HAMILTON TOWNSHIP

BICYCLE & PEDESTRIAN CIRCULATION STUDY

FINAL REPORT

NJDOT Local Technical Assistance Program
May 2011

Chapter 1 – Existing Conditions

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NJDOT provides the information contained in these Local Bicycle and Pedestrian Plans as a service to local communities. The Department and its consultants strive to provide quality planning studies that include a range of recommended improvements, but make no claims, promises, or guarantees about the availability of funding to complete the projects recommended.

Introduction

Hamilton Township in Mercer County is currently preparing an update to its master plan, including updates to circulation and sustainability. As part of this effort the Township seeks to develop a plan for bicycle and pedestrian circulation that improves access and provides connections to key generators of non-motorized traffic. This plan 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. This study includes three chapters: Chapter 1 examines the existing conditions, Chapter 2 presents the recommended improvements, and Chapter 3 is a Pattern Book that provides guidance on how to design and implement pedestrian and bicycle facilities.

This study includes an overview of the existing conditions for bicyclists and pedestrians in Hamilton Township, recommendations for improved facilities, and recommended strategies to encourage safe biking and walking. It includes an analysis of crash data, identification of key pedestrian and bicycle traffic generators and other activity centers, review of key corridors for non-motorized traffic within the township, recommended measures to enhance the overall pedestrian network, including improved sidewalks, crossings and curb ramps and review of bicycle compatibility of key roadways within the township.

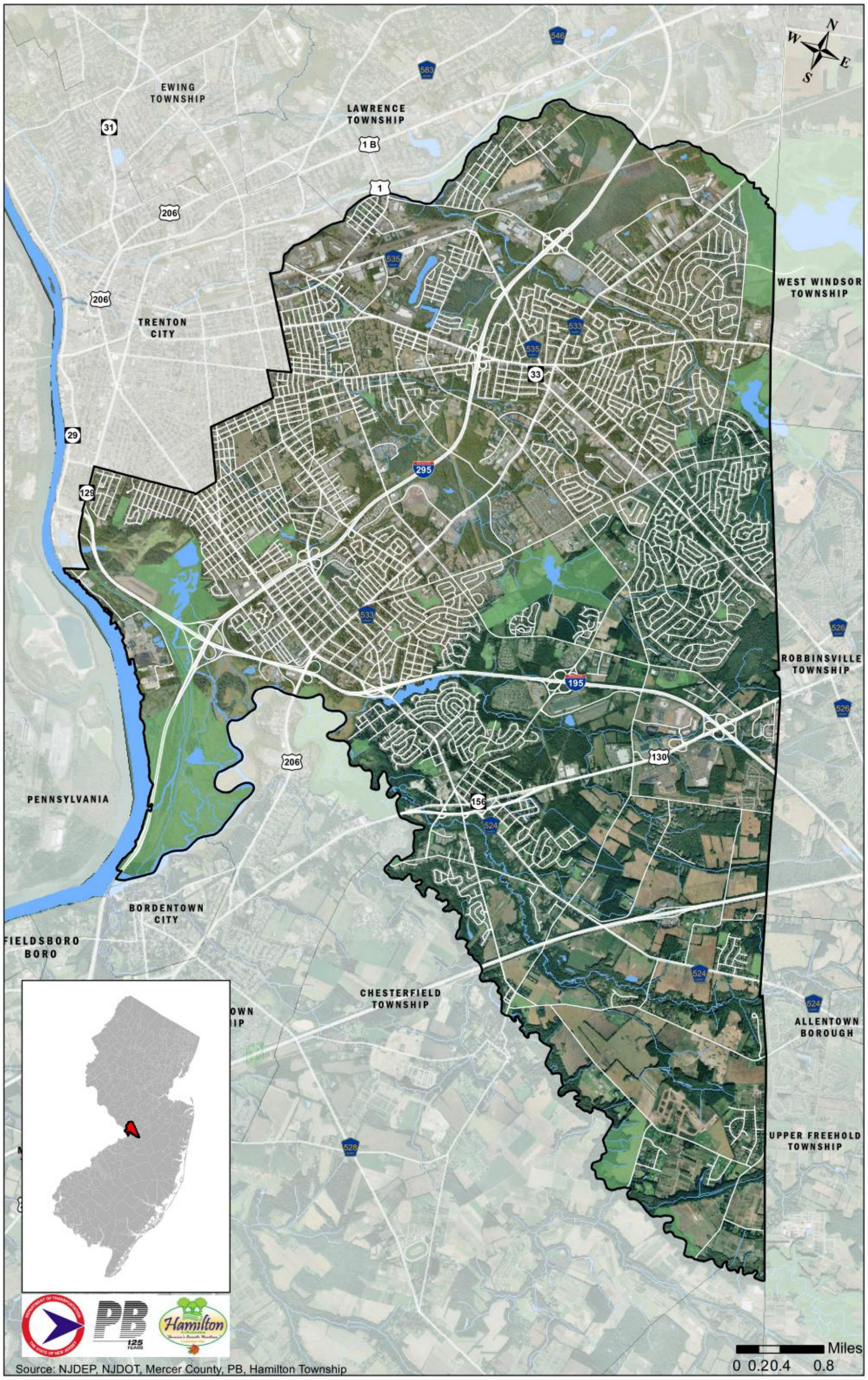
Background

Hamilton Township is one of the largest municipalities in NJ at 40.4 square miles. Billing itself as "America's Favorite Hometown," Hamilton has approximately 88,500 residents (2010 Census), with a centralized location and easy accessibility to the regional roadway system that make it an attractive place to live, work, and do business. New York City, Philadelphia, and the Jersey Shore are less than an hour's drive away.

Hamilton is served by major transportation routes including I-195, I-295, NJ Route 130 and NJ Turnpike as well as the Northeast Corridor line at Hamilton Transit Center; other major routes include NJ Route 206, NJ Route 33, and a series of county and municipal routes which include Quakerbridge Road, Klockner Road, Kuser Road, and Nottingham Way. Many of these roadways change considerably in character and profile as they pass through Hamilton's various residential, commercial, industrial, and retail districts. Hamilton's location and principal roadways are depicted in Figure 1.

Land use patterns vary considerably throughout the township, with a densely developed street grid system adjacent to the City of Trenton in the west and more sprawling suburban neighborhoods and open space in the east. Many of Hamilton's residential areas, including some of those most recently developed, offer limited street connectivity to adjacent districts and roadways, with many cul-de-sacs and dead end streets.

Figure 1 - Context and Roadways



Hamilton lacks a downtown center; instead the township is composed of a collection of smaller villages, each with its own centers and main streets, including Hamilton Square, Mercerville, Yardville, White Horse, Bromley, and Groveville. A variety of commercial centers are scattered throughout the township, with strip malls lining most major arterials.

Study Methodology

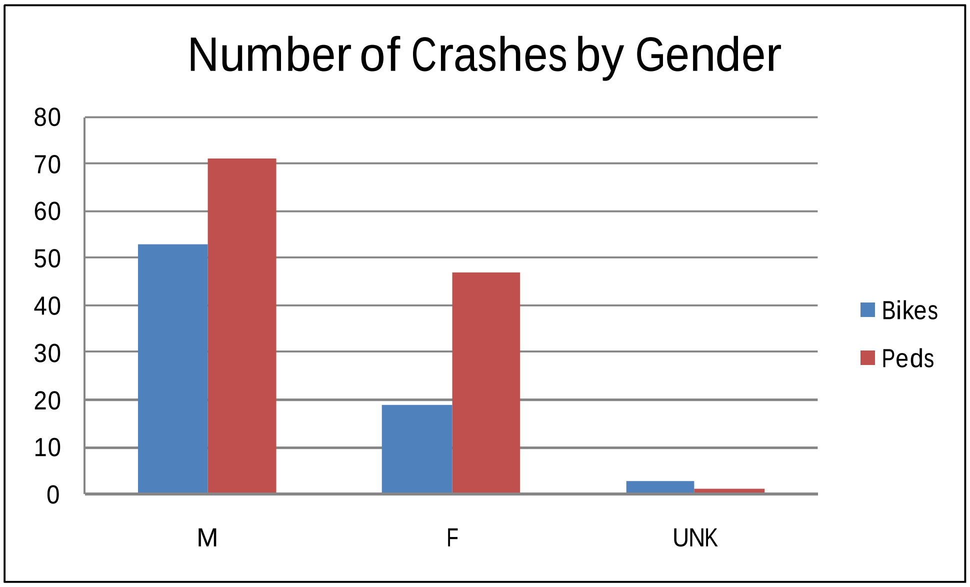
Due to the large size of the municipality, it became necessary to select 'hot spots' where needs and conditions warranted detailed, in depth examination, and for which recommendations would be developed. This determination began by gathering information on recent crash records, bicycle and pedestrian attractors and generators, and roadway bike compatibility (using NJ straight line diagrams). These three components were mapped to determine areas of confluence that might indicate specific, documented, problems or inadequate bicycle and pedestrian facilities.

Crash Records

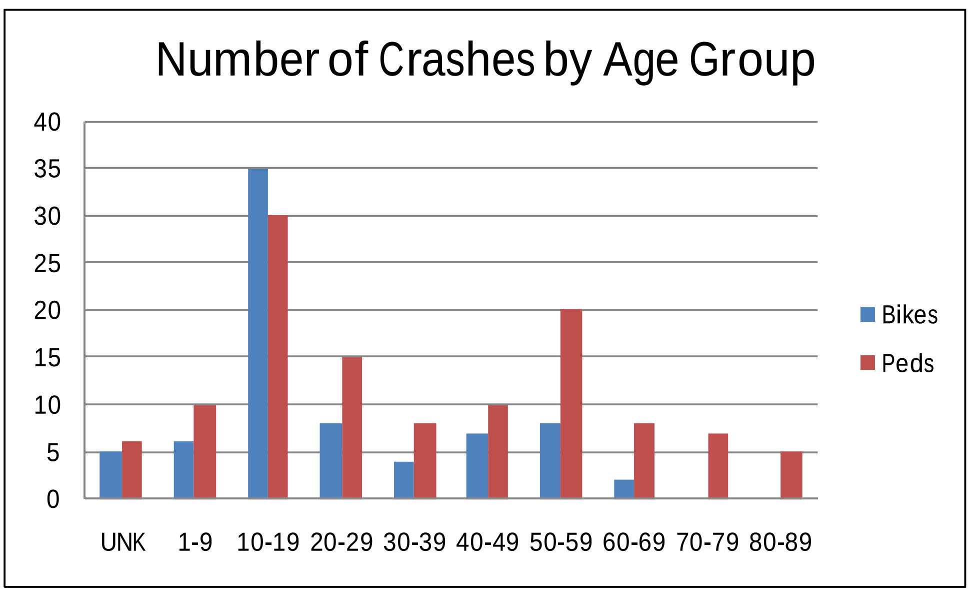
Crash records were obtained from NJDOT and Hamilton Township for 2007-2009, which revealed 168 crashes involving pedestrians or pedacycles. The crash data includes:

- Age
- Gender
- Type of traffic control
- Alcohol involvement
- Contributing circumstance(s)
- Type of injury
- Direction of travel
- Pre-crash action – includes both the motorist and the bicyclist/pedestrian

Of the total of 168 crashes, 95 involved pedestrians, and 73 involved pedacycles. An examination of crash reports indicated that in many instances, the apparent cause of the crash was either driver inattention or action by pedestrian/pedacyclist (the technical term in crash data is pedacycle rather than bicycle, so references to these data use the technical term). Three of those crashes resulted in fatalities. In-depth examination of these crashes resulting in fatalities did not indicate any obvious contributing factors. In general, the crashes involved males roughly twice as often as females.



The age group most often involved was 10-19 years old, with an additional disproportionately large number of pedestrian crashes in the 50-59 year age group. The most common action in bike crashes was bicycles going straight. Jaywalking was the highest pedestrian action, followed by crossing a marked crosswalk, then standing in the road, then crossing at unmarked crosswalk, and finally crossing midblock. Fewer than 5 crashes involved walking trips to/from school.



Attractors and Generators

Locations that could attract or produce a high number of pedestrian or bike trips were catalogued and mapped. Attractors and generators were sorted into the following categories:

- Schools – children (an age group considered most at risk) walking or biking to school
- Recreation – many users include children

- Government services
- Transit – many transit riders arrive at bus stops by foot or bike
- Retail – some shoppers arrive on foot or by bike, but many park and still have to walk into store
- Houses of worship – some worshipers walk to services, while others who drive may need to park on-street and have to cross or walk some distance to enter the house of worship

Figure 2 provides a map of crash locations and attractors and generators of pedestrian and bike trips. Crashed do not appear to occur more frequently at locations with attractors/generators than without. Also, only 5 of the 168 crashed occurred near schools.

Major roadways in Hamilton Township were also checked for bicycle compatibility. This was done by comparing lane and shoulder widths from the most recent Straight Line Diagrams to NJDOT's Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines. Many areas were found to be incompatible. Discussion and analysis of Bicycle Compatibility is presented later in this report. Crashes occurred in both compatible and incompatible roadways. Figure 3 overlays crash data on bicycle compatibility of Township roadways.

Additionally, several of these roadways were traveled by bike to assess the bicycle compatibility of each

These three pieces of information (crashes, generators, and bike compatibility) were analyzed together to determine if any 'hot spots' existed within the Township. For example, a high number of pedestrian crashes near a large generator (like a school) might indicate a recurring problem. In some cases, major roadways had a series of crashes that spread beyond one intersection, and those were designated as corridor hot spots.

The three intersections selected for analysis are:

1. Sloan Avenue/Flock Road at Quakerbridge Road (CR 533)
2. Whitehorse Mercerville Road (CR 533) at NJ Route 33
3. Hamilton Avenue at South Olden Avenue

These intersections (also described in more detail in the Field Conditions Summary) were evaluated for pedestrian signals (including presence of countdown heads), push buttons, ADA curb ramps, obstructions, lighting, crosswalks, driveways, points of interest on corners, bus stops, and sidewalks.

Figure 2 - Pedestrian and Bicycle Attractors, Generators, and Crashes

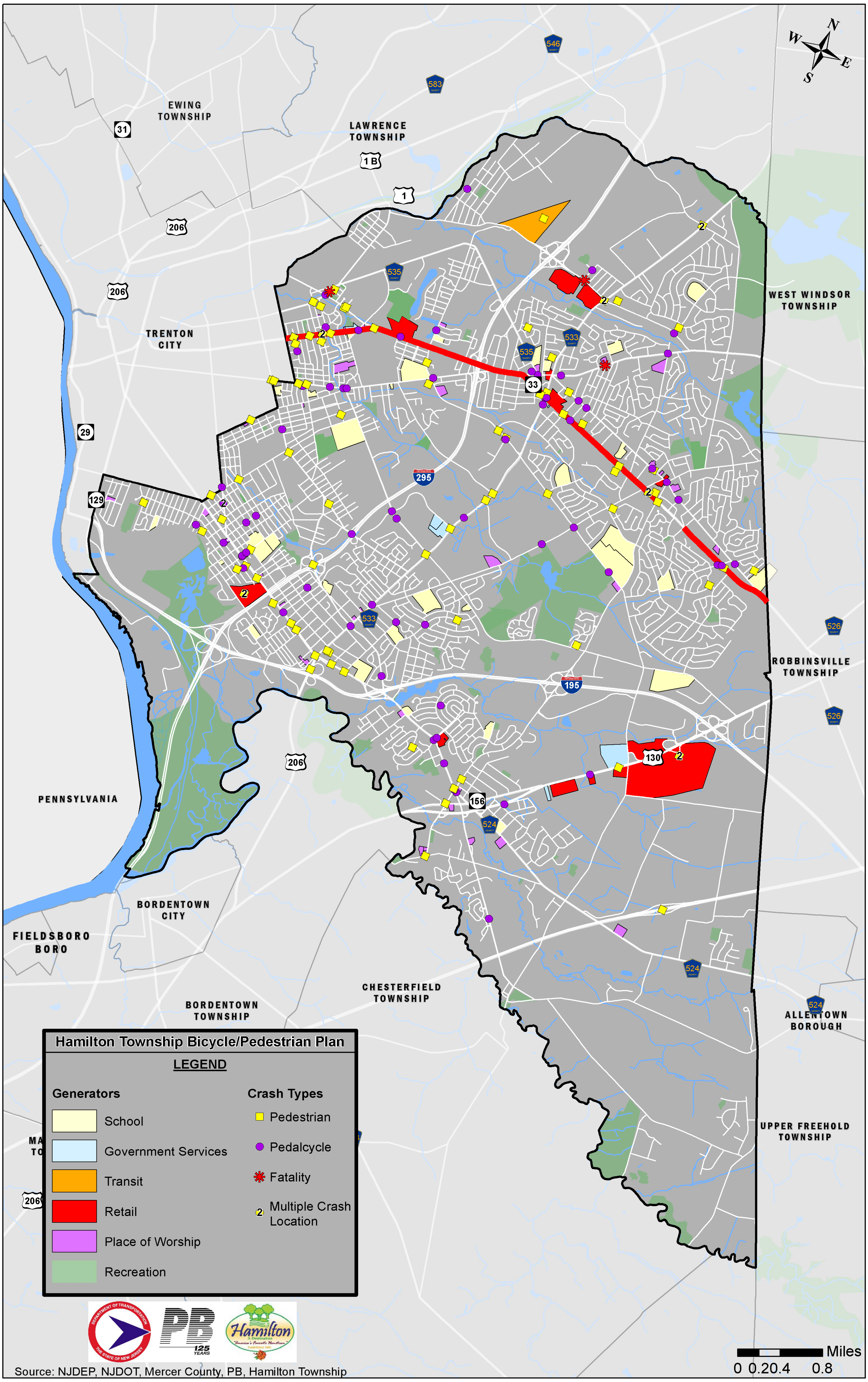
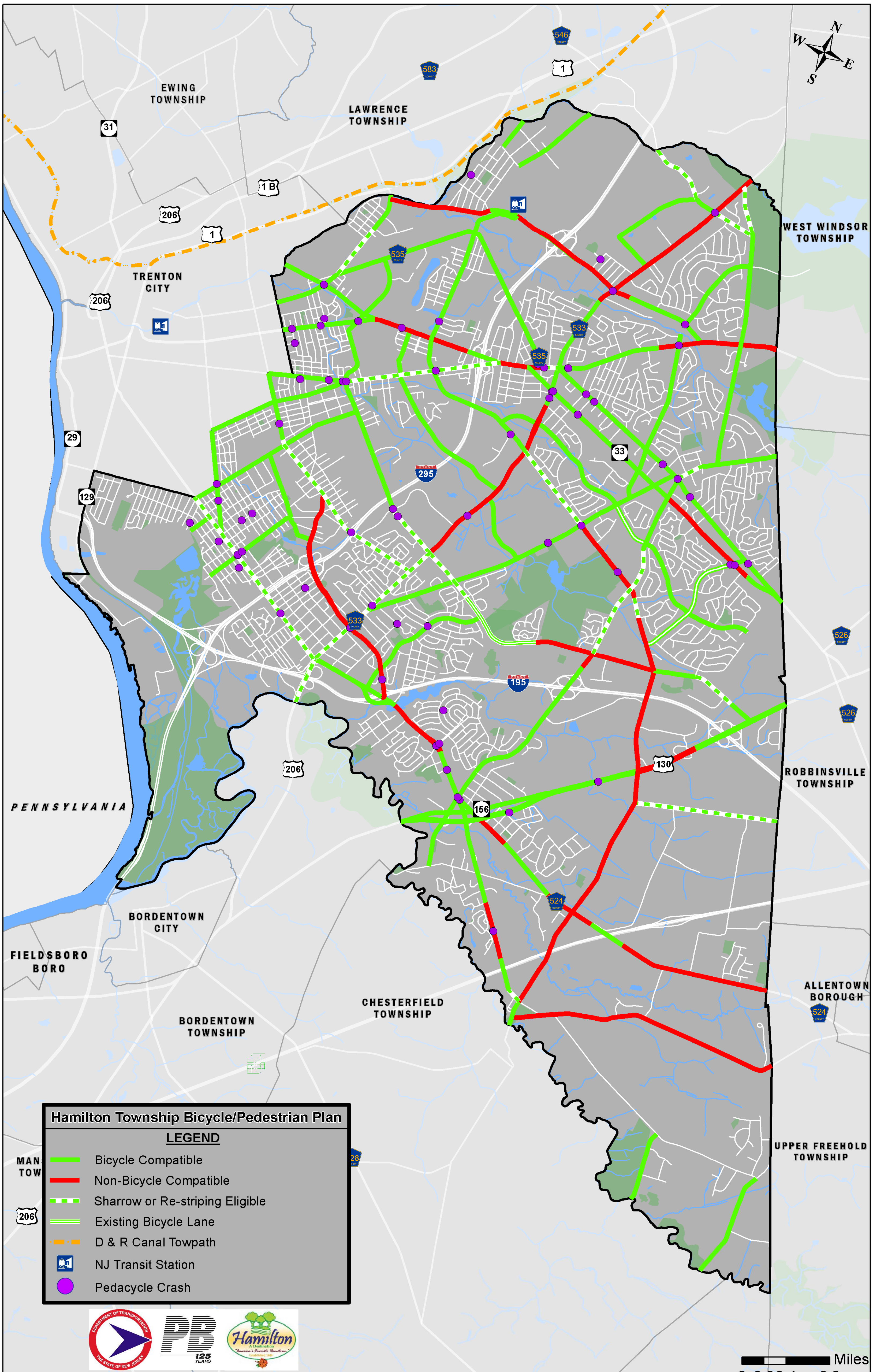


