that the extensiveness of the bike network (measured by density) was a positive and statistically significant contributor to the prices for all property types, even after proximity was controlled for with respect to bike facilities and other property, neighborhood, and transaction characteristics. Finally, estimated coefficients were applied to assess the property value impacts of the Green Loop (i.e., the proposed Portland, Oregon, signature bike infrastructure concept), which illustrated the importance of considering the accessibility and the extensiveness of bike facility networks.

In 2013, REMAX Realty in Atlanta explained that homes near the BeltLine—a transit and trail loop around the city that will include a planned total of 33 miles (53 km) of pedestrian and bicycle trails—were selling within 24 hours. Before the Atlanta BeltLine project began, homes along the corridor had typically stayed on the market for 60 to 90 days. Furthermore, real estate listings near trails and bike facilities frequently mention trail access in their advertisements and for-sale signs often appear on the trail side of properties.

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9 Liu, Jenny & Shi, Wei., 2016 - Impact of Bike Facilities on Residential Property Prices
Retail, Tourism and Economic Development Impacts

Bicycle infrastructure is playing an increasing role in local economic development and has the potential to promote and strengthen a local community’s tourism sector. According to a 2009 report by the League of American Bicyclists, the national bicycle industry contributes approximately $133 billion annually to the U.S. economy by supporting over 1 million jobs, generating nearly $18 billion in federal, state, and local taxes, and providing nearly $47 billion for meals, transportation, and lodging purchases during bike trips and tours. Economic development impacts range from higher value rents and property prices, more retail sales, more aesthetically pleasing neighborhoods and commercial corridors, better tourist and recreational transportation options, and more. Jobs relating to bike infrastructure range from sale and maintenance of bikes and bike facilities to ancillary jobs such as those that are tied to increased tourism.10

Local stores particularly benefit more than others. Local bike and service shops keep money in their communities on a much larger scale than multi-national firms that often send money overseas or to national firms which send money to investors and shareholders across the nation. Numerous studies of businesses across the nation show that cyclists are competitive consumers, spending similar amounts or more, on average, than their counterparts using automobiles. On average, though cyclists spent less per trip, they made more trips and more trips to local stores rather than to national chain big box stores.

A study by the Salt Lake City DOT found that “replacing parking with protected bike lanes increased retail sales.” A general street upgrade on Broadway Avenue removed 30% of on-street parking from nine blocks of the major commercial street, but improved crosswalks and sidewalks and added protected bike lanes. In the first six months of the next year, retail sales were up 8.8% over the first six months of the previous year, compared with a citywide increase of only 7%. After the changes, 59% of business owners said they supported the street improvements, 23% were neutral and only 18% opposed them.11

“Business is up 20% since last year. I’m excited about the changes to the neighborhood. The bike lanes and lower speed limits help to calm car traffic and increase pedestrian traffic – all positives for my business.” - Paradise Palm. John Mueller, Owner

11 Salt Lake City DOT, “300 South Progress Report” Sept. 2015,
A study of the Pinellas Trail in Florida found that the downtown area of Dunedin, Florida was suffering a 35 percent storefront vacancy rate in the early 1990’s until the Pinellas Trail came into town. Now, storefront occupancy is 100 percent and business is booming. New businesses included several restaurants, a bike shop, an outdoor equipment supplier, a bed-and-breakfast operation, and a coffee shop.\textsuperscript{12}

The Rails-to-Trails Conservancy found that the Schuylkill River Trail, a popular Circuit route, generated $7.3 million in direct economic impact along its route in 2009, and the Delaware & Lehigh Trail, a 165-mile (265 km) rail-trail through eastern Pennsylvania, was found to have generated an annual economic impact exceeding $19 million in 2012. As part of the study, a survey was conducted and found that 77% of respondents indicated they had purchased some hard-durable goods during the past year because of their use of the trail, with the average expenditure amounting to more than $400 per user on top of an average of $9.07 per visit.\textsuperscript{13}

\section*{Tourism in Mercer County and New Jersey}

Tourism and recreation plays a significant role in the Mercer County economy. According to a recent New Jersey Tourism study, expenditures in Mercer County were $1.311 billion in 2016, a 5.5\% increase from 2015 and accounts for nearly 12,833 positions or 4.5\% of all employment. State and local tourism-related tax receipts for Mercer County increased by 4.1\% to $166.0 million. In 2016, total tourism demand in the State of New Jersey grew to $44.1 billion, a 2.9\% increase from 2015. In 2016, the tourism industry directly supported 321,231 jobs in New Jersey and sustained 517,559 jobs including indirect and induced jobs. These jobs represent 9.8\% of total employment or 1-in-10 jobs in New Jersey. Without the tourism industry, New Jersey households would need pay an additional $1,525 each in order to maintain the current level of state and local government services.\textsuperscript{14}

Though domestic visitor (NJ residents) markets comprise the majority (88.4\%) of tourism sales in New Jersey, there are some national and international visitors to NJ that come to enjoy our rich education, arts and history assets. Unlocking Mercer County to more of the national and international community would vastly help our tourism industry. Mercer County has well developed local and regional trail network of existing trails as well as trails under construction or in the planning stages. Trails such as the Lawrence Hopewell Trail, Delaware and Raritan Canal State Park Trails, not to mention many other smaller trail networks provide the backbone to our system. The County highway network provides a significant opportunity to connect these networks and their missing segments. As County highways connect our

\begin{footnotesize}
\begin{enumerate}
\item WMTH Corporation, “Economic Impact of Biking” 2009
\item Rails to Trails Conservancy, “Schuylkill River Trail 2009 User Survey and Economic Impact Analysis” Nov. 2009
\end{enumerate}
\end{footnotesize}
municipalities, they provide the long connections required for a continuous and connected bicycle network that other trails or bike lanes can connect into.

More specifically within the tourism industry, active transportation is a growing industry in the region and state. According to a Rutgers report on “The Economic Impacts of Active Transportation in New Jersey, in total, active transportation-related infrastructure, businesses, and events were estimated to have contributed $497.46 million to the NJ economy in 2011 or $565.15 million in 2019 dollars and supported 4,018 jobs. Active transportation also added $153.17 million in compensation ($174.01 million in 2019 dollars), added $278.12 million to state GDP ($315.97 million in 2019 dollars), and generated an estimated $49 million in total tax revenue ($55.67 million in 2019 dollars).15

Other Key VTC Study Results

- In 2011, it was estimated through surveys on revenues from bicycling, running, or walking related equipment and services that 317 independent businesses received $267.5 million in annual revenue. This provided 2,253 full and part-time jobs, paying out $37 million in salaries and wages.
- Participation in run and walk events was estimated to total 197,930 in 2011, with 44,408 participating in bicycling events for an overall total of 242,338. Some 19% of participants were estimated to have traveled from outside of New Jersey to attend, with 6.7% of respondents indicating that their trip required an overnight stay. Participants were estimated to spend over $35 million annually in the state as part of their trips to events, with over $10 million of that spending deriving from visitors traveling from outside NJ.
- The model output estimated that these active transportation-related events generated $57.82 million in economic activity in 2011. This resulted in an estimated 369 jobs at New Jersey businesses, with compensation amounting to $17.79 million. The total estimated tax contribution in 2011 as a result of event participant spending was $6.45 million, with a contribution of $31.2 million to the state’s GDP.

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Bicycle, Pedestrian & Trail Facility Employment Impacts

Though not a factor for making improvements, bicycle facility construction helps stimulate and support local employment. Construction of facilities benefits the local economy as it requires local labor to go out and physically construct improvements. Once constructed, businesses often benefit from these facilities and employ workers to service the facility patrons. In 2011, The Political Economy Research Institute released a study of 58 separate bicycle and pedestrian projects across the United States. Impacts studied in the report are specific to the design and construction of roads, bicycle, and pedestrian facilities. They do not consider the ongoing maintenance and use of these facilities nor do they account for additional economic development or potential ancillary effects in regards to job creation.

In the table below, it can be seen that on average, every $1 million spent on the design and construction of bicycle and pedestrian specific projects results in approximately 8.42 jobs (4.2 direct, 2.2 indirect, 2.02 induced). The greatest job generation is produced for infrastructure projects specific to bicycling (11.41 jobs created for every $1 million spent) while the lowest job creation is for road-only projects such as repaving or widening (7.75 jobs per $1 million spent).

**Sample Calculation of Job Creation within Mercer County:**

- 149 miles of on-road bike facilities @ $37.1 Million Construction Cost x 11.41 jobs = 423 total jobs
- 25 miles of off-road bike facilities @ $23.7 Million Construction Cost x 9.57 jobs = 227 total jobs

**For a total of 650 total jobs (direct, indirect and induced) with a full network buildout**

*The above total is a rough estimate for planning purposes, as exact costs cannot be quantified at this time.

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Road</th>
<th>Bicycle</th>
<th>Pedestrian</th>
<th>Off Street Multi-Use Trail</th>
<th>Direct Jobs per $1 Million</th>
<th>Indirect Jobs per $1 Million</th>
<th>Induced Jobs per $1 Million</th>
<th>Total Jobs per $1 Million</th>
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<td>4.78</td>
<td>2.15</td>
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</tbody>
</table>

Original Data Source: Garrett-Peltier, Bicycle and Bicycle Infrastructure: A National Study of Employment Impacts, Political Economy Research Institute, 2011
Public Health Benefits

Regular exercise, such as cycling and walking is important to good health. Health professionals recommend at least 30 minutes of moderate-intensity physical activity each day. This is enough to maintain good health, even if the exercise is broken up into short 10 minute bursts. Riding a bike to work, school, college, or taking neighborhood trips is a convenient and practical way to incorporate regular exercise into your busy day.

New Jersey’s adult obesity rate is approximately 27.4%, up from 17% in 2000 and from 12.3% in 1995.\textsuperscript{16} By comparison, in 2016 approximately 33.7% of Mercer residents reported a BMI ≥30. According to a Greater Mercer Public Health Partnership study of Mercer County residents, the percent of Mercer County residents reporting diabetes increased from 8.3% in 2011 to 12.2% in 2016. Also in 2016, Mercer County had the second highest percentage of patients reporting diabetes among comparison counties in the State.

In addition to obesity and diabetes, it was found that in 2012, the leading causes of mortality in Mercer County were heart disease (159.9 per 100,000 persons) and cancer (156.5 per 100,000 persons).\textsuperscript{17}

A 2008 national study found that obesity-related employment absenteeism annual cost is between $79 and $132, per obese individual, in productivity costs.\textsuperscript{18} With 94,335 considered obese in Mercer County, this translates into between $7.45 million and $12.45 million in annual obesity-related absenteeism costs or $8.84 and $14.78 million in 2019 dollars.

According to 2014 County Health Rankings data (based on the CDC’s, The National Diabetes Surveillance System), 22% of adults over 20 years of age or some 60,987 persons, in Mercer County had not participated in a leisure-time physical activity. This inactivity is not only hurting our health but is also impacting us financially. A 2004 national study found that the annual individual medical cost of inactivity is approximately $622 or with 60,987 physically inactive adults currently living in Mercer County, this translates to approximately $51,351,054 in medical costs per year in 2019 dollars (equivalent to $842 per person). That same report found that this cost of inactivity is more than 2 ½ times the annual cost per user of bike and pedestrian trails ($318 in 2019 dollars).\textsuperscript{19}

For individuals with heart disease, the savings are even greater. According to an analysis of 26,239 men and women published in the Journal of the American Heart Association, patients with heart disease who met weekly guidelines for moderate to vigorous exercise saved on average more than $2,500 in annual


healthcare costs. Healthy patients, and those with cardiovascular risk factors, who exercised as recommended also had lower average medical costs.\textsuperscript{20}

The new study examined data from a 2012 national survey sample of more than 26,000 Americans age 18 or older, excluding people who were underweight, pregnant, or unable to walk up to 10 steps. People in the study who already had cardiovascular disease — specifically coronary artery disease, stroke, heart attack, arrhythmias or peripheral artery disease — had higher healthcare costs. But those patients who regularly exercised at recommended levels logged average healthcare costs more than $2,500 lower than those who didn’t meet exercise guidelines. The research suggests that even if just 20 percent of patients with cardiovascular disease who are not getting enough physical activity would meet exercise goals, the nation could save several billion dollars in healthcare costs annually.

Residents of Mercer County would benefit from additional exercise and providing a space for them to do so may allow more people to live more health conscious lifestyles. For those with busy schedules, incorporating exercise into their daily work/ school commute may be an attractive alternative. In a research study by the University of Glasgow in which 263,450 people and their travel to work was tracked for five years, commuters who cycled to work had a 41\% lower risk of dying from all causes than people who drove or took public transport. They also had a 46\% lower risk of developing and a 52\% lower risk of dying from cardiovascular disease, and a 45\% lower risk of developing and a 40\% lower risk of dying from cancer.

There are many factors that affect cancer and cardiovascular disease in addition to how a person travels to work and researchers went to great lengths to control many of these factors. The analyses were carried out controlling for sex, age, ethnicity, deprivation (measured as a combination of household unemployment and overcrowding, and non-ownership of a car or home), other illnesses such as diabetes, hypertension and depression, body mass index, smoking, diet (alcohol, fruits and vegetables, red meat, oily fish, poultry, and processed meat), time spent walking for pleasure or engaged in strenuous sport, level of occupational physical activity, and sedentary behavior.\textsuperscript{21}

Locally, the trails of “The Circuit” (which the Lawrence-Hopewell Trail, Johnson Trolley Line, Delaware & Raritan Canal State Park Trail, and many others are a part) also contribute to the health of Mercer County and Greater Philadelphia. A 2011 study by the GreenSpace Alliance and the Delaware Valley Regional Planning Commission found that residents’ use of southeastern Pennsylvania’s parks and trails, including the Circuit, avoids $199 million per year in direct medical costs and $596 million in indirect costs.

\textsuperscript{20} Javier Valero-Elizondo, et al., “Economic Impact of Moderate‐Vigorous Physical Activity Among Those With and Without Established Cardiovascular Disease” 2016 \url{https://www.ahajournals.org/doi/10.1161/JAHA.116.003614}

\textsuperscript{21} University of Glasgow, Association Between Active Commuting and Incident Cardiovascular Disease, Cancer, and Mortality: Prospective Cohort Study” 2017, \url{https://www.bmj.com/content/357/bmj.j1456}
Transportation & Social Equity

Mercer County is committed to promoting equality and equity within all of our planning endeavors and initiatives. We aim to this high standard by convening the widest array of partners to inform and facilitate data-driven decision-making. In doing an analysis of potential facility choice in the following chapter, Mercer County used a data driven method that looks at AADT, posted speeds, cartway widths, bus routes, truck routes and overall road geometry. By doing an analysis of the entire Mercer County owned highway network, Mercer County is providing equal resources to all of our towns and neighborhoods and allows us to move forward to provide for greater equity.

To understand the County’s road network, one must understand that the Mercer County Road system is one of the oldest in the nation, with some routes predating the United States itself, having originated with Native American trails and roads. As a result, we do not have the wide cartways and organized grid patterns that many newer cities and states enjoy. In the City of Trenton, Princeton, Hightstown and other older communities, roads were oftentimes built to accommodate livestock and took winding turns based on ownership and natural geography. Homes and especially businesses were often built up close to the edge of roadways, leaving little room for any further widening. Much of our older urban fabric illustrates this and as a result, many older urban roadways have limited cartways to this day.

In the post WWII period, Mercer County as well as countless other communities throughout the USA, evolved rapidly in an auto centric fashion where automobile traffic dominated over all other modes. No direct democratic vote, referendum or debate was given to this transition of public ROW and as a result, the network evolved at the discretion business and developer interests under the guise of economic development. Today, though we cannot correct decades of auto-centric market design, we can strive to have an accessible road network for all and to distribute County right-of-way in such a way that accommodates “Complete Streets” and all modes of travel.

Communities designed exclusively for motor vehicles impose a major financial penalty on those who are compelled to take on the expense of driving. Less affluent household and especially those living below the poverty line are most affected by the auto-centric market design of our urban fabric. From 2016-2017, The New Jersey-New York Metro Area saw households spent 11.7% of their budgets on transportation while the Philadelphia Metro Area spent 14.5%. This is in comparison to the 15.9% national average. According to AAA’s “Your Driving Cost” Study in 2018, owning and operating a new vehicle in 2018 will cost a driver an average of $8,849 annually and roughly $10,215 for a pickup truck, based on 15,000 miles.

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driven annually.\textsuperscript{23} According to another recent study by the personal finance website Bankrate, just the average annual cost of repairs, insurance and gasoline in 2014 for New Jersey was approximately $2,421.\textsuperscript{24} This makes NJ the 5th most expensive state to own a car in the United States. This financial burden is imposed on many residents of auto centric communities and furthers economic inequality.

Being able to thrive without a car is essential to many African-Americans, 22\% of who have no access to a car, and Latinos, 14\% of who are carless, according to a report by the Leadership Conference Education Fund.\textsuperscript{25} For individuals who don't own a car or have access to one, alternative transportation such as bicycling represents important pathways to opportunity. For a 3 car family switching to 2 cars or 2 car family switching to 1 would save them on average $7,500 - $13,000 per vehicle dropped. According to estimates by Transportation Alternatives, an advocacy organization devoted to environmentally-friendly transportation, bicycle riding costs the frequent cyclist only one-quarter as much as driving, assuming cyclists replace their bicycles every three years. Additionally, safe bicycling conditions provide low-income Americans with an opportunity to get to jobs, education, stores and transit so they don't have to spend their limited capital or go into debt to buy a vehicle.

Cycling also provides economic and independent travel for those who might otherwise have their travel options restricted. Over one-third of Americans do not drive, a figure increasing with our aging population, and transportation choice and accessibility are critical issues of social equity. Cycling offers increased mobility to many groups of the population with low rates of car ownership, such as low income earners, minorities, unemployed persons, the elderly and those under 18 years of age as well as urban residents. These populations are disproportionately affected to have limited transportation choices, especially when the affordable transportation options of biking, walking and transit are not sufficiently safe, effective or available. This in turn leads to significant social and economic isolation and decline, with frequent poor health outcomes.

Mercer County, as many Central New Jersey communities has recently seen a significant influx of warehouse and light manufacturing employment along the NJ Turnpike. These jobs often do not require higher education and many of the employees working at these facilities rely on hourly wages. As these warehouses and manufacturers are located far from urban areas or older and smaller housing stock that low income earners can afford, they must travel considerable distances to the nearest affordable housing. Living such a considerable distance away from these employment centers disproportionally affects these residents and has a direct effect on social equity for our residents and labor productivity for our businesses. This disconnect between employment centers, housing and limited transportation choices hiders our ability for economic development and promotion of social equity.

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\textsuperscript{23} AAA’s “Your Driving Cost” 2018. https://newsroom.aaa.com/auto/your-driving-costs/

\textsuperscript{24} Bankrate “Best and Worst States for Drivers” https://www.bankrate.com/auto/best-and-worst-states-for-drivers-ranked/

Equity and Cost of On-Street Parking

Free parking serves as a powerful market and government subsidy to cars and car trips in which legally mandated parking, via zoning requirements, lowers the market price of parking spaces, often to zero. A generalized system of zoning and development restrictions often require a large number of parking spaces attached to a store or a smaller number of spaces attached to a house or apartment block, many of which are only used a few times a year during peak holiday shopping demand. This requirement not only takes up valuable urban land and destroys the concept of a “Main Street” type streetscape but also adds a financial burden on developers, residents and tenants. If developers were allowed to face directly the high land costs of providing so much parking, the number of spaces would be a result of a careful economic calculation rather than a matter of satisfying a legal requirement. Money saved could be then used for other amenities such as sidewalk, bicycle facilities, lighting, landscaping, façades or other treatments.

