3

METHODOLOGY & ANALYSIS

Creating the Bike Plan

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.

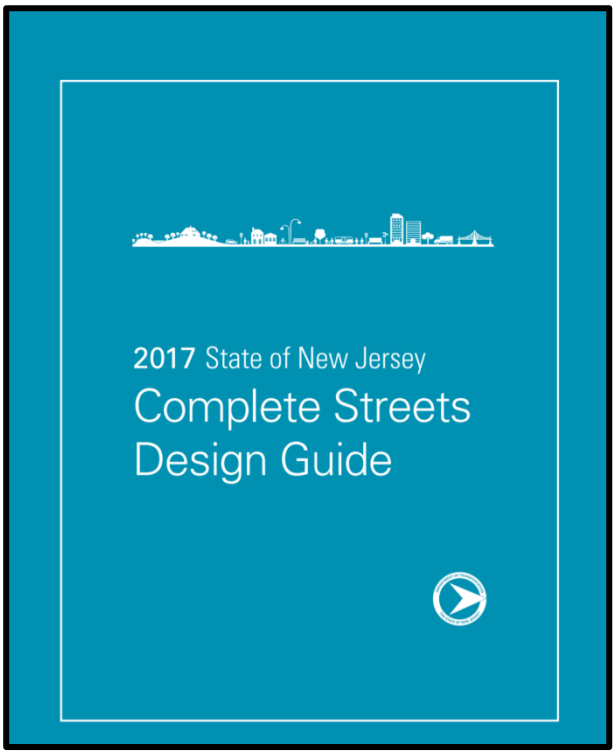
Implementation of the County's bike plan will be broken down into an immediate and short term improvements plan that can be incorporated relatively quickly, efficiently and economically as well as long term improvement plan that will require significant capital investment, right-of-way, and road reconstruction. 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.

Complete Streets Policy

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.

Bicycle Crashes

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.

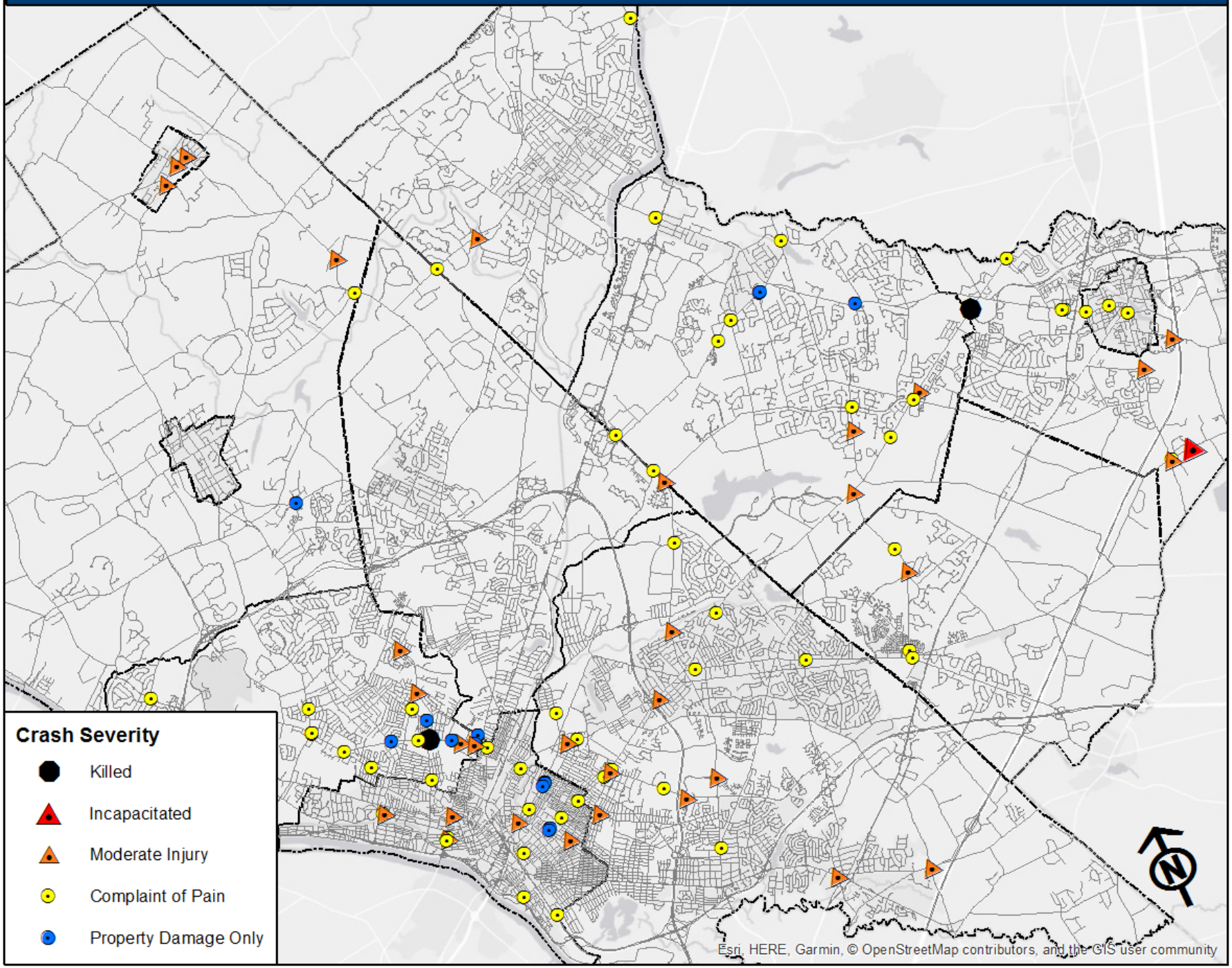
In this 5 year period, approximately 92% of crashes occurred in dry conditions and roughly 74% occurred during daylight hours. In addition only 2 out of 296 involved cell phone usage and only 9 involved alcohol as variables. This data shows us that a majority of crashes occur in normal conditions with 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%.[1] Essentially the larger the separation, whether a stripped/rumbled buffer or protected lane, the larger the increase in safety.