Figure 3 - Bicycle Compatibility and Crashes



The corridors identified for analysis are:

1. NJ Route 33 (Nottingham Way/Greenwood Avenue) from Donald Drive to the Hamilton-Trenton border (~1.07 miles)
2. Hamilton Avenue from I-295 to the Hamilton-Trenton border (~1.94 miles)
3. Nottingham Way east from Quakerbridge Road (CR 533) to NJ Route 33 (~2.81 miles)
4. South Broad Street (CR 524) from I-195 to NJ Route 130 (~1.58 miles)
5. South Broad Street from I-195 to Hamilton-Trenton border (~2.42 miles)
6. NJ Route 33 from Whitehorse-Hamilton Square Road to Yardville-Hamilton Square Road (~0.17 miles)

Each of these corridors is described in more detail in the Field Conditions Summary section. The corridors were evaluated for presence of shoulders (approximate widths), crosswalks, roadway widths/number of lanes, on street parking, sewer grates, speed limit, sidewalks, grades, lighting, driveways, ADA curb ramps, and bus stops.

Crosswalks can be either lateral (perpendicular to the travel lanes and driver's field of vision) or longitudinal (parallel to the travel lanes and driver's field of vision). Standard crosswalks consist of two parallel lateral lines and are used at most signalized intersections. Longitudinal crosswalks include ladder or continental style. A ladder crosswalk looks like the name suggests – a pair of parallel lateral stripes connected with longitudinal stripes. A continental crosswalk is a series of wide, longitudinal stripes that enhance crosswalk visibility by appearing larger and more visible to the driver at a distance than lateral markings.

Bus stops were noted in the field where practicable. However, an in-depth analysis of bus stops and access to them is beyond the scope of this study, and it is recommended that further investigation should be undertaken. A summary of findings is given in the section below.

Figure 4 indicates the locations of the corridors and intersections selected for analysis and field conditions evaluation.

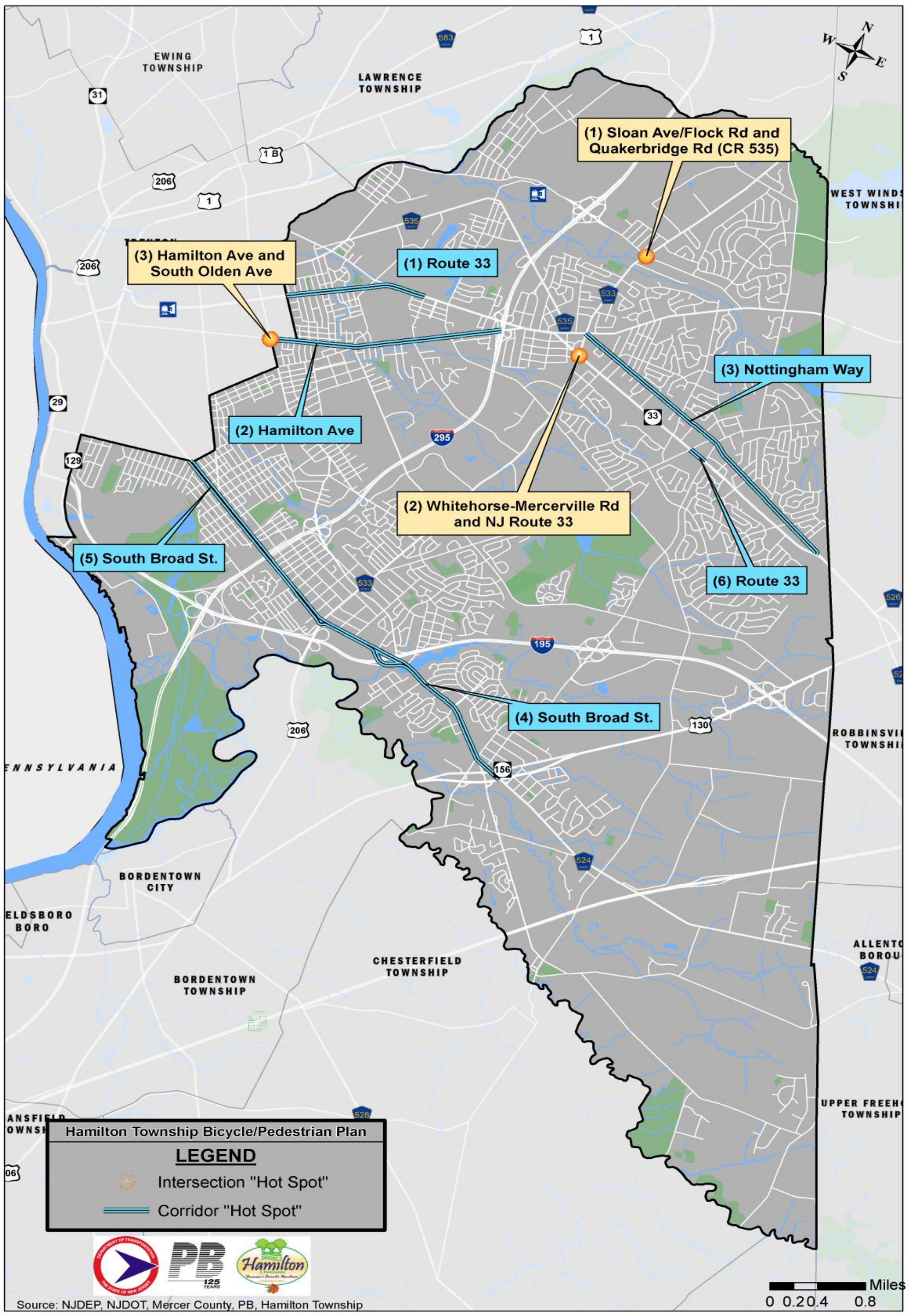
Field Conditions Summary

Intersections

Sloan Avenue / Flock Road at Quakerbridge Road (CR 533)

The conditions of the intersection of Sloan Avenue and Flock Road with Quakerbridge Road were examined due to several crashes in the vicinity within the last three years, including both pedestrian and pedacycle crashes. Quakerbridge Road is a major north/south corridor in the area, linking Hamilton Township with US Route 1 and Princeton Borough to the north. This is one of the busiest and most congested intersections in the Township and region. Sloan Avenue provides access to the Hamilton New Jersey Transit Commuter Rail station approximately one mile to the west, as well as a link for vehicular traffic to Interstate 295. Significant trip generators at the intersection include a grocery store, fitness center, and a Burger King establishment at the southwest corner, a ShopRite liquor store on the southeast corner, and a gas station at the northeast corner. An AMC 24 screen movie theater and restaurant site are located just to the west along Sloan Avenue. There is also a transit shelter approximately 500 feet south of the intersection along Quakerbridge Road.

Figure 4 – Intersections and Corridors



The intersection has three pedestrian crossings with standard crosswalks, whose striping is generally in fair condition. The southern end of the intersection (crossing Quakerbridge Road) is the only leg of the intersection without pedestrian facilities. A pedacycle crash occurred on this leg of the intersection in 2008. Each crosswalk has pedestrian signals and countdown timers with push button activation on each corner. On corners with two pedestrian crossings, there is a separate button for each crossing direction to activate crosswalk signals independently. The field investigation indicated that all push buttons and pedestrian signals are functioning and the countdown timers provide a reasonable amount of time to safely cross the intersection. The push buttons appear to prompt a 'walk' signal for the selected crossing at the next appropriate time in the traffic signal's light phasing, rather than force a 'walk' signal at the next light change.

All three standard crosswalks have non-ADA compliant curb ramps at either end. The curb ramps lack detectable warnings, such as a red, textured surfacing, to accommodate pedestrians with poor vision. There is also a sidewalk deficiency on the northwest corner of the intersection which is shown in Figure 5. Though a depressed curb exists, there is no sidewalk along Quakerbridge Road southbound at this corner. A worn path in the grass along the road indicates significant pedestrian traffic, as this crosswalk on the north leg of the intersection is the only pedestrian crossing of Quakerbridge Road. Due to the lack of a sidewalk, the push button control to cross Quakerbridge Road is also not handicap accessible.

Figure 5 : Missing sidewalk on NW corner

Lighting at this intersection is low, as the only lighting is provided by two utility pole mounted lights, one each on the northeast and southeast corners. Ample ambient lighting is provided by the Exxon station at the northeast corner. Marginal ambient lighting is provided by commercial development at the southeast and southwest corners. This combination of lighting fixtures and ambient light supplies adequate lighting on the eastern leg of the intersection (crossing Flock Road) and the northbound lanes of Quakerbridge Road. However, the southbound lanes of Quakerbridge are dimly lit and the western leg of the intersection (crossing Sloan Avenue) is very dim. The northwest corner, in particular, is very dark, as it is wooded and lacks any lighting fixtures or ambient light. Additionally, the transit shelter south of the intersection is very dim. There are no light fixtures in close proximity on the southbound side of Quakerbridge Road and mature trees surrounding the commercial plaza on the southwest corner prevent ambient light from adequately illuminating the shelter. Poor lighting was noted as a factor in the pedacycle crash reported at this intersection in 2008.

Another potential problem area of this intersection is a driveway to the Exxon station on the northeast corner from Quakerbridge Road northbound. This driveway is approximately 20 feet north of the pedestrian crossing of Quakerbridge Road, potentially causing hazardous conditions between pedestrians at the intersection and vehicles entering/exiting the Exxon station.

Additional features of this intersection include a pedestrian refuge island along the east leg of the intersection crossing Flock Road. This island shields pedestrians from vehicles making a channelized right turn from Quakerbridge Road northbound.

Intersection 2 – Whitehorse-Mercerville Road (CR 533) at NJ Route 33

Several pedestrian and pedacycle crashes occurred in the vicinity of the intersection of Whitehorse-Mercerville Road and NJ Route 33 over the last three years. This location is the intersection of two major corridors through Hamilton Township. Quakerbridge Road is a north/south route linking Hamilton Township with US Route 1 and Princeton Borough to the north. Route 33 is an east/west route through the Township, linking it with Trenton to the west and US Route 130 to the east. There are several major pedestrian generators at this intersection, including the Mercerville Shopping Center at the northeast corner, a CVS at the northwest corner, and an Applebee's at the southeast corner.

The main pedestrian deficiency of this intersection is the southern leg crossing Whitehorse-Mercerville Road. This crossing lacks a crosswalk; however, it has been outfitted with ADA compliant curb ramps, pedestrian signals, and countdown timers. This inconsistency creates significant confusion for pedestrians, as well as vehicular traffic, as to whether this leg of the intersection is an appropriate and safe place for pedestrians to cross Whitehorse-Mercerville Road.

Figure 6 illustrates the problems with this leg of the intersection.

Figure 6: Missing crosswalk; existing curb ramps and pedestrian signals

The remaining three legs of the intersection have standard crosswalks with striping in fair to good condition. Each of the three marked crossings also has pedestrian signals with countdown timers. There is one push button activator at each corner; different crossing directions are not activated independently. All the buttons are accessible and appear to function. The push buttons appear to prompt a 'walk' signal at the next appropriate time in the traffic signal's light phasing for each crossing direction (including the unmarked south leg of the intersection), rather than force 'walk' signals at the next light change. However, it was unclear in the field whether 'walk' signals are automated in the signal timing regardless of pedestrian activity, or if the push buttons are the only generator of a 'walk' signal. The countdown timers provide a reasonable amount of time to safely cross the intersection.

In addition to pedestrian signals, each corner also has curb ramps. The southwest corner appears to have been recently renovated and is ADA compliant; it incorporates the more current detectable warning system – a red surface with truncated domes. The curb ramps at the other three corners are non-ADA compliant. Though each ramp has a red, slightly textured surface, they lack the more effective surfacing of red truncated domes to aid visually impaired pedestrians, as required by ADA specifications. Each corner has complete sidewalks approaching the crosswalks as well. However, east of the northeast corner, along Route 33 westbound, there is approximately 100 feet of missing sidewalk between the corner and an entrance/exit to the Mercerville Shopping Center. On the southwest corner, the sidewalk is complete, although the route for pedestrians along eastbound Route 33 and attempting to use the crosswalk across Route 33 is a bit indirect and involves a pedestrian refuge, as shown in Figure 7. There is also missing sidewalk in front of the Lukoil station along NJ Route 33 eastbound.

Figure 7: Poor sidewalk alignment and incomplete sidewalk at the southwest corner, near Lukoil station

Lighting at this intersection is adequate; each corner has one utility pole mounted light fixture, although the fixture on the northeast corner was malfunctioning at the time of the field visit. Additionally, ambient light from commercial development at all four corners provides supplemental lighting, particularly the Lukoil station at the southwest corner.

This intersection also has a pedestrian refuge island on the northwest corners to shield pedestrians from vehicles making a right turn from Whitehorse-Mercerville Road southbound to Route 33 westbound.

An additional issue at this intersection is the close proximity of driveways at the Lukoil station to the southwest corner. Interaction between pedestrian activity near the intersection and vehicles entering/exiting Lukoil could pose a safety concern.

Intersection 3 – Hamilton Avenue at South Olden Avenue

Several pedestrian crashes occurred at the intersection of Hamilton Avenue and South Olden Avenue within the last three years. This area of Hamilton Township is more densely developed and has more mixed-use development, generating more pedestrian activity. A major generator at this intersection is a Dunkin Donuts establishment at the northeast corner. Additionally, there are transit stops approximately 100 feet to the east and west of the intersection along Hamilton Avenue. There are no shelters at these stops.

Pedestrian crossings are provided for all four legs of this intersection. Standard crosswalks are present for all four crossings; however, the striping is in poor condition and heavily worn in the wheel paths. There are pedestrian signals at all four corners. The signals are an older style and lack countdown timers. There are also no push button controls; a 'walk' signal is generated automatically by the traffic signal timing for each crossing direction during the appropriate light phases.

Non-ADA compliant curb ramps are present at each corner. However, there is only one curb ramp centered at each corner; rather than a separate curb ramp for each crossing direction. This presents some misalignment issues on some crossings between the curb ramp and the crosswalk, as shown in Figure 8. By ADA requirements, at the bottom of a centered curb ramp there must be a 48-inch wide area contained within the crosswalk markings to protect pedestrians from traffic in the intersection after they descend the ramp. This criterion is not met by the current crosswalk striping. Additionally, none of the curb ramps are equipped with a detectable warning surface for visually impaired pedestrians.

Figure 8: Curb ramp not aligned with crosswalk

Lighting at the intersection is generally adequate, with three of the corners using a combination of both utility pole mounted light fixtures and decorative, pedestrian scale lampposts along Hamilton Avenue. Additionally, ambient light is provided by businesses along the sidewalk, particularly at the southwest corner (tavern and liquor store) and northeast corner (Dunkin' Donuts). The southeast corner is the main lighting deficiency at this intersection, where lighting is relatively poor. This corner is a vacant lot and lacks any nearby streetlights and has minimal ambient light.

A summary table of crosswalk and curb ramps is detailed Table 1 on the following page.

Table 1 - Crosswalk and Curb Ramp Conditions at Spot Locations

Spot Location 1	Crosswalk (Type) *North leg*	*South leg*	*East leg*	*West leg*	Curb Ramps (ADA Compliance) *NW corner*	*NE corner*	*SW corner*	*SE corner*
Sloan Ave./Flock Rd. at Quakerbridge Rd (CR 533)	standard	none	standard	standard	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface

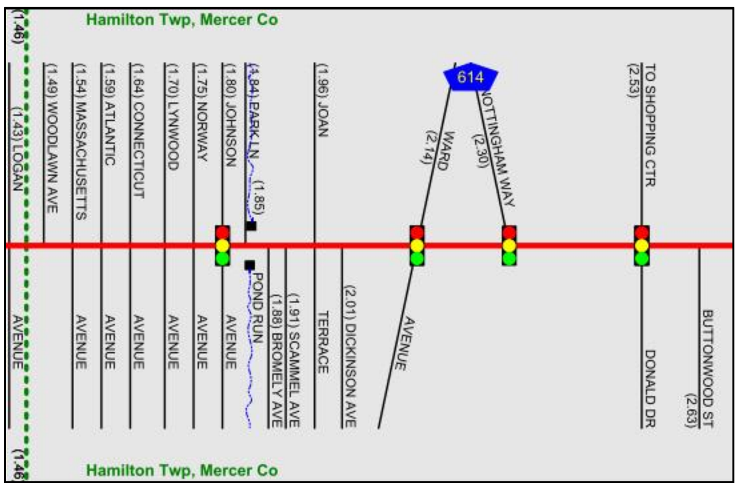
Spot Location 2	Crosswalk (Type) *North leg*	*South leg*	*East leg*	*West leg*	Curb Ramps (ADA Compliance) *NW corner*	*NE corner*	*SW corner*	*SE corner*
Whitehorse-Mercerville Rd. (CR 533) at Route 33	standard	none	standard	standard	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	ADA	non-ADA: red surfacing without truncated domes

Spot Location 3	Crosswalk (Type) *North leg*	*South leg*	*East leg*	*West leg*	Curb Ramps (ADA Compliance) *NW corner*	*NE corner*	*SW corner*	*SE corner*
South Olden Ave. at Hamilton Ave.	standard	standard	standard	standard	non-ADA: no detectable warning surface and poor striping alignment	non-ADA: no detectable warning surface and poor striping alignment	non-ADA: no detectable warning surface and poor striping alignment	non-ADA: no detectable warning surface and poor striping alignment

Corridors

Corridor 1 – NJ Route 33 (Nottingham Way/Greenwood Avenue) from Donald Drive to the Hamilton-Trenton border

A field study of Route 33 from Donald Drive to the Hamilton-Trenton border (~ 1.07 miles) was conducted due to numerous pedestrian and pedacycle crashes on the corridor within the last three years. This corridor has several uses that tend to generate pedestrian activity, including a bus route, retail, parks and recreation, Greenwood Elementary School, and the Hamilton Township Municipal building. The general character of this section of roadway varies between the limits, and it was therefore divided into two sections for easier review: Nottingham Way (Donald Drive to Greenwood Avenue) and Greenwood Avenue (Nottingham Way to the Hamilton-Trenton border).