Today, many suburbanites take free parking for granted. Whether it’s in the lot of a big-box store or at home in the driveway, people expect free parking wherever they go. Over the past century, we’ve come to regard parking as a basic public good that should be freely shared but in reality, free parking isn’t a public good and isn’t used by everyone. While roadways are used by and benefit all in one form or another, whether it is for travel, commerce, or goods movements, parking is not used by all. The cost of land, pavement, street cleaning, and other services related to free on-street parking spots come directly out of tax dollars (usually municipal or state funding sources). Each on-street parking space is estimated to cost around $1,750 to build and $400 to maintain annually.26 Residents who do not own or use a car are in turn subsidizing car owner’s parking spaces. As a third of the nation does not drive, that one third in turn theoretically helps subsidizes the other 2/3 of the population who do not use these services and provide no social benefits like other necessary services (transportation, fire, police, education, healthcare) provide.

In urban areas such as Trenton, Princeton, Hightstown, Pennington and Hopewell, carless residents must not only subsidize parking but also give up valuable public right-of-way to allow for street parking. Mercer County holds that to promote economic equality and equity, parking shall be held as a secondary benefit of a roadway, second to bicycle and pedestrian facilities which promote safety and mobility for residents. This is especially true for disenfranchised and low-income residents who may not be able to afford and maintain a vehicle but have the same right as all other residents to travel in a safe marked lane. Free parking is a luxury that comes second to providing a safe way for our residents to get to their jobs, homes, schools, doctors, and other destinations.

**Pavement Management and Maintenance**

This current generation of young adults has the most to gain and lose from the transportation investments that we make today because they and their children will be impacted by our investments for decades to come. According to DVRPC, the millennial generation is driving less, getting driver’s licenses later (if at all), and are less interested in car ownership compared to previous generations. Almost half of more than 1,000 consumers surveyed do not enjoy most of the time they spend driving, said a study by Arity, a Chicago-based transportation technology and data company created by Allstate. The numbers are starkest for millennials. More than half of adults between the ages of 22 and 37 say a car is not worth the money spent on maintenance, and that they would rather be doing something other than driving.\(^{27}\)

The daily wear and tear of vehicles on our road system has significant maintenance implications and requires the County to repave every single County Road every few years depending on use and other variables. This requires a vast expenditure of County funds to maintain our roads in a state of good repair. A study by the U.S. General Accounting Office (GAO) determined that the road damage caused by a single 18-wheeler was equivalent to the damage caused by 9,600 cars.\(^{28}\) The study found that road damage was exponentially worse with more weight. If one vehicle carries a load of 1,500 pounds per axle and another carries a load of 3,000 pounds on each axle, the road damage caused by the heavier vehicle is then not twice as much, but 2 to the 4th power as much (2x2x2x2 = 16 times as much road damage as the lighter vehicle). Looking at this from alternative travel modes, bicycles do nearly no damage to our road surface. Comparing a passenger car and a bicycle, say a bike and its rider weigh in at 200 pounds, and the car at 4,000 pounds. The weight of the car is also 20 times greater than the bike and rider, and the road damage caused would be 160,000 times greater. It would take 700 trips by a bicycle to equal the damage caused by one Smart Car. It would take 17,059 trips by bike to equal the damage caused by an average car. And it would take 364,520 bike trips to equal the damage caused by just one Hummer H2.

In a hypothetical scenario, if every 1,000 miles traveled in an average sized car equals $1 worth of damage to the road that will have to come out of County budget for repair work, a bicyclist would have to travel over 17 million miles to cause the same $1’s worth of damage. Or another way to look at that, for the $1’s worth of damage that a car does to a road, a bicycle, traveling the same distance on the same road, would perpetrate $0.0005862 worth of damage. A Hummer on the other hand would cause $21.37 worth of damage for the same distance as a bicycle. Since car weight is an unpriced external cost within the transportation sector for all but freight trucks and toll roads, we do not price these additional costs into our County tax structure. By increasing bike lanes (as well as multi-modal travel and carpooling), we can extend pavement life and in turn save taxpayer money that otherwise would need to go towards more frequent resurfacing and repaving.

\(^{27}\) Arity, LLC. November 2018 [https://www arity com/](https://www.arity.com/)

Facility Design and Crash Safety

Bike facilities also provide for many transportation safety improvements, not just for bicyclists but also to drivers. Foremost, the most cited safety benefit of dedicated facilities such as bike lanes, buffered lanes, protected lanes and multi-use paths is the fact that bikes have a reduced need to travel in a vehicle lane. Marked facilities send a message to drivers that bicyclists can and should be expected and the physical lane markings separate their expected travel behavior from expected rider behavior.

A comprehensive study looking at 13 years of crash and street design data from 12 cities found that roads with protected bike lanes make both cycling and driving safer. The authors amassed a huge data set: 17,000 fatalities and 77,000 severe injuries between 2000-2012 in cities like Minneapolis, Seattle, Denver, Portland, Dallas, Houston, Austin, Kansas City, and Chicago. All these cities have experienced a rise in cycling’s popularity, have added bike amenities at various levels of investment, and have seen a range of safety outcomes. The study found that where cycle tracks were most abundant on a citywide basis, fatal crash rates dropped by 44% compared to the average city, and injury rates were halved. 29

Design of bicycle facilities can also incorporate features that improve both driver and cyclist safety. According to the FHWA, run-off-the-road crashes account for approximately one-third of the deaths and serious injuries each year on the Nation's highways. Drift-off crashes, caused by drowsy, distracted, or otherwise inattentive driving, are a subset of run-off-road crashes. As part of the County’s typical buffered bicycle lane design, items such as rumble strips and raised reflective pavement markers (RPMs) will be considered. FHWA states that studies of milled freeway shoulder rumble strips in Michigan and New York documented drift-off-road crash reductions of 38 and 79% while NCHRP Report 641 documents milled shoulder and edge rumble strips to provide statistically significant reductions in single-vehicle run-off-road injury crashes: 10-24% on rural freeways, and 26-46% on two-lane rural roads. 30 31

Shoulder and edge line rumble strips may also serve as an effective means of locating the travel lane during inclement weather such as fog, snow, or rain as these conditions often obscure pavement markings. The vibration provided by rumble strips can assist drivers from unintentionally leaving the roadway in these conditions or if the driver is inattentive. There are also potential visibility benefits as even a light rain can seriously reduce the retroreflective capacity of pavement markings. When the edge line marking is placed within the rumble strip, the vertical component will often still be visible under these adverse conditions. Bike facilities intrinsically provide for an additional 4’-10’ of cartway outside of travel lanes and can be designed with rumble strips as well as RPMs that have a dual purpose of keeping cyclists safe and motorists in their lanes.

Though not a primary function of bicycle facilities, this additional space can be used in extreme emergencies by motorists to stop in the event of a mechanical difficulty, health emergency, or to escape or reduce their severity of a potential crashes. Emergency vehicles also have the ability to use this space to maneuver in the roadways if they temporarily need to utilize the bike lane to bypass debris or motorists. Since bike lanes are supposed to be free of debris, parked cars and other large items, they provide the added benefit of greater sight distances for motorists.

**Congestion**

A common reason for opposition to bike lanes is that, according to the rules of traffic engineering, they lead to congestion. Evidence and studies however prove counter to this argument. In a 2014 study by New York City DOT of roadways with new bicycle facilities, congestion went down on those roads. Rather than increase delay for cars, the protected bike lanes on Columbus Avenue actually improved travel times in the corridor. According to city figures, the average car took about four-and-a-half minutes to go from 96th to 77th before the bike lanes were installed, and three minutes afterward—a 35 percent decrease in travel time. This was true even as total vehicle volume on the road remained fairly consistent. Over on Eighth Avenue, where bike lanes were installed in 2008 and 2009, DOT figures show a 14 percent overall decline in daytime travel times in the corridor from 23rd to 34th streets once the protected bike lanes were installed. That quicker ride was consistent throughout the day: travel time decreased during morning peak (13 percent), midday (21 percent), and evening peak (13 percent) alike. To repeat: a street that became safer for bikes saw a reduction in travel time for motorists.

County highways by their nature are designed to be inter-municipal and inter-county routes of travel. They often provide the most direct and common ways of travel and in conjunction with State and US routes and act as the arteries for our County. Designing them to accommodate all modes of travel, especially bike facilities can help reduce the number of single-occupancy cars on our roadways which benefits all users.

A major form of congestion known to many residents is school traffic during morning peak hours. Parents and residents driving past schools know all too well that our society has increasingly been relying on dropping students off in single-occupancy vehicles and that walking to school or riding a bike is becoming a relic of the past in many communities. In 1969, half of American schoolchildren walked or rode their bikes to school but by 2009; just 13 percent of kids walked or biked to school. Despite many schools being constructed further from where people live, the majority of car trips to school are still within walking distance, though direct and safe routes are often unavailable in auto-centric communities. Developing bike

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facilities for students would allow them to walk or bike to school and reduce the number of vehicles arriving at schools, thus reducing congestion.

The community of Lakewood, Ohio can prove that alternative transportation is possible as the city does not and never has bused its students. The city of 52,000 only runs a small transportation program for students with special needs — about 100 students use it, out of 5,800. To this day, nearly every student walks to school. Not only does this help reduce peak hour congestion, but as an added benefit, it helps kids stay focused and be generally healthier. According to a Danish "Mass Experiment 2012" project study, 20,000 participating kids who walked or biked to school had performed better on tasks requiring concentration than those who were driven to school or took public transit. Researchers found that the lift in concentration lasts for about four hours into the school day. Other benefits of biking to school include a stronger connection to the community, a taste of independence, numerous health benefits, family bonding time and of course — exercise.

Overall, in order to reduce congestion, we need to take a multi-modal approach to see real progress. This applies to not only long distance trips but especially to last mile connections. Mercer County is one of the most densely populated places in the United States with approximately 1,615 persons per square mile. In order to provide for an efficient transportation system, we need to work together with municipal and State partners to provide a complete network of sidewalk, bicycle facilities and transit routes as reduce single occupancy vehicle trips. In order to do so, our citizens need facilities to make that happen. In the image below, we can see the space requirements for 70 people walking, taking transit, riding their bikes or driving solo (regardless of vehicle type).

Left to Right: Space required to transport 70 people walking, taking public transit, biking and driving (regardless if car is autonomous, electric, hydrogen, or other alt-fuel)

Environmental Considerations

The transportation sector is a significant source of our nation’s pollution and the effects of automobile pollution are especially widespread, affecting air, soil and water quality. Air pollutants such as that of Nitrous Oxide, contributes to the depletion of the ozone layer, which shields the Earth from harmful ultraviolet radiation from the sun. Sulfur dioxide and nitrogen dioxide mix with rainwater to create acid rain, which damages crops, forests and other vegetation and buildings (especially historic buildings and monuments of marble and sandstone). Carbon monoxide, another exhaust gas, is particularly dangerous to infants and people suffering from heart disease because it interferes with the blood’s ability to transport oxygen.\(^34\) \(^35\)

Other car pollutants that harm human health include Benzene, Formaldehyde and many more volatile organic compounds and particulate matter. Some 24,000 vulnerable people die prematurely each year and similar numbers are admitted to hospital because of exposure to air pollution from particulates, ozone, and sulfur dioxide, much of which is related to road traffic. Air quality is often worse in more deprived areas and affects vulnerable populations more, exacerbating the symptoms of people with asthma, for example.\(^36\) Particulate matter, hydrocarbons, carbon monoxide and other car pollutants harm human health. Diesel engines emit high levels of particulate matter, which are airborne particles of soot and metal. These cause skin and eye irritation and allergies, and very fine particles lodge deep in lungs, where they cause respiratory problems. Hydrocarbons react with nitrogen dioxide and sunlight and form ozone, which is beneficial in the upper atmosphere but harmful at ground level. Ozone inflames lungs, causing chest pains and coughing and making it difficult to breathe.

Vehicles also significantly contribute to the poor nature of our nation’s water quality. Vehicles leave oil, antifreeze, grease, nitrogen and phosphorous from washing detergents, metals and various chemicals on streets and driveways. Water pollution in the form of oil and fuel spills from cars and trucks oftentimes seeps into the soil near highways, and discarded fuel and particulates from vehicle emissions contaminates lakes, rivers and wetlands. Americans dump enough oil to contaminate about 1.5 trillion


\(^{35}\) EPA “Transportation, Air Pollution, and Climate Change” [https://www.epa.gov/transportation-air-pollution-and-climate-change](https://www.epa.gov/transportation-air-pollution-and-climate-change)

\(^{36}\) World Health Organization “How Air Pollution is Destroying our Health” [https://www.who.int/air-pollution/news-and-events/how-air-pollution-is-destroying-our-health](https://www.who.int/air-pollution/news-and-events/how-air-pollution-is-destroying-our-health)
gallons of water every year. Nearly all of our storm sewers drain directly to creeks, rivers, lakes or our oceans with no water-quality treatment.\textsuperscript{37}

These toxins then settle in our waters and kill fish, plants, aquatic life and even people. One quart of oil will contaminate thousands of gallons of water because it cannot dissolve and break down. These toxins as well as trace metals and degreasing agents used on automobiles can also contaminate drinking water and can cause major illness. Some of these toxins and metals are absorbed in various aquatic life and cause medical problems to people when eaten. Phosphorus and nitrogen cause explosive growth of algae, which depletes water of oxygen, killing fish and aquatic life. This has a direct impact on our recreational and commercial fishing viability within our region.\textsuperscript{38}

There is also the issues of noise pollution as vehicles in rush hour traffic can reach noise levels of 70 decibels or higher in intensity, where prolonged exposure to noises above 85 decibels can damage hearing. Exposure to prolonged exposure can cause annoyance, stress, sleep disturbance, psychological conditions, and cardiovascular diseases.\textsuperscript{39} This in turn exerts a higher burden on the cost of health care. It results in lost productivity and leads to a diminished quality of life.

Cycling on the other hand uses minimal fossil fuels, is nearly silent and is a pollution-free mode of transport. Bicycles reduce the need to build, service and dispose of cars (regardless of fuel type) and the need for vast lithium, cobalt, oil, gas or hydrogen operations to fuel them. The carbon footprint of making a car is immensely complex and though bicycles also must be manufactured, they require much less complex input. Ores have to be dug out of the ground and the metals extracted. These have to be turned into components that then have to be brought together: rubber tires, plastic dashboards, paint, and so on. All of this involves transporting components around the world where environmental regulations are often much more lax. The whole automobile then has to be assembled, and every stage in the process requires energy. The companies that make cars have offices and other infrastructure with their own carbon footprints, which we need to somehow allocate proportionately to the cars that are made. For a given journey, the energy consumed by a driver is at least 42 times more than by a cyclist, a bus passenger uses 34 times as much, and a train passenger 27 times as much. The cyclist requires less space than all but the train passenger and pedestrian.\textsuperscript{40}

\begin{itemize}
\item \textsuperscript{37} Hilary Nixon and Jean-Daniel Saphores, UC Irvine “Impacts of Motor Vehicle Operation on Water Quality: Clean-up Costs and Policies” 2007. \url{https://escholarship.org/uc/item/8tn1w17s}
\item \textsuperscript{38} EPA, “Polluted Runoff: Nonpoint Source (NPS) Pollution” \url{https://www.epa.gov/nps}
\item \textsuperscript{39} National Institute on Deafness and Other Communication Disorders “Noise-Induced Hearing Loss” \url{https://www.nidcd.nih.gov/health/noise-induced-hearing-loss}
\item \textsuperscript{40} Max Glaskin, “Cycling Science: How Rider and Machine Work Together” 2012. Print.
\end{itemize}
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Mercer County’s Bicycle Master Plan is intended to serve as the guiding document for the development of an integrated network of bicycle facilities and supporting programs, linking neighborhoods, activity centers, employment centers, parks and open space and more in throughout our twelve towns. The network will not only make cycling a more viable mode of transportation but will contribute to enhanced quality of life for residents and visitors.

This plan includes an inventory of all existing County roads and County maintained roads, a network of existing bicycle facilities, a proposed bike route system segmented by route and appropriate facility type, cost estimate and an implementation plan. The plan identifies optimal bicycling routes, preferred roadway treatments, design guidelines, and current best practices.

It serves as a critical reference document and direct follow up to the County’s Complete Streets Policy adoption. This document will ensure that bicycle facilities are considered during routine road maintenance, repaving, reconstruction, construction, and land development reviews/approvals. This plan also contains recommendations for programs and policies that will support bicycling, which will enable Mercer County to be recognized as one of the most bicycle-friendly counties in New Jersey.

Implementation of the County’s bike plan will be broken down into an immediate and short term improvements plan that can be incorporated relatively quickly, efficiently and economically as well as long term improvement plan that will require significant capital investment, right-of-way, and road reconstruction. The ultimate focus of the plan is a series of routes and facility improvements for cyclists more comfortable riding on the street. A level of traffic stress (LTS) of 2 (discussed in the following chapters), is preferred but may ultimately not be possible due to many constraints. Regardless, Mercer County is dedicated to implementing complete streets and bicycle facilities and understands that phasing in projects is essential to the safety of our riders. With this vision in mind, the plan is intentionally bicycle-focused and gives reduced consideration to other modes of transportation.

Goal Targets

1. Build out at least 30 miles of bike facilities by end of 2025.
2. Double the bicycle commuting mode share in Mercer County by 2030.
3. Improve safety for pedestrians and bicyclists by reducing bicycle & pedestrian crashes on County roads by 50% by 2030.
4. Encourage biking and walking events to promote healthy, active living and to enjoy the associated economic and environmental benefits.
5. Continue the connectivity of adjacent off-road and on-road bikeways and walking trails.
6. Achieve a minimum of LTS 3 rating on Mercer County Highways but aim for LTS 1 & 2.
7. Establish a working relationship with local planners, engineers and officials as well as with NJDOT staff for efficient project advancement and coordination.
Bicyclists have a legal right to use public roads in New Jersey, unless noted, though it may not always be safe to do so. Mercer County’s long term vision is to provide all of our residents with the ability to utilize any County roadway to ride their bicycles in a safe and stress free manner. This plan builds upon Mercer’s dedication to implementing our Complete Streets Policy and with respect to the State and 12 Municipal Complete Street Policies. Complete Streets essentially balance the needs of drivers, pedestrians, bicyclists, transit vehicles, emergency responders, and goods movement and are designed to benefit entire communities by addressing the needs of all road users regardless of age, ability, or mode of transportation. Among other benefits, Complete Streets address issues related to mobility and accessibility, community and economic development, safety, physical and environmental health, transportation cost, and equity.

At this time, Mercer County is the only county in New Jersey where every single municipality has committed to a complete streets policy. In addition to the County and municipalities, the State has adopted a complete streets policy which means the complete streets policy applies to all levels of government in Mercer County. For the purpose of this project and plan, though only Bicycle facilities were considered during a particular project, all aspects of complete streets can be considered under the draft complete streets checklist which can be found in Appendix B.