Row Labels	Count of Severity
Fatality	**4**
Killed	4
Injury	**239**
Complaint of Pain	138
Incapacitated	4
Moderate Injury	97
Property Damage Only	**53**
Property Damage Only	53
Grand Total	**296**

Source: NJDOT Safety Voyager

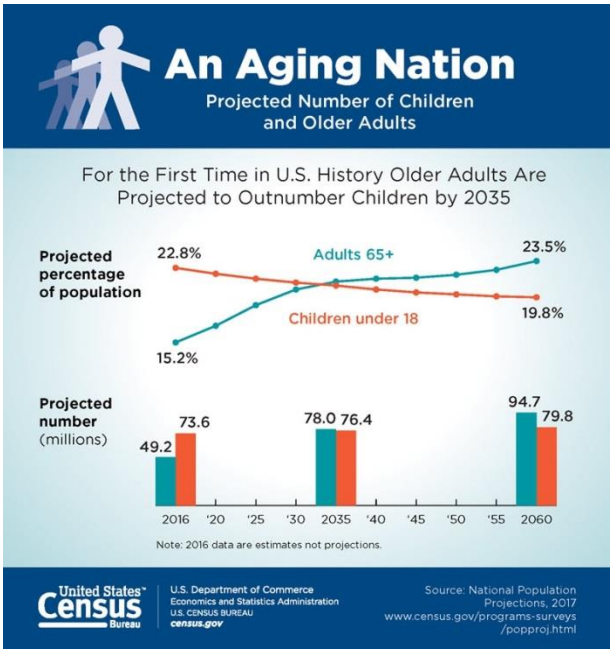
[1] University of British Columbia, "Route Infrastructure and the Risk of Injuries to Bicyclists: A Case-Crossover Study," November 2012, https://ajph.aphapublications.org/doi/full/10.2105/AJPH.2012.300762?journalCode=ajph

Bicycle Crashes from 2012-2016 on County Roadways



Network Connectivity, LTS and 8-80 Design

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.



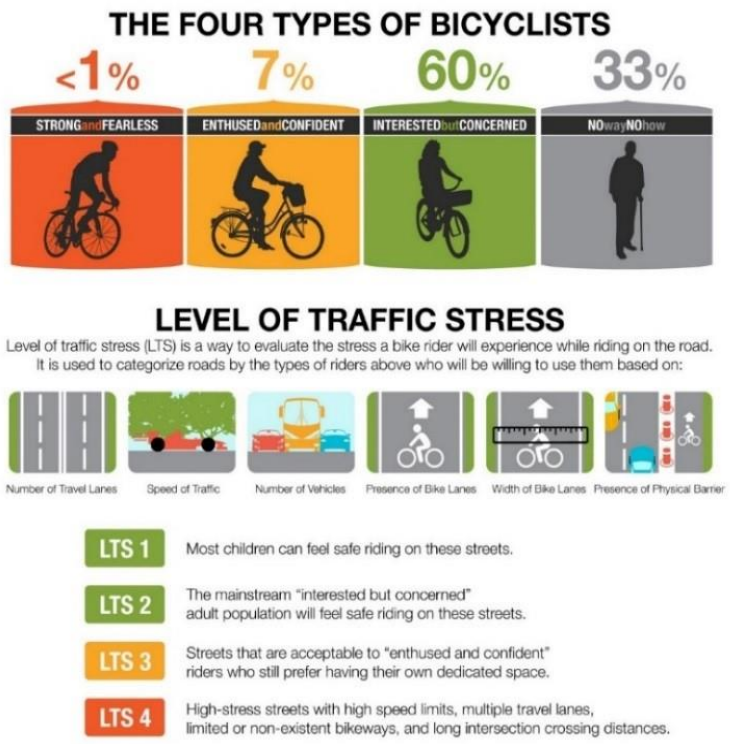
Source: US Census Bureau

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]