Nottingham Way

Nottingham Way is a four lane roadway approximately 50-55 feet wide with a posted speed limit of 40 mph as depicted in Figure 9. There is a Burger King and a bus stop along this section of the corridor, but otherwise few pedestrian generators. The large shopping plaza along the westbound side is largely vacant.

This portion of Nottingham Way has sidewalks in both the eastbound and westbound directions, although there are two long discontinuous sections (approximately 150 feet each) on the westbound side of Nottingham Way. The pedestrian crossings at Donald Drive are marked with standard crosswalks and equipped with non-ADA compliant curb ramps. These ramps have a red textured surfacing, but lack the red truncated domes to serve as a proper detectable warning. The pedestrian crossing just west of the intersection across the exit driveway from Burger King and the shopping plaza is not striped.

Pedestrian lighting along this segment is poor. There are several utility pole mounted fixtures along the segment on both sides of the roadway, but they are widely spaced and several were malfunctioning at the time of the field visit. There is also minimal ambient light along the segment. The sidewalk along eastbound Nottingham Way fronting the Greenwood Cemetery is particularly dark. Crossings at signalized intersections are also poorly lit. There is no lighting at the Donald Drive intersection and only one utility pole mounted light fixture at the Greenwood Avenue intersection, which is not well aligned with the marked crosswalk. Additionally, the transit shelter at the intersection with Donald Drive along Nottingham Way westbound has no lighting and is very dark.

Regarding bicycle facilities, there is a narrow shoulder (approximately 2-4 feet); however, multiple traffic lanes and scattered sewer grates generally deter bicycle usage. This section is not bicycle compatible.

Figure 9: Nottingham Way

Greenwood Avenue

Greenwood Avenue has many pedestrian generators, such as an elementary school, municipal building, places of worship, bus stops, and a mix of retail and residential uses. It is a two lane road with a speed limit of 30 mph. Evident in Figure 10, the roadway is generally 40 feet wide, allowing for 20 foot lanes with on-street parking in each direction. Figure 9 also shows that the sidewalks are generally in good condition and continuous throughout the section. Standard crosswalks and curb ramps are provided at major crossings, though the ramps are generally non-ADA compliant. These features of the major intersections are summarized in Table 2.

Pedestrian lighting along the segment is limited overall. Lighting is generally provided by widely spaced utility pole mounted fixtures on both sides of the road. Lighting at crossings of signalized intersections is also relatively low. Transit stops along the segment do not have direct lighting, but generally have ambient lighting from street lights in the vicinity. Lighting is much improved between Joan Drive and Norway Avenue by the addition of decorative, pedestrian scale lampposts as well as the utility pole fixtures. This portion of the segment also has more commercial properties, which provide some marginal ambient lighting as well.

Greenwood Avenue is bicycle compatible. There are no marked bicycle lanes or shoulders; however, the wide travel lanes (20 feet) and lower vehicular speeds are amenable for cycling, particularly if the on-street parking is not fully utilized. The roadway is relatively flat and sewer grates are widely scattered.

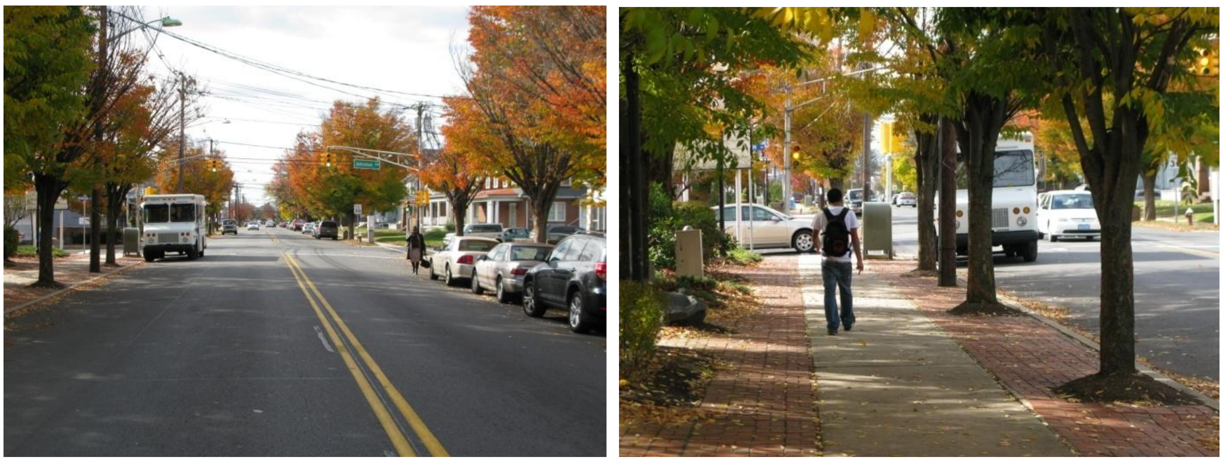


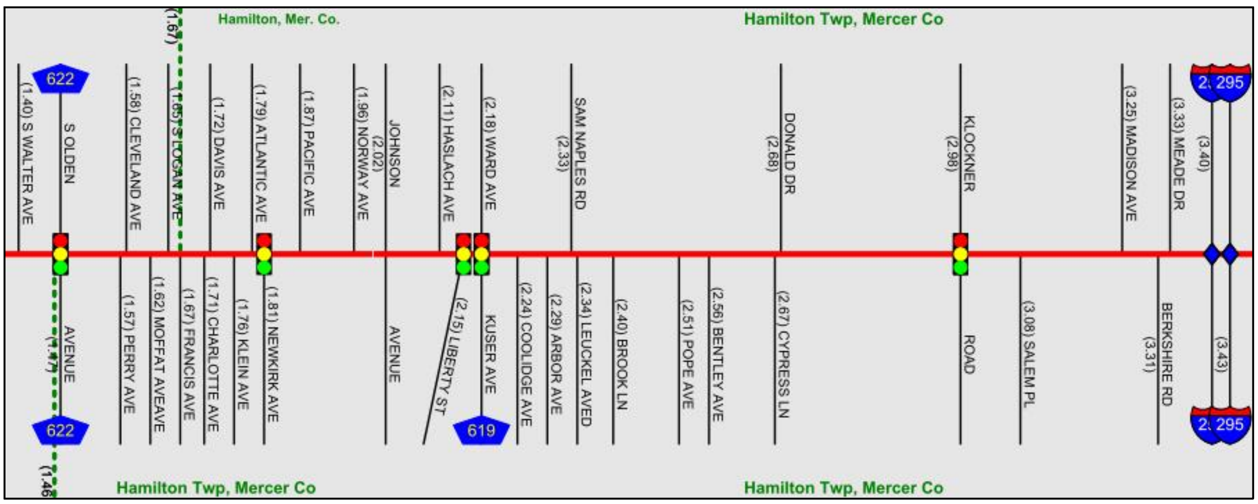
Figure 10: Greenwood Avenue

Table 2: Summary of Conditions at Major Intersections and Crossings along Corridor 1

Corridor 1 Nottingham Way / Greenwood Avenue	Crosswalk (Type)				Curb Ramps (ADA Compliance)				Lighting *(UPL = utility pole light)*
	North leg	*South leg*	*East leg*	*West leg*	*NW corner*	*NE corner*	*SW corner*	*SE corner*	
Nottingham Way (east/west link) at Donald Drive (north/south link)	standard	standard	standard	none	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	poor lighting no street lights minimal ambient lighting nearby transit shelter not lit
Nottingham Way (east/west link) at Greenwood Ave (south link) (3 leg intersection)	n/a	standard	none	none	n/a	n/a	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	poor lighting 1 UPL, but not aligned with crosswalk
Greenwood Ave (north/south link) at Ward Ave (east/west link)	standard	standard	none	standard	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	fair lighting UPLs at 3 corners (however 1 was out)
Greenwood Ave (north/south link) at Johnston Ave (east/west link)	standard	standard	standard	standard	non-ADA: red surfacing without truncated domes and poor striping alignment	non-ADA: red surfacing without truncated domes and poor striping alignment	non-ADA: red surfacing without truncated domes and poor striping alignment	non-ADA: red surfacing without truncated domes and poor striping alignment	low lighting 1 UPL decorative lampposts near 3 corners no lighting NW corner

Corridor 2 – Hamilton Avenue from I-295 to Hamilton-Trenton border

Several pedestrian and pedacycle crashes were reported along the length of Hamilton Avenue over the last three years. The majority of these crashes were located on the western half of the corridor, west of Liberty Avenue. This half of the corridor contains more mixed commercial and residential land uses, as well as several bus stops, and so may experience higher pedestrian activity. Other pedestrian generators include the Newgrange School and St. Anthony's Convent near the intersection of Hamilton Avenue and South Olden Avenue, as well as the Chapel of Lord Church-Nazarene. The crashes reported east of Liberty Avenue were in the vicinity of Nottingham High School.



The entire corridor (~ 1.9 miles) is a two lane roadway approximately 40 feet wide. The grade is relatively flat and the sewer grates are bike safe and are widely spaced, making the corridor compatible with cycling. Figure 11 reflects this typical cross-section. There are no marked shoulders or bike lanes throughout the corridor. The western half is more conducive to pedestrian and cycling activity, with lower vehicular speeds (25-30 mph) and on-street parking. East of Liberty Street, the speed limit increases to 35 mph and on-street parking is prohibited. Overall, the western half of the corridor (west of Liberty Street) is bicycle compatible, while the eastern half is not. Bicycle conditions for the whole corridor could be improved by providing proper striping.

Sidewalks are generally in good condition and continuous throughout the corridor. Standard crosswalks are present at major intersections and crossings. Curb ramps are generally present at major crossings, but are not ADA compliant due to either missing or substandard detectable warning surfaces for the visually impaired. Pedestrian conditions at major crossings along the corridor are summarized in Table 3. Crosswalks at side streets are generally nonexistent or the striping is badly worn.

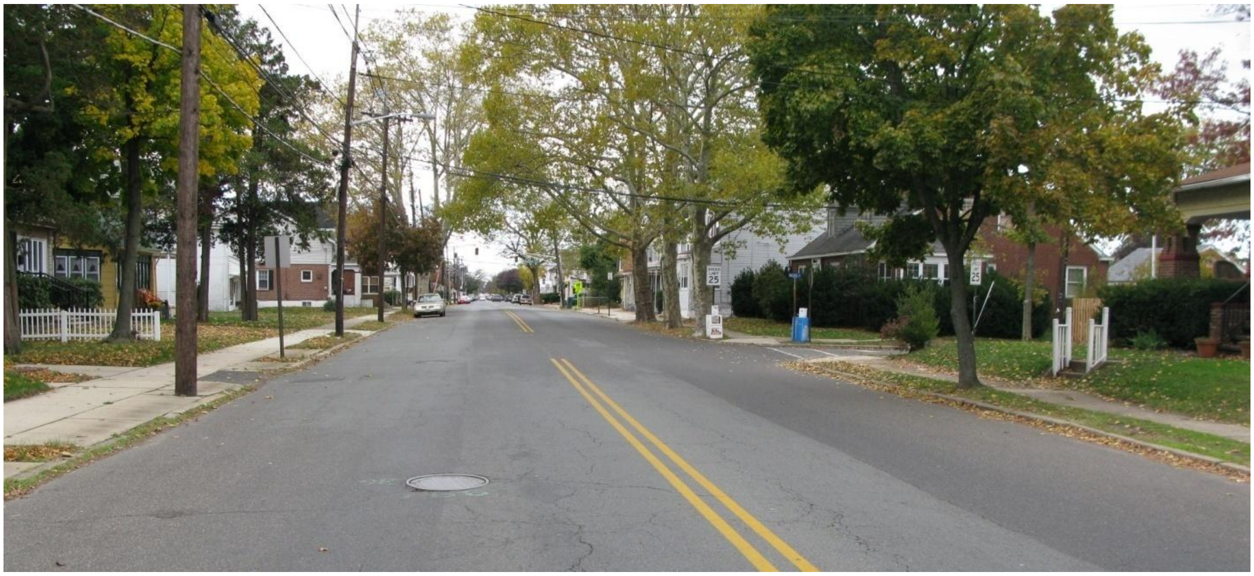


Figure 11: Hamilton Avenue

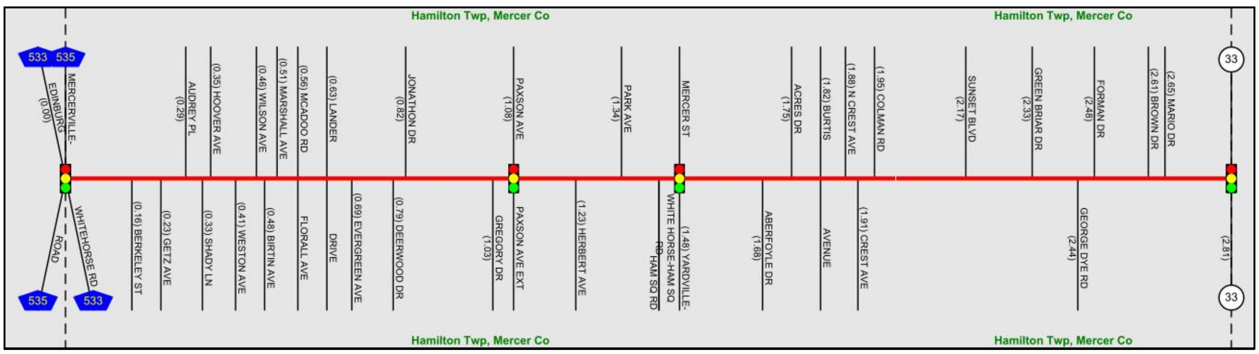
Pedestrian lighting over the more urban western portion of the corridor from Olden Avenue to Francis Avenue is adequate. This portion has both utility pole mounted fixtures and decorative, pedestrian scale lampposts along both sides of the street. There is also moderate ambient lighting from small retail properties along the sidewalks. East of Francis Avenue, however, the corridor becomes more suburban and lighting is low. This section of Hamilton Avenue is lit by scattered utility pole mounted fixtures on both sides of the street. Figure 12 establishes examples of the lighting in these two different sections. Additionally, mature tree canopy along the corridor may slightly reduce the area illuminated by each fixture during summer months. Crossings throughout the corridor are generally poorly lit. Transit stops along the corridor also do not have direct lighting.

Figure 12: Lighting along more urban, western section of Hamilton Avenue (left) with lampposts and utility pole lights; lighting along more suburban eastern end of Hamilton Avenue (right), with widely spaced utility pole lights on westbound side.

Table 3: Summary of Conditions at Major Intersections and Crossings along Corridor 2

Corridor 2	Crosswalk (Type)				Curb Ramps (ADA Compliance)				Lighting
Hamilton Avenue	*North leg*	*South leg*	*East leg*	*West leg*	*NW corner*	*NE corner*	*SW corner*	*SE corner*	*(UPL = utility pole light)*
Hamilton Ave (north/south link) at Klockner Rd (east/west link)	standard	standard	standard	standard	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	poor lighting 1UPL minimal ambient light
Mid-Block Crossing: in front of Nottingham High School	n/a	n/a	ladder	n/a	n/a	non-ADA: no detectable warning surface	n/a	non-ADA: no detectable warning surface	fair lighting UPL over crosswalk entrance on WB side; ambient light on EB side
Hamilton Ave (north/south link) at Cypress Ln/Donald Dr (east/west link)	none	standard	standard	standard	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	poor lighting no direct lighting of crosswalks 1 UPL at center of intersection some ambient lighting
Hamilton Ave (north/south link) at Kuser Rd/Ward Ave (east/west link)	standard	none	standard	standard	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	poor lighting 1 UPL minimal ambient light
Hamilton Ave (north/south link) at Liberty Ave (west link)	none	none	n/a	none	non-ADA: no detectable warning surface	No curb ramp	No curb ramp	No curb ramp	poor lighting 1 UPL
Hamilton Ave (east/west link) at Newkirk Ave (south link) (3 leg intersection)	n/a	standard	standard	none	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	poor lighting 1UPL
Hamilton Ave (east/west link) at South Olden Ave (north/south link)	standard	standard	standard	standard	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	fair lighting 3 UPLs 3 lampposts moderate ambient lighting SE corner dim

Corridor 3 – Nottingham Way east from Quakerbridge Road (CR 533) to NJ Route 33
This corridor (~ 2.81 miles) is largely residential, with a concentration of retail at Hamilton Square near the intersections with Whitehorse-Hamilton Square Road and Yardville-Hamilton Square Road, located towards the center of the corridor as indicated in Figure 13 (left). Additional pedestrian traffic is generated by bus stops throughout the corridor, Sayen Elementary School, a YMCA preschool, St. Gregory the Roman Parish School, and several places of worship. This corridor was reviewed due to numerous pedestrian and pedacycle crashes along the corridor over the last three years, several of which occurred in the vicinity of Hamilton Square. This is also an important pedestrian corridor for Hamilton Township because it provides a parallel, alternative route to Route 33, which is one block south of Nottingham Way and has higher vehicular traffic volumes.



Overall, Nottingham Way is a bicycle compatible corridor as shown in this typical cross-section, Figure 13 (right). It is a two lane roadway generally 40 feet wide. For the majority of the corridor, the speed limit is 40 mph. On-street parking is generally permitted, though it is not heavily utilized. No striped shoulder is provided; however, the wide lane width, lightly used on-street parking, and flat grade generally make the corridor conducive to bicycling. In the vicinity of the Hamilton Square commercial area (between Park Avenue and Aberfoyle Drive) road width reduces to approximately 30 feet and on-street parking is prohibited. Though speed is reduced to 30 mph, the narrower lane width and congested vehicular traffic in this area makes it less favorable for bicycle use. Three pedacycle crashes occurred in this section of the corridor over the past three years.

Good sidewalk condition is typical throughout the corridor. However, there are scattered discontinuous sections along the eastern half of the corridor. In the westbound direction, there are some gaps in the sidewalk between Sunset Boulevard and Coleman Road. In the eastbound direction, there are several short gaps between South Burtis Avenue and Route 33. This includes missing sidewalk at the southwest corner of the intersection with George Dye Road, a major connector to Route 33, Estates Boulevard, and Kuser Road. This critical intersection has standard crosswalks at two of the three legs of the intersection; however, there is only one curb ramp, located at the southeast corner. This curb ramp is not ADA compliant. At the other corners, the crosswalks terminate at a hard curb with no curb cut. Non-ADA compliant or missing curb ramps are typical of major intersections and crossings on this corridor, as summarized in Table 4. Existing curb ramps on Nottingham Way generally lack an appropriate detectable warning surfacing to accommodate the visually impaired. Several intersections with side streets are also lacking any curb ramps, particularly between Burtis Avenue and George Dye Road.