There is no singular design prescription for Complete Streets; each one is unique and responds to its community context. A complete street may include: sidewalks, bike lanes (or wide paved shoulders), special bus lanes, comfortable and accessible public transportation stops, frequent and safe crossing opportunities, median islands, accessible pedestrian signals, curb extensions, narrower travel lanes, roundabouts, and more. These facilities and improvements serve to increase the safety and availability for alternative modes of transportation. For the purpose of this plan, the County examined bicycle facilities which is an integral part of Complete Streets and will help advance our Complete Streets Policy from resolution to action.
Safety is of paramount importance for Mercer County and one of the primary drivers of this long range bike plan. Since bicycles today do not have dedicated facilities on a majority of roadways, they are faced with traversing public roads with drivers. Many of these drivers follow speed limits and pay attention to the road but a significant amount drive the speed they feel safe driving at, which may be much higher than the posted limit. Increasingly, drivers are also becoming more distracted as mobile devices have become a part of daily life. With that said, it is important to analyze existing crashes and their cause so we can move forward with a planned course of action.

As expected, when a crash occurs between motor vehicle and a bike, it is the cyclist who is most likely to be injured or killed. Nationally, approximately 840 cyclists were killed in motor vehicle crashes in 2016 and bicyclists accounted for 2.2 percent of all traffic deaths according to the National Highway Traffic Safety Administration. Mercer County is no different and unfortunately, in the 5 year period from 2012-2016, there were 4 cyclist fatalities in Mercer County, two of which occurred on County Roads. During this time there were also 4 incapacitating injury crashes, 97 moderate injury crashes and 138 complaints of pain following a crash. With 53 property damage crashes this brings the total number of cyclist crashes to 296 of which 107 occurred on County Roads. This is a high number which on paper may seem like just another statistic but that number represents our community. Each victim is a brother, sister, mother, father, son, daughter, grandparent, coworker or friend.

In this 5 year period, approximately 92% of crashes occurred in dry conditions and roughly 74% occurred during daylight hours. In addition only 2 out of 296 involved cell phone usage and only 9 involved alcohol as variables. This data shows us that a majority of crashes occur in normal conditions with limited externalities influencing crashes. Surprisingly, some 36% of crashes occurred in locations where the posted speed limit was 25 mph. This indicates that drivers may not see bicyclists (visual noise of roadway), do not pay attention or cannot stop in time due to speed. It is likely that road conditions such as speeding or inattentive drivers, narrow cartways, high volumes and others are the predominant factor influencing the crash rate. As a result, it would be beneficial to have dedicated facilities for bicyclists. A study by the University of British Columbia found that bicycle lanes can reduce injury rates by approximately 50% while protected bike lanes can reduce injuries by up to 90%.

<table>
<thead>
<tr>
<th>Row Labels</th>
<th>Count of Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality</td>
<td>4</td>
</tr>
<tr>
<td>Killed</td>
<td>4</td>
</tr>
<tr>
<td>Injury</td>
<td>239</td>
</tr>
<tr>
<td>Complaint of Pain</td>
<td>138</td>
</tr>
<tr>
<td>Incapacitated</td>
<td>4</td>
</tr>
<tr>
<td>Moderate Injury</td>
<td>97</td>
</tr>
<tr>
<td>Property Damage Only</td>
<td>53</td>
</tr>
<tr>
<td>Property Damage Only</td>
<td>53</td>
</tr>
<tr>
<td>Grand Total</td>
<td>296</td>
</tr>
</tbody>
</table>

Source: NJDOT Safety Voyager

Bicycle Crashes from 2012-2016 on County Roadways
As we move forward into the new millennia, our population is aging at a significant rate. The year 2030 will mark an important demographic turning point in U.S. history according to the U.S. Census Bureau’s 2017 National Population Projections. By 2030, all baby boomers will be older than age 65 which means that 1 in every 5 residents will be of retirement age. With the aging of baby boomers, in just a couple decades, older people are projected to outnumber children for the first time in U.S. history. By 2035, there will be 78.0 million people 65 years and older compared to 76.4 million under the age of 18. Mercer County is home to many families with young children and will continue to be a family friendly community but will have to adapt to these future demographics.

As a result, moving forward, the County hopes to follow an 8 to 80 form of design and planning when implementing complete streets. The 8 to 80 form of planning is based on the premise that if we build a community that is accommodating for an eight year old and an 80 year old, than we will build a successful community for everyone. Think of a child who is around eight years old and an older adult you know who is approximately 80 years young. Once you have that child and that older adult in your mind, ask yourself: Would I send them out together for a walk to school or the park; or perhaps to the store in my town? If you would, the public realm is safe and accommodating to them. If you wouldn’t, public improvements are needed. We need to rethink the construction of auto-centric communities as if everyone was 30 years old and athletic, wealthy enough to afford a vehicle or young/old enough to drive themselves.

In addition to having a safe network, Mercer County aims to have a connected network. A connected bike network provides a safe and comfortable transportation experience, enabling people of all ages and abilities to get where they want to go and offers multiple ways to get there. Connected bike networks increase ridership and improve safety. In 2007, the City of Seville, Spain focused on connecting a bike network across the entire city, fully separating network facilities from auto traffic to make it safe and comfortable for people of all ages and abilities to ride. Between 2006 and 2013, the network grew from just 12 km of protected bike lanes to 152 km spanning the entire city. With these improvements (and other bike friendly policies and programs), the city observed a 435% increase in the number of bike trips and a 61 percent drop in bike-motor vehicle crash rate.2

In order to analyze the current state of facilities and be able to quantify our network for this 8 to 80 design standard, we have utilized a Level of Traffic Stress (LTS) methodology for the purpose of planning future facilities. This allows us to set benchmarks for measuring performance and plan improvements based on the existing benchmark. Currently the Mercer County road network has predominantly LTS 4 facilities which means that there are no dedicated bicycle facilities on a majority of our roads. This means that riders must ride with existing vehicular traffic with no dedicated facilities to separate them. This means that only the most fearless cyclists feel safe enough to ride their bicycles while the rest of the general public is forced to drive their bikes to their destination, ride on discontinuous sidewalk or forgo biking altogether.

In moving forward with our analysis, Mercer County strives to make every County roadway an LTS 3 facility or better. This would not only allow much more of the general public to feel safe riding their bikes and increase ridership numbers but as mentioned before, reduce the crash rate for cyclists. Ultimately while an LTS 1 is preferred and most accommodating, the cost of constructing these facilities and implications of private land ownership often make it difficult and lengthy if not impossible to construct. With careful analysis of existing cartway, posted speeds and Average Annual Daily Traffic (AADT) we have created a list of potential facility recommendations for each County roadway at the lowest cost. Once we have a significant amount of LTS 3 facilities across the County, we will be able to proceed with building more accommodating facilities prioritized by demand. Priority however will be to get to LTS 3 at the minimum.
There has been an increasingly significant of research pointing to a strong death correlation between auto speeds and survival rates for pedestrians as well as cyclists hit by vehicles. Without the protection of an automobile, the human body has a limited tolerance for speeds higher than 20 miles per hour. Speed is especially lethal for people walking and biking. Young persons and the elderly are even more likely to die if struck by a vehicle. Work by Northeastern University's Peter Furth also gives a strong correlation between auto speeds interaction with bikeway design and peoples willingness to bike. People are generally unwilling to risk riding a bike with high speed traffic buzzing past them (as mentioned in the previous LTS section). For high speed roads, separated facilities or buffers are highly recommended to provide a larger space between bikes and vehicular traffic. This not only provides a more comfortable ride and higher LTS but also increases cyclist safety.

In order to accommodate bicycle facilities, in certain situations, the case can be made to reduce speed limits. Currently, rather than arbitrarily setting a speed limit, Mercer County uses MUTCD recommended 85th percentile speed studies to determine the posted speed limit which provides us with an accurate representation of what speeds drivers are actually driving. This method while accurate, fails to account for additional factors critical to pedestrian and cyclist safety such as land use, crash history and other users other than automobiles. In 2017, the National Transportation Safety Board (NTSB) released a new Safety Study titled “Reducing Speeding-Related Crashes Involving Passenger Vehicles” which found that raising speed limits to match the 85th percentile speed can result in unintended consequences. It may lead to higher operating speeds, and thus a higher 85th percentile speed. In general, the 85th percentile speed within a given traffic flow doesn’t always equate to the speed with the lowest crash involvement rate for all road types and the safest operating speed is influenced by many environmental factors.
NTSB identified dangerous speeds as an under-appreciated problem despite the fact that it poses one of the greatest threats to public safety. More than 112,000 people died in speeding-related crashes in the U.S. from 2005 to 2014, averaging more than 10,000 deaths each year. This is on par with the number of drunk driving fatalities during the same time period, NTSB reported, yet receives far less attention. Alternative approaches and expert systems for setting speed limits are available, which incorporate factors such as crash history and the presence of vulnerable road users such as pedestrians.

Moving forward with this bike plan, road segments were also analyzed to determine whether existing posted speeds should be lowered to increase pedestrian and cyclist safety. The NTSB report recommends use of FHWA’s online USLIMITS2 tool to determine speeds with external factors. This AASHTO approved tool can improve the setting of speed limits by allowing traffic engineers to systematically incorporate crash statistics and other factors in addition to the 85th percentile speed, and to validate their engineering studies. USLIMITS2 is also one of the proven safety countermeasures offered by the FHWA and has been proven to produce an unbiased and objective suggested speed limit value based on the 50th and 85th percentile speeds, volumes, road characteristics, cyclist and pedestrian activity and crash data.

When using this tool, data is input into an online interface and ends up with a report for the recommended speed limit. Based on a series of trials of Mercer County roads and the USLIMITS2 tool, we found that speeds can change on average 0-10 mph with a 5 mph reduction the most common change. This reduction recommendation is common in areas where over the years, certain parts of Mercer County gradually have transitioned from a low density rural-residential development to more dense residential-commercial. As a result, the 2020 Bike Plan data includes a field for existing speed as well as a proposed speed limit that shows a typical reduction of 5 mph and in extreme conditions, a reduction of 10 mph.

Though this may be unpopular with some people, at the end of the day, the County’s priority is the safety and wellbeing of the general public. We must ask ourselves as neighbors, how much are we willing to slow down to save another person’s life? The County’s responsibility is to provide for the general welfare, safety and preservation of life of the general public even if it adds an extra minute to motorist’s trips.
As part of the GMTMA Trail Plan effort, their consultant WSP Global Inc. (WSP), has created a travel demand model that analyzes a variety of demographic and geographic factors. Quantitative modeling of the demand for bicycles is an essential part of any coherent attempt to establish the bicycle’s role in an urban transportation system and is a more efficient way of looking at where bicycle capital improvement would be best prioritized for the greatest impact. Demographic factors such as population density under 18 and over 64, zero car household density, bike/walk/transit to work density as well as an income-poverty ratio density were used. In addition, geographic factors such as population density, job density, school/university access, park access, commercial access, and bus/train access were used.

This combination of elements looks at a variety of factors that influence demand for bicycle travel ranging from socio-economic factors to environmental factors to demographic and population geography factors. While a higher population and job density pull in more riders due to higher concentrations of people, places like parks, schools, universities and commercial retail centers pull in people due to their daily operations. Populations without car access, persons of low-income, persons under 18 and over 65 are also much more likely to ride out of necessity. This combination of elements ultimately produces a final quantifiable “score” of demand.

These individual factors were then given a different weight based on their respective importance to a bikable trail. The different factors of the bicycle demand analysis were aggregated at the U.S. Census block group level, and demographic factors were normalized to the block group area to account for differences in block group size. Each factor was assigned a weight to give greater heft to different factors and balance factors representing or associated with trip generators (origins) and those that represent trip attractors (destinations). In the end, a score of 1-10 was created for each block group. The table below shows the different weights given to each factor within the travel demand model.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pop Density</td>
<td>18%</td>
</tr>
<tr>
<td>Job Density</td>
<td>17%</td>
</tr>
<tr>
<td><strong>Key Destinations</strong></td>
<td></td>
</tr>
<tr>
<td>School Access</td>
<td>4%</td>
</tr>
<tr>
<td>University Access</td>
<td>8%</td>
</tr>
<tr>
<td>Park Access</td>
<td>4%</td>
</tr>
<tr>
<td>Commercial Access</td>
<td>8%</td>
</tr>
<tr>
<td>Bus Access</td>
<td>3%</td>
</tr>
<tr>
<td>Train Access</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Equity Factors</strong></td>
<td></td>
</tr>
<tr>
<td>Under 18 Density</td>
<td>6%</td>
</tr>
<tr>
<td>Over 64 Density</td>
<td>1%</td>
</tr>
<tr>
<td>Zero Car HH Density</td>
<td>8%</td>
</tr>
<tr>
<td>IP Ratio &lt; 1.25 Density</td>
<td>5%</td>
</tr>
<tr>
<td>Bike to Work Density</td>
<td>6%</td>
</tr>
<tr>
<td>Walk or Transit to Work Density</td>
<td>4%</td>
</tr>
</tbody>
</table>
Published in 2017, the NJDOT Complete Streets Guide provided the County with a reliable methodology of looking at the relationship between ADT and posted speeds. Based on methodology from other states and with the same concept of reaching the highest possible LTS with limited resources and limited cartway, NJDOT prepared a “Bicycle Facility Table” for a simplified analysis. This table however offers a conservative selection for maximum comfort and while fitting the goals of NJDOT, it doesn’t allow for the flexibility of incorporating the maximum amount of facilities and while providing for a better LTS, will limit the amount of facilities NJDOT ultimately constructs.

### Bicycle Facility Table

<table>
<thead>
<tr>
<th>ADT</th>
<th>≤ 20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>≥50</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤2,500</td>
<td>ABCDEF</td>
<td>A\textsuperscript{2}BCDEF</td>
<td>CDEF</td>
<td>CDEF</td>
<td>CDEF</td>
<td>DEF</td>
<td>DEF</td>
</tr>
<tr>
<td>2,500–5,000</td>
<td>BCDEF</td>
<td>BCDEF</td>
<td>CDEF</td>
<td>CDEF</td>
<td>DEF</td>
<td>DEF</td>
<td>DEF</td>
</tr>
<tr>
<td>5,000–10,000</td>
<td>B\textsuperscript{3}CDEF</td>
<td>B\textsuperscript{3}CDEF</td>
<td>CDEF</td>
<td>DEF</td>
<td>DEF</td>
<td>DEF</td>
<td>EF</td>
</tr>
<tr>
<td>10,000–15,000</td>
<td>DEF</td>
<td>DEF</td>
<td>DEF</td>
<td>DEF</td>
<td>EF</td>
<td>EF</td>
<td>EF</td>
</tr>
<tr>
<td>≥15,000</td>
<td>DEF</td>
<td>DEF</td>
<td>DEF</td>
<td>DEF</td>
<td>EF</td>
<td>F</td>
<td>F</td>
</tr>
</tbody>
</table>

A: Shared Street/Bicycle Boulevard  B: Shared-lane Markings  C: Bicycle Lane  D: Buffered Bicycle Lane
E: Separated Bicycle Lane  F: Shared-use Path

\textsuperscript{1}If data not available, use posted speed

\textsuperscript{2}Bicycle boulevards are preferred at speeds ≤25 mph

\textsuperscript{3}Shared-lane markings are not a preferred treatment with truck percentages greater than 10%

### Bikeway Treatments and Minimum Requirements

- **Standard Bicycle Lane**:
  - 6 min (4' without curb)

- **Buffered Bicycle Lane**:
  - 1.5' min (3' preferred)
  - 6 min (4' without curb)

- **One-way Separated Bicycle Lane**:
  - 7' min from curb
  - 1.5' min (3' preferred)
  - 5' min (4' without curb)

- **Two-way Separated Bicycle Lanes**:
  - 1.5' min (3' preferred)
  - 10' min (12' preferred)

- **Shared-use Path**:
  - 10' min (12' preferred)

*Source: NJDOT Complete Streets Design Guide*
Mercer County has created a facility selection table that builds off the NJDOT Bicycle Facility Table. In the County vision, ADT and Speed limits for facilities are increased. For example, while NJDOT may recommend bicycle lanes up to an ADT of 10,000, the County will allow them for ADTs of 30,000 when speeds are 30 mph or less. While the NJDOT table creates a less stressful experience for cyclists, it would essentially prevent inclusion of facilities on much of the County road network as many County Highways are limited on ROW and cartway widths and speeds are difficult to realistically reduce. Taking cyclists out vehicle lanes with high speed traffic into dedicated facilities is preferable over creating a low stress experience. Where possible, maximum LTS facilities will be sought, and over time as funding is available, high stress facilities can be upgraded to create less stressful rides.

Below is a custom facility selection table based off the one in NJDOT's Complete Street Guide that was used by Mercer County staff in determining an appropriate facility type for each County Roadway and road under County jurisdiction. Following a USLIMITS2 traffic engineering study, staff can determine which facility will fit the existing cartway and be appropriate for the new posted speed limit and road ADT.

### Mercer County Bicycle Facility Selection Table

<table>
<thead>
<tr>
<th>ADT</th>
<th>≤ 20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>≥50</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 2,500</td>
<td>ABCDEF</td>
<td>ABCDEF</td>
<td>CDEF</td>
<td>CDEF</td>
<td>CDEF</td>
<td>D*EF</td>
<td>F</td>
</tr>
<tr>
<td>2,500–5,000</td>
<td>BCDEF</td>
<td>BCDEF</td>
<td>CDEF</td>
<td>CDEF</td>
<td>D*EF</td>
<td>D*EF</td>
<td>F</td>
</tr>
<tr>
<td>5,000–10,000</td>
<td>BCDEF</td>
<td>BCDEF</td>
<td>CDEF</td>
<td>C*DEF</td>
<td>D*EF</td>
<td>D*EF</td>
<td>F</td>
</tr>
<tr>
<td>10,000–15,000</td>
<td>C*DEF</td>
<td>C*DEF</td>
<td>C*DEF</td>
<td>C*DEF</td>
<td>D*EF</td>
<td>D*EF</td>
<td>F</td>
</tr>
<tr>
<td>15,000–30,000</td>
<td>C*DEF</td>
<td>C*DEF</td>
<td>C*DEF</td>
<td>D*EF</td>
<td>EF</td>
<td>E*F</td>
<td>F</td>
</tr>
<tr>
<td>≥30,000</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
</tbody>
</table>

A: Shared Street/Bicycle Boulevard
B: Shared-lane Markings
C: Bicycle Lane
C*: Bicycle Lane (After careful consideration)
D: Buffered Bicycle Lane
D*: Buffered Bicycle Lane (After careful consideration)
E: Separated Bicycle Lane
E*: Separated Bicycle Lane (After careful consideration)
F: Shared-use Path

1. If USLIMITS2 data not available, use posted speed
2. Bicycle boulevards are preferred at speeds ≤25 mph
3. Shared-lane markings are not a preferred treatment with truck percentages greater than 10%
4. Buffered Bike Lanes may include Rumble Strips if designed to Mercer County Bike Friendly Standards.

Source: Mercer County Department of Planning, Trenton, New Jersey
Mercer County’s bicycle facility selections were based on a careful analysis of the roadway conditions and surrounding land use in order to provide context sensitive recommendations for each road segment. In order to do this analysis, a vast amount of data sources were compiled within a geographic information system (GIS), which is a framework for gathering, managing, and analyzing data.