[2] Marqués & Hernández-Herrador, "On the effect of networks of cycle-tracks on the risk of cycling. The case of Seville," March 2017, https://www.ncbi.nlm.nih.gov/pubmed/28319756

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 predominantely 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 discontinious sidewalk or forgo biking altogether.



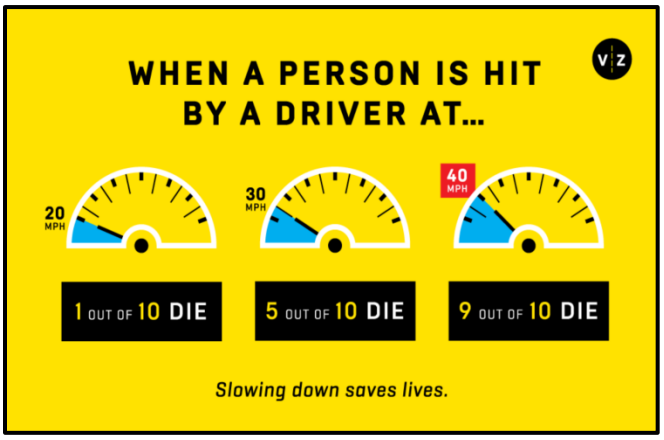
Above Graphic Courtesy of Alta Planning + Design

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 preffered and most accomedating, the cost of constructing these facilies 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 accomedating facilities prioritized by demand. Priority however will be to get to LTS 3 at the minimum.

Above Graphic Courtesy of Alta Planning + Design

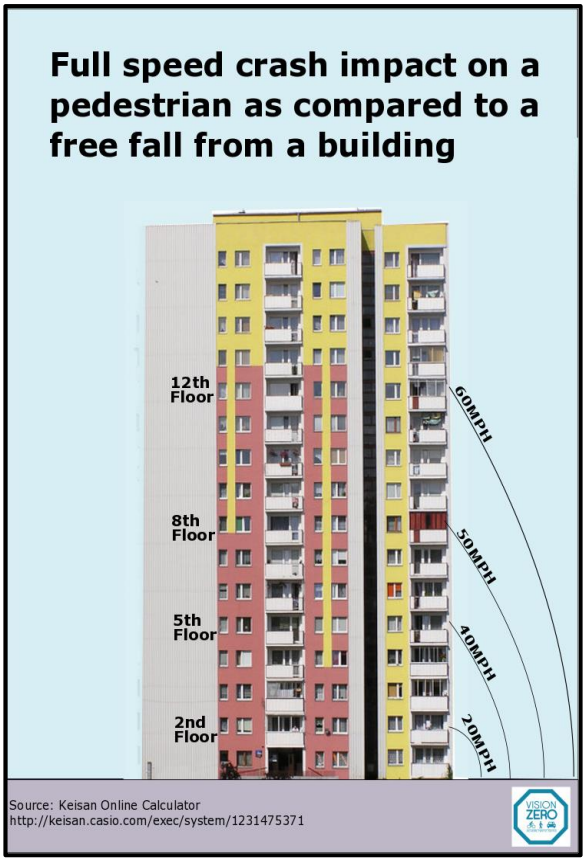
AADT and Posted Speed Relationship

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.



Source: Philadelphia Vision Three-Year Zero Action Plan

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.