Pedestrian lighting along the corridor is poor. Lighting is provided by utility pole mounted fixtures every few utility poles, but light output from the fixtures is low and not directed at the sidewalks or crosswalks. The majority of the fixtures are on the eastbound side of the corridor. Additionally, a mature tree canopy along the corridor may slightly reduce the area illuminated by each fixture during summer months. Nottingham Way is largely a suburban residential area with minimal ambient lighting. The commercial properties in Hamilton Square are largely closed in the evening and also provide minimal ambient lighting. Crossings along the corridor are also generally poorly lit. The busy intersections in the vicinity of Hamilton Square, in particular, are poorly lit and have minimal additional light fixtures in the area.

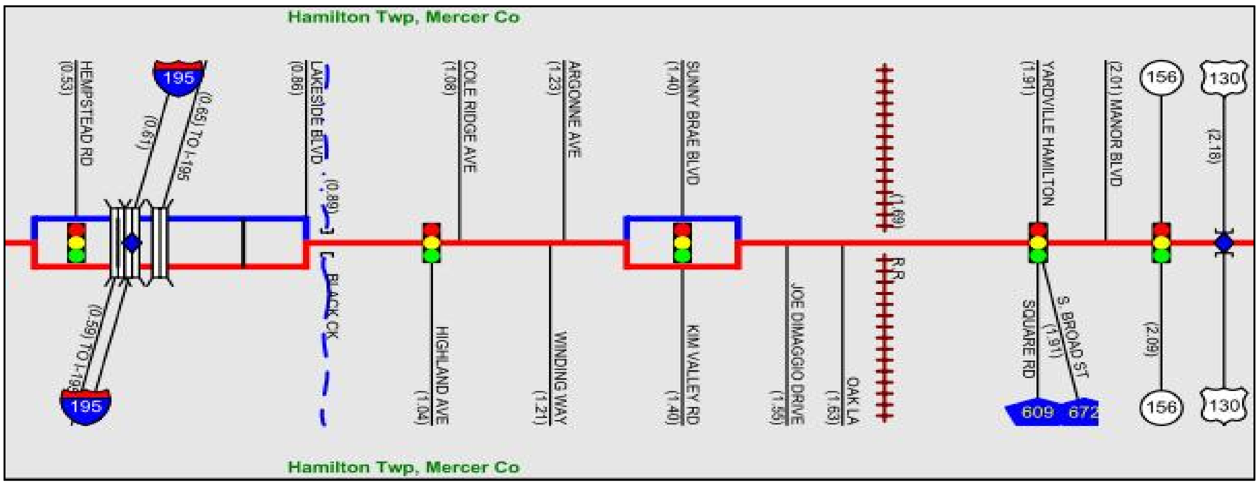
Figure 13: Nottingham Way – vicinity of Hamilton Square (left), typical section (right)

Table 4: Summary of Conditions at Major Intersections and Crossings along Corridor 3

Corridor 3	Crosswalk (Type)					Curb Ramps (ADA Compliance)					Lighting *(UPL = utility pole light)*
Nottingham Way	*North leg*	*South leg*	*East leg*	*West leg*	*Northeast leg*	*NW corner*	*NE corner*	*SW corner*	*SE corner*	*East corner*	
Nottingham Way (east/west link) at Quakerbridge Road (north/south link) and Edinburg Rd (northeast link) (5 leg intersection)	standard	standard	standard	recently repaved; striping not yet repainted (as of 12/20/10)	standard	ADA compliant	No curb ramp	ADA compliant	non-ADA: no detectable warning surface	No curb ramp	adequate lighting no light at east corner/island UPL out at SE corner UPLs all other corners some ambient lighting
Mid-Block Crossing: in front of Sayen Elementary School	n/a	n/a	continental	n/a	n/a	n/a	non-ADA: no detectable warning surface and not flush with roadway	n/a	non-ADA: no detectable warning surface and not flush with roadway	n/a	low lighting 1 UPL on WB side just west of crossing
Nottingham Way (east/west link) at Paxson Ave (north/south link)	standard	standard	none	continental	n/a	ADA compliant	ADA compliant	ADA compliant	ADA compliant	n/a	poor lighting 1 UPL at SW corner UPL for right turns at SE corner is out
Nottingham Way (east/west link) at Whitehorse Square Rd (south link) (non-signalized; 3 leg intersection)	n/a	standard	continental	continental	n/a	No curb ramp	No curb ramp	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	n/a	poor lighting no direct lighting of crossings minimal ambient lighting 1 UPL west of intersection
Nottingham Way (east/west link) at Mercer St/Yardville-Hamilton Square Rd (north/south link)	standard	standard	standard	standard	n/a	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface and not flush with roadway	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	n/a	poor lighting no direct lighting of crossings no UPLs minimal ambient lighting decorative lampposts north of intersection on Mercer St
Mid-Block Crossing: near Aberfoyle Dr	n/a	n/a	standard	n/a	n/a	n/a	No curb ramp	n/a	No curb ramp	n/a	poor lighting no direct lighting of crossings
Nottingham Way (east/west link) at George Dye Rd (south link) (non-signalized; 3 leg intersection)	n/a	standard	standard	none	n/a	No curb ramp	No curb ramp	No curb ramp	non-ADA: no detectable warning surface and not flush with roadway	n/a	poor lighting no direct lighting of crossings
Mid-Block Crossing: in front of St. Gregory the Great Parish and School	n/a	n/a	ladder	n/a	n/a	n/a	No curb ramp	n/a	non-ADA: no detectable warning surface and poor striping alignment	n/a	poor lighting no direct lighting of crossing moderate ambient lighting
Nottingham Way/Office plaza (north/south link) at Route 33(east/west link)	none	none	none	standard	n/a	non-ADA: red surfacing without truncated domes	No curb ramp	non-ADA: red surfacing without truncated domes	No curb ramp	n/a	low lighting 2 UPLs Crosswalk lit on WB side

Corridor 4 – South Broad Street (CR 524) from I-195 to NJ Route 130

This section of Broad Street (~1.58 miles) was evaluated because several pedestrian and pedacycle crashes occurred along the corridor within the last three years. The segment is generally a mix of commercial and residential uses. There is a concentration of retail trip generators towards the middle of the segment near the intersection with Sunnybrae Boulevard/Kim Valley Road, including a 7-Eleven, Rite Aid, and small retail plaza. Additionally, there are several bus stops along the route and Yardville Heights Elementary School is located toward the western end of the corridor at the intersection with Coleridge Avenue.



The roadway is approximately 42 feet wide throughout the corridor and has a 35 mph speed limit. Broad Street is generally one lane in each direction with no painted shoulder, Figure 14 (left); however, lane configuration varies in different sections, visible in Figure 14 (right). In the vicinity of the Sunnybrae Boulevard/Kim Valley Road intersection, Broad Street is four lanes with a center median. West of Sunnybrae Boulevard, the two westbound lanes drop to one lane at Argonne Avenue, while the two eastbound lanes drop to one lane farther west at Highland Avenue. The multiple lanes and dynamic nature of the lane configuration make the western half of this corridor incompatible for bicycle activity. East of Sunnybrae Boulevard, however, Broad Street is bicycle compatible. This section is only two lanes and, though it lacks a defined shoulder or bike lanes, the wide lane width can accommodate bicycle traffic.

There is a large section of discontinuous sidewalk along Broad Street eastbound between Lakeside Boulevard and Winding Way. Sidewalk in the remainder of the corridor is in generally good condition. Standard crosswalks and curb ramps are provided at most major intersections in the corridor, though the curb ramps are not ADA compliant due to either missing or substandard detectable warning surfaces for the visually impaired. Crosswalks are missing at several side streets, and striping is badly worn at other locations. The pedestrian crossing conditions at major intersections along the corridor are summarized in Table 5.

Figure 14: Broad Street – typical section east of Sunnybrae Blvd (left); multiple lanes west of Sunnybrae (right)

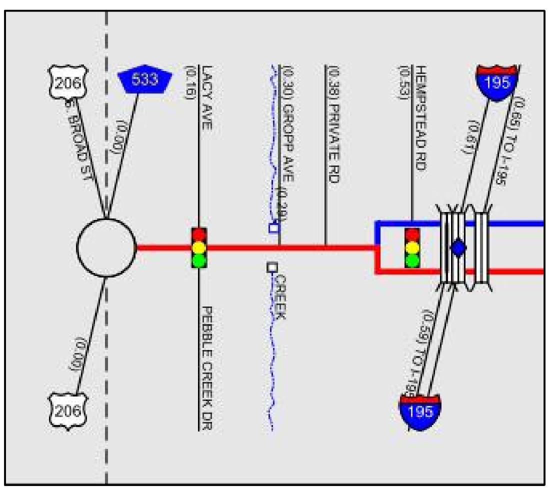
Pedestrian lighting along the corridor is limited. Lighting is provided mostly by utility pole mounted fixtures every few utility poles. The light fixtures are generally on the westbound side, leaving the eastbound sidewalk markedly darker. With the exception of corner businesses at the Sunnybrae Boulevard and Yardville-Hamilton Square intersections, there is minimal ambient lighting along the corridor. Lighting of major pedestrian crossings is also low overall. The crossings at Sunnybrae Boulevard are lit largely by only surrounding ambient lighting, while the Highland Avenue crossing in front of the Yardville Heights Elementary School has only one light fixture, leaving half the intersection very dim.

Table 5: Summary of Conditions at Major Intersections and Crossings along Corridor 4

Corridor 4	Crosswalk (Type)				Curb Ramps (ADA Compliance)				Lighting
South Broad Street (CR 524)	*North leg*	*South leg*	*East leg*	*West leg*	*NW corner*	*NE corner*	*SW corner*	*SE corner*	*(UPL = utility pole light)*
Yardville-Allentown Road (east/west link) at Rt 156 (north/south link)	standard	none	standard	none	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	No curb ramp	non-ADA: red surfacing without truncated domes	low lighting NW and SE corners dark 1 UPL 1 UPL out some ambient light
South Broad Street/Yardville-Allentown Road (east/west link) at Yardville-Hamilton Square Rd (north/south link)	standard	standard	standard	standard	ADA compliant	non-ADA: no detectable warning surface	ADA compliant	non-ADA: no detectable warning surface	adequate lighting UPLs all 4 corners UPL at NW corner was out some ambient light
South Broad Street (east/west link) at Sunnybrae Blvd/Kim Valley Rd (north/south link)	standard	standard	standard	standard	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface and poor striping alignment	non-ADA: no detectable warning surface and poor striping alignment	poor lighting 1 UPL at NW corner other corners rely on ambient lighting from corner businesses
South Broad Street (east/west link) at Highland Ave (south link) (3 leg intersection)	n/a	continental	none	ladder	ADA compliant	no curb ramp	ADA compliant	ADA compliant	poor lighting UPL at NW corner illuminates north half of crossing south side of intersection dark minimal ambient light

Corridor 5 – South Broad Street (CR 524/US 206) from I-195 to the Hamilton-Trenton border
A field study of South Broad Street from Hempstead Road to Leonard Avenue was conducted due to numerous pedestrian and pedacycle crashes on the corridor within the last three years. This corridor (~ 2.42 miles) has a variety of uses that tend to generate pedestrian activity, including bus routes, retail establishments, and schools. The surrounding area transitions from suburban densities, land uses, and streets systems at the eastern limit to an urban grid which meets the City of Trenton at Lalor Street. Both I-295 and I-195 create barriers to through travel, limiting street connectivity, and pushing additional traffic onto Broad Street, which must meet both local access and regional mobility needs. With its mix of urban and suburban features, South Broad Street features many curb cuts and driveways, creating numerous conflicts and complications for both bicycles and pedestrians. Due to the overall length, and the many changes and variations in general character of this section of roadway, it was divided into three sections for easier review.

Segment 5A: South Broad Street (CR524) from I-195 to Whitehorse Circle
This section of the corridor is largely residential, with mostly apartment complexes on the eastbound side of the roadway and detached housing on the westbound side. Pedestrian generators include St. Raphael School and Miriam Morris Private School towards the eastern half of the segment, a playground at the Miriam Morris School just west of Gropp Avenue, and several bus stops. Retail establishments include fast food, a restaurant, and a car rental business.



This section of South Broad Street is approximately 42 feet wide and carries two lanes of traffic with a posted speed of 35 mph. The road grade is relatively flat, bike safe sewer grates are widely scattered, and lanes are generally wide enough to accommodate bicycle traffic; however, there are no painted shoulders or bike lanes (Figure 15). No roadway divider is provided, except at the westbound approach to Whitehorse Circle. Parking is generally prohibited by signage, although several vehicles were parked on the westbound side in the vicinity of the Miriam Morris Private School and playground (between Gropp Avenue and Lacey

Avenue). This section of South Broad Street is bicycle compatible, though appropriate striping would improve conditions.

Conditions for pedestrians along this section of South Broad Street are poor. Sidewalks are largely absent on the eastern half of the segment (from approximately east of Gropp Avenue) on both sides of the road (Figure 15). No crosswalks are provided at the signalized intersection on the corridor (intersection with Pebble Creek Drive) and only two of the four corners have curb ramps, which are not ADA compliant. The use of curb ramps at side street intersections is variable; some corners have them while others do not. None of the existing curb ramps have a detectable warning feature for the visually impaired. Additionally, none of the cross streets or major driveways (to apartment complexes or school) have crosswalks.

The Whitehorse Circle, at the western limit of this segment, is a hazardous area for both pedestrians and bicyclists. There was one pedestrian crash at the intersection and others in the vicinity during the last three years. The non-traditional configuration of the intersection, high volume of vehicular traffic, and lack of pedestrian and bicycle facilities makes it difficult for non-motorized travelers to navigate and mix with motorized traffic. There are no crosswalks at all and limited sidewalks on the eastbound side of the circle. The pedestrian crossing conditions at major intersections along the corridor are summarized in Table 6.

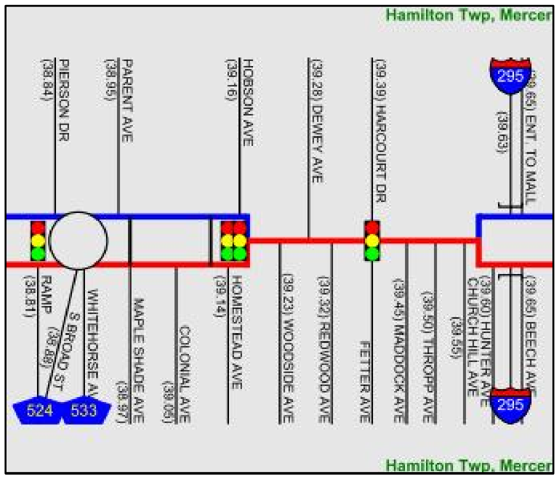
Figure 15: South Broad Street; sidewalk missing east of Gropp Avenue

Pedestrian lighting along this segment is poor. There are utility pole mounted fixtures every few poles, largely in the eastbound direction. The westbound shoulder, in particular, is very dim. Mature tree canopy along the segment may slightly reduce the area illuminated during summer months. Most of the segment is residential, so there is minimal ambient lighting throughout. There is a transit shelter in the westbound direction near Rosario's Pizzeria, but it is dark and completely unlit. Crossings along the segment generally have low lighting. The Whitehorse Circle does have adequate lighting, particularly in the westbound direction.

Table 6: Summary of Conditions at Major Intersections and Crossings along Corridor 5A

Corridor 5a South Broad Street (CR 524)	Crosswalk (Type) *North leg*	*South leg*	*East leg*	*West leg*	Curb Ramps (ADA Compliance) *NW corner*	*NE corner*	*SW corner*	*SE corner*	Lighting *(UPL = utility pole light)*
South Broad Street (east/west link) at Hempstead Rd (north/south link)	standard	none	none	none	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	no curb ramp	no curb ramp	low lighting UPLs at SE and NW corners were out
South Broad Street (east/west link) at Pebble Creek Dr(north/south link)	none	none	none	none	no curb ramp	no curb ramp	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	low lighting UPLs at SE and NE corners NW corner very dark SW corner dim minimal ambient light
South Broad Street (east/west link) at White Horse Ave/US 206 (north/south link) (Whitehorse Circle)	none	none	none	none	ADA compliant	non-ADA: no detectable warning surface	no curb ramp	no curb ramp	adequate lighting particularly WB side of intersection, where sidewalk is more continuous UPLs and overhead lighting throughout circle some ambient lighting

Segment 5B: South Broad Street (US 206) from Whitehorse Circle to I-295 overpass
This segment of South Broad Street is a largely commercial strip, including several fast food restaurants. Many land uses are high-turnover type businesses with many driveways and curb cuts; shared parking and cross-access are non-existent. The corridor mixes suburban-type land access and parking lots with an urban environment, creating numerous turning movements and conflicts between motorized and non-motorized traffic. The corridor also has bus stops serviced by three bus lines, generating additional pedestrian traffic.



The roadway in this segment is approximately 69 feet wide and carries four lanes of traffic, plus an approximately 17 foot wide center section, which varies in use between a curbed median, center turn lane, or turn bays. A typical section is shown in Figure 16. The posted speed is 35 mph. There is a 4-5 foot wide shoulder from the Whitehorse Circle west to Hobson Avenue; the remainder of the segment has no shoulder. Parking is prohibited in this segment. Much of the corridor is divided by a raised grassy median with alternating and opposing protected left turn bays. A two-way-center-left-turn-lane configuration is used between Homestead Avenue and the overpass of I-295. The lack of bike lanes or striped shoulder along the majority of the roadway, plus the large number of driveways accessing high-use retail properties, multiple travel lanes, and high traffic volume make this section of the corridor incompatible for bicycle use.

Sidewalks are generally continuous throughout the segment. Standard crosswalks and curb ramps are provided at the major signalized intersections on the corridor; however, the curb ramps are not ADA compliant due to missing or substandard detectable warning surfacing for the visually impaired. Pedestrian crossing conditions at signalized intersections are summarized in Table 7. Despite being a multi-lane roadway with several sections of median, there are no pedestrian refuge islands in this section of the corridor. The pedestrian crossing conditions at major intersections along the corridor are summarized in Table 7.