This data allowed staff to visualize each segment of road and nearby infrastructure as well as nearby environmental assets and constraints. With this data, staff was able to look closely at each road segment to make a good faith determination on what facility to recommend to our Planning and Engineering staff. Though site conditions may change, these recommendations are based on a significant amount of data that is relatively current and can serve to give staff a good overview on what should be improved on a per case basis.

The most critical element of this method, which serves as our control point for each route, is the linear referencing system for the network, which is located within the Mercer County Road Centerline shapefile. That file is based on milepostings developed by State of New Jersey and covers the entire network of public roads in the State. It gives us the ability to cut each segment into any length we need based on those milepostings or call out specific locations based on an exact milepost location. In addition to this data, there are 18 other data sources and 3 aerial imagery sources we used to determine our facility selection. In order to verify many of these locations, Google Street View was utilized to confirm assets and constraints. Below is a list of all data sources utilized in the County’s analysis.

<table>
<thead>
<tr>
<th>Transportation Data</th>
<th>Land Use and Environmental Data</th>
<th>Aerial &amp; Street Imagery</th>
</tr>
</thead>
<tbody>
<tr>
<td> Mercer County Multi-Use Trails (2018)</td>
<td> Preserved Farmland -Local, County and State (2018)</td>
<td></td>
</tr>
<tr>
<td> Mercer County On-Street Bicycle Facility Data (2018)</td>
<td> Preserved Open Space -Local, County and State (2018)</td>
<td></td>
</tr>
<tr>
<td> Mercer County Guard Rail Data (2016)</td>
<td></td>
<td></td>
</tr>
<tr>
<td> Mercer County Pavement Extents (2014)</td>
<td></td>
<td></td>
</tr>
<tr>
<td> Mercer County Airport Layer Data (2017)</td>
<td></td>
<td></td>
</tr>
<tr>
<td> Mercer County Traffic Signal Data (2012)</td>
<td></td>
<td></td>
</tr>
<tr>
<td> Mercer County Bridge and Culvert Data (2016)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In performing this analysis, staff created an excel table for data entry and within our GIS platform, took the following steps to identify current conditions and potential recommendations:

**Step1:** Open and load GIS platform and insert all relevant data shapefiles and aerial imagery. Layer these in proper order to perform your analysis and turn off/on layers as needed. Find the starting point of a County Route Segment (Milepost 0.000) and zoom to that location on the map. In an excel table, create a new line item for this road and input the road’s name as well as Standard Route Identifier (SRI), which is a number associated with each County Route that helps to geolocate the segment. The SRI can be found by clicking on the road line using the **Identify tool** and then can be copied/pasted from GIS to excel. In the following steps, you will break each roadway segment into appropriate sizes based on the location’s AADT, roadway speeds, cartway, environmental factors and constraints. This segmentation will then allow for automatic length calculations which can then be used with multipliers to give a magnitude of scale and rough cost estimates. It also allows for different symbology designs based on desired map outcome.

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**Above:** Within our geographic information system (GIS), we utilized NJDOT 2014 centerline information to break up each route into segments based on identified AADT, speeds, pavement cartway, pinch points, and other relevant information. The entire Mercer County Bikability network is as a result based on the 2014 Standard Route Identifier (SRI) and Linear Referencing Systems (LRS). Each segment as a result can be looked at individually, which is much more helpful when determining costs and improvements. In addition to the improvement and design codes provided for each segment, a field for additional comments was included to provide more detail.
Step 2: Once the SRI and the beginning milepost location information is entered, look at the roadway volumes (AADT) as well as posted speeds. Posted speeds may need to be obtained from Google Street view or via GIS if data is available. For AADT, if the road segment if located between two count locations, do an average of the two numbers and if count is closer to one location, apply a heavier pull towards that count. Then round the number up to the nearest 100. Input that data into the excel table.

Step 3: Now look at the aerial imagery to measure the road cartway. This important step determines what facilities can physically fit in each space and should be carefully measured and remeasured. Nearmap imagery was Mercer County’s preferred imagery due to its high accuracy but in cases where there were obstructions (trees, solar panels, vehicles, etc.), other imagery was used, such as our 2015 DVPRC aerials or 2009 Pictometry imagery. Most often, measurements were made with two sources for improved accuracy. Since roads may vary in size, we tried to break up road segments to keep similar widths. In many cases, where the cartway dropped below 32’, a new segment would be created due to the fact that it couldn’t accommodate bicycle lanes (Two 11’ lanes and two 5’ bicycle lanes). Similarly, if a road increased in size from 34’ to 35’, it may become a new segment due to the fact that it could now hold two 11’ vehicle lanes and two 5’ bike lanes with 1.5’ buffers. Wherever possible within existing cartway, we aim for the higher LTS facility so buffered lanes would beat out regular lanes. Segmentation was based on multiple factors but relied heavily on this step of measuring out cartways.

Step 4: Once cartway, speeds and AADTs are measured, a proper segment can be determined. Use the Identify Route Location tool in GIS to find the Mile Posting ending point. In the example on the previous page, we look at breaking up Sullivan Way from Route 29 (0.000) to the D&R Canal (0.070) due to the constraints posed because of the canal support piers and cartway reduction. Now input the ending milepost into the excel table.

Step 5: Now look for additional roadway information such as if the road is a truck route or bus route for any bus services. If there are bus or truck routes, Mercer County aimed to keep lanes at 12’ for increased comfort and safety of cyclists. In some cases 11’ was required due to space constraints but where possible, aim to keep 12’ or even 13’ where truck or bus traffic is extremely heavy. Also look for on-street parking and mark it in the excel table. If parking needs to be removed, this table will indicate which segments will require parking reconfiguration.

Step 6: Now look at any other environmental factors that may be required to make an informed decision. Are there are stream, rivers, wetlands, large trees or wildlife crossings? Make note of guiderail, rail lines, traffic signs, elevation changes, preserved open space, preserved farmland, school locations, and any other relevant elements. In some cases, the speeds may be high for the selected segment and may be proposed for a 5mph reduction. As bicycle lanes will narrow vehicle lanes and create a better defined barrier to drivers, we can anticipate the 85th percentile speeds to be reduced when plugged into the USLIMITS2 interface as mentioned in the previous sections. Only in very limited and severe cases will the posted speed be allowed to be reduced by 10mph. Most reductions of 10 mph and all reductions of 15mph and more will likely require geometric changes
to the roadway as the road was most likely designed for much higher speeds and arbitrarily lowering speed limits may actually decrease safety. This is to keep drivers and cyclists safe as contrary to popular belief, reducing speed limits arbitrarily may actually increase crashes and be more dangerous. Once the table is filled with information from Steps 1-6 and you have information regarding the segment in question, reference the Mercer County Bicycle Facility Selection Table to determine the appropriate facility choices based on AADT and speeds and determine which ones can fit within the existing cartway.

Now look at your choices and determine what improvements will be required to incorporate each facility. Make note of what type of improvement is required to make your facility a reality. In some cases, the road may need to be widened or sidewalk may need to be converted into a multi-use path. In other cases, full intersection improvements may be required. Look at the Improvement Code Table below and enter the “Facility Type”, “Improvement”, and “Design” codes into the excel table.
As a result of this input, cost estimates can be then provided in the future when determining facility improvement costs. These draft cost estimates were based on data from 2019 County construction bids and contracts. Minor differences in cost distinguish facility types. These codes can then be factored into a multiplier within the excel table that will multiply the segment length by the improvement code to give a cost estimate of each segment improvement. These estimates can be changed at future point when better data is available at the state or local level. As Mercer County produces more bicycle improvements, we will be able to analyze those costs to create better estimates tailored specifically to our Metropolitan Region and County.

**Step 8:** In the comments section, enter a brief description of improvements in as little words as possible. If this attribute field is to be input into GIS at a later time, it will need to meet the character limit for whatever GIS platform you are using or will not populate properly, if at all. For additional notes, keep a separate comments section for *Additional Comments* and enter those comments there. Before converting the excel table into a GIS shapefile, you may need to delete that field due to character limits.

**Step 9:** Now to convert the excel table and routes into shapefiles, which display your collected data, follow the following steps:

I. Place all the data in one spreadsheet tab and save the file as a .csv
II. In Arc Catalog, create a new geodatabase by navigating to the desired folder, right click on the folder > new > File Geodatabase
III. In Arc-gis, navigate to your geodatabase in the catalog window on the right. Right click on the geodatabase > import > table (single). The table should now be displayed in your Table of Contents on the left.
IV. Right click on the table > display route events
V. Once your lines draw, right click on the layer file > data > export data
VI. Your table data should now be in shapefile form.

The following pages are the Mercer County Bicycle Facility Analysis Sheets:

**Final Countywide Totals:**

931,957 feet analyzed or 176.5 miles
<table>
<thead>
<tr>
<th>SRI</th>
<th>MP_Start</th>
<th>MP_End</th>
<th>Fact_Type</th>
<th>Proposed_Speed</th>
<th>Proposed_AADT</th>
<th>Approximate</th>
<th>Improvement</th>
<th>Code</th>
<th>Carriageway_Width</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000057/2</td>
<td>33.055</td>
<td>33.491</td>
<td>1 40 25</td>
<td>3,120</td>
<td>4,057</td>
<td>2 24</td>
<td>35'</td>
<td>.Point buffer binned lanes in existing shoulders</td>
<td>No Parking</td>
<td>2,400</td>
</tr>
<tr>
<td>8000057/2</td>
<td>33.245</td>
<td>32.645</td>
<td>3 40 30</td>
<td>1,063</td>
<td>85</td>
<td>20 28'</td>
<td>Build sidepath on the north side of the road. Opportunity to build upon existing path extending south from Etna-Lake Park on Old Mill Road</td>
<td>No Parking</td>
<td>3,168</td>
<td>Truck Route</td>
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<td>32.645</td>
<td>31.285</td>
<td>5 45 40</td>
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<td>110</td>
<td>60 25</td>
<td>Continue existing shoulders here</td>
<td>No Parking</td>
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<tr>
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<td>43.653</td>
<td>43.645</td>
<td>1 25 25</td>
<td>12,300</td>
<td>4,057</td>
<td>2 24'</td>
<td>35'</td>
<td>Build lanes to 35 in bike lanes and 2 buffers</td>
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<td>42</td>
</tr>
<tr>
<td>8000057/2</td>
<td>43.383</td>
<td>42.262</td>
<td>3 30 35</td>
<td>15,000</td>
<td>80</td>
<td>20 34'</td>
<td>Continue binned lanes on SB side and expand sidewalk to multi-use path on NB side</td>
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</tr>
<tr>
<td>8000057/2</td>
<td>41.355</td>
<td>42.860</td>
<td>5 30 40</td>
<td>15,000</td>
<td>7,965</td>
<td>4 34'</td>
<td>Diet lane to 11' put in 5 bike lanes and 2 buffers (long term temporary road on mill road) and on road</td>
<td>No Parking</td>
<td>2,749</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>43.330</td>
<td>41.566</td>
<td>3 30 35</td>
<td>15,000</td>
<td>6,144</td>
<td>2 34'</td>
<td>Stripe buffer binned lanes in existing shoulders</td>
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<td>4,034</td>
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</tr>
<tr>
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<td>41.361</td>
<td>3 30 35</td>
<td>14,880</td>
<td>55</td>
<td>20 37'</td>
<td>32'</td>
<td>Widen out to 35 for 11' bike lanes and 2 bike buffers</td>
<td>No Parking</td>
<td>1,852</td>
</tr>
<tr>
<td>8000057/2</td>
<td>40.000</td>
<td>40.058</td>
<td>3 30 35</td>
<td>14,920</td>
<td>6,144</td>
<td>2 34'</td>
<td>Buffer binned lanes</td>
<td>No Parking</td>
<td>1,060</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>40.753</td>
<td>40.710</td>
<td>2 40 30</td>
<td>15,400</td>
<td>5,242</td>
<td>2 43'</td>
<td>52'</td>
<td>18' Diet through lanes and create dashed bicycle lane connecting curvilinear binned lane across right turn lane to 35' bike lane between and through right turn lane. NB Continue binned lane through intersection</td>
<td>No Parking</td>
<td>227</td>
</tr>
<tr>
<td>8000057/2</td>
<td>40.710</td>
<td>40.471</td>
<td>3 30 35</td>
<td>15,400</td>
<td>6,144</td>
<td>2 68'</td>
<td>Road and stripe buffer binned lanes in both directories</td>
<td>No Parking</td>
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<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>40.471</td>
<td>40.452</td>
<td>5 30 35</td>
<td>15,400</td>
<td>55</td>
<td>50 34'</td>
<td>Widen Road from 34-40 feet - may require moving telephone pole - could also make a short sidewalk here.</td>
<td>No Parking</td>
<td>629</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>40.331</td>
<td>40.084</td>
<td>5 30 35</td>
<td>22,000</td>
<td>80</td>
<td>50 52'</td>
<td>Diet road to a single through lane and a right turn lane, stripe buffer binned lanes.</td>
<td>No Parking</td>
<td>1,304</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>40.004</td>
<td>39.469</td>
<td>5 30 35</td>
<td>25,000</td>
<td>110</td>
<td>50 45'</td>
<td>Continue Multi Use Path for this segment. Also be difficult with homes but no alternative.</td>
<td>No Parking</td>
<td>2,247</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
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<td>39.386</td>
<td>3 30 35</td>
<td>29,500</td>
<td>80</td>
<td>50 55'</td>
<td>Turn existing sidewalk on South side of Princeton Hightown Rd into multi use path</td>
<td>No Parking</td>
<td>458</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>39.386</td>
<td>39.294</td>
<td>5 30 35</td>
<td>29,500</td>
<td>80</td>
<td>50 55'</td>
<td>Build sidepath - all need to work with homeowners</td>
<td>No Parking</td>
<td>750</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>39.294</td>
<td>38.800</td>
<td>5 30 35</td>
<td>29,500</td>
<td>80</td>
<td>50 55'</td>
<td>Turn existing sidewalk on South side of Princeton Hightown Rd into multi use path.</td>
<td>No Parking</td>
<td>2,344</td>
<td>Truck Route</td>
</tr>
<tr>
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<td>38.800</td>
<td>38.688</td>
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<td>29,500</td>
<td>80</td>
<td>50 55'</td>
<td>Build sidepath - all need to work with homeowners</td>
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<td>602</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>38.686</td>
<td>38.627</td>
<td>3 30 35</td>
<td>24,000</td>
<td>80</td>
<td>50 60'</td>
<td>Create carriewalk buffer off of bridge over bear brook</td>
<td>No Parking</td>
<td>312</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
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<td>38.167</td>
<td>5 30 35</td>
<td>24,000</td>
<td>80</td>
<td>50 60'</td>
<td>Build sidepath</td>
<td>No Parking</td>
<td>766</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>38.177</td>
<td>38.117</td>
<td>2 30 35</td>
<td>24,000</td>
<td>80</td>
<td>50 60'</td>
<td>Turn existing sidewalk on South side of Princeton Hightown Rd into multi use path</td>
<td>No Parking</td>
<td>264</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>38.117</td>
<td>38.056</td>
<td>4 30 35</td>
<td>24,000</td>
<td>80</td>
<td>50 60'</td>
<td>Build sidepath</td>
<td>No Parking</td>
<td>269</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>38.045</td>
<td>38.000</td>
<td>5 30 35</td>
<td>24,000</td>
<td>80</td>
<td>50 60'</td>
<td>Turn existing sidewalk on South side of Princeton Hightown Rd into multi use path</td>
<td>No Parking</td>
<td>427</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>37.089</td>
<td>37.012</td>
<td>3 30 35</td>
<td>14,423</td>
<td>100</td>
<td>50 70'</td>
<td>Build sidepath</td>
<td>No Parking</td>
<td>11,495</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>35.812</td>
<td>35.594</td>
<td>5 30 35</td>
<td>16,000</td>
<td>0</td>
<td>0 50'</td>
<td>Cross Princeton Hightown Rd at 1 mile Road and Use existing sidewalkpath north side of road</td>
<td>No Parking</td>
<td>1,151</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>35.594</td>
<td>35.358</td>
<td>5 30 35</td>
<td>16,000</td>
<td>0</td>
<td>0 50'</td>
<td>Build sidepath</td>
<td>No Parking</td>
<td>412</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>35.358</td>
<td>35.326</td>
<td>2 30 35</td>
<td>16,000</td>
<td>0</td>
<td>0 50'</td>
<td>Wide slightly to 60' to accommodate crosswalks and continue 5 bike lanes to intersection</td>
<td>No Parking</td>
<td>169</td>
<td>Truck Route</td>
</tr>
<tr>
<td>8000057/2</td>
<td>35.326</td>
<td>35.526</td>
<td>3 25 25</td>
<td>10,603</td>
<td>5,242</td>
<td>2 28'</td>
<td>Diet travel lanes to 10' and put in 4' bicycle lanes</td>
<td>No Parking</td>
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<td>Roadway Improvement</td>
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<tr>
<td>SRI</td>
<td>MP Start</td>
<td>MP End</td>
<td>Fac. Type</td>
<td>Speed</td>
<td>Proposed Speed</td>
<td>Proposed Approach AADT</td>
<td>Improvement Code</td>
<td>Design Code</td>
<td>Cartway/WIDTH</td>
<td>Comments</td>
</tr>
<tr>
<td>-----</td>
<td>----------</td>
<td>--------</td>
<td>----------</td>
<td>--------</td>
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<td>-----------</td>
</tr>
<tr>
<td>11000081</td>
<td>0.767</td>
<td>0.770</td>
<td>3</td>
<td>45</td>
<td>45</td>
<td>5,600</td>
<td>5.242</td>
<td>2</td>
<td>30'</td>
<td>Do not widen to 20'</td>
</tr>
<tr>
<td>11000081</td>
<td>0.767</td>
<td>0.770</td>
<td>4</td>
<td>25</td>
<td>25</td>
<td>16,000</td>
<td>2.742</td>
<td>2</td>
<td>30'</td>
<td>Widen to 20' and put in 5' bike lanes. No median</td>
</tr>
<tr>
<td>11000081</td>
<td>0.767</td>
<td>0.770</td>
<td>5</td>
<td>30</td>
<td>30</td>
<td>14,000</td>
<td>2.742</td>
<td>2</td>
<td>30'</td>
<td>Widen to 20' and put in 5' bike lane.</td>
</tr>
</tbody>
</table>