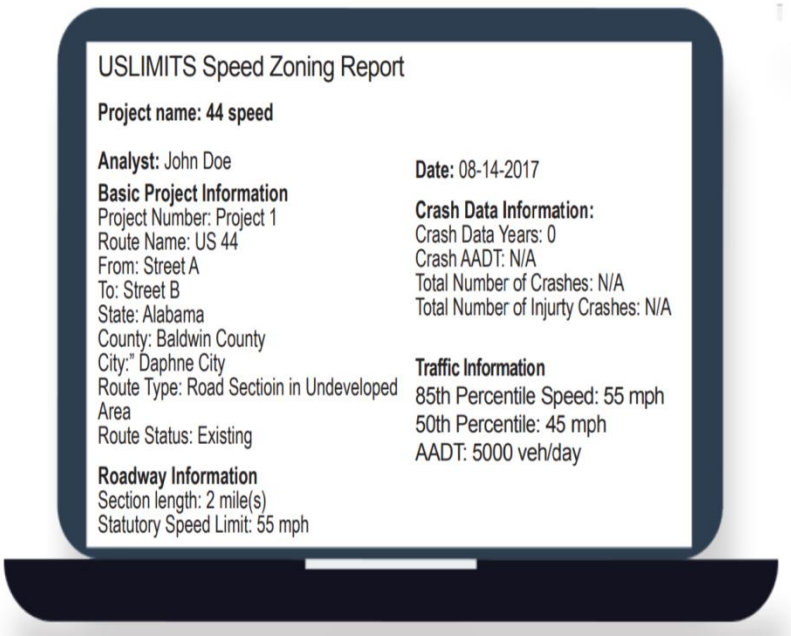


NTSB identified dangerous speeds as an under-appreciated problem despite the fact that it is poses one of the greatest threats to public safety. More than 112,000 people died in speeding-related crashes in the U.S. from 2005 to 2014, averaging more than 10,000 deaths each year. This is on par with the 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.



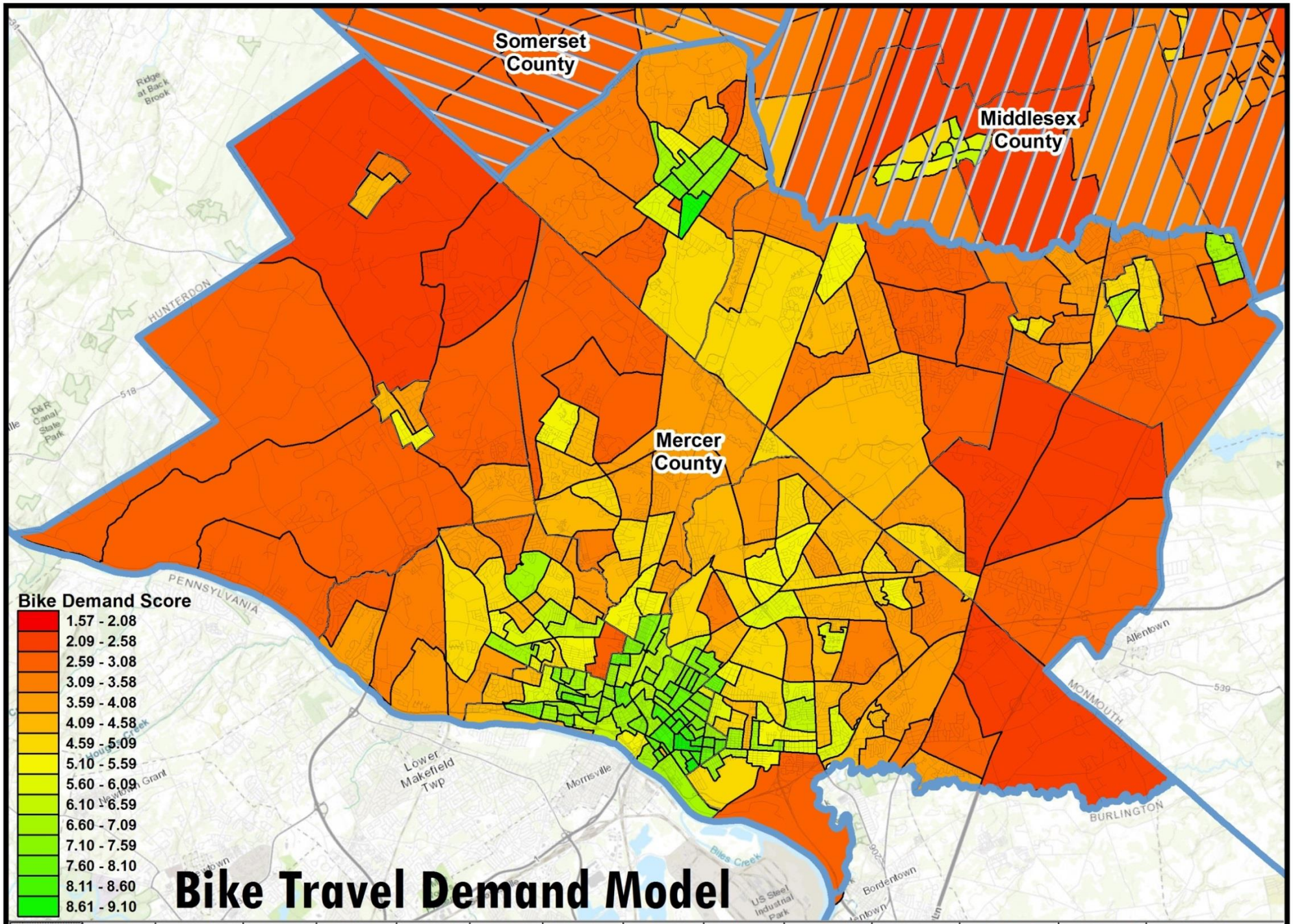
Bicycle Travel Demand Modeling

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.