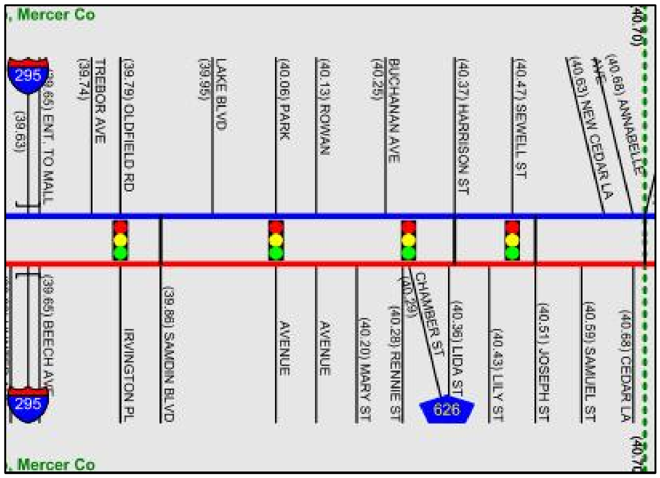
Pedestrian lighting is variable, but low overall. Utility pole mounted fixtures are used throughout the segment, approximately every other pole and alternating sides of the street. The large roadway width generally prevents light fixtures on one side of the road from providing sufficient lighting for the sidewalk or shoulder on the opposite side. Lighting is improved by the addition of lamppost fixtures in the median from Whitehorse Circle to Hobson Road; however, the eastbound sidewalk in front of Colonial Memorial Park remains dim. West of Hobson Road, there are no median lampposts to provide additional lighting. The section from Hobson Road to Redwood Avenue is lowly lit. West of Redwood Avenue, there is a larger amount of strip commercial development, which provides some ambient lighting. Lighting at pedestrian crossings is also generally low. Transit stops along the corridor generally do not have direct lighting at the signed bus stops, but have ambient lighting from fixtures in the vicinity.

Figure 16: South Broad Street, vicinity of Fetter Avenue intersection

Table 7: Summary of Conditions at Major Intersections and Crossings along Corridor 5B

Corridor 5b South Broad Street (US 206)	Crosswalk (Type) *North leg*	*South leg*	*East leg*	*West leg*	Curb Ramps (ADA Compliance) *NW corner*	*NE corner*	*SW corner*	*SE corner*	Lighting *(UPL = utility pole light)*
South Broad Street (east/west link) at White Horse Ave/US 206 (north/south link) (Whitehorse Circle)	none	None	none	none	ADA compliant	non-ADA: no detectable warning surface	no curb ramp	no curb ramp	adequate lighting particularly WB side of intersection, where sidewalk is more continuous UPLs and overhead lighting throughout circle some ambient lighting
South Broad Street (east/west link) at Homestead Ave/Hobson Ave (north/south link)	standard	Standard	none	standard	ADA compliant	ADA compliant	ADA compliant	ADA compliant	low overall NW corner very dark UPL at NE corner other corners dim minimal ambient light
South Broad Street (east/west link) at Fetter Ave/Harcourt Dr (north/south link)	standard	Standard	standard	none	ADA compliant	ADA compliant	ADA compliant	ADA compliant	fair overall UPLs NE and NW corners some ambient light all 4 corners SE corner quite dim

Segment 5C: South Broad Street (US 206) from I-295 overpass to Hamilton-Trenton border
This segment of South Broad Street is largely a mixture of commercial and residential uses. Additional pedestrian generators include West Hamilton High School two blocks north of the corridor and several bus stops serving three bus lines. Several pedestrian and pedacycle crashes occurred along this segment of the corridor over the last three years.



As with the previous segment, the roadway is approximately 68 feet wide and carries 4 lanes of traffic. Lane width is approximately 15 feet, with an eight foot curbed median through the majority of the segment as evident in Figure 17. The speed limit is 35 mph, dropping to 25 mph toward the western end of the corridor. On-street parking is allowed through much of the segment. This segment also lacks striped shoulders or bike lanes. Although many residential properties have direct driveway access to this segment of Broad Street, shared parking among business has been introduced in some locations, and no two-way-center-left-turn configurations are present. Though conditions for bicycling are improved in this section of Broad Street due to a lesser amount of driveways accessing high use retail properties, the multi-lane configuration and lack of bike lanes or shoulders makes this section incompatible for bike use.

Sidewalks are provided throughout the segment. Signalized intersections are equipped with standard crosswalks and curb ramps; however, the curb ramps are not ADA compliant due to missing or substandard detectable warning features to assist the visually impaired. Pedestrian features at the segment's signalized intersections are summarized in Table 8. Striped crossings are provided near the intersections with New Cedar Lane and Samuel Street. These crossings have standard crosswalks, pedestrian refuge islands in the median, and non-ADA compliant curb ramps. At unsignalized cross street intersections, crosswalk striping is missing at numerous locations.


Figure 17: South Broad Street

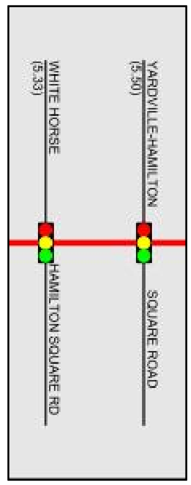
Pedestrian lighting is adequate overall. Utility pole mounted fixtures are used throughout the segment, approximately every other pole and alternating sides of the street. The large roadway width generally prevents light fixtures on one side of the road from providing sufficient lighting for the sidewalk or shoulder on the opposite side. This is alleviated by the addition of median lamppost fixtures through the majority of the segment. Additionally, there are decorative, pedestrian scale lampposts along the sidewalks between Park Avenue and Sewall Avenue on both sides of the roadway. This section of the segment also has a greater amount of commercial properties, which provide ambient lighting. East of Park Avenue and west of Sewall Avenue the segment is generally dense residential and there are lower amounts of ambient lighting. Lighting at major pedestrian crossings is generally adequate. Small trees in the median and scattered mature trees along the roadway shoulders may reduce the area illuminated by the light fixtures during summer months.

Table 8: Summary of Conditions at Major Intersections and Crossings along Corridor 5C

Corridor 5c South Broad Street (US 206)	Crosswalk (Type) *North leg*	*South leg*	*East leg*	*West leg*	*Northwest leg*	Curb Ramps (ADA Compliance) *NW corner*	*NE corner*	*SW corner*	*SE corner*	*North Corner*	Lighting *(UPL = utility pole light)*
South Broad Street (east/west link) at Irvington Pl/Lafayette Ave (north/south link)	standard	standard	standard	none	n/a	ADA compliant	ADA compliant	ADA compliant	ADA compliant	n/a	low lighting median light on west leg intersection is out, dimming that side of intersection median light on east leg illuminates east leg crossing UPL SW corner
South Broad Street (east/west link) at East Park Ave/West Park Ave (north/south link)	standard	standard	standard	standard	n/a	ADA compliant	ADA compliant	ADA compliant	ADA compliant	n/a	low lighting UPL at NW corner SE corner very dim ambient light at NE, NW, and SW corners
South Broad Street (east/west link) at Chambers St/Rennie St (northwest/north link)	standard	n/a	none	standard	standard	ADA compliant	ADA compliant	ADA compliant	n/a	ADA compliant	adequate lighting median light at west crossing UPL & lamppost at SW and NE corners ambient light NW corner
South Broad Street (east/west link) at Sewell Ave (south link) (3 leg intersection)	n/a	standard	standard	none	n/a	n/a	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	non-ADA: no detectable warning surface	n/a	adequate lighting UPL SE corner lamppost NE corner no direct lighting SW corner
Mid-Block Crossing: at Samuel St	n/a	n/a	standard	n/a	n/a	n/a	non-ADA: no detectable warning surface	n/a	non-ADA: no detectable warning surface	n/a	adequate lighting WB lanes well lit - UPL north side of crossing plus median lamppost EB lanes dimmer - no direct light on south side of crossing, only light from median lamppost
Mid-Block Crossing: at New Cedar Ln	n/a	n/a	standard	n/a	n/a	n/a	non-ADA: no detectable warning surface	n/a	non-ADA: no detectable warning surface	n/a	adequate lighting reflective pedestrian crossing signage EB & WB EB lanes well lit - UPL south side of crossing plus median lamppost WB lanes slightly dimmer - no direct light on south side of crossing, only light from median lamppost

Corridor 6 – NJ Route 33 from Whitehorse-Hamilton Square Road to Yardville-Hamilton Square Road

This one-block section of NJ Route 33 (~ 0.17 miles) was reviewed in the field because crash data revealed several pedestrian crashes in this short stretch within the last three years. This is a retail corridor, with the main pedestrian generator being a large shopping plaza on the south side of the road, which includes a ShopRite grocery store.



The roadway is approximately 42 feet wide and carries two lanes of traffic plus a center turn lane. Figure 18 (left) illustrates this typical cross-section. Despite the heavy vehicular traffic and higher speeds (40 mph), this section is bicycle compatible. There is a wide, roughly eight foot shoulder in the eastbound direction, and a four foot shoulder in the westbound direction, providing a safe area for cyclists. The segment is also relatively flat and, though there is a high use retail plaza, shared parking limits the number of driveways in the eastbound direction. In the westbound direction, a cluster of driveways for high turnover commercial establishments near the intersection with Yardville-Hamilton Square Road does present the potential for a higher number of vehicle-bicycle conflicts. Though overall this segment is bicycle compatible, the wide shoulder is not typical of the rest of Route 33; to the east and west of this one-block segment, the shoulder narrows to approximately 3-4 feet.

The sidewalk in this section is in poor condition. In the westbound direction, there is no sidewalk on the western half of the block, in front of a defunct car dealership. In the eastbound direction, there is no sidewalk in front of the ShopRite shopping plaza, which occupies the majority of the block. However, construction is in progress to install a full sidewalk along the length of the block in the eastbound direction as shown in Figure 18 (right). Deficiencies will remain in the westbound direction.

Curb ramps are in place at the intersections at either end of the block. However, the red, textured surfacing intended to aid visually impaired pedestrians is generally in poor condition and peeling in several locations. These curb ramps are not ADA compliant. The intersection with Yardville-Hamilton Square Road has standard crosswalks for all four legs of the intersection. The intersection with Whitehorse-Hamilton Square Road has standard crosswalks at three legs of the intersection; the western leg, crossing Route 33, is not striped with a crosswalk. The crosswalks are generally in fair condition, with some of the striping beginning to look worn. All crosswalks at both intersections are equipped with pedestrian signals, countdown timers, and push buttons that appear to be functioning. Pedestrian features at theses two signalized intersections are summarized in Table 9.

Pedestrian lighting in this corridor is poor. There are no light fixtures along the corridor; all lighting along the segment is provided by ambient lighting from the ShopRite shopping plaza and Exxon station along the eastbound side, and a Getty station and commercial properties in the westbound direction. The western half of the westbound roadway is very dark, as it fronts a defunct automotive dealership property, which no longer provides ambient lighting. Despite poor lighting along the segment, crossings at the intersections on either end of the segment are adequately lit. Both intersections have multiple utility pole mounted fixtures and ambient lighting to sufficiently illuminate the corners and crossings.

Figure 18: Route 33 (left); sidewalk under construction in eastbound direction, pedestrians using the shoulder (right)

A summary of sidewalk conditions for all six corridors is depicted in Table 10 - Corridor Sidewalk Inventory. Sidewalks are generally continuous with a few exceptions that are detailed in the table.

Table 9: Summary of Conditions at Major Intersections and Crossings along Corridor 6

Corridor 6	Crosswalk (Type)				Curb Ramps (ADA Compliance)				Lighting
Route 33	*North leg*	*South leg*	*East leg*	*West leg*	*NW corner*	*NE corner*	*SW corner*	*SE corner*	*(UPL = utility pole light)*
Route 33 (east/west link) at Whitehorse Hamilton Square Rd (north/south link)	standard	standard	standard	none	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	adequate lighting UPLs SE and NW corners ambient light at NW and SW corners NE corner dim
Route 33 (east/west link) at Yardville Hamilton Square Rd (north/south link)	standard	standard	standard	standard	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	non-ADA: red surfacing without truncated domes	adequate lighting UPLs SE, SW, and NW corners ambient light at SE corner NE corner dark

Table 10 - Corridor Sidewalk Inventory

Corridor	Street	Westbound/Northbound	Eastbound/Southbound
Corridor 1 - Route 33	Nottingham Way	continuous between Donald Dr and Greenwood Ave	(2) ~150 ft discontinuous sections between Donald Dr and Greenwood Ave
	Greenwood Avenue	continuous throughout segment	continuous throughout segment
Corridor 2 - Hamilton Avenue	Hamilton Avenue	continuous throughout segment	continuous throughout segment
Corridor 3 - Nottingham Way	Nottingham Way	Some gaps between: Sunset Blvd - Coleman Rd	Some gaps between: Route 33 - George Dye Rd George Dye Rd - Crest Ave Crest Ave - S. Burtis Ave
Corridor 4 - South Broad St	South Broad St	continuous throughout segment	Missing sidewalk Lakeside Blvd to Winding Way; near Rt 156 intersection
Corridor 5a - South Broad St (CR 524)	South Broad St	Missing sidewalk Hempstead Rd to Gropp Ave	Missing sidewalk Hempstead Rd to Gropp Ave
Corridor 5b (US 206) - South Broad St	South Broad St	continuous throughout segment	continuous throughout segment
Corridor 5c (US 206) - South Broad St	South Broad St	continuous throughout segment	continuous throughout segment
Corridor 6 - Route 33	Route 33	none	under construction

Additional Field Observations

Quaker Bridge Road – some sections evaluated as bicycle compatible based on NJDOT criteria, but most of these would not be recommended for bicycle use, due to numerous driveways and turning movement conflicts, travel speeds, and traffic volumes.

U.S. Route 130 – some section evaluated as bicycle compatible based on NJDOT criteria, but most of these would not be recommended for bicycle use, due to numerous driveways and turning movement conflicts, travel speeds, and traffic volumes.

Edinburg Road – 4 lane section provides access to Mercer County Community College so this is a critical link, but the 4 lane section and roadway profile limit options for restriping. Needs further evaluation to find an alternate route or a design solution.

Paxson Avenue Extension – this short 4-lane section between NJ Route 33 and Whitehorse Hamilton Square Road is a potential road diet candidate. Need to evaluate whether 4 lanes are necessary to accommodate travel demand or whether restriping can be accommodated.

Hughes Drive and Youngs Road at Quakerbridge Road – these short residential roadway segments sections are very wide and attract complaints of high traffic volumes, speeding, and heavy trucks. Both are potential traffic calming candidates, including restriping and a possible roundabout at the intersection of Hughes Drive and Youngs Road.

Yardville Hamilton Square Road between Nottingham Way and Route 33 – due to narrow roadway width which limits possible restriping, the segment is a candidate for posted speed limited change to 35 MPH to accommodate Sharrows.

Klockner Road between Yardville Hamilton Square Road and Whitehorse Hamilton Square Road – this roadway is not bicycle compatible but provides access to Veterans Park and Steinert High School. This location is a potential candidate for HAWK signal, additional sidewalks, and/or possible restriping.

Kuser Road between Yardville Hamilton Square Road and Klockner Road – this 4-lane section with no adjacent land uses (much of it open space) encourages speeding and is one of just 2 segments of Kuser Road that is not bicycle compatible. Kuser Road is otherwise a significant link in the regional bicycle network. This segment needs additional analysis to examine potential mitigations.

Kuser Road between Yardville Hamilton Square Road and Country Lane – this section is generally very narrow with little or no shoulder. Adjacent land uses may preclude simple improvement. Kuser Road is otherwise a significant link in the regional bicycle network.

Kuser Road intersections at Whitehorse Hamilton Square Road and White Horse Avenue are very busy with many turning movements, limited accommodations for bicycle through movement. These segments need additional analysis to examine potential mitigations including a bicycle box. Kuser Road is otherwise a significant link in the regional bicycle network.

Current state of practice dictates smooth transitions, tapering, and signing at the end of striped bicycle lanes. These should be adopted as part of standard roadway design reconstruction practice in Hamilton Township.

Nottingham Way near Trenton Border – roadway is narrow, sidewalk needs maintenance, and lighting is poor or non-existing at NE Corridor rail underpass. Investigate possible mitigations including Sharrow markings.

Whitehead Road at border with Lawrence Township - considered by Lawrence to be not bicycle compatible. Improvements to address the noted deficiencies are included in the Lawrence Township Bicycle and Pedestrian Planning Assistance Study – Implementation Workbook.

Mercer Street/Hutchinson Road at border with Robbinsville Township – changes from 25 mph in Hamilton to 40 mph in Robbinsville. A transitional zone with is required to provide a better speed limit transition.

Bicycle Compatibility of Roadways

A bicycle compatible roadway is intended to reduce conflicts and provide a safer environment for all roadway users. The NJDOT criteria for bicycle compatibility include roadway and shoulder width, posted speed limit, roadway usage and type, and area type, as indicated in Table 11: Minimum Conditions for Bicycle Compatibility. The intention is that bicyclists ride on the roads, sharing the available capacity with vehicles and other roadway users.

Table 11: Minimum Conditions for Bicycle Compatibility

AADT up to 2,000

Posted Speed Limit	Urban w Parking	Urban w/o Parking	Rural
Up to 30 mph	12 ft – shared lane	11 ft – shared lane	10 ft – shared lane
31 – 40 mph	14 ft – shared lane	14 ft – shared lane	12 ft – shared lane
41 – 50 mph	15 ft – shared lane	15 ft – shared lane	3 ft – shoulder
Greater than 50 mph	Not Compatible	4 ft – shoulder	4 ft – shoulder

AADT 2,001 – 10,000

Posted Speed Limit	Urban w Parking	Urban w/o Parking	Rural
Up to 30 mph	14 ft – shared lane	12 ft – shared lane	12 ft – shared lane
31 – 40 mph	14 ft – shared lane	14 ft – shared lane	3 ft – shoulder
41 – 50 mph	15 ft – shared lane	15 ft – shared lane	4 ft – shoulder
Greater than 50 mph	Not Compatible	6 ft – shoulder	6 ft – shoulder

AADT over 10,000 or Trucks over 5 %

Posted Speed Limit	Urban w Parking	Urban w/o Parking	Rural
Up to 30 mph	14 ft – shared lane	14 ft – shared lane	14 ft – shared lane
31 – 40 mph	14 ft – shared lane	4 ft – shoulder	4 ft – shoulder
41 – 50 mph	15 ft – shared lane	6 ft – shoulder	6 ft – shoulder
Greater than 50 mph	Not Compatible	6 ft – shoulder	6 ft – shoulder

Source: Bicycle Compatible Roadways and Bikeways, 1996, NJDOT

PB evaluated several hundred miles of roadways in Hamilton Township for bicycle compatibility, using a variety of data sources including base mapping, GIS data files, NJDOT Straight Line Diagrams, and traffic data from both NJDOT and Hamilton Township. PB also conducted field evaluations on four separate occasions to take measurements and verify the various roadway features and parameters.

A hierarchical assessment was undertaken to assess Township roadways in the following order:

- Primary streets – federal, state and county roadways, including portions of Klockner Road, Kuser Road, Nottingham Way, and Hughes Drive, Route 33. Many primary streets are compatible, but are very wide and lack appropriate lane and shoulder striping. Significant portions of many regional roadways are not compatible such as Quaker Bridge Road, Klockner Road, Arena Drive, South Broad Street, and Mercerville-White Horse Road. Other roadways, including Hughes Drive, Kuser Road, and East State Street are fully compatible or have short, or limited, non-compatible segments
- Secondary Streets – municipal and residential streets that provide access to key bicycle and pedestrian generators or that support local and regional mobility within the township, including Estates Blvd, George Dye Way, Cypress Street , Paxson Avenue, and Hempstead Avenue. Nearly all secondary streets are compatible, but many are very wide and lack, and lack appropriate lane and shoulder striping
- Trail and park connections – roadways that provide access to township and regional parks and trails, including Veterans Park, Mercer County Park, and the D&R Canal towpath. The D&R Canal towpath, for example, can significantly augment regional mobility in the western area of the Township which lacks sufficient network connectivity and compatible roadways; so providing access to the Canal towpath is a critical feature of the Township's bicycle network
- External connections – facilities that connect Hamilton to neighboring municipalities. Nearly all external connections are bicycle compatible, including a variety of federal, state, county, and municipal roadways

Three segments of existing bicycle lanes are currently provided in Hamilton on both the primary and secondary networks, including portions of Kuser Road, Estates Boulevard, and George Dye Road. Some arterial highways, primarily U.S. 206 and U.S. 130 are considered bicycle compatible based on the NJDOT criteria, and have been observed with bicycle activity, but may not be recommended as appropriate for most bicyclists.