**Legend**
- **SRI:** Street Route Identification
- **MP Start:** Milepoint Start
- **MP End:** Milepoint End
- **Fac. Type:** Facility Type
- **Speed:** Current Speed
- **Proposed Speed:** Proposed Speed
- **Proposed Approach AADT:** Proposed Approach AADT
- **Improvement Code:** Improvement Code
- **Design Code:** Design Code
- **Cartway/WIDTH:** Cartway/Width
- **Comments:** Comments
- **Proposed Parking:** Proposed Parking
- **Length(Ft):** Length (Ft)
- **Bus & Truck Route:** Bus and Truck Route
<table>
<thead>
<tr>
<th>SRI</th>
<th>MP_Start</th>
<th>Fac Type</th>
<th>Proposed Speed</th>
<th>Approximate AADT</th>
<th>Improvement Code</th>
<th>Design Code</th>
<th>Cartway_Width</th>
<th>Comments</th>
<th>Proposed_ Parking</th>
<th>Length(ft)</th>
<th>Track or Bus Route</th>
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</thead>
<tbody>
<tr>
<td>11111527_</td>
<td>0.000</td>
<td>0.117</td>
<td>2 25 25</td>
<td>8,500</td>
<td>0.117</td>
<td>0.281</td>
<td>3 25 25</td>
<td>8,500</td>
<td>6.14</td>
<td>2 38' Diet lanes to 12' and put in 5' bike lanes</td>
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</tr>
<tr>
<td>11111527_</td>
<td>0.381</td>
<td>0.580</td>
<td>3 25 25</td>
<td>8,500</td>
<td>1000</td>
<td>38' Need intersection improvements to get bikes across Route 129 and this section of Cass</td>
<td>No Parking</td>
<td>697</td>
<td>Bus Route</td>
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<tr>
<td>11111527_</td>
<td>0.413</td>
<td>0.680</td>
<td>3 25 25</td>
<td>6,500</td>
<td>6.14</td>
<td>2 38' Diet lanes to 12' and put in 5' bike lanes</td>
<td>No Parking</td>
<td>882</td>
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<td>44.291</td>
<td>44.500</td>
<td>2 25 25</td>
<td>12,000</td>
<td>6.14</td>
<td>2 38' Diet lanes to 11.5' and put in 1.5' buffers</td>
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<tr>
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<td>44.721</td>
<td>4 35 30</td>
<td>12,000</td>
<td>1000</td>
<td>42'</td>
<td>48' Diet lanes to 12' and put in 6' bike lanes</td>
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<td>1,104</td>
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<tr>
<td>00000206Z_</td>
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<td>44.935</td>
<td>2 30 30</td>
<td>12,000</td>
<td>10.14</td>
<td>2 42'</td>
<td>45' Intersection with Brunswick Circle needs significant bike/ped improvements</td>
<td>No Parking</td>
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<tr>
<td>00000206Z_</td>
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<td>45.000</td>
<td>2 30 30</td>
<td>12,000</td>
<td>10.14</td>
<td>2 42'</td>
<td>45' Intersection with Route 206 needs significant bike/ped improvements</td>
<td>No Parking</td>
<td>364</td>
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</tr>
<tr>
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<td>45.276</td>
<td>3 30 30</td>
<td>12,000</td>
<td>10.14</td>
<td>2 48'</td>
<td>Intersection with Route 206 needs significant bike/ped improvements</td>
<td>No Parking</td>
<td>458</td>
<td>Bus Route</td>
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</tr>
<tr>
<td>00000206Z_</td>
<td>45.276</td>
<td>45.549</td>
<td>3 30 30</td>
<td>12,000</td>
<td>10.14</td>
<td>2 48'</td>
<td>Intersection with Route 206 needs significant bike/ped improvements</td>
<td>No Parking</td>
<td>1,130</td>
<td>Bus Route</td>
<td></td>
</tr>
</tbody>
</table>

**County Wide Totals**

931,957
This section serves as an introduction to the set of recommended facilities to be considered to enhance bicycle safety, connectivity, and accessibility in Mercer County. The types of facilities are both related to the existing conditions, strengths, and constraints discussed in chapter two, and reflective of established guidelines and design recommendations.

The designs and recommendations to be considered are derived from a series of design and policy manuals from both local and national contexts. These manuals aim to share standards, best practices, and strategies for design and construction of bicycle facilities. The following section outlines the guides referenced for development of these recommendations. It is important to note that many Mercer County Roads have limited right-of-way and without massive corridor improvement projects and takings, the County is mainly limited to existing road cartways & Right of Way. As such, staff will look at cost-effective benefits to the general public and utilize context-sensitive solutions for the roadway environment.

It is important to note that there is significant room for flexibility in highway and roadway design and the often used AASHTO Green Book is not a detailed design manual but a guidance document to be used by users to make better informed decisions. There is a significant range of roadway conditions within Mercer County so a “one size fits all” approach will not work. Context sensitive solutions must be used to reflect the location and community. As a result, a range of design reference and guidance documents will be used to design and implement bicycle facilities throughout the County. The following page refers to the most current and applicable reference documents for Mercer County staff.

It is important to note that the County does however need to follow the Manual on Uniform Traffic Control Devices (MUTCD) to stay in standards conformance with FHWA and can only follow recommendations if in line with the MUTCD. The MUTCD is adopted by reference in accordance with Title 23, United States Code, Section 109(d) and Title 23, Code of Federal Regulations, Part 655.603, and is approved as the national standard for designing, applying, and planning traffic control devices. As the MUTCD and other federal guidance changes, these recommendations may change during the life of this plan.

AASHTO GREEN BOOK NOTE:

“The intent of this policy is to provide guidance to the designer by referencing a recommended range of values for critical dimensions. It is not intended to be a detailed design manual that could supersede the need for the application of sound principles by the knowledgeable design professional. Minimum values are either given or implied by the lower value in a given range of values. The larger values within the ranges will normally be used where the social, economic, and environmental (S.E.E.) impacts are not critical.”
Reference and Guidance Documents
Bicycle Facilities To Be Considered

1. Sharrows and Shared Lane Markings
2. Bikable Paved Shoulders *(temporary or when cartway restricted)*
3. Standard Bike Lanes
4. Buffered Bike Lanes (Painted and Rumble)
5. Two-Way Cycle Tracks & Hybrid Bike Lanes
6. Separated/ Protected Bike Lanes
7. Multi-Use Path and Shared-Use Paths
8. Through Lanes
9. Combines Bike Lane/ Turn Lanes
10. Intersection Crossings
    - Intersection Bike Box
    - Two-Stage Turn Queue Box
    - Protected Intersection
    - Signal Timing and Cycle Length
    - Leading Bike/ Pedestrian Interval
    - Signalized Turns
    - Bike Boxes and Two-Stage Bike Turn Boxes
11. Road Diet and Lane Diets
12. Driveway Design
13. Bikeway through Existing Bridge and Underpass/ Tunnel Considerations
14. Entrance/ Exit Ramp Designs
15. Midblock Crossings
16. Pavement Markings, Wayfinding, and Signage Standards (MUTCD)
A sharrow, or shared lane marking, is a street marking indicating that a lane should be used by both bicyclists and motor vehicles. The image, a bicycle below two wide directional arrows, identifies proper bicyclist positioning within the cartway. Sharrows can also be helpful tools for wayfinding and signaling directionality.

Benefits
> Does not require additional street space.
> Reduces bicyclists riding against motor vehicle traffic.
> Provide wayfinding and directionality guidance for bicyclists.

Considerations
> “May Use Full Lane” Signs encourage bicyclists to use the full lane to discourage unsafe within-lane passing
> Bike-and-chevron lane sharrow marking were approved for use within the US per the 2009 MUTCD.
> Frequency of sharrows should be increased when being used to fill gaps in other facilities, or in areas with high motor vehicle volume/speed.
> Placing sharrows in the center of a travel lane when possible will reduce marking wear from motor vehicle tires.
> The “door zone” should be avoided when determining lateral sharrow placement.
> In the absence of on-street parking, sharrows should be placed so as to avoid gutters, seams and other hazardous obstacles.
> The chevron orientation may be adjusted to serve wayfinding purposes.
> Color may be used to enhance the visibility of the sharrow.

Design Recommendations
- Sharrow spacing, high volume street: 50-100’
- Sharrow spacing, low volume street: 250’ or more
- Minimum distance from curb: 4’ (no parking)
- Shared Lane Marking (MUTCD 9C-9)
- MUTCD Sign Options: R4-11 > W11-1 & W16-1

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<th>Mercer County Bicycle Facility Selection Table</th>
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A: Shared Street/Bicycle Boulevard
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F: Shared-use Path

Source: Town of Frisco, CO
Source: NJDOT Complete Streets Design Guide
Bikable Paved Shoulder

Paved shoulders may be used as space for bicyclists and pedestrians to travel adjacent to a motor vehicle lane and provide motorists with an area to pull over in emergencies. In cases of incomplete bicycle networks, paved shoulders can serve as an unofficial connection until such connection can be made.

Benefits

> May not require additional street space.
> Reduces bicyclists riding against motor vehicle traffic.
> Provides wayfinding and directionality guidance for bicyclists.

Considerations

> Physical separation, such as rumble strips in the buffer area, can be used to alert drivers that they are encroaching on the bike lane and increase bicyclist comfort/safety.
> Bicyclist signage is not required, but could be used to signify a bicycle route.
> The solid shoulder line should be discontinued at intersections and major driveways. Dotted white lines may be used to extend the shoulder and signify bicycle travel space through these areas.
> Provide more than the minimum 4’ shoulder width when possible to increase bicyclist and pedestrian comfort.
> Contrasting colors may be used to distinguish the shoulder from the motor vehicle lanes.
> Paved shoulders should be considered during routine roadway maintenance, reconstruction, and in new constructions.

Design Recommendations

- Paved shoulders can be considered as a precursor to dedicated bicycle facilities and marked routes
- Minimum shoulder width: 4’ (wider shoulders and rumble strips should be considered on roads with higher speeds AADTs)
- If rumble strips included, place rumble strips to overlap with the roadway edge line
- Rumble lines should provide a 12’ gap every 40’-60’ to allow for bicycle access into and out of the shoulder
  - 12 inch spacing center to center
  - 6-8 inches long perpendicular to roadway
  - 6 inches wide, measured parallel to roadway
  - 3/8 inch deep
Standard Bicycle Lane

Standard bicycle lanes are delineated by solidly striped lines and can be marked with a combination of bicycle symbols, directional arrows, and words. Lanes are located between a vehicular travel lane and parking or the curb, directing bicyclists to move with traffic.

Benefits

> Further separates sidewalks, if present, from motor vehicle travel lanes.
> Provides a space exclusively for bicyclist travel.
> Establishes a level of predictability for bicycle and vehicle placement and behavior.

Considerations

> Markings for bike lanes should not be dotted when passing through a driveway crossing, as driveways are not considered intersections (MUTCD 2009, AASHTO Bike Guide 2012).
> When determining the width of bike lanes, one should take into account the presence of curb faces, guardrails, on-street parking, and other features.
> Larger bike lanes (~7’) may enable parking or driving within the lane. In this case, consider adding a buffer zone to clarify.
> When the bike lane is adjacent to a guard rail or physical barrier, add two feet to the bike lane width.
> A distance of four inches should be used to separate a bike lane from a parking lane.
> Obstacles in the bicycle lane such as gutters, drainage inlets, and utility covers should be designed so as not to interfere with bicycle tires. These features should be oriented appropriately and level with the ground.

Design Recommendations

-Lane width: 4’-6’
-Cartway width: 28’ min.
-Line width: 6’-8”
-Green paint can be an appropriate tool in areas where motor vehicles need to cross bike lanes, such as merging. (MUTCD Interim Approval)
Buffered Bicycle Lane

To increase separation between bikers and motor vehicle traffic, bicycle lanes may be enhanced with a buffer. Buffers can include visual separation, such as a painted area marked with longitudinal stripes, or physical separation such as rumble strips to alert drivers when they are entering the bike lane. Buffer treatments improve safety and bicyclist comfort on roadways with high traffic volumes and speed, as well as those with trucks or oversized vehicles.

Benefits

> Expands the benefits of a conventional bike lane by providing greater distance between bicyclists and motor vehicles compared to conventional bike lanes.
> Allows space for bicyclists to pass each other without having to enter the vehicle travel lane.
> Distinguishes larger bike lanes from travel or parking lanes.
> Can create separation between bicyclists and ‘door zone’.

Considerations

> Physical separation, such as rumble strips in the buffer area, can be used to alert drivers that they are encroaching on the bike lane and increase bicyclist comfort/safety.
> A bike lane should be transitioned to a through bike lane when a right turn only lane approaches, placed to the left of the turn lane. If space does not permit, a shared bike lane/turn lane should be used.
> At intersections without a right turn only lane, buffer markings should become a conventional dashed line. Bike boxes may also be helpful in these scenarios.
> A 6”-8” solid white line may be painted to mark the separation from a motor vehicle travel lane.

Design Recommendations

- Lane width: 4′-6′
- Cartway width: 35′ min
- Buffer width: 12″ White Line or other buffer ≥18″
> Optional rumble lines should provide a 12′ gap every 40′-60′ to allow for bicycle access into and out of their lane.
- A buffered bike lane is allowed as per MUTCD guidelines for buffered preferential lanes (section 3D-01).
- Buffer width: 3 ft. min. for hatching within buffer

“When crosshatch markings are used in paved areas that separate traffic flows in the same general direction, they shall be white and they shall be shaped as chevron markings, with the point of each chevron facing toward approaching traffic…” (MUTCD section 3B.24)
Default Mercer County Painted Buffer

*Default will vary depending on most current version of MUTCD, engineering judgement as well as Road Geometry and Cartways and other factors.

Default Mercer County Rumble Strip Buffer

*Default will vary depending on most current version of MUTCD, engineering judgement as well as Road Geometry and Cartways and other factors.
Separated Bicycle Lane

Separated bicycle lanes utilize a vertical buffer to distinguish the bicycle lane from motor vehicle traffic. Separated bicycle lanes differ from multi-use paths in that they are exclusively for bicyclists. They differ from conventional or buffered bike lanes in that they incorporate a vertical element as the buffer. Various treatments may be used as the vertical buffer, including: curbs, medians, on-street parking, landscaping, bollards, flexible delineators, and planters, depending on context and funding.

Benefits

> Provide a greater separation from motor vehicle traffic compared to buffered bike lanes.
> Appeals to more levels of bicyclists than conventional or visually buffered bike lanes.
> Bicyclist fear/risk of conflict with vehicles is eliminated, including crashes and “dooring”.
> Provide a more comfortable experience on high speed corridors than on-road shoulders.

Considerations

> Physically separated bicycle lanes can be one-way or two-way, as appropriate. Two-way separated bicycle lanes can be utilized to save space in the cartway.
> Solid white lines may be used to separate motor vehicle parking from the bicycle lane, diagonal crosshatching may be used to distinguish neutral areas.
> Increase the bicycle lane width when the gutter seam reaches more than 12 inches from the curb.
> Parking should not be allowed within 30 feet from an intersection to improve visibility when a lane is parking protected.
> To ease hazards at conflict areas, use color, yield lines and “Yield to Bikes” signage.

Design Recommendations

-Lane width: 4’-6’
-Road width: 33’ min
-Buffer minimum: 1.5’ min; 3’ preferred
-Sight triangle from minor street crossings: 20’
-Sight triangle from driveway crossing: 10’

Mercer County Bicycle Facility Selection Table

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A: Shared Street/Bicycle Boulevard
B: Shared-lane Markings
C: Bicycle Lane
D: Buffered Bicycle Lane
E: Separated Bicycle Lane
F: Shared-use Path

Source: Alta Planning + Design (CC-BY-SA)
Source: Dianne Yee, FHWA Separated Bike Lane Planning and Design Guide
Two-Way Cycle Track

Two-way cycle tracks are a physically separated set of bike lanes that allow bicycle movement in both directions on the same side of a street. Two-way cycle tracks tend to be good for bicyclists of all experience levels due to their physical separation from traffic, their ability to avoid the risk of being “doored” by a parked vehicle, and because they reduce indirect travel by allowing movement against the direction of one-way streets.

Benefits

> Provide dedicated and protected space to a cyclist, which improves their perceived feelings of safety.

> Reduces risk of dooring.

> Attractive to bicyclists with a range of ages and abilities.

Considerations

> Two way Cycle Tracks may be configured as:

  - A protected cycle track at street level with a barrier such as a flexible delineator and/or with parking.
  - Raised cycle tracks provide vertical separation from adjacent vehicular traffic.

> Function better on streets with fewer driveways and curb cuts and should be placed on the side of street with more desired destinations.

> Useful on streets with higher traffic volumes.

> Useful on higher stress streets with higher speeds and higher traffic volumes.

> Intersection controls should be oriented towards bicyclists going in both directions.

Design Recommendations

- Minimum Track Width 8’, Desired Width: 12’.
- When parking protected, 3’ buffer is need between parked cars and cycle track.
- Dashed yellow centerline should be used to separate lanes.
- Approximately 10’-20’ sight triangles are recommended at driveways and intersections. Parking should be prohibited near these driveways.
- Color, yield markings, and signage should be used to identify conflict zones.
- A “ONE WAY” sign (MUTCD R6-1, R6-2) should be provided if located on a one way street.
- A “DO NOT ENTER” with “EXCEPT BIKES” sign (MUTCD R5-1) sign should be provided.
Multi-Use Sidepath

A sidepath is a bidirectional shared use path located immediately adjacent and parallel to a roadway and provides a travel area separate from motorized traffic for bicyclists, pedestrians, skaters, wheelchair users, joggers, and other users. Sidepaths can offer a high-quality and low-stress experience for users of all ages and abilities using the network for transportation or recreation as compared to on-roadway facilities in heavy traffic environments.

Benefits

> Encourages bicycling and walking in areas where high-volume and high-speed motor vehicle traffic would otherwise discourage it.
> Appropriate for walkers and bikers, as well as wheelchairs, roller blades, skateboards, etc.
> Provides a more appropriate facility for users of all ages and abilities than shoulders or mixed traffic facilities on roads with moderate or high traffic intensity.
> Very supportive of rural character when combined with vegetation.

Considerations

> Utilize medians and raised crossings at intersections to prioritize path travel and increase safety/comfort of path users.
> Widths and design details of sidepath elements may vary in response to the desire for increased user comfort and functionality, the available right-of-way, and the need to preserve natural resources.
> Landscaping can be used to further increase the separation between a path and the roadway, and add to the recreational appeal of the facility.
> When appropriate, sidepaths should transition to on-road facilities when the path ends.

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Source: DRWC
Multi-Use Sidepath

Design Recommendations

- Multi-Use sidepaths can be incorporated at any speed or volume of adjacent roadway.
- Intersections need to be carefully designed and other guides should be referenced for additional information.
- 10’ width is recommended in most situations and will be adequate for moderate to heavy use.
- A “BIKES YIELD TO PEDS” (R9-6) sign may be used at the entrances of path segments to remind bicyclists of the requirement to yield.
- A “RIGHT TURN YIELD TO PEDESTRIANS” sign (MUTCD R10-15) should be provided at road crossings with right turn intersections.
- Preferred minimum separation width is 6.5’ and minimum separation distance is 5’
- Where a sidepath terminates, it may be necessary for path users to transition to a facility on the opposite side of the road.
- Paths with a high volume of bidirectional traffic should include a centerline. When striping is required, use a 4 inch broken yellow center line stripe with 4 inch solid white edge lines. Solid center lines can be provided on tight or blind corners and on the approaches to roadway crossings.
Multi-Use Sidepaths require special attention at intersections and crossings, especially at mid-block crossings where motorists may be unaware of them. In the State of New Jersey, vehicles must yield the right of way to pedestrians at marked crosswalks and at intersections where stop signs or flashing red signals are in place. Pedestrians must yield the right-of-way to vehicles when crossing outside of a marked crosswalk or an unmarked crosswalk at an intersection with no stop sign. In many instances, multi-use paths will need to cross a County Highway away from a marked intersection.

Considerations

> Designs should consider the desire for natural directional flows, and the potential for conflicts with adjacent traffic. Use should be made of median islands and horizontal deflection of the roadway travel lanes to slow motor vehicle traffic and offer improved crossing conditions for path users.