Factor	Weight
Pop Density	18%
Job Density	17%
Key Destinations	
School Access	4%
University Access	8%
Park Access	4%
Commercial Access	8%
Bus Access	3%
Train Access	8%
Equity Factors	
Under 18 Density	6%
Over 64 Density	1%
Zero Car HH Density	8%
IP Ratio < 1.25 Density	5%
Bike to Work Density	6%
Walk or Transit to Work Density	4%



PopDenSc	JobDenSc	SchoolAcce	UniAccSc	ParkAccSc	ComAccSc	BusAccSc	RailAccSc	Un18DenSc	Ov64DenSc	ZeroCarHHD	IPLess1_25	BikeModeSc	WlkTranMod	Bike Demand Score
1.44	1.08	0	0	0.4	0.8	0.3	0	0.54	0	0	0.4	0	0.2	5.301667
0.18	0.18	0	0	0.4	0.8	0.3	0	0.06	0	0	0.15	0	0.08	2.429167
1.62	1.44	0	0	0.4	0.8	0.3	0	0.54	0	0.72	0.45	0	0.36	6.6925

NJDOT & Mercer County Facility Selection Table

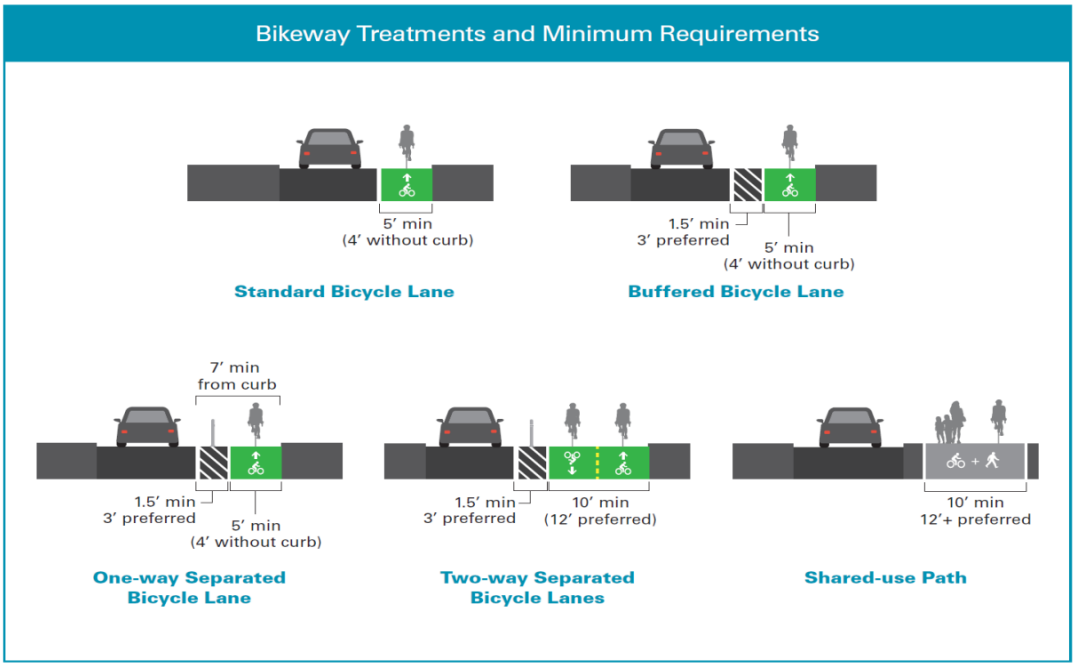
Published in 2017, the NJDOT Complete Streets Guide provided the County with a reliable methodology of looking at the relationship between ADT and posted speeds. Based on methodology from other states and with the same concept of reaching the highest possible LTS with limited resources and limited cartway, 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 doen'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.

A Bicycle Facility Table

	85TH PERCENTILE SPEED[1]						
ADT	≤ 20	25	30	35	40	45	≥50
≤ 2,500	ABCDEF	A[2]BCDEF	CDEF	CDEF	CDEF	DEF	F
2,500–5,000	BCDEF	BCDEF	CDEF	CDEF	DEF	DEF	F
5,000–10,000	B[3]CDEF	B[3]CDEF	CDEF	DEF	DEF	EF	F
10,000–15,000	DEF	DEF	DEF	DEF	EF	EF	F
≥15,000	DEF	DEF	DEF	EF	EF	F	F

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

[1]If 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%



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 determening 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