Maps of each are presented on the following pages in Figures 19-22, with a composite map in Figure 23. The composite presents a full assessment of the current state of bicycle compatibility in Hamilton, with more than one hundred miles of compatible roadways. In general, residential streets are considered compatible and do not require any special striping or signing.
Although identified as bicycle compatible based on the NJDOT criteria, many of these roadways are very wide and lack the appropriate striping or signing to safely accommodate bicycling activity. The composite therefore represents the starting point for identifying the priority bicycle routes in the Township. The next step will be to identify candidates for re-striping with shoulders, bike lanes, or Sharrow markings, and prioritize the improvements so as to develop a complete bicycle compatible network for Hamilton Township.

Figure 19- Bicycle Compatibility – Primary Streets

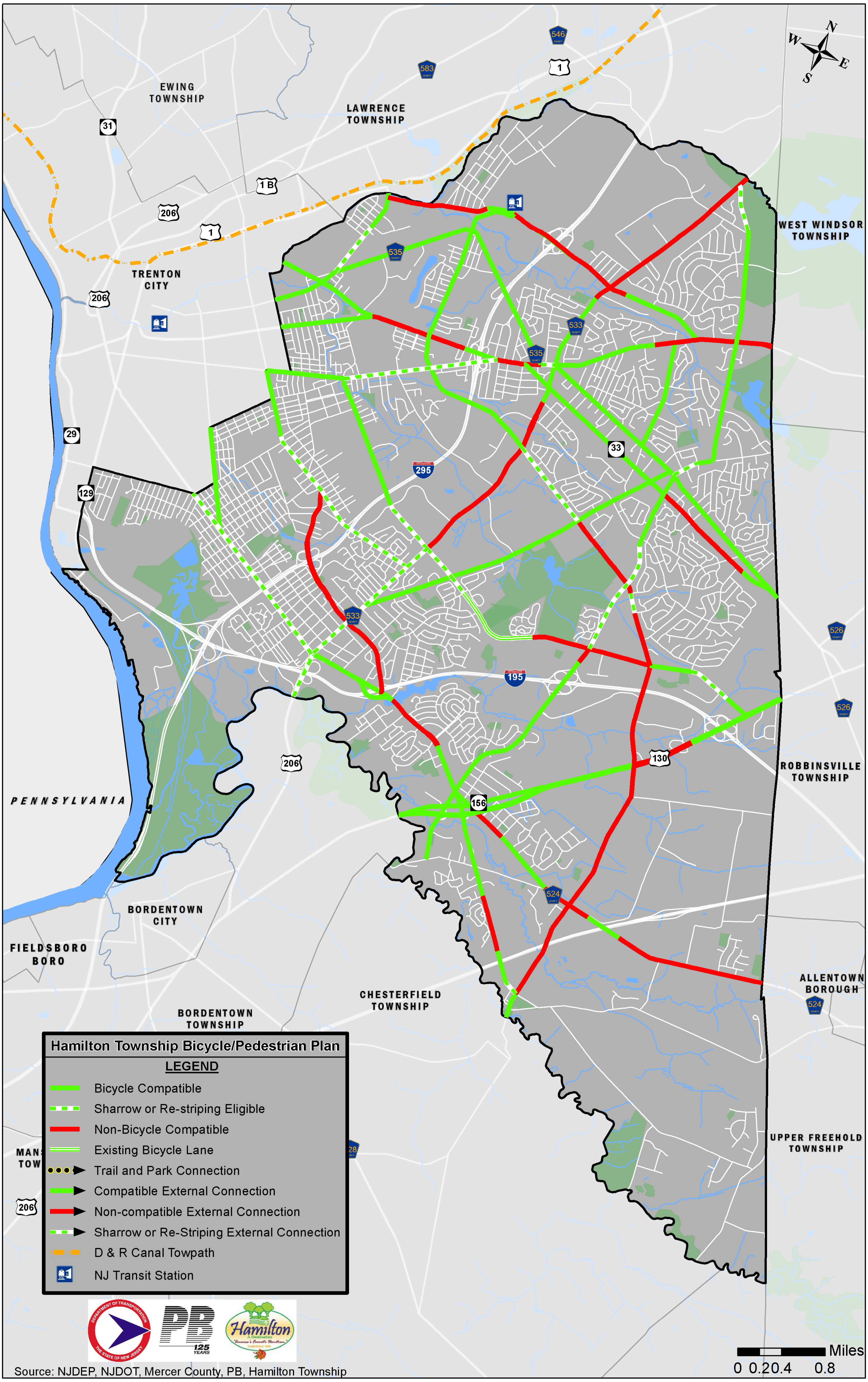


Figure 20 - Bicycle Compatibility – Secondary Streets

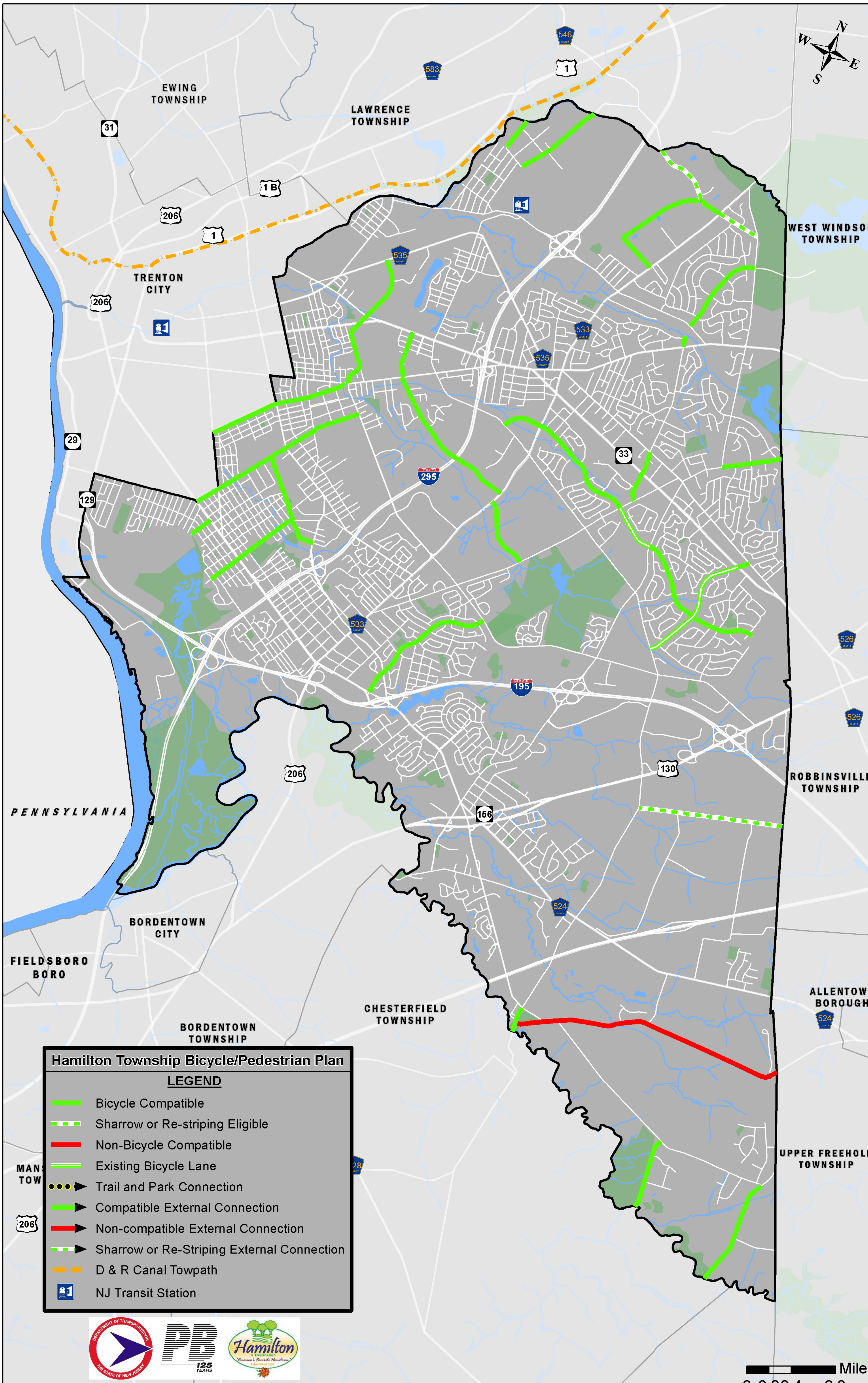


Figure 21 - Bicycle Compatibility – Trail and Park Connections

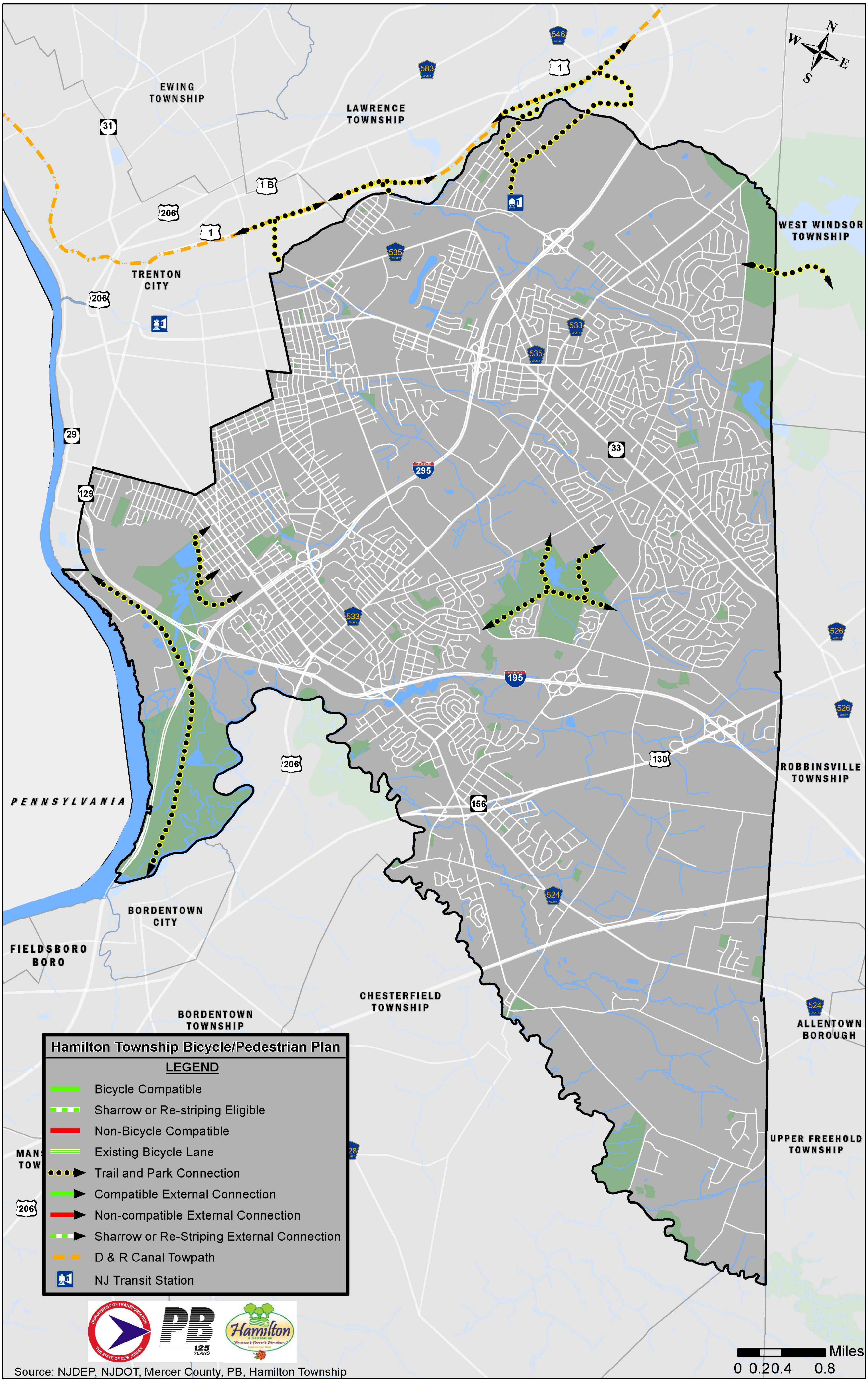


Figure 22- Bicycle Compatibility – External Connections

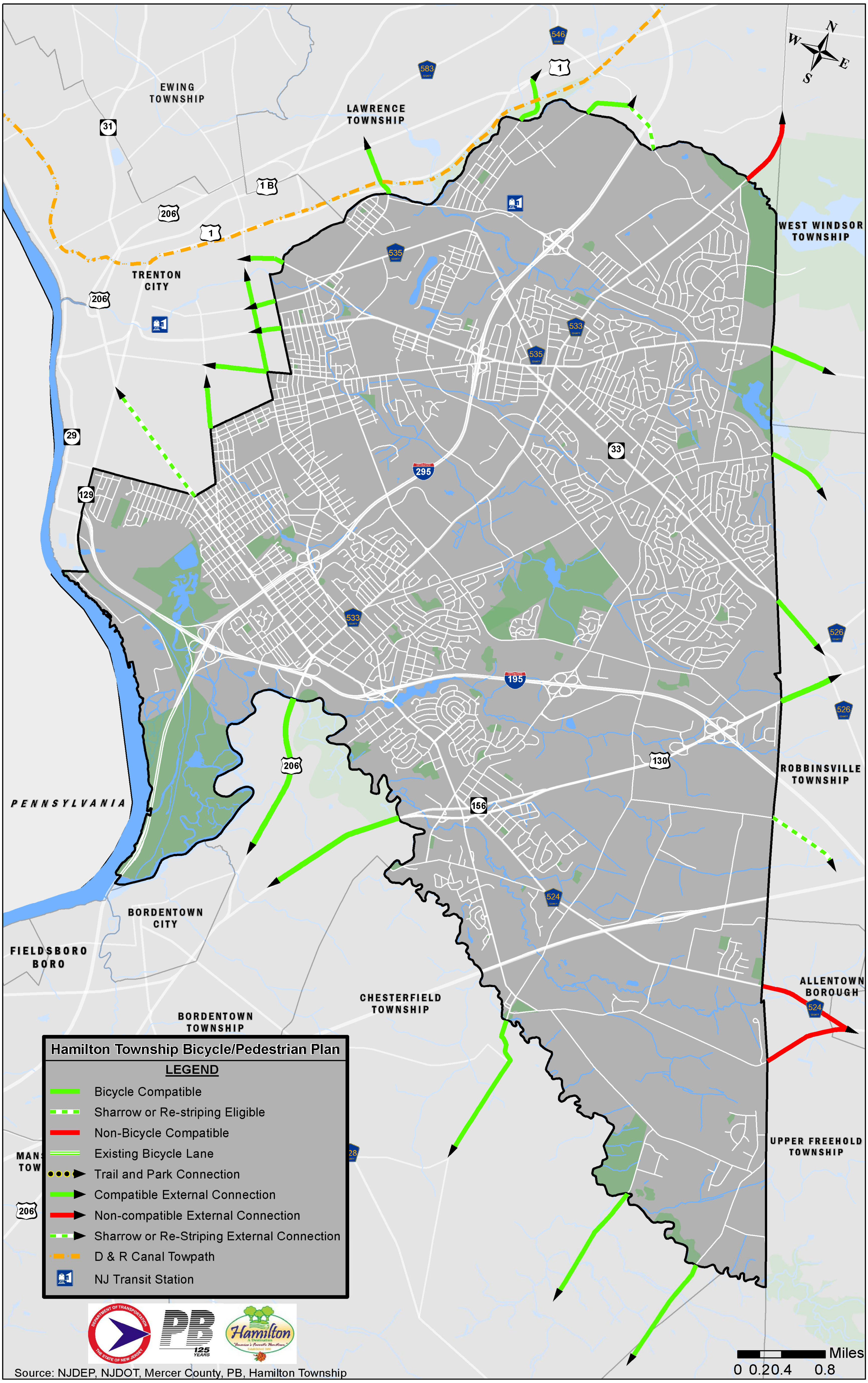
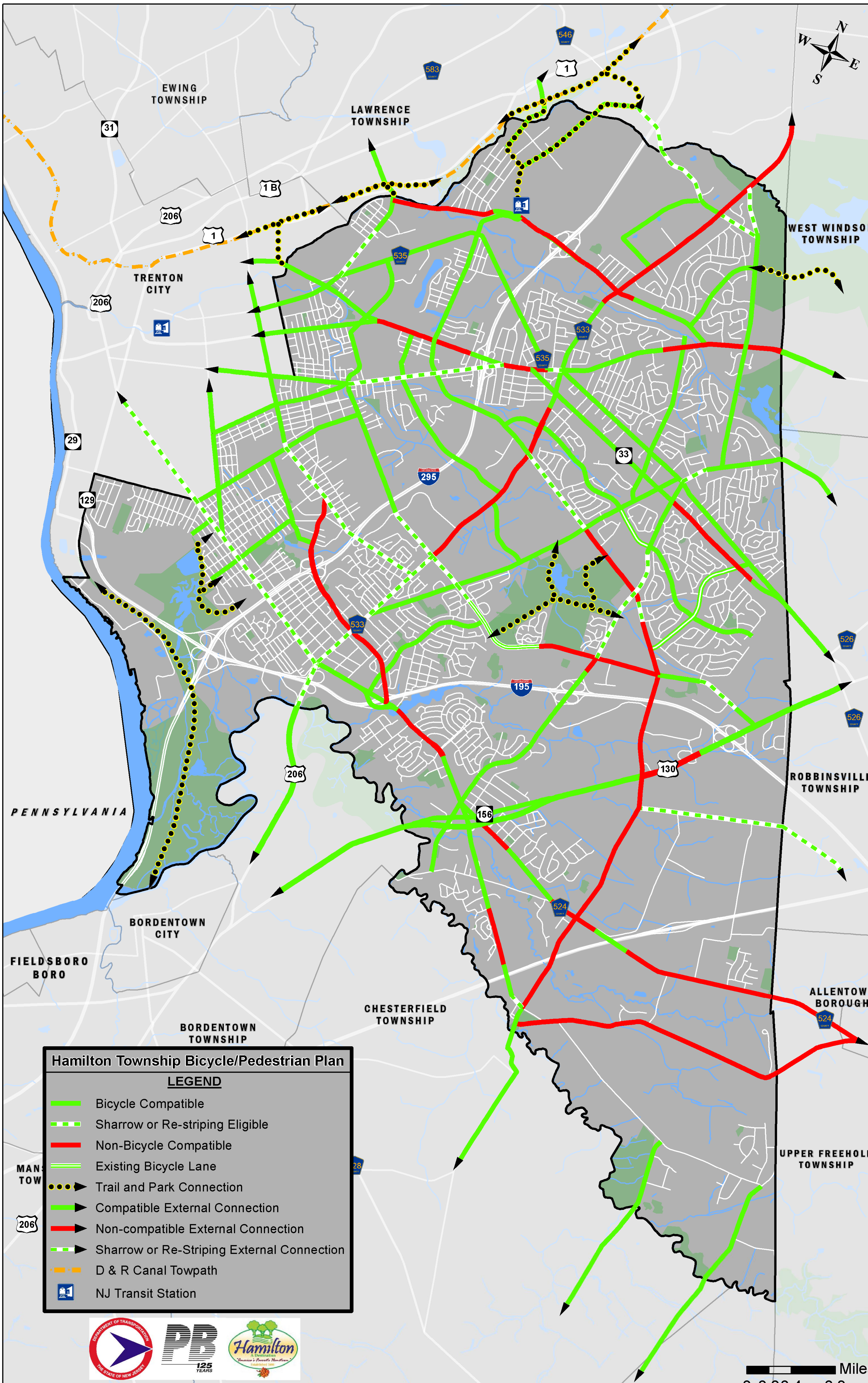


Figure 23 - Bicycle Compatibility – Composite Bicycle Network



Chapter 2 – Recommendations

Table of Contents

NJDOT provides the information contained in these Local Bicycle and Pedestrian Plans as a service to local communities. The Department and its consultants strive to provide quality planning studies that include a range of recommended improvements, but make no claims, promises, or guarantees about the availability of funding to complete the projects recommended.