> A basic marked shared use path crossing consists of a marked crosswalk, plus signs and other markings to slow or stop traffic.

> High-visibility crosswalk markings are the preferred marking type at uncontrolled marked crossings. Transverse lines are “essentially not visible” when viewed from a standard approaching vehicle.

> At high-speed and high-volume intersections, it may be necessary to make full intersection improvements.

> Visual obstructions should be low to provide unobstructed sight of the crossing from the major street. Both motorists and path users should have a clear and unobstructed view of each other at intersections and driveways.
Multi-Use Sidepath “Mid-Block” Crossings

FHWA’s report *Safety Effects of Marked Crosswalks at Uncontrolled Locations, 2005* recommends crossing enhancements on high-speed and high-volumes roadways where crosswalk markings alone are not a viable safety measure. There are several methods to create these safer crossings. For crossings on low-speed and low-volume roads, a simple marked crossing consisting of a marked crosswalk, signs and other marking to slow traffic, such as below. Crosswalk markings are necessary to establish a legal crosswalk at areas away from intersections. Crossing sign assemblies and advance crossing sign assemblies using W11-15 and W16-7P signs should be used to warn users of the crossing location and high-visibility crosswalk markings should be used.

For higher-speed and higher-volume roads where greater visibility or traffic control is desired, a rectangular rapid flash beacon (RRFB) or pedestrian hybrid beacon (PHB) may be used. Where drivers fail to stop for pedestrians and compliance is low, RRFBs should also be incorporated. RRFBs are a yield enhancement device for use at uncontrolled crossings. They may be configured with solar power where it is the most cost-effective option. See an updated FHWA Interim Approval (March 2018) for guidance on the application of RRFBs. “State Law: Stop for Pedestrian” may also be placed to advise drivers of this requirement.
Multi-Use Sidepath “Mid-Block” Crossings

On treacherous and hard to cross multilane streets with high volumes and few gaps for crossing, a Pedestrian Hybrid Beacon (PHB) may be used to increase yielding rates. A pedestrian hybrid beacon, also known as a high intensity actuated crosswalk (HAWK), is a pedestrian actuated traffic control device for mid-block pedestrian crossing locations. They enable pedestrians to cross high-speed and high-volume roadways while traffic is stopped. As the name implies, it is essentially a hybrid between a RRFB and a full traffic signal. It provides planners and engineers with an intermediary option for locations that do not meet requirements for a traffic signal warrant, but where traffic conditions exceed the limitations of an RRFB. PHB’s provide a red signal indication to drivers, and create yielding rates similar to that of a conventional traffic signal. PHBs are particularly useful on undivided roadways with multiple lanes in any one direction. PHBs are an FHWA Proven Safety Countermeasure.

For many road segments, crossing islands or pedestrian refuge islands can be considered. These median islands are beneficial on roadways with high volumes and/or high speeds, and on roadways with three or more travel lanes. Median islands particularly benefit people who may travel slower, such as children, older adults, and people with disabilities. They enable pedestrians to make a crossing in two stages—crossing one direction of vehicular travel lanes, pausing at the island, and then completing the crossing. This reduces the exposure time of pedestrians to vehicular traffic. Crossing islands should be a minimum of 6 feet wide, with a preferred width of 8 to 10 feet, and a minimum of 6 feet long. They should also have a “nose” that extends beyond the crossing to protect pedestrians from turning vehicular traffic. Median islands are an FHWA Proven Safety Countermeasure which the FHWA identified as an effective, proven, tested and studied tool to promote safety.
Additional Design Considerations and Facilities
Through Lanes

A through bike lane uses dashed lines and/or colored lane to position bicyclists to the left of right turn lanes or to the right of left turn lanes and gets bicycles across dangerous or busy intersections.

Benefits

> Reduces conflict between turning motorists and cyclists going straight.

> Provides more predictable travel movements for all users.

> Alerts motorists to yield to merging traveling.

Design Recommendations

- Desired width of a through lane is 4’-6’.

- Dotted white line should be 6” wide and 2 ’long with 6’ gap between dashes.

- Dashed lines should begin a minimum of 50’ before an intersection, 100’ if on a high volume corridor.

- The through bike lane shall be placed to the left of the right-turn only lane.
Combined Right Turn / Bike Sharrow

A combined bike sharrow lane / turn lane uses signage and bike sharrow markings within a turn lane to suggest a route to delineate space for cyclists and to guide them through the intersection. Sharrow markers also provide a visual warning to vehicles to watch for cyclists.

Benefits

> Helps to position and guide cyclists through intersections by aligning them to the left of right-turning vehicles and encourages motorists to yield to cyclists.

> Reduces risk of "right hook" collisions by keeping bikes left of vehicles making right turn. Cheapest alternative for streets with limited cartway.

Design Recommendations

- Only MUTCD sharrow markings (with no alterations) shall be used to clarify bicyclist positioning within the combined lane. No bicycle lane markings or lines shall be used to attempt to create and establish a bike lane.

- Width of combined lane should be 9 feet minimum, 13 feet maximum. A full bicycle through lane can be accommodated if the vehicle right-turn only lane can be made 14 feet or wider.

- Chapter 5.3 of the NJDOT Roadway Design Manual: On land service highways states that where it is not practical to provide a shoulder adjacent to the outside lane (design exception required), the outside lane width shall be 15 feet to accommodate bicyclists. Where alternate bike access is provided, the outside lane width should be 1 foot wider than the adjacent through lane width. The designer should strive to accommodate the bicyclist and pedestrian on all projects.
Intersection Crossings

Intersection crossing markings help to guide bicyclists through intersections by providing clear and direct paths using arrows and dashes. These marking are also helpful in that they make bicyclists’ paths more predictable for drivers, reinforcing that they have priority over turning vehicles and bringing attention to their presence.

Benefits

> Reduces conflict between turning motorists and cyclists going straight and Increases the visibility of bicyclists.

> Provides more predictable travel movements for all users.

> Guides bicyclists through the intersection in a straight and direct path.

> Reinforces that through bicyclists have priority over turning vehicles or vehicles entering the roadway (from driveways or cross streets).

> Reduces bicyclist stress by delineating the bicycling zone.
Design Recommendations

- Dotted lines shall bind the bicycle crossing space.
- Pavement markings extended into or continued through an intersection or interchange area shall be the same color and at least the same width as the line markings they extend.
- Striping width shall be a minimum of 6 inches adjacent to motor vehicle travel lanes and shall otherwise match the width and lateral positioning of leading bike lane striping, except when using elephant’s feet markings.
- Dotted lines should be 2 foot lines with 2 to 6 foot spacing. Markings should be white, skid resistant and retro-reflective.
- Crossing lane width should match width and positioning of the leading bike lane.
- On crossings of two-way paths and cycle tracks, markings should indicate that there is two-way traffic either by marking the path center line through the intersection, or by marking bicycle silhouettes and / or chevrons in opposite directions in the two lanes. See Two-Way Cycle Tracks.
- Chevrons may be used for increased visibility within conflict areas or across entire intersections. Placement shall be in the middle of the moving lanes, and close to crosswalks.
- Shared lane markings (MUTCD Figure 9C-9) may be used for increased visibility within conflict areas or across entire intersections. Placement shall be in the middle of the moving lanes, and close to crosswalks.
**Intersection Bike Box**

A bike box is a designated area at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get ahead of queuing traffic during the red signal phase.

**Benefits**

>Groups bicyclists together to clear an intersection quickly, minimizing impediment to transit or other traffic.

>Provides more predictable travel movements for all users.

>Helps prevent ‘right-hook’ conflicts with turning vehicles at the start of the green indication.

>Reduces signal delay for bicyclists.

>Facilitates bicyclist left turn positioning at intersections during red signal indication. This only applies to bike boxes that extend across the entire intersection.

>Facilitates the transition from a right-side bike lane to a left-side bike lane during red signal indication. This only applies to bike boxes that extend across the entire intersection.

[Sources: NIDOT Complete Streets Guide, NACTO, Portland, OR, NACTO, Urban Street Design Guide]
Design Recommendations

-A box formed by transverse lines shall be used to hold queuing bicyclists, typically 10-16 feet deep. Deeper boxes show less encroachment by motor vehicles.

-Stop lines shall be used to indicate the point behind which motor vehicles are required to stop in compliance with a traffic control signal.

-Pavement markings shall be used and centered between the crosswalk line and the stop line to designate the space as a bike box. The marking may be a Bike Symbol (MUTCD 9C-3A) or Helmeted Bicyclist Symbol (MUTCD 9c-3B.)

-At intersections that currently permit right turns on red signal indications, a “No Turn on Red” sign shall be installed overhead to prevent vehicles from entering the Bike Box.

-A “Stop Here on Red” sign should be post-mounted at the stop line to reinforce observance of the stop line.

-Colored pavement should be used as a background color within the bike box to encourage compliance by motorists.

-An ingress lane should be used to define the bicycle space. Colored pavement may be used. When color is used, length shall be 25 to 50 feet to guarantee bicycle access to the box.

-An egress lane should be used to clearly define the potential area of conflict between motorists and bicyclists in the intersection when intersection is operating on a green signal indication.

-A “Yield to Bikes” sign should be post-mounted in advance of and in conjunction with an egress lane to reinforce that bicyclists have the right-of-way going through the intersection.
Two-Stage Turn Queue Boxes

A two-stage bike turn box provides a more comfortable and safe way for bicyclists to cross multi-lane streets with high vehicle speeds or volumes. Similar to a jug-handle for motor vehicles, bicyclists complete a left turn by dividing it into two movements. Bicyclists first proceed through the intersection with traffic to a bike box on the far side of the intersection, where they position themselves in front of the traffic queue on the cross street. When the traffic signal turns green for the cross street, they cycle across the intersection with traffic, completing the left turn.

Benefits

> Improves bicyclist ability to safely and comfortably make left turns.
> Provides a formal queuing space for bicyclists making a two-stage turn.
> Reduces turning conflicts between bicyclists and motor vehicles.
> Prevents conflicts arising from bicyclists queuing in a bike lane or crosswalk.
Protected Intersection

A protected intersection extends the physical barrier of the protected bike lane into the intersection, creating a clear and safe, continuous path of travel for all modes. Protected intersections have four main design elements: a corner refuge island, a forward stop bar for cyclists, a setback bicycle and pedestrian crossing, and bicycle-friendly signal phasing. The corner refuge island is a physical barrier that protects people on bikes from cars making turns. After yielding to pedestrians, cyclists can either turn right safely or continue into the intersection past the crosswalk to the forward stop bar, where they can wait at a red light buffered from vehicles by the refuge island.

Benefits

> Improves bicyclist ability to safely and comfortably make left turns.

> Reduces turning conflicts between pedestrians, bicyclists and motor vehicles.

> Reduces crossing distances for bicyclists and pedestrians.
A lane diet is a treatment that involves decreasing the size of lanes, rather than the number, to reduce vehicle speeds and encourage yielding. The size of the lane that is removed may be reallocated as a bicycle facility. According to the AASHTO Green Book, for rural and urban arterials, lane widths may vary from 10 to 12 feet. Ten feet is the recommended minimum width for travel lanes and turn lanes, while eleven feet is recommended for areas frequented by trucks and buses.

Benefits

>Narrower lanes typically result in lower speeds due to their effect on driver psychology, which can help to reduce the severity of crashes.

>Narrowed lanes help to create space for bicycle facilities.

>According to FHWA, there are “No significant safety or capacity differences between 10-foot and 12-foot wide travel lanes under most urban and suburban conditions.”

Design Recommendations

-Lanes greater than 11 feet should not be used as they may cause unintended speeding and assume valuable right of way at the expense of other modes.

-Parking lane widths of 7–9 feet are generally recommended. Cities are encouraged to demarcate the parking lane to indicate to drivers how close they are to parked cars.

-For multi-lane roadways where transit or freight vehicles are present and require a wider travel lane, the wider lane should be the outside lane (curbside or next to parking).
Generally, road diets involve reallocating roadway space by removing vehicle travel lanes from a roadway and using that space for other modes or uses. One of the most common conversions is moving from a four-lane road to one with two through lanes and a center two-way left-turn lane, an example of which is shown to the right. By reducing lanes, other features such as bicycle lanes, widened sidewalks, or landscaped boulevards can be added to the right-of-way, resulting in fewer vehicle conflicts and improved safety outcomes.

Benefits

> The space provided by removing a travel lane can be used to create bicycle lanes on both sides of the cartway.

> Bike lanes provide greater separation between motor vehicles and the sidewalk, creating a more comfortable pedestrian environment.

> Center turn lanes reduce crashes and conflicts with turning vehicles without reducing throughput. Center turn lanes have been shown to reduce crashes between 19% and 47%.

Design Recommendations

- Lane reductions on roadways with more than 20,000 AADT should be studied to assure that driveway access and signals are appropriate for higher volumes. Roadways with up to 25,000 AADT have successfully road dieted.

- Travel lane widths can be 10’ to 12’.

- Width of center lane is 10’ to 16’ depending on types of vehicles using street.
**Driveway Design**

Driveways pose an often unforeseen danger to pedestrians and cyclists in that many are designed as intersections which promote high-speed turns and increase the likelihood that drivers will not stop for pedestrians or give cyclists the right of way.

**Benefits**

> Proper driveway design discourages high-speed turns and forces drivers to make slower turning movements. This allows drivers to better identify pedestrians and cyclists.

> Proper design is especially critical to safety for multi-use paths and facilities which include cyclists.

**Design Recommendations**

- According to ADAAG, driveways should be designed with the following guidance:
  
  - Cross slope should not exceed 2 percent.
  - Changes in level or grade should be flush with a ¼-inch maximum gap in surface rise.
  - The slope of the driveway apron flare should not exceed 10 percent.
  - Sidewalk grade should not exceed 5 percent.

  - Max grade differential between driveway apron and street shall be no more than 8%.

Where volumes are high, alternative B is preferred.
Bridges can be significant barriers to bicycle and pedestrian movement. Many bridges can be retrofitted to provide a bicycle/pedestrian crossing under the barrier by creating a crossing where there are no bicycle or pedestrian accommodations, or by upgrading the existing bicycle/pedestrian crossing.

**Benefits**

> Proper design allows for continuous bicycle facilities that are easy for cyclists or pedestrians to use.
> Separating cyclists and pedestrians from vehicle traffic increases safety of all user groups.

**Design Recommendations**

- **It is preferred that bikeways have a width of 10 feet, but 8 feet may be allowable for short segments.**

- **Where access for emergency vehicles is necessary, vertical clearances shall be a minimum of 10 feet, otherwise vertical clearances over the bikeway shall be a minimum of 8 feet.**

- **Providing adequate drainage may also be a problem; providing a surface that does not become excessively slippery when wet is important. Proper drainage design is a key element to prevent wet silt deposits that are a common hazard for bicyclists using bridge underpasses.**
Underpass and Tunnel Considerations

A bikeway underpass should be considered if there is no safe and direct on-street crossing, if the facility to be crossed is elevated, if an existing motor vehicle under-crossing is too narrow for a bicycle facility, and when the underpass would not require bicyclists to negotiate significant elevation changes. Underpass costs may be significantly lower than those for overpasses and encounter fewer constraints.

Benefits

> Underpasses are protected from weather and provide users from inclement weather. They also do not require snow removal or preventative application of deicing materials.

> Provides ability to reconnect divided neighborhoods and provides critical connections within a municipality.

Design Recommendations

- Underpasses can be dark and intimidating to users and may pose safety concerns. Visibility through a tunnel and adequate lighting enhance users’ perception of personal safety. For short underpasses or tunnels, modest lighting may all that is required. In many cases, lighting may be required on daily, 24-hour bases, especially for tunnels longer than 50 feet. All lighting should be recessed and vandal resistant.
- Underpasses are usually constructed of pre-cast concrete in a shape having the proper vertical/horizontal clearances.
- Providing adequate drainage may also be a problem; providing a surface that does not become excessively slippery when wet is important. Proper drainage design is a key element to prevent wet silt deposits that are a common hazard for bicyclists using bridge underpasses.
- Underpasses need to be connected into Existing multi-use path networks with clear signage, adequate signage and ADA compatibility.
Some County arterials may contain high speed freeway-style channelized right-turn lane designs, which can create difficulties for bicyclists. The entrance lanes typically have intrinsic visibility problems because of low approach angles and feature high speed differentials between bicyclists and motor vehicles. Even with signage and striping improvements, free-flow ramps present significant challenges for pedestrians and bicyclists but getting bicycles across difficult to cross high-speed channelized turn lanes and entrance ramps is critical to the safety of cyclists.

**Benefits**

> Signage and striping provides a predictable environment to pedestrians, cyclists and vehicles.

**Design Recommendations**

On low-speed entrance ramps (≤ 35 mph) the bike lane should travel straight through the merge area.

  - Dashed lines, colored pavement and signs can be used to define bicyclist priority over merging traffic.

At high-speed entrance ramps/ channelized right-turn lanes (≥ 40 mph), with dedicated receiving lanes, bicyclists should be encouraged to yield to merging traffic and cross when safe.

  - Bike lane should be angled as close to a right angle as possible so as to increase the approach angle with entering traffic.
  
  - The crossing should be positioned before the drivers’ attention is focused on the upcoming merge.

Source: City of El Paso 2016 Bike Plan
Some County arterials may contain high speed freeway-style exit ramps and channelized right-turn lane designs, which can create difficulties for bicyclists. The entrance lanes typically have intrinsic visibility problems because of low approach angles and feature high speed differentials between bicyclists and motor vehicles. Even with signage and striping improvements, free-flow ramps present significant challenges for pedestrians and bicyclists but getting bicycles across difficult to cross high-speed channelized turn lanes and exit ramps is critical to the safety of cyclists.

**Benefits**

> Signage and striping provides a predictable environment to pedestrians, cyclists and vehicles.

**Design Recommendations**

- In constrained conditions, bicyclists may exit onto the sidewalk and complete the maneuver with pedestrians in the crosswalk.

- On low-speed entrance ramps (≤ 40 mph) the bike lane should travel straight through the merge area.
  - Dashed lines, colored pavement and signs can be used to define bicyclist priority over merging traffic.

- On high-speed exit ramps (≥ 45 mph), use a jug handle turn to bring bicyclists to a visible location with exiting traffic.
  - Design should include a 45 foot (35 foot minimum) taper from roadway.
  - Design should include a 45 foot (35 foot minimum) jughandle turn.