	USLIMITS2 Recommended Speed						
ADT	≤ 20	25	30	35	40	45	≥50
≤ 2,500	A B C D E F	A B C D E F	C D E F	C D E F	C D E F	D* E F	F
2,500–5,000	B C D E F	B C D E F	C D E F	C D E F	D* E F	D* E F	F
5,000–10,000	B C D E F	B C D E F	C D E F	C* D E F	D* E F	D* E F	F
10,000–15,000	C* D E F	C* D E F	C* D E F	C * D* E F	D* E F	D* E F	F
15,000-30,000	C* D E F	C* D E F	C* D E F	D* E F	E F	E* F	F
≥30,000	F	F	F	F	F	F	F

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

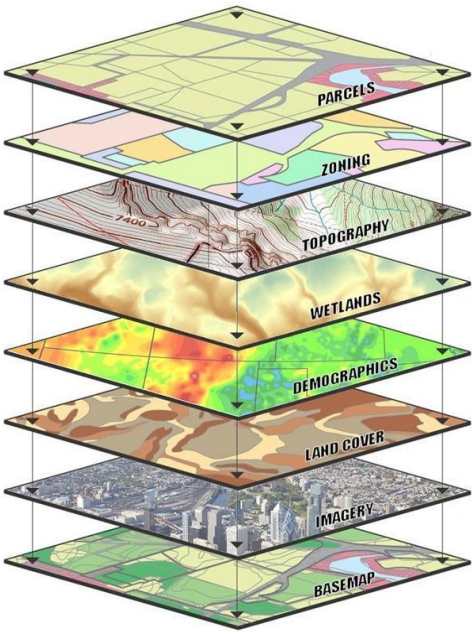
1. If USLIMITS2 data not available, use posted speed
2. Bicycle boulevards are preferred at speeds ≤25 mph
3. Shared-lane markings are not a preferred treatment with truck percentages greater than 10%
4. Buffered Bike Lanes may include Rumble Strips if designed to Mercer County Bike Friendly Standards.

Source: Mercer County Department of Planning, Trenton, New Jersey

Geographic Information System Analysis

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.



Above: Simplified visualization of overlapping GIS data.

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.

GIS DATA USED IN ANALYSIS

Transportation Data

- Mercer County Road Centerlines (2014)
- DVRPC and NJDOT Annual Average Daily Traffic (AADT) Counts (2010-2019)
- NJ DOT Truck Routes (2018)
- NJ Transit Bus Routes (2018)
- NJ Rail Line and Station Data (2018)
- Mercer County Multi-Use Trails (2018)
- Mercer County On-Street Bicycle Facility Data (2018)
- Mercer County Guard Rail Data (2016)
- Mercer County Pavement Extents (2014)
- Mercer County Airport Layer Data (2017)
- Mercer County Traffic Signal Data (2012)
- Mercer County Bridge and Culvert Data (2016)