Recommended Bicycle Network

Building on the existing conditions analysis, the next step in the bicycle evaluation is to identify the Priority Bicycle Network by overlaying the composite network on top of the key generators of non-motorized traffic. The Priority Bicycle Network identifies a network of township area roadways that provide access to the bicycle attractors and generators and addresses the locations identified in the crash analysis. The generators, attractors, and crash locations are identified Chapter 1: Existing Conditions in the Study Methodology section and depicted in Figure 2 of Chapter 1.

Priority Bicycle Network

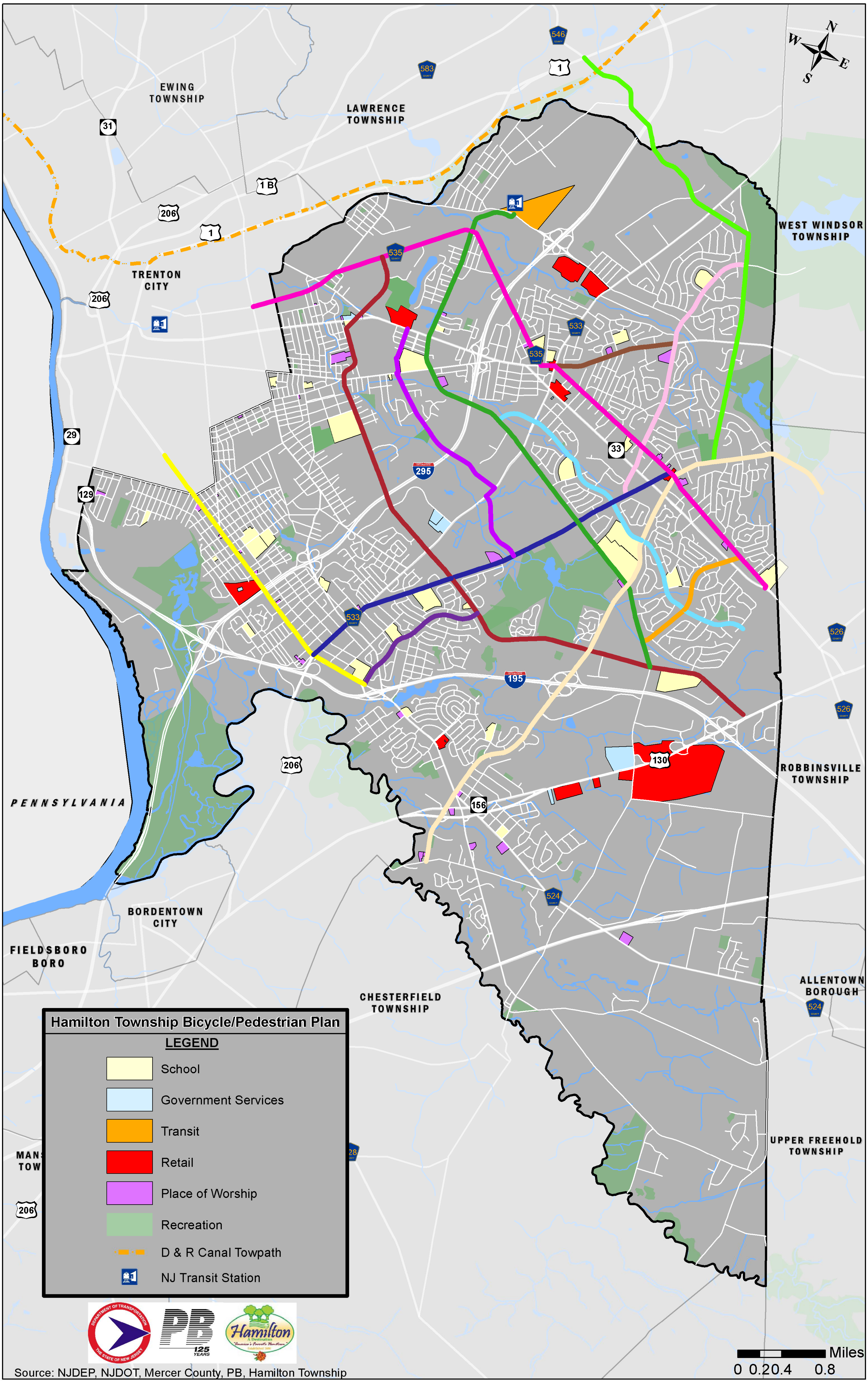
By comparing the composite network of bicycle compatibility with these data points, PB is able to recommend where appropriate improvements to provide for safe bicycle travel are most needed; these recommendations include restriping to provide shoulders, bike lanes, or sharrow markings.

Based on this assessment, the principal bicycle routes in Hamilton Township are recommended for the following priority routes, as depicted in Figure 1:

- Kuser Road/Ward Avenue – connects U.S. 130 to East State Street, and provides access to Crocket Middle School, Faith Christian School, Trenton Catholic Academy, and the Grounds for Sculpture
- Paxson Street – connects Mercer County Park with Route 33 and Whitehorse Hamilton Square Road, and provides access to Mercer County Park, University Heights Elementary School, and Route 33 commercial and retail
- Whitehorse Hamilton Square Road/White Horse Avenue – connects Nottingham Way to South Broad Street, and provides access to Robert Wood Johnson Hospital, Veterans Park, and Grice Middle School
- Klockner Road – connects the Hamilton Train Station to Yardville Hamilton Square Road and provides access to Nottingham High School - North, Robert Wood Johnson Hospital, Veterans Park, and Steinert High School - East
- Estates Boulevard – Connects Klockner Road to George Dye Road, and provides access to Langtree Elementary School, Reynolds Middle School, Alexander Elementary School, and several small town parks
- Church Street/Yardville- Hamilton Square Road/Mercer Street/Hutchinson Road – connects Main Street in Groveville to Robbinsville Township/Hutchinson Road, and provides access to Veterans Park, Steinert High School East, Reynolds Middle School, and Robbinsville Township

- Cypress Lane/Buttonwood Street – connects Nottingham Way to Whitehorse Hamilton Square Road and provides access to Nottingham High School North and Veterans Park
- East State Street/East State Street Extension/Nottingham Way – connects Trenton City to Route 33 at the Robbinsville municipal border, and provides access to St. Gregory the Great School
- South Broad Street/Old York Road – connects Trenton City to Hamilton Township, and provides access to South Broad Street retail areas, several parks including John A. Roebling Memorial Park, and Hamilton High School West
- Youngs Road/Hughes Drive – connects Route 1 in Lawrence Township to Mercer Street, and provides access to the D&R Canal towpath and Mercer County Park
- Edinburg Road/Old Trenton Road – connects Nottingham Way to West Windsor, and provides access to Mercer County Community College
- Hempstead Road – connects Kuser Road to South Broad Street, provides access to Veterans Park, other small town parks, South Broad Street retail area, and Robinson Elementary School
- George Dye Road – connects Nottingham Way to Klockner Road, provides access to Route 33 retail area, Alexander Elementary School, and several small town parks

Figure 1 - Priority Bicycle Network



Priority Bicycle Recommendations

Based on this assessment of the priority bicycle network, PB reviewed each of the 11 routes to determine existing bicycle compatibility, identified the proposed changes to individual roadway segments required to provide bicycle compatibly, and developed a proposed bicycle network that depicts the 11 routes and how they should be striped and marked to provide for a safe and consistent system of bicycle compatible roadways throughout the Township, with a minimum of transitions between the various designations.

Starting with the Priority Bicycle Network routes (Figure 1), PB identified the changes needed to upgrade all of these routes to full bicycle compatible. PB emphasized minimal physical changes to any roadway segment and minimizing cost to provide for bicycle safety. Almost all of the proposed changes simply involve restriping and providing appropriate signs and symbols within the existing right-of-way. Only one short segment cannot be made bicycle compatible without some minor widening or change to the cross-section, number of lanes, or speed limit. These recommendations are depicted in Figure 2– Priority Bicycle Recommendations. For the Priority Bicycle Network, this map indicates roadway segments that need no changes to be bicycle compatible; those that need restriping, signs, or painted symbols to upgrade the roadway to bicycle compatibility; and those that cannot be bicycle compatible without a significant change in design, width, or posted speed limit.

Once all of the recommended changes are implemented, the proposed network of fully compatible roadways will take the form depicted in Figure 3 – Proposed Bicycle Network. Proposed changes were reviewed to provide for a consistent profile along each route with a minimum of change in design and function. These recommendations include bicycle lanes, sharrow symbols and associated signs, and, where possible, no change at all. Consistency and simplicity will enable cyclists and motorists alike to easily recognize and navigate appropriate travel routes and to share the Township's roadways, without expensive or confusing changes.

This report has documented an interconnected network of bicycle compatible roadways based on identified needs and safety considerations, and that connects residents with priority destinations, including schools, parks, shopping areas, and public buildings.

It should be noted that a significant portion of the Township, generally the area south of I-195, lacks sufficient bicycle compatible roadways due to a variety of deficiencies including posted speed limit, roadway width, and lack of sufficient shoulders. A longer term evaluation of these roadways should be undertaken in the future.

Figure 2 - Priority Bicycle Recommendations

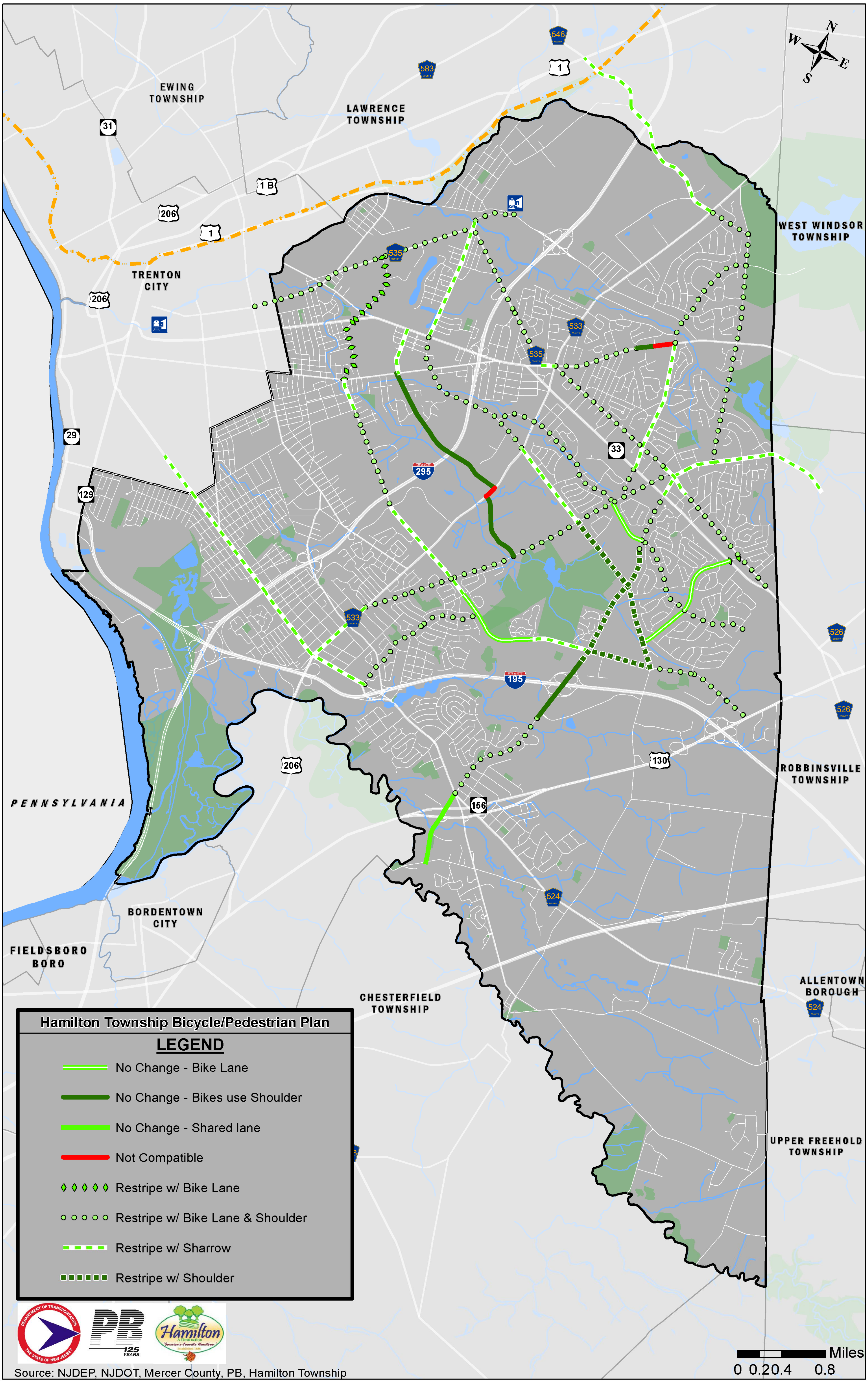
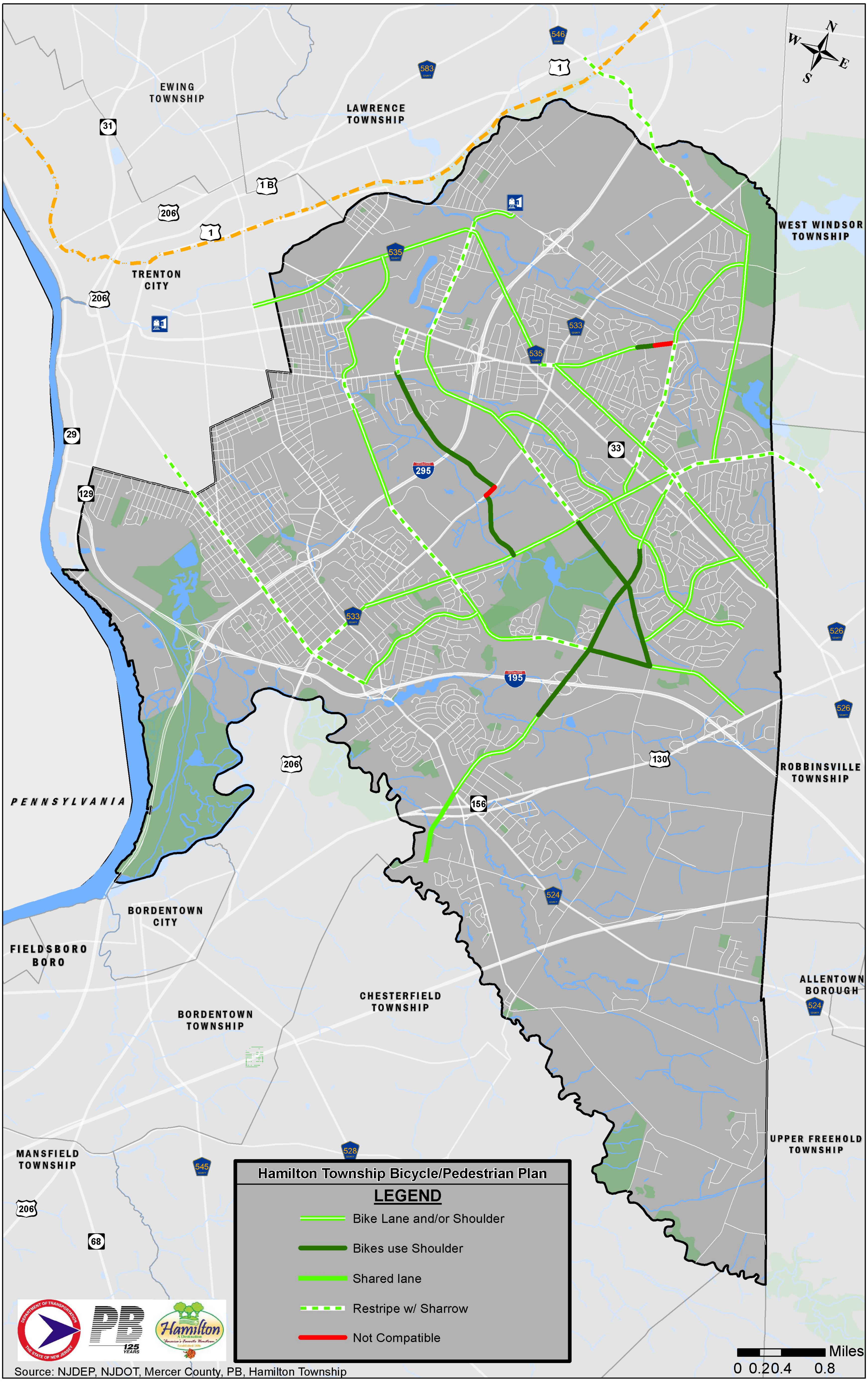


Figure 3 - Proposed Bicycle Network



Implementation and Prioritization

The priority routes were evaluated to determine a general order in which improvements should be made. Over time, the network will build upon existing bike lanes and compatible roadways to create a network that covers much of the Township.

Using the generators, attractors, and crash data as the principal criteria, PB prepared a high, medium, and low prioritization scheme. This scheme first builds upon existing bike lanes and seeks to add improvements over time based on proximity and access to facilities likely to generate the highest level of bicycle demand and where safety needs are greatest, including the many schools located throughout Hamilton Township.

High Priority – build up the core network by leveraging existing bicycle lanes on Estates Boulevard, George Dye Road, and Kuser Road; provide safe access to numerous schools, parks, and the Hamilton train station.

- Estates Boulevard – provides access to Langtree Elementary School, Reynolds Middle School, Alexander Elementary School, and several small town parks
- Kuser Road/Ward Avenue – provides access to Crocket Middle School, Faith Christian School, Trenton Catholic Academy, and the Grounds for Sculpture
- Klockner Road – provides access to Nottingham High School North, Robert Wood Johnson Hospital, Veterans Park, and Steinert High School East
- Whitehorse Hamilton Square Road/White Horse Avenue – provides access to Robert Wood Johnson Hospital, Veterans Park, and Grice Middle School
- George Dye Road – provides access to Route 33 retail area, Alexander Elementary School, and several small town parks

Medium Priority – expand the core network to include facilities both along the perimeter of the Township and within the high priority internal core; provide safe access to schools, parks, and the D&R Canal towpath.