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*Source: City of El Paso 2016 Bike Plan*
Bicycle Facility Pavement Marking and Signage

Signs and pavement markings supplement good design, create a predictable environment for motorists/cyclists and reinforce appropriate behavior for all roadway users. This section provides a summary of the most commonly used signs and pavement markings related to separated bike lane installation.
Figure 9B-3. Warning Signs and Plaques and Object Markers for Bicycle Facilities

A fluorescent yellow-green background color may be used for this sign or plaque. The background color of the plaque should match the color of the warning sign that it supplements.
MARKINGS GUIDANCE

- Standard arrows for pavement markings (example shown)
  MUTCD Fig. 3B-24
- Bicycle pavement marking: bike symbol
  MUTCD Fig. 9C-3
- Bicycle pavement marking: helmeted bicyclist symbol
  MUTCD Fig. 9C-3

- Bicycle pavement marking: word legends
  MUTCD Fig. 9C-3
- Pavement marking
  MUTCD Fig. 9C-5
- Shared lane marking
  MUTCD Fig. 9C-9

- Bike detector pavement marking
  MUTCD Fig. 9C-7
- Recommended yield line pavement markings layout
  MUTCD Fig. 3B-16
Figure 9C-1. Example of Intersection Pavement Markings—Designated Bicycle Lane with Left-Turn Area, Heavy Turn Volumes, Parking, One-Way Traffic, or Divided Highway

Dotted line (optional)

Dotted lines (optional)
Figure 9C-6. Example of Pavement Markings for Bicycle Lanes on a Two-Way Street

Example of application where parking is prohibited:
- Normal width solid white line

Example of application where parking is permitted:
- Normal width solid white line (optional)

- Dot line for bus stops immediately beyond the intersection is optional; otherwise use normal width solid white line
- 50 to 200 feet of dotted line - 2-foot line, 6-foot space

- R3-17
- R7 series sign (as appropriate)

Minor intersection

Signalized intersection
IMPLEMENTATION
Implementing Bicycle Facilities

Implementing bicycle facilities on all Mercer County highways is a long term goal which may ultimately not be realized for every roadway. A series of recommended treatments are included in earlier chapters of this plan for consideration when and if implementation becomes feasible. These recommendations are based on the existing roadway conditions, traffic characteristics and realistic outcomes, as opposed to more idealistic targets which some residents may prefer. While these facilities are recommended at this time, future design phases may reveal preference for other facility types. As time passes and Mercer County becomes ever-denser and built out, roadway conditions as well as development patterns will change and this analysis may need to be updated.

Many County highways already have the capacity to incorporate bicycle facilities and only require a lane diet, or additional striping and signage. Other roadway segments however are less equipped and may require additional right-of-way, widening, drainage improvements, grading, vegetation removal, sign relocation, driveway or sidewalk relocation, or other significant design and construction improvements. As such, the County will initially target roadways that can easily accommodate bicycle facilities while simultaneously begin to advance more complicated segments as funding and project management capacity permit.

This chapter briefly reviews factors to be considered before, during, and after construction of on-road bicycle facilities. Long-term maintenance is a particular concern as is the Land Development process. In addition, motorist and cyclist education will become increasingly important as the network grows, and local police departments may need to step up enforcement of unsafe or uneducated motorists and cyclists.

Resurfacing, Reconstruction and Construction Project Cost Efficiencies

All levels of government operate with constrained budgets for building and maintaining roadways. Coupling a bicycle facility into another County project is more cost effective than undertaking a standalone project. When the County is looking at intersection improvement, corridor improvement, reconstruction, and resurfacing projects, significant savings can be achieved for implementing bike facilities. This is primarily due to reduced surveying, permitting, administrative, staging, mobilization, police enforcement and other costs that are built into any project. Regardless if bike facilities are included or not, these costs are observed within any project, so by incorporating bike facilities into a larger endeavor, significant saving can be grasped.

In 2016, FHWA published a report on Incorporating On-Road Bicycle Networks into Resurfacing Projects which explains the benefits and cost efficiencies of combining resurfacing projects with bicycle lane implementation. Mercer County has a pavement management system which takes into consideration various conditions to determine a resurfacing schedule for each work year. At some point, every County
roadway will need to be resurfaced and repaved and some may need full reconstruction. This provides the County with an opportunity to implement facilities at a relatively small added cost. For a majority of resurfacing projects, the only added costs for dedicated bicycle lanes would be that of paint and signage. In certain cases, new bicycle safe stormwater grates may need to be installed as well. As a result, the primary and cheapest method for bicycle facility implementation in Mercer County will be to implement projects within a resurfacing and reconstruction schedule.

The first step in incorporating bicycle facilities as part of resurfacing projects takes planning, which this report and its analysis serves (see reference table and maps). With a facility recommendation for every County highway, staff can quickly and easily identify road conditions (such as speeds, AADT, cartways, etc.) and determine how to best move forward. As our list of resurfacing projects is finalized, staff can begin to narrow down on feasible segments, begin to reach out to municipalities on coordination efforts, and begin to draft concepts. Feasible segments will have new striping plans prepared that will also oftentimes incorporate various complete street features in addition to bicycle facilities. Conceptual plans will be revised based on County Planning and Engineering staff comments and then circulated among municipal partners before being finalized. Once plans are accepted by all, they are sent over to County Traffic and Signal staff within the Mercer County Highway Division for implementation.

Above: FHWA report on incorporating bicycle facilities into resurfacing projects.
Following resurfacing, the County or County contractors will restripe the road and install signage as needed. During this time, Mercer County may narrow travel and turn lanes to 11’ or 12’ in width. This reduction oftentimes provides the space required for bicycle lanes and serves to act as a traffic calming measure. In certain cases, a road diet may be implemented which will reduce the number of travel lanes. This is most often a reduction of 4 travel lanes to 2 travel lanes with a center turn lane. This has not only the benefit of providing space for bicycle lanes but also has been proven to reduce crash rates for vehicles.

Traffic congestion may also be reduced, as vehicles in the travel lane have free-flow movement while all left turning movements are moved outside of the travel lane. A reduction in the number of through lanes can calm traffic, reduce weaving, reduce the number of lanes for pedestrians to cross, and reduce left-turn conflicts as well as head-on & side swipe crashes from opposing traffic. Road diets going from 4 to 3 lanes will be considered on a case by case basis and only if AADT is below 25,000. These types of projects may need to undergo further evaluation and will be implemented at the discretion of the County Engineer.

Additional steps in the planning process include reaching out to our municipalities to coordinate efforts and work with municipal councils to enact potential no parking ordinances, debris ordinances and resolutions of support. This also allows municipalities to work with the County on their own complete street efforts and allows for a larger scale network projects that may complement County improvements. Given that the County only finalizes its annual paving program the year before the construction season, time for coordination may be short. Projects may need to be split into two phases which may require a bikable shoulder before a full bicycle facility is implemented. The County will however make every effort to provide municipalities with time to review and comment on facility improvements.

For larger project such as roadway, bridge and culvert reconstruction, bicycle and pedestrian facilities need to be considered early in the process. This is to provide enough time to identify the facility required, determine right-of-way, to calculate impact and added cost, to determine drainage, utility or permitting issues, and other considerations. In some case, especially those on high speed and high volume roadways, accommodating bikes and pedestrians may require an off road multi-use path or path that is built into or cantilevered off an existing bridge.
At the time of this Master Plan Element effort, Mercer County has begun implementing pilot bicycle improvements along several routes to work out the implementation workflow and better understand conflicts and opportunities. This implementation is based primarily on our paving schedule and includes segments that can easily accommodate facilities within the existing cartway. As part of the 2019 Pilot Bicycle Paving Program, staff oversaw design and implementation of 6.78 miles of new bicycle lanes on: N Main Street (CR 539) in Hightstown, Ewingville Road (CR 634) and Scotch Road (CR 611) in Ewing, Elm Road (CR 604) in Princeton and East State Street (CR 535) in Hamilton, and oversaw implementation of bicycle sharrows on Ingleside Ave (CR 631) in Pennington.

As we move forward with future resurfacing seasons, the County will gain valuable experience and grow the bicycle facilities from individual segments to long distance interconnected network. In certain cases, bikable shoulders may need to be phased in first before designating an official bicycle route. Official designation will oftentimes take place when practical extents can be achieved, such as when longer continuous segments and connections can be created or two major nodes are connected. For larger projects on longer timeframes, which may need traffic signal alterations, right-of-way, or geometrical changes, the County may either design facilities in house or work with outside contractors to develop design plans for construction.
Before

Scotch Road (CR 611) Complete Street Improvements
Road Diet, Bicycle Lanes, Pedestrian Crossings & ADA Ramps

DATE: August - November 2019  TOWN: Ewing Township

After

Scotch Road (CR 611) Complete Street Improvements
Road Diet, Bicycle Lanes, Pedestrian Crossings & ADA Ramps

DATE: August - November 2019  TOWN: Ewing Township
PROJECT: Scotch Road (CR 611) Complete Street Improvements
Road Diet, Bicycle Lanes, Pedestrian Crossings & ADA Ramps

DATE: August - November 2019  TOWN: Ewing Township

PROJECT: Scotch Road (CR 611) Complete Street Improvements
Road Diet, Bicycle Lanes, Pedestrian Crossings & ADA Ramps

DATE: August - November 2019  TOWN: Ewing Township
Above: Preliminary draft plans for a future road diet and bicycle lanes on Spruce Street (CR 613) at Mercer Crossings.

Above: Preliminary draft plans for a future road diet and bicycle lanes on Arctic Parkway (CR 639) at Mercer Crossings.
Once facilities are constructed, it will be essential for the community to utilize these facilities in a safe manner. Proper design and physical infrastructure can only go so far in creating a safe and comfortable environment. It is up to motorists and cyclists to follow state and local laws when using public facilities. Programs sponsored by nonprofits, non-government organizations and municipalities can educate the public of laws and etiquette to foster a mutual respect between cyclists and motorists. Supportive policies across jurisdictions also can ensure that the facilities are properly maintained. The following programs and policies may contribute.

**Education**

Educational programs provide roadways users with information about their rights, duties, responsibilities, and applicable laws that can promote a predictable, safe and comfortable ride for all. Educational programs can take many forms. Schools can teach students the proper rules of the road and their responsibilities as cyclists. Driver education programs for young adults and new drivers should include an emphasis of riding with multiple road users such as pedestrians and cyclists. Hands-on training for the community can also be incorporated.

Within Mercer County, organizations such as the Greater Mercer TMA have led the way in road user education. Some of their many programs include bike safety and pedestrian safety education, travel training, walking school bus, community fairs, walkability audits, safe routes to school projects, Bicycle Rodeos / Skills Clinics, and many more. Many municipalities and school districts also have their own programs. The County should continue to work with these organizations to promote public education. In addition, driver education and reeducation should be increased and the NJ DMV should be brought into the conversation regarding new laws and regulations as well as updated MUTCD signs and traffic control.

*Source: https://gmtma.org/*
Enforcement

Bicycling in New Jersey is regulated under Title 39 of the Motor Vehicles and Traffic Regulation laws and enforced by local jurisdictions. Enforcement by a ticketing agency such as the local police department ensures that laws and regulations are followed and that each person's road rights are provided. Aggressive, speeding, distracted and drunk drivers should be targeted as they pose the greatest threat to pedestrians and cyclists. The State of New Jersey is an FHWA 2019 designated “Pedestrian and Bicycle Focus State”, which means that NJ has one of the highest fatalities and/or fatality rates in this category.

Moving forward, it will be important for local jurisdictions, the County and the State to work together not only to improve facilities but to enforce the proper use. Police are important in ensuring that drivers and cyclists follow laws and regulations for their safety and other road user’s safety. It is especially important that local police enforce bicycle design elements such as No Parking ordinances. These are specifically established so that cyclists have a clear and continuous travel lane. Parked cars, trucks, and or trailers create obstructions that require cyclists to swerve into vehicle lanes and hazardous situations.

Keeping drivers from speeding is also important as higher speeds equate with higher fatality rates. Some current laws relevant to cycling are listed in the callout box below. For the full set of regulations and laws as well as updates, please check with the state:

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**Important State Bicycling Laws Under Title 39**

**Title 39:4-14.5 Definition**

“Bicycle” means any two wheeled vehicle having a rear drive which is solely human powered and having a seat height of 25 inches or greater when the seat is in the lowest adjustable position.

**Title 39:4-10 Lights on Bicycles**

When in use at nighttime every bicycle shall be equipped with: 1) A front headlamp emitting a white light visible from a distance of at least 500 feet to the front; 2) A rear lamp emitting a red light visible from a distance of at least 500 feet to the rear; 3) In addition to the red lamp a red reflector may be mounted on the rear.

**Title 39:4-11 Audible Signal**

A bicycle must be equipped with a bell or other audible device that can be heard at least 100 feet away, but not a siren or whistle.

**Title 39:4-14.1 Rights and Duties of Persons on Bicycles**

Every person riding a bicycle on a roadway is granted all the rights and subject to all of the duties of the motor vehicle driver.

**Title 39:4-14.2, 39:4-10.11 Operating Regulations**

Every person riding a bicycle on a roadway shall ride as near to the right roadside as practicable exercising due care when passing a standing vehicle or one proceeding in the same direction. A bicyclist may move left under any of the following conditions: 1) To make a left turn from a left turn lane or pocket; 2) To avoid debris, drains, or other hazardous conditions on the right; 3) To pass a slower moving vehicle; 4) To occupy any available lane when traveling at the same speed as other traffic; 5) To travel no more than two abreast when traffic is not impeded, but otherwise ride in single file. Every person riding a bicycle shall ride in the same direction as vehicular traffic. In New Jersey, the law states a bicyclist must obey all state and local automobile driving laws. A parent may be held responsible for the child’s violation of any traffic law.

**Title 39:4-10.1**

In New Jersey, anyone under 17 years of age that rides a bicycle or is a passenger on a bicycle, or is towed as a passenger by a bicycle must wear a safety helmet.
Equity

The American Planning Association states that, “Mobility and access to opportunity are essential to move the needle toward equity. Groups disproportionately challenged by mobility needs, and those in traditionally underserved communities, include low-income people, people of color, people with disabilities, people with lower levels of education, and the old and the very young. Without access to jobs, schools, health care, healthy foods, recreation, goods, and services, it is difficult to envision a pathway to opportunity” (Planning for Equity, 2019)

Mercer County understands that improving transportation opportunities for all people is critical to providing our residents with connections that will allow them to meet basic needs, be engaged in their communities, thrive, and contribute to the economy. Having a data driven construction and maintenance program ensures that all communities are equally represented, regardless of political sway or wealth. Social equity also means that impoverished urban communities are just as much represented as affluent rural and suburban communities. Moving forward, all repaving jobs will be reviewed to determine if bicycle facilities are appropriate, feasible and can be efficiently implemented regardless of community wealth.

In cases where dedicated facilities cannot be implemented on County Routes, alternative routes may be feasible and recommended via local roads, private property or via trails. Certain urban County roads may have limited cartway and buildings located just feet from the curb which make widening all but impractical without massive community disruption. Other routes may have on-street parking that the community does not wish to remove. Certain rural roads may require massive slope adjustment and environmental impacts. At such time when facilities are not feasible, the County can work with community groups, non-profits and municipal representatives to find alternatives so every community can be represented.

Encouragement

Promoting a community that has a bike-friendly culture and appropriate facilities can increase the number of bicyclists. Businesses that provide shower and locker facilities for their employees and bike parking for customers go a long way to promote the culture. College campuses are especially ripe centers for cycling as students living on or near campus often do not bring personal vehicles to school or live close enough to ride to and from class. Princeton University has an especially proactive cycling policy and heavily promotes cycling as a transportation mode. The University even has 3,600 bicycle parking spaces scattered throughout its campus with plans for more as it develops its Lake Campus.
Recently, Princeton University and the County have both partnered with private bike-share companies to provide bicycles in select locations. Princeton welcomed Zagster bike-share to campus in early 2016 and charges members a one-time $20 fee, and through a smartphone app (iPhone/Android) members can rent a bike from any of its current 14 locations (with more planned). In 2019, The County of Mercer, the Mercer County Park Commission and Zagster have launched a bike-share program now available to the public in the County Parks system. Bikes are located at Mercer County Park near the 9/11 memorial and in Mercer Meadows, located both at Rosedale Lake and the Red Barn in Pole Farm section of the park. Ten bikes are at each location and can be rented by downloading the app.

County Executive Brian M. Hughes said that, “One of my goals is to make Mercer County more bike-friendly, whether it is on our county roadways or in our parks. The bike share provides our park users with a recreational activity that promotes both fun and fitness.” A future expansion is anticipated that will include more County locations. Companies are also looking into municipal projects and parks as well.

Implementing bicycle rentals as well as parking at public spaces, parks, historical sites and other destinations allows bicycle riders to feel like they are welcomed and open to ride their bicycles. It gives them a place to rent bike if they do not have one or lock up their private bike without worry of a ticket or police confiscation. This not only puts more bikes on the road but takes also takes vehicles off the road which reduces congestion, air/water pollution and reduces the wear and tear on our roadway. Having town policies (both official and unofficial) which make biking safer and more enjoyable makes residents feel more comfortable and more likely to cycle.
With approximately 180 miles of County roads, it is important to prioritize improvements. Not only is funding limited but municipal cooperation and citizen support are required to widen roadways, improve intersections, and possibly remove parking. To make prioritization simpler, more efficient, and data drive, the County has overlaid a linear foot cost of improvements over the WSP Bicycle Demand Model to show where facilities can be improved at the lowest cost and where demand is highest.

The map on the following page shows route segments where total costs (both construction and design) come out to less than $35 per linear foot (LF). They are overlaid on census tracts that, according to the WSP Bicycle demand model, have the highest demand for bicycle facilities (further explanation can be found in the 2020 GMTMA Trail Plan). Only those tracts with a score of 5 or higher are included on the following map. In addition, bicycle crashes along county routes (2012-2016) are also shown. These three factors, safety need, cost, and demand, provide a data driven method for prioritizing facility improvements and upgrades.

Of the three areas that most fit the three prioritization criteria, the Ewing-Trenton-Hamilton urbanized cluster stands out most clearly. This part of the County has high concentration of bicycle crashes, high bicycle demand, as well as facilities that can be upgraded at a cost under $35 per LF, with most routes coming in at under $10 per linear foot. This three town area (including a small section of Lawrence Township as well) is where the County can see the greatest impact for the lowest cost for our residents. The areas around Princeton, West Windsor, and Hightstown also meet the prioritization criteria, though these areas have fewer reported crashes. Several roads in those areas can be retrofitted at a nominal cost. Though facilities are needed across the entire county, efforts could be made to improve connections and conditions on routes in these areas in the near term to benefit the largest number of residents at an economical cost.

It is important to be realistic with prioritization and implementation. In many cases, alternative routes may be required for certain segments where implementation isn’t feasible for physical or financial reasons. Projects that require massive widening or demolition of structures are unlikely to take place unless there is significant community support and funding available. As such, large scale projects will be undertaken on a case by case basis, which are oftentimes championed by municipal officials or local community groups.
Improvement Prioritization
Based on LF Cost, Crash Data
and WSP Bicycle Demand Model

Three Major Areas of High Bicycle Demand
and Low-Cost Improvements in Hightstown,
Princeton and Ewing-Trenton-Hamilton Corridor

*Only tracts with a bicycle demand score of 5 or higher out of 10
are selected and only bicycle improvements under $35,000
per linear foot are shown for clarity. Only crashes along County
Routes from 2012-2016 are shown.
Over the next 10 years, the County will undertake a number of projects to create new bicycling infrastructure. As the County moves forward with implementation we will work with local and State partners as well as developers, non-profits and residents. Future short term and long term projects can be roughly broken into one or more of the categories below:

**Project Implementation Categories**

**REPAVING PROJECTS**
These projects will consist of new or improved bicycle facilities within scheduled and emergency repaving projects. Mercer County has a list of roads that need to be repaved based on a pavement condition inventory as well as through observations and requests from our municipalities.

**NETWORK CONNECTION PROJECTS**
These projects will consist of new or improved bicycle facilities that will facilitate new connections between existing projects. These can include links between County bicycle facilities and State or Local facilities or between two existing County facilities.