Land Use and Environmental Data

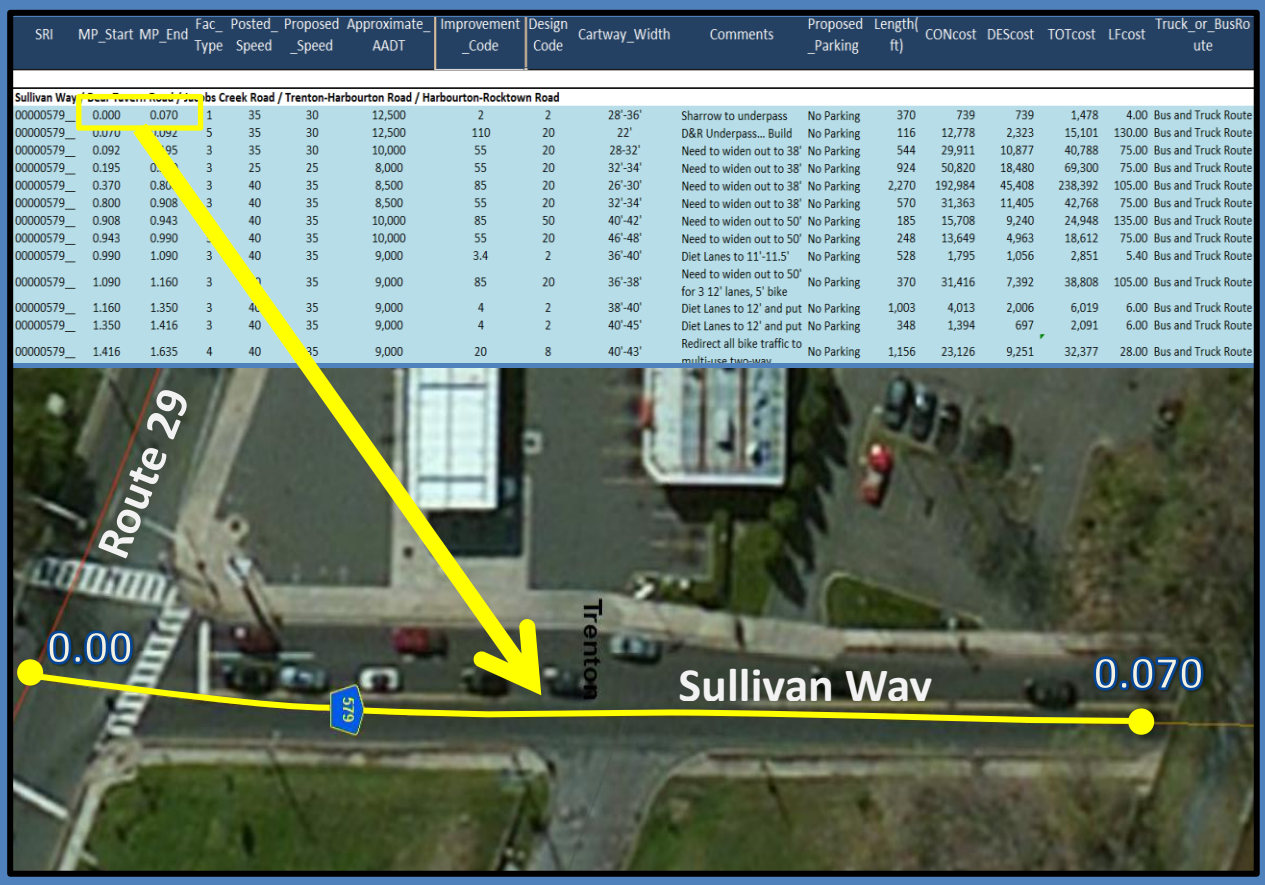
- DVRPC Land Use Data (2015)
- Mercer County Mod4 Parcel Data (2018)
- Mercer County Digital Elevation Model Data (2005 & 2009)
- Mercer County Schools and Educational Site Data (2014)
- Mercer County Wetlands, Streams and Water Bodies (2018)
- Preserved Farmland -Local, County and State (2018)
- Preserved Open Space -Local, County and State (2018)

Aerial & Street Imagery

- Nearmap Aerial Imagery (2018-2019)
- Google Earth/ Street View (2014-2019)
- DVRPC Aerial Imagery (2015)
- Pictometry Aerial Imagery (2009)

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.



SRI	MP_Start	MP_End	Fac_ Type	Posted_ Speed	Proposed _Speed	Approximate_ AADT	Improvement _Code	Design Code	Cartway_Width	Comments	Proposed _Parking	Length(ft)	CONcost	DEScost	TOTcost	LFcost	Truck_or_BusRo ute
Sullivan Way / [illegible] Creek Road / Trenton-Harbourton Road / Harbourton-Rocktown Road																	
00000579_	0.000	0.070	1	35	30	12,500	2	2	28'-36'	Sharrow to underpass	No Parking	370	739	739	1,478	4.00	Bus and Truck Route
00000579_	0.070	0.092	5	35	30	12,500	110	20	22'	D&R Underpass... Build	No Parking	116	12,778	2,323	15,101	130.00	Bus and Truck Route
00000579_	0.092	0.195	3	35	30	10,000	55	20	28-32'	Need to widen out to 38'	No Parking	544	29,911	10,877	40,788	75.00	Bus and Truck Route
00000579_	0.195	0.370	3	25	25	8,000	55	20	32'-34'	Need to widen out to 38'	No Parking	924	50,820	18,480	69,300	75.00	Bus and Truck Route
00000579_	0.370	0.800	3	40	35	8,500	85	20	26'-30'	Need to widen out to 38'	No Parking	2,270	192,984	45,408	238,392	105.00	Bus and Truck Route
00000579_	0.800	0.908	3	40	35	8,500	55	20	32'-34'	Need to widen out to 38'	No Parking	570	31,363	11,405	42,768	75.00	Bus and Truck Route
00000579_	0.908	0.943	3	40	35	10,000	85	50	40'-42'	Need to widen out to 50'	No Parking	185	15,708	9,240	24,948	135.00	Bus and Truck Route
00000579_	0.943	0.990	3	40	35	10,000	55	20	46'-48'	Need to widen out to 50'	No Parking	248	13,649	4,963	18,612	75.00	Bus and Truck Route
00000579_	0.990	1.090	3	40	35	9,000	3.4	2	36'-40'	Diet Lanes to 11'-11.5'	No Parking	528	1,795	1,056	2,851	5.40	Bus and Truck Route
00000579_	1.090	1.160	3	40	35	9,000	85	20	36'-38'	Need to widen out to 50' for 3 12' lanes, 5' bike	No Parking	370	31,416	7,392	38,808	105.00	Bus and Truck Route
00000579_	1.160	1.350	3	40	35	9,000	4	2	38'-40'	Diet Lanes to 12' and put	No Parking	1,003	4,013	2,006	6,019	6.00	Bus and Truck Route
00000579_	1.350	1.416	3	40	35	9,000	4	2	40'-45'	Diet Lanes to 12' and put	No Parking	348	1,394	697	2,091	6.00	Bus and Truck Route
00000579_	1.416	1.635	4	40	35	9,000	20	8	40'-43'	Redirect all bike traffic to multi-use two-way	No Parking	1,156	23,126	9,251	32,377	28.00	Bus and Truck Route

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.

Category	GIS Code	Description	Epoxy Cost/mi	Bike Plan Notes
Facility Type	1	Sharrow		ADT/SPEED LIMIT: 10,000/0-25; or obstructing structure
	2	Bicycle Lane		ADT/SPEED LIMIT: 30,000/0-30; 15,000/35; 2,500/40
	3	Buffered Bicycle Lane		ADT/SPEED LIMIT: 30,000/0-35; 15,000/40-45
	4	Separated Bike Lane		ADT/ SPEED LIMIT: 30,000/0-45
	5	Multi-Use Path		ADT/SPEED LIMIT: No Limit
Posted Speed	##	This is the posted speed on this road		
Proposed Speed	##	Speed needed for proposed facility		Desired speed to accommodate facility type. Typical reduction of 5 mph and never more than 10 mph reduction. Use 10 mph only in limited cases.
Approximate AADT	#,###	Rounded approximate number in segment		
Cartway Width	##'	Approximate width range of cartway		Try to keep this as small as possible by segmentation. Base segmentation on cartway widths (approximately)
Improvement	0	No Improvements		N/A
	0.648	Edge Stripe	$ 3,421	4" White Line (x2)
	4.057	Sharrow	$ 21,421	Pavement Markings & Signs
	4.389	Convert Existing Shoulders to Bike Lanes	$ 23,174	Pavement Markings, Signs & RPMs
	5.242	Regular Bike Lane	$ 27,678	6" White Line (x2), Pavement Markings, Signs & RPMs
	7.36	Bike Lane with One Parking Lane	$ 38,861	6" White Line (x2), 4" White Line, Pavement Markings, Signs & RPMs
	7.686	Bike Lane with Two Parking Lanes	$ 40,582	6" White Line (x2), 4" White Line (x2), Pavement Markings, Signs & RPMs
	6.14	Painted Buffered Lane	$ 32,419	6" White Line (x2), Pavement Markings, Signs & RPMs
	7.965	Rumble Buffered Lane	$ 42,055	6" White Line (x2), Rumble Strips (x2), Pavement Markings, Signs & RPMs
	10.14	Bike Lanes with Road Diet	$ 53,539	Mill 4 Lines, 6" White Line (x2), 4" Yellow Lines (x4), Pavement Markings, Signs & RPMs
	13.843	Protected Lane	$ 73,091	Mill 4 Lines, 6" White Line (x2), 4" Yellow Lines (x5), Pavement Markings, Signs & Flexible Posts
	55	Widen (<6')	$ 290,400	Mill, subase, 8" HMA, edge line
	85	Widen (6-12')	$ 448,800	Mill, subase, 8" HMA, edge line
	160	Widen (16')	$ 844,800	Mill, subase, 8" HMA, edge line
	80	Convert Sidewalk to Multi-Use Path	$ 422,400	Widen (4'-6') + Clearing 4' (2' either side)
	110	New Multi-Use Path	$ 580,800	Widen (7-12') + Clearing 18'
	1000	Full Intersection Improvement/ Redesign	$ -	New signals & stripes, 200' segment ($200k total)
Design	1	Paint		Simple
	2	Paint & Signs		More complex
	4	Paint & Signs & Rumble Strips/ RPMs		Much more complex
	8	Protected Lane		Extremely complex engineering design
	20	Widen		Consider drainage, etc.
	50	ROW		DES only, ROW cost not included
	60	ROW & NEPA		DES & permitting, ROW cost not included

*Improvement and design codes are temporary, will need further calibration for more accurate cost estimates. Can do this later on, after road analysis.

This table specifies coded values ('code') to be entered into attributes ('category') for each road segment to create a bicycle facility with a reasonable level of traffic stress. When the 'improvement' and 'design' values are multiplied by the segment length, an order of magnitude cost for implementation results. Only the 'intersection' improvement type has a pre-defined segment length (100' either side of an intersection node) to generate an appropriate improvement cost. Note that 'costs' are for planning purposes only; they are not estimates of actual project costs.

As a result of this input, cost estimates can be then be 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