**PARTNERSHIP PROJECTS**
These projects will consist of bicycle facilities in coordination with Local or State partners as well as non-profits, private land owners and developers as well as our neighboring Counties. The County may be able to provide local technical assistance or general concept development help depending on staff availability.

**NODE CONNECTION PROJECTS**
These projects will consist of new or improved bicycle facilities that will serve to connect important nodes such as schools, libraries, community centers, parks, commercial corridors, urban areas, and other important attractors.

**STATE & FEDERAL GRANT PROJECTS**
These projects will consist of new or improved bicycle facilities that are funded via State or Federal funding sources and will need to go through full project development schedules and phases. Due the complexity of these grant sources, this funding is typically used only for larger scale projects.

**MASS TRANSIT CONNECTION PROJECTS**
These projects will consist of connections to existing or proposed mass transit. These connections to bus stations, train stations or light rail will expand the distance residents are able to travel and allow for larger trips to destinations across the County.
ew Jersey’s Municipal Land Use Law (N.J.S.A. 40:55D-1 et seq.) gives towns and cities responsibility for managing land use, while the County Planning Act (N.J.S.A. 40:27-1 et seq.) reserves to Counties responsibility for maintaining the safety and capacity of the shared stormwater management system and the County highway network, which provides mobility between towns (600 routes) and between counties (500 routes). With representatives from the Freeholder Board and the County Administration, and through the Land Development Review process, the County Planning Board seeks to balance the desires of private developers with the general welfare and safety of the traveling public.

In compliance with the County’s Complete Streets policy and this sub-element of the County Master Plan, the County Planning Board and staff should consider bicycle and pedestrian facilities during review of subdivision and site plans. Through the County Land Development process, the Planning Board may require the installation of bicycle and pedestrian facilities on County highways or require that accommodations to be made for future projects. Where municipal streets provide potentially desirable bicycle access to the County network, the Planning Board may recommend consideration of bicycle safety improvements on those streets. These actions by the planning board and staff are vital to implementing our Complete Streets Policy and to accommodate all abilities and modes of travel. While this plan provides specific data driven facility type recommendations for every County Highway, based on current best practices and standards, final design decisions and implementation schedules are at the discretion of the County Engineer.

While this Bicycle Facility Master Plan offers design standards and facility type recommendations for bicycle mobility, the Mercer County Master Plan Mobility Element does the same for all modes, with emphasis on motor vehicle traffic. The Mobility Element identifies five roadway types or ‘access levels’ for County highways, with desirable typical sections (DTS) that define right of way requirements and facilities for travel by motor vehicle, bicycle, foot, and wheelchair. (Future editions and updates of the Mobility Element and this Bicycle Plan may include consideration of electric bicycles and other micro-mobility devices.)

Maps within the Mobility Element display DTS assignments for each segment of County Highway, as well as comparable DTS assignments for State Highways, from the New Jersey Highway Access Code (N.J.A.C. 16:47). County access level and DTS assignments are displayed in tabular form in Appendix A of the Mobility Element, comparable to bicycle facility type recommendations in Chapter 3 of this plan. These DTS assignments define right-of-way dedications required for approval of subdivision and site plans. Within these DTS assignments, right of way is identified to include shoulders or on-street parking, bicycle lanes, sidewalks, buffers, as well as vehicular travel lanes and medians or center left two way turn lanes.
Examples of incorporating facilities into the land development process may include:

- On high speed and high volume roads, on-road bicycle facilities may be undesired or inappropriate. When multi-use paths are more feasible, or in many cases necessary, to accommodate bicycle and pedestrian users, an 8’-10’ paved multi-use path should be requested rather than a 5’ concrete sidewalk. As parcels redevelop over time and funding is available for dedicated projects, a continuous interconnected network will be created.
- For sidepath project, DTS assignments should be reviewed to determine required easements & dedications.
- At intersections where widening is necessary to accommodate continuous bicycle facilities, right of way and curb lines should be set to appropriately. Typically an additional +/-10’ may be required to accommodate one bicycle lane in each direction.
- As parcels redevelop over time, some may need to replace deteriorating curb or construct new curb along the frontage. Where feasible, the County Engineer may request curb and sidewalk to be set to accommodate road widening.
- Though the County does not have jurisdiction over land use, the Planning Board may recommend bicycle accommodations to applicants, such as bicycle racks and or lockers. For major residential and commercial development projects, applicants should consider internal bicycle facilities, such as bike lanes or trails, that link to the County or Municipal network. The Planning Board may also recommend consideration of connections to adjacent existing or proposed trails.
Long term maintenance must be considered for proper functionality of bicycle facilities. Just like regular vehicle lanes, bike lanes should be kept clear of debris, free of hanging vegetation, free of standing water, free of parked vehicles and require removal of snow during the wintertime. In addition, a proactive and reactive de-icing program in conjunction with snow removal is necessary to help maintain good riding conditions along bikeways in the winter.

Mercer County already has the necessary programs, maintenance vehicles, and equipment to clear our roadways of debris, clear snow and to maintain our pavement. These vehicles are also available to clear bike lanes and shoulders in the same manner as vehicle lanes or shoulders, so long as there is no impediment for maintenance vehicles. Due to the cost of new trucks and machines, the County at this time can realistically only maintain roadways without impediments such as pylons, planters or other items that prevent our plows or sweeping trucks from navigating down these lanes.

As a result, Mercer County at this time does not use plastic pylons, rubber delineators or concrete/asphalt buffers in buffered and protected bicycle lanes. However, it may be possible to create physical barriers for on-road two-way cycle tracks, as those facilities can be designed wide enough for a County maintenance vehicle to clear. In the future, if County was to implement additional barriers, physical separations or separate bicycle facilities, new maintenance staff and equipment will be necessary to maintain these facilities.

Above: A typical plow will have a 8-12’ front plow but can include an additional wing. Plowing 180 miles of County Highways for the general public requires trucks that do this quickly and effectively.
Bike lanes should also be free of debris and parked cars. Yard waste or trash and recycling should not be left in the path of travel as these lanes should be treated in the same manner as a vehicle travel lane. These types of impediments require cyclists to swerve out of their lane into traffic which can put them in danger. Residents should also make sure that their vegetation does not grow into the path of travel of a County Road. While the County can sweep up minor debris, it will be up to residents to keep their yard waste, trash bins, recycling and other items out of the roadway.

When necessary, the County will work with a municipality on implementing “No Debris” ordinances to keep County highways clear. Municipal staff will need to work with residents and businesses to ensure they understand this new requirement. In cases where vegetation or obstacles fall into the County ROW due to weather events (example: trees, power lines or tree branches after storm), residents should call in to report such issues.

Residents and businesses should also alert the County of unexpected and unforeseen items such as sinkholes, trash thrown from passing vehicles or trucks, debris from construction vehicles or trash collection, or other randomly uncontrollable items that the County may not be aware of without help from residents.
Pavement preservation is a topic of concern for the County and our cyclists. As for general maintenance work, bicycle lanes require just as much consideration as vehicle lanes. Since bicycles have much smaller wheel dimensions than vehicles, care must be given to filling cracks and patching potholes that may affect a cyclist. Moving forward, Mercer County should expand its pavement preservation system to incorporate bicycle facilities. Mercer County may need to perform emergency maintenance, preventative maintenance and resurfacing of our on-road bicycle facilities on a periodic basis in order to provide suitable riding surface. These tasks can be broken down into three major categories below:

Emergency/ Routine Maintenance
Cracks, potholes, depressions, raveling and rutting are unavoidable within an asphalt surface as pavement ages. The County can repair these as they are reported and the County becomes aware of them. This would be considered emergency or routine maintenance as needed. As it is impossible to be aware of every single problem along every foot of a 180 mile network, it will be important for residents, drivers and cyclists as well as our towns to report issues for the County to repair.
Preventative Maintenance

Preventive Maintenance is a type of maintenance that is the most effective to extend pavement life in a cost effective way. Preventative maintenance is a strategy of surface treatments when the asphalt is in relatively good condition. From crack filling small cracks to sealing the pavement, preventative maintenance addresses minor issues before they become serious issues. For preventative maintenance, the County has multiple options to keep a pavement surface in good condition. They include things like crack sealing, full depth patch repair, micro-surfacing, slurry seals, fog seals, top coats, chip seals, cape seals and other techniques. Sealcoating asphalt pavement protects the surface of asphalt from oxidation and damage from oil, gas and salt. It also minimizes the need for asphalt repairs by weatherizing the surface which helps prevent water from being able to seep into cracks. If not properly sealed, pavement starts to unravel and potholes form. Asphalt should be sealed approximately every 3 to 5 years depending on weather conditions, traffic patterns, and wear and tear.

For roadways which are significantly more uneven due to rutting, buckling, utility cuts or other items that cause an uneven surface, a thin hot-mix overlay may be the best option. Thin hot-mix overlays are able to be placed between a 5/8” to 1.5” thick and significantly improve pavement smoothness after treatment. They can extend the road lifespan between 8-15 years depending on weather conditions, traffic patterns, and wear and tear.

Resurfacing, Milling and Paving

At some point, every roadway will need to be milled and resurfaced. Partial milling removed will remove the top 1.5” to 3” of surface while full depth milling will remove the entire asphalt surface including both the binder and surface asphalt layers. During this time, roadways may be closed or detoured or include new traffic patterns. If a roadway has a new freshly milled surface, loose stones, grade changes and obstructions will be present for cyclists. Utility covers and panels will typically have a high grade change due to the loss in pavement height. In these cases cyclists should expect to walk their bicycles or take extra care when riding on such temporary surfaces. As this is unavoidable in the life cycle of a roadway, cyclists should be prepared for cases when roads are under construction.
County Roadway Sweeping

Roadway sweeping is important for keeping bicycle facilities clear for cyclists and preserve pavement condition. The County already sweeps all roads every 2 years and predominantly commercial and curbed roads with stormwater inlets once per month. Moving forward this will need to be increased as 2020 NJDEP requirements come into effect.

The current 2009 NJDEP Storm Water Management rules require that County Highway Agencies establish a Street Sweeping Program for streets operated by the Highway Agency. County Highway Agencies are required to sweep curbed streets with storm drains that have a posted speed limit of 35 mph or less in predominately commercial areas a minimum of once per month, weather and street conditions permitting. All remaining streets (including roads or highways) that they own or operate shall be swept at a minimum of once every 2 years.

Updated 2019 DRAFT NJDEP permit requirements, when adopted, will constitute a significant overall increase in the road miles that will need to be swept on an annual basis. This is due to the fact that the number of road miles required to be swept monthly under the existing permit is more limited as those roads had to be in a predominately commercial area and owned by the Highway Agency, have storm drain inlets, curbs, and a posted speed limit of 35 MPH or less. The vast majority of the road miles do not fit under these conditions, and therefore were only required to be swept once per two years. For the sections of the roads that do have storm drain inlets, or discharge directly to surface water, the frequency of sweeping is proposed to increase from once per 2 years to 3 or 4 times/year for non-Limited Access Roads or Limited Access Roads, respectively. For the sections of the roads that do not have storm drain inlets or discharge directly to surface water, the frequency of sweeping is proposed to increase from once per 2 years to once per year. These revised requirements also remove the exemption that allowed on and off ramps not to be swept.
Future Considerations and Expansion

As mentioned in the prior sections, with the addition of bicycle facilities on select County Routes, Mercer County will need to undertake greater care in maintenance of the County road system. With the addition of cyclists and dedicated bicycle lanes, there will be a need for increased sweeping, increased snow plowing, epoxy traffic line restriping, and an increase in pavement preservation projects. This increase in maintenance activities will be responsibility of the Mercer County Highway Division and it is important to note that additional resources may need to be provided, when needed, to provide for continued maintenance of these facilities. As bicycle facility lane miles increase, there may be a need for additional staff to maintain these facilities and operate machinery.

Facilities constructed at this time consist of sharrows, bicycle lanes and buffered lanes as Mercer County at this time can realistically only maintain roadways without major impediments that prevent plows or sweeping trucks from navigating down these lanes. If in the future the County was to implement additional improvements such as protected bicycle lanes or elevated bicycle lanes, the County may need to either work with towns on shared service agreements to maintain protected facilities or acquire machinery and staff to maintain these facilities ourselves.

Shared service agreements would put the maintenance responsibility on the municipality while distributing the cost between the County and municipality. This would essentially mean that while the County builds the facility and is responsible for structural elements, a municipality would be responsible for sweeping, cleaning and clearing the facility of impediments. Another alternative is for the County to maintain these protected facilities ourselves under an expanded public works program. If the County was to implement additional barriers, physical separations, elevated bicycle lanes or separate bicycle facilities, new smaller and specialized equipment would need to be purchased and new staff would need to be hired to run this equipment. At such point, budgetary considerations will need to be given to increasing the Highway Division’s budget to accommodate new staff and machinery to maintain these new facilities for residents.

Above: Smaller snow plows such as the one above in Denver would need to be purchased and operated to clean and clear protected bicycle facilities of debris and snow.
Pursuing local, regional, state, and federal funding will be one of the most critical steps for the success of this plan, especially for projects other than simple restriping jobs. For more complex complete streets or corridor projects, outside funding will be critical to implementing facilities. The following information highlights a number of common programs that Mercer County may pursue. The types of activities that are eligible under each funding program are identified in the following tables. Beyond those included here, there are a number of other programs and funding sources available that are not bicycle and pedestrian specific. These opportunities will also be tracked. Often partnering with our municipalities can be a successful strategy for securing funding and developing projects and efforts will be made to work with municipalities on future funding efforts.

Source: DVRPC, Downtown Trenton Bicycle and Pedestrian Plan
### Safe Routes to School (SRTS)

**Program Administrator**
- DVRPC

**Summary**
This program provides funds to improve the ability of elementary and middle school students to safely walk and bike to school.

**Types of Projects**
- Projects to educate and encourage school children on bicycle and pedestrian safety
- Infrastructure projects that improve the built environment within a two-mile radius of K-8 schools

**Application Process**
- **Who can apply?**
  - Any state, county, municipal government, school district, or school
  - Non-profits cannot receive direct grants but may partner with public agencies to apply

- **Process**
  1. Contact a regional SRTS coordinator and visit the website for requirements
  2. Form an SRTS team that might include a school administrator, school staff person, parent, police officer, community representative, and municipal representative
  3. Obtain resolutions of support from both the municipality and the school or school district
  4. Obtain letters of support from community organizations, elected officials, and interested parties

**Amounts**
- **Annual Total** $5.69 M (FY 2012)
- **Typical Allotments** Approximately $100,000 and up

**Website**
[www.dvrpc.org/saeroutes](http://www.dvrpc.org/saeroutes)

### Transportation Alternatives Program (TAP)

**Program Administrator**
- NJDOT

**Summary**
Funds programs and projects that are defined as transportation alternatives, including design and construction of bicycle lanes and recreational trails.

**Types of Projects**
- Off- and on-road trails and bicycle infrastructure
- Conversion of abandoned railroad corridors to trails
- Community improvement and environmental mitigation activities
- Other non-motorized transportation infrastructure enhancements

**Application Process**
- **Who can apply?**
  - Local governments, regional transportation authorities, and transit agencies
  - Non-profits cannot receive direct grants, but may partner with public agencies to apply

- **Process**
  1. Visit website for more program information
  2. Consult with DVRPC on how the proposed project relates to and supports the DVRPC 2040 Plan and the Transportation Improvement Program (TIP)

**Amounts**
- **Annual Total** $15.5 M (FY 2014)
- **Typical Allotments** $150,000 to $1,000,000

**Website**
[www.dvrpc.org/TAP/](http://www.dvrpc.org/TAP/)

### Congestion Mitigation and Air Quality Program (CMAQ)

**Program Administrator**
- DVRPC

**Summary**
Projects that demonstrably reduce air pollution emissions or reduce traffic congestion.

**Types of Projects**
- Bicycle and pedestrian projects, transit improvement programs, congestion reduction and traffic flow improvements, diesel retrofit and repower projects, freight projects, and funding of transportation demand management programs, among other eligible project types

**Application Process**
- **Who can apply?**
  - Public agencies, non-profits, and public-private partnerships with a public agency sponsor

- **Process**
  1. Attend a mandatory information session held at DVRPC
  2. Fill out the project application form on the DVRPC website

**Amounts**
- **Annual Total** $2.6 M
- **Typical Allotments** Up to $160,000–$1 M

**Website**
[www.dvrpc.org/cmaq](http://www.dvrpc.org/cmaq)

### Bikeway Grant Program

**Program Administrator**
- NJDOT

**Summary**
Funds projects that promote bicycling as an alternative mode of transportation. 20% match is required.

**Types of Projects**
Priority is given to construction of new bike paths; however, the proposed construction or delineation of any new bicycle facility will be considered.

**Application Process**
- **Who can apply?**
  - Federal, state, county, and local governments; non-profit organizations

- **Process**
  - Apply to the program via New Jersey’s System for Administering Grants Electronically website

**Amounts**
- **Annual Total** $1 M
- **Typical Allotments** $180,000–$330,000

**Website**
[www.state.nj.us/transportation/business/localaid/bikewaygrants.htm](http://www.state.nj.us/transportation/business/localaid/bikewaygrants.htm)

Source: DVRPC, Downtown Trenton Bicycle and Pedestrian Plan
### Recreational Trails Program (RTP)

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<th>Funding Type</th>
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<tbody>
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<td>Federal</td>
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</table>

#### Summary
- Funds to improve access to open space and provide additional biking and hiking opportunities.
- **20% match is required**

#### Types of Projects
- Maintenance and restoration of existing recreational trails
- Development and rehabilitation of trailside and trailhead facilities and trail linkages for recreational trails
- Purchase and lease of recreational trail construction and maintenance equipment
- Construction of new recreational trails in existing parks or in new rights-of-way
- For motorized use only, acquisition of easement and fee simple title to property for recreational trails

#### Application Process
- **Who can apply?** Government agencies and non-profit organizations
- **Process** Obtain and submit the application from the NJDEP website

#### Amounts
- **Annual Total** $2.2 M
- **Typical Allotments** Up to $24,000
- Website: [www.state.nj.us/dep/parksforests/natural/trail_grants.htm](http://www.state.nj.us/dep/parksforests/natural/trail_grants.htm)

### Transportation and Community Development Initiative (TCDI)

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<td>State</td>
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</table>

#### Summary
- This effort is to ensure greater quality-of-life choices by providing and maintaining essential infrastructure, supporting local and regional economic development, and linking land use and transportation planning.
- **20% match is required**

#### Types of Projects
- Planning, analysis, or design initiatives for projects or programs that enhance development or redevelopment and improve the efficiency of the regional transportation system

#### Application Process
- **Who can apply?** Municipal and county governments
- **Process** Submit to DVRPC:
  - Grant application and budget form
  - Study area map
  - Description of the project
  - Description how the project will affect the area and population
  - Proposed approach to achieve public- and private-sector cooperation
  - Summary of how the project fits the TCDI goals, and other supporting materials

#### Amounts
- **Annual Total** $1 M
- **Typical Allotments** Up to $100,000
- Website: [www.dvrpc.org/TCDI](http://www.dvrpc.org/TCDI)

### Other Bicycle and Pedestrian Funding Programs

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<td>Private Foundation Funding</td>
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<td>Varies</td>
</tr>
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Source: DVRPC, Downtown Trenton Bicycle and Pedestrian Plan
Appendix

A. Complete Streets Resolutions
B. Potential Complete Streets Checklist
C. Public Outreach Materials