- Church Street/Yardville- Hamilton Square Road/Mercer Street/Hutchinson Road – provides access to Veterans Park, Steinert High School East, Reynolds Middle School, and Robbinsville Township
- South Broad Street/Old York Road – provides access to South Broad Street retail areas, several parks including John A. Roebling Memorial Park, and Hamilton High School West
- Youngs Road/Hughes Drive – provides access to the D&R Canal towpath and Mercer County Park
- Paxson Street – provides access to Mercer County Park, University Heights Elementary School, and Route 33 commercial and retail area
- Hempstead Road – provides access to Veterans Park, other small town parks, South Broad Street retail area, and Robinson Elementary School

Low Priority – complete the remaining portions of the network, including several routes with lower posted speed limits.

- Cypress Lane/Buttonwood Street – provides access to Nottingham High School North and Veterans Park
- East State Street/East State Street Extension/Nottingham Way – provides access to St. Gregory the Great School
- Edinburg Road/Old Trenton Road – connects Nottingham Way to West Windsor, and provides access to Mercer County Community College

A detailed sheet of route segments, features, and recommendations is provided in the appendix.

Estimated Costs

The final element of the bicycle analysis is the estimated cost to implement the Proposed Bicycle Network. These improvements would create nearly 45 additional miles of designated bicycle compatible roadways in Hamilton Township through the use of striping and signing improvements. Including the current total of 3 miles of designated bike lanes on Estates Boulevard, George Dye Road, and Kuser Road, the designated bicycle compatible network would total 48 miles at full build-out.

The total estimated cost of these improvements is approximately $689,000, to create an additional 45 miles of bicycle compatible roadways, including $440,000 for bike lanes, $243,000 for sharrow markings and signs, and $6,000 for bicycle compatible shoulders and shared travel lanes (see Table 1). These estimates are based on industry and NJDOT standards for per unit costs of striping and signing improvements, and typical spacing for signs and on-street markings.

A detailed sheet of cost calculations and assumptions is provided in the Appendix.

Table 1 - Summary of Bicycle Compatible Roadway Distance and Estimated Cost

	Distance (Miles)		Estimated Cost ($) Striping & Signing
	Compatible Roadways	Non-Compatible Roadways	
Bike Lanes	24.6		$440,152
Sharrow	13.1		$242,790
Bikes on Shoulder/Shared Lane	6.8		$5,670
Not Compatible		0.3	
Total Proposed	*44.5*	*0.3*	*$688,612*
Existing Bike Lanes	3		
Total Network	*47.5*	*0.3*	

Bicycle Summary and Future Considerations

In this study, PB has presented a methodical evaluation of bicycle needs and conditions; analysis of bicycle compatibility of Hamilton Township roadways based NJDOT guidelines that take into account roadway and shoulder width, posted speed limit, roadway usage and type, and area type; identification of priority roadways and bicycle network; a program of proposed improvements including bike lanes, Sharrows, shared travel lanes, and bicycle compatible shoulders; a prioritized list of improvements; and a summary of estimated costs.

The goal of this effort has been to improve safety and mobility for all roadway users and to safely accommodate bicycle travel in Hamilton Township. This effort builds upon and is entirely consistent with improvements already made by the Township to municipal roadways, including Estates Boulevard, George Dye Road, and Kuser Road, where existing roadways with overly wide travel lanes were restriped to provide both an adequate vehicular travel lane and a bicycle lane or compatible width shoulder.

These are low cost improvements that typically involve only restriping of roadways with no construction costs or right-of-way impacts. In almost every case, these recommendations amount to converting existing roadways to “complete streets” at minimal cost to the Township. As such, the recommended improvements should also create a safer travel environment for all roadway users and provide traffic calming benefits on many roadways that are currently much wider than needed. Furthermore, it is recommended that improvements be made in accordance with scheduled road maintenance, repaving, and reconstruction to further minimize costs and leverage the maximum benefit from the capital improvement program.

Beyond the proposed improvements, many township roadways with posted speed limits of 35 mph or less are bicycle compatible and require little or no additional striping or signing to safely accommodate bicycle users. This includes a significant portion of township roadways in the southwestern quadrant adjacent to the City of Trenton, where almost all roadways provide bicycle compatible features among lane and shoulder width, posted speed limit, and usage. Furthermore, this section of Hamilton provides an adequate network of two-lane roadways with excellent street connectivity that distributes traffic efficiently and without the need for complicated intersections and traffic control schemes.

Future considerations to further improve bicycle safety and mobility in Hamilton Township should include the following:

- The Proposed Bicycle Network (Figure 3) lacks coverage in the southeastern quadrant of the Township, where the predominant development pattern is rural or low density in character. Many of the existing roadways are too narrow to accommodate the type of simple restriping improvements that form the bulk of this plan. Additional effort in the future should concentrate on this area to expand the network of bicycle compatible roadways.
- Hamilton’s many cul-de-sacs and dead end roadways limit street connectivity and impede mobility and circulation within and through the Township. It is recommended that bicycle-

and pedestrian-only connections and paths be considered at some of these locations to enhance mobility and safety, without connecting any roadways. In this way, adjacent neighborhoods and community facilities can be connected without the controversy of opening streets to vehicular through traffic.

- The land use and sustainability elements of the Master Plan should address the issues of bicycle compatibility and providing support facilities and infrastructure, including bicycle racks at office buildings, shopping centers, and public buildings and facilities.
- A township-wide complete streets policy, resolution, or ordinance should be considered and adopted. This would make the methods and recommendations of this report an everyday part of how Hamilton goes about the business of designing and maintaining its streets, intersections, and bridges, and how proposed development applications are reviewed. In this manner, Hamilton would demonstrate its commitment to multi-modal safety and mobility, and help ensure that existing problems are mitigated and no new problems are created.

Pedestrian Improvement Recommendations

New Jersey State Law requires motorists to yield to pedestrians in a crosswalk. Many factors contribute to the effectiveness of crosswalks, including land use patterns, roadway width, the number of travel lanes, vehicular speeds, lighting conditions, and intersection configuration. Two general types of crosswalks need to be considered: those placed at signalized or stop-controlled intersections, and those without traffic controls. Marked crosswalks and pedestrian signal heads should be provided at all signalized intersections. Pedestrian signal phasing should accommodate walkers of various speeds and abilities. NJDOT recommends the use of countdown pedestrian timers that help pedestrians determine how much time they have to finish crossing.

Based on the results of the field visits, improvement recommendations were developed for each of the intersections and corridors. In the following sections, they are listed by corridor/intersection, as well as shown graphically on an aerial. Most recommendations listed involve improvements to crosswalks and curb ramps, and are divided into short- and long-term improvements.

For each set of improvements, an aerial view is shown depicting recommendations. Pedestrian signal head recommendations are not shown on the aerials, as placement will need to be determined upon individual engineering review of the intersection. Lighting recommendations are shown, but actual placement would also require further engineering evaluation. These are instead listed with the short and long term improvements.

Intersections

Intersection 1 - Quakerbridge Road at Sloan Ave/Flock Road

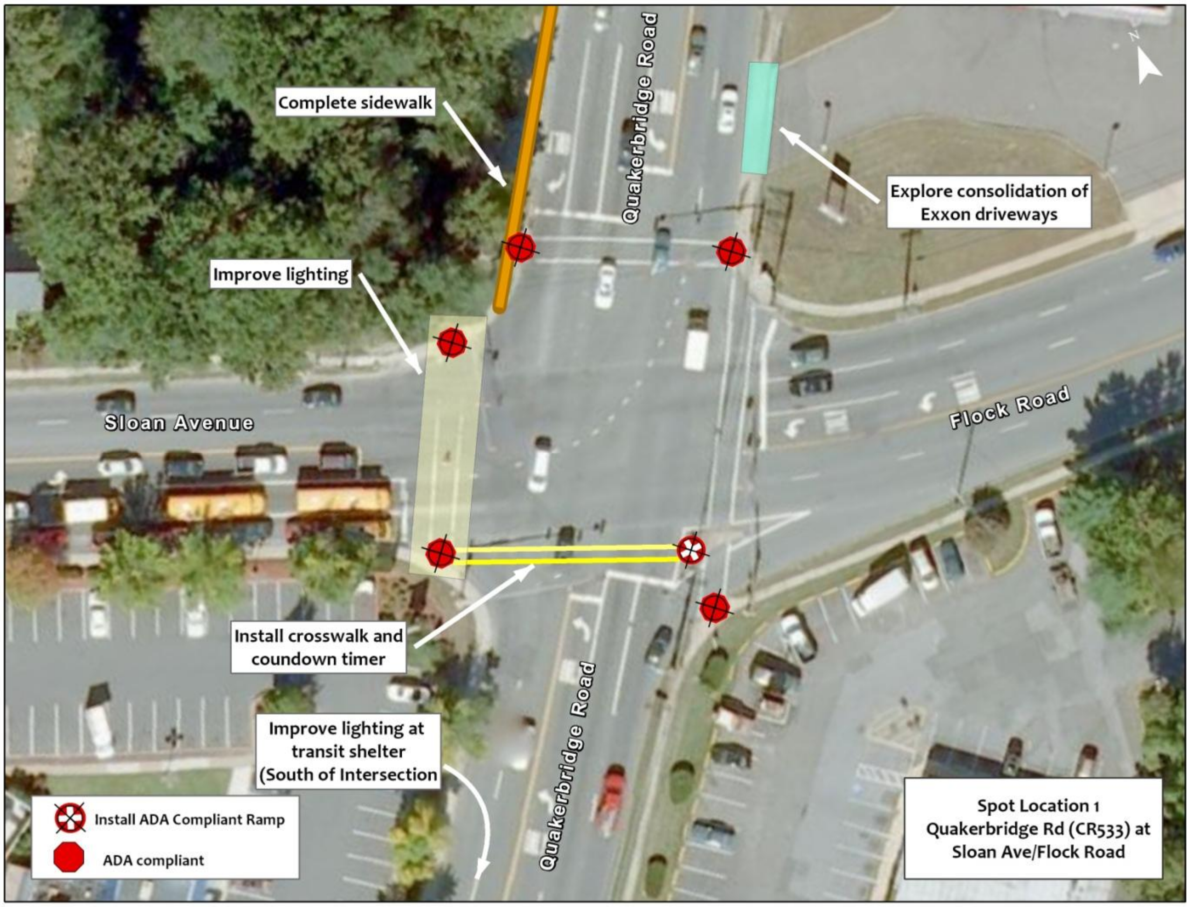
<u>Short term</u>

- Add crosswalk and countdown signal timer to southern leg of intersection (across Quakerbridge Road)
- Complete sidewalk on Quakerbridge Road southbound on northwest corner
- Improve lighting
    - Crossing at western leg (Sloan Avenue)
    - Northwest corner
    - Transit shelter south of intersection

<u>Long term</u>

- During next maintenance cycle, add ADA-compliant detectable warnings to existing curb ramps
- Explore consolidation of driveways at Exxon station on northeast corner to reduce conflicts at crosswalk

Figure 4 – Recommended improvements at Quakerbridge Road at Sloan Ave/Flock Road



Intersection 2 – Whitehorse-Mercerville Rd (CR 533) at NJ Route 33

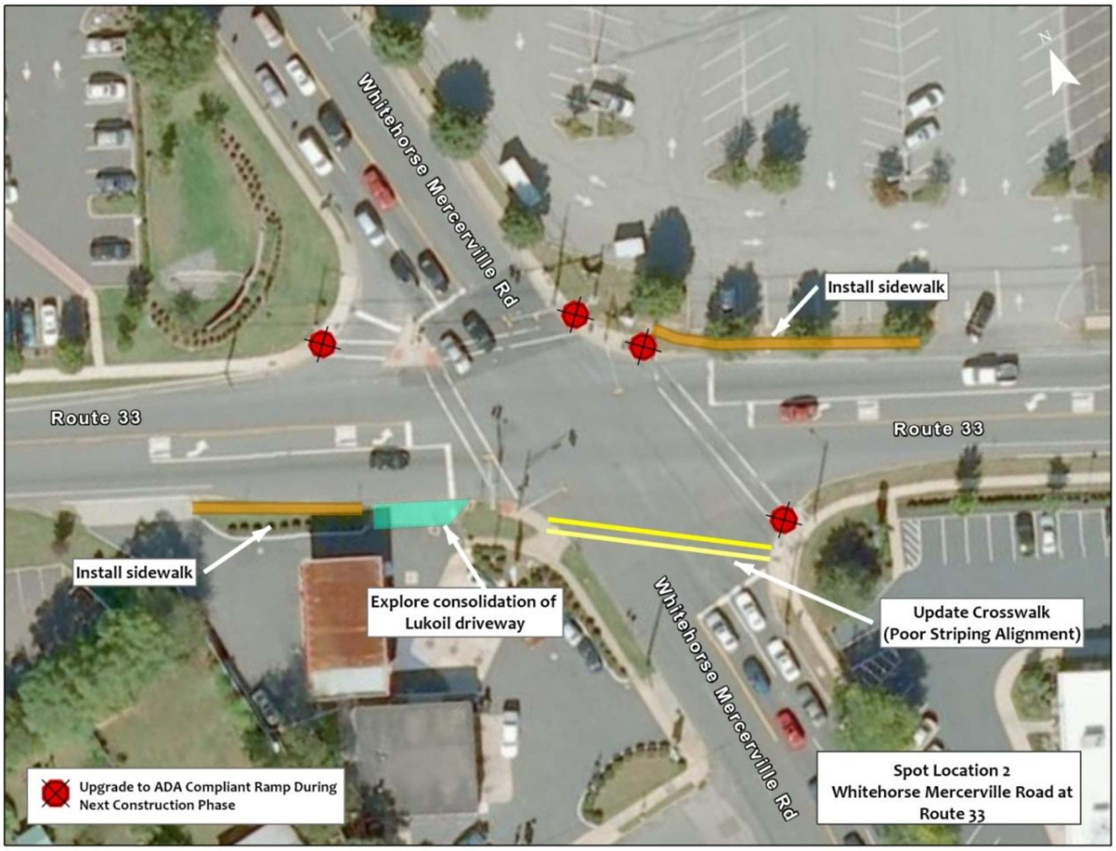
Short term

- Add crosswalk to southern leg of intersection (across Whitehorse-Mercerville Road). May need to move ADA compliant ramp away from skewed corner.
- Fill in missing sidewalk (approximately 100 feet) along Route 33 westbound between northeast corner and entrance to Mercerville Shopping Center
- Fill in missing sidewalk in front of Lukoil Station along Route 33 eastbound

Long term

- During next maintenance cycle, add ADA-compliant detectable warnings to existing curb ramps
- Explore consolidation of driveways at Lukoil station

Figure 5 – Recommended improvements at CR 533 and NJ 33



Intersection 3 – Hamilton Avenue at South Olden Avenue

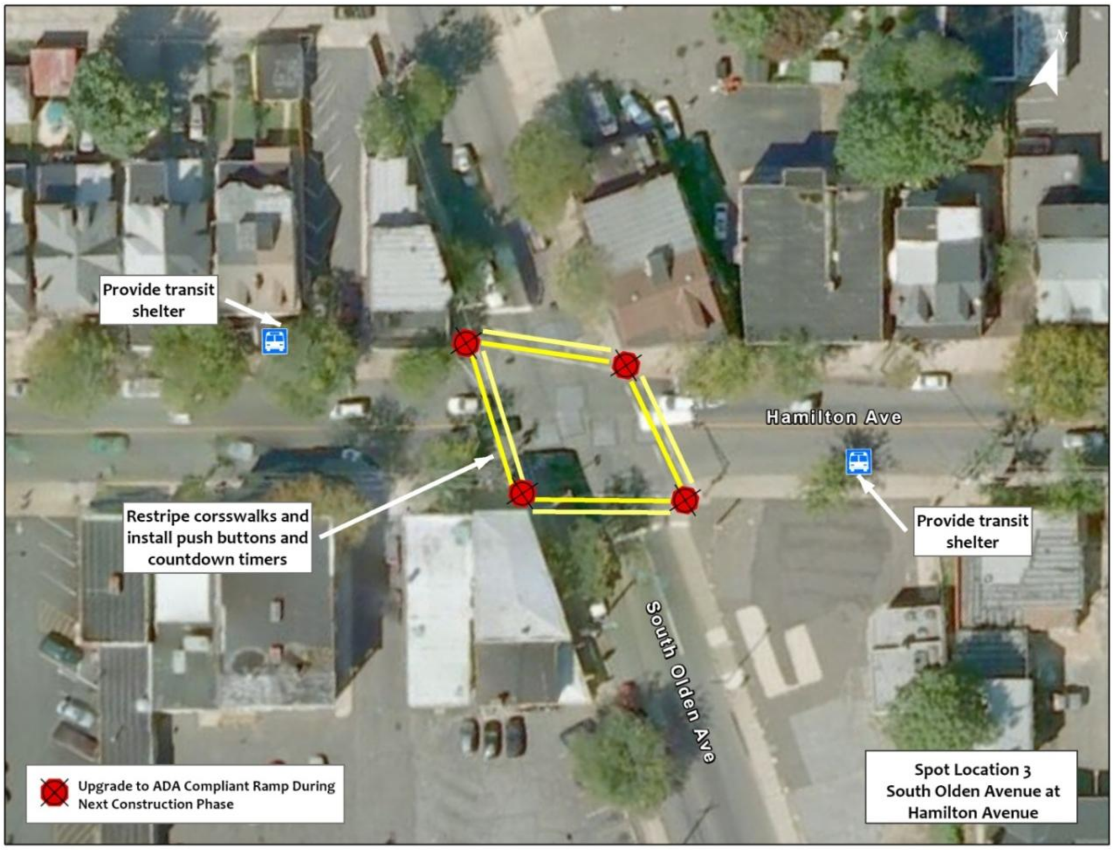
Short term

- Restripe crosswalks
- Install push buttons and countdown timers for all crosswalks

Long term

- During next maintenance cycle, add ADA-compliant detectable warnings to existing curb ramps
- Provide transit shelters at stops immediately east and west of intersection
- Improve lighting in southeast corner, perhaps as a condition of redevelopment

Figure 6 - Recommended improvements at Hamilton Ave and S. Olden Ave



Corridors

Corridor 1 – NJ Route 33(Nottingham Way/Greenwood Avenue) from Donald Drive to Hamilton-Trenton Border
Nottingham Way
Short term

- Add crosswalks to:
    - East leg of Greenwood Avenue at Ward Avenue
- Fill in missing sidewalk (approximately 150 feet each) at two locations along westbound side of Nottingham Way
- Improve lighting
    - Donald Drive, particularly at transit shelter
- Install pedestrian signal heads that meet current MUTCD standards at:
    - Donald Drive
    - Greenwood Avenue
    - Johnston Avenue

Long term

- During next maintenance cycle, add ADA-compliant detectable warnings to existing curb ramps at:
  - Donald Drive
  - Greenwood Avenue
- Investigate installation of midblock crossing at intersection of Nottingham Way and Greenwood Avenue

Greenwood Avenue

Long term

- During next maintenance cycle, add ADA-compliant detectable warnings to existing curb ramps at Ward Avenue and Johnston Avenue
- As traffic signals are replaced, install current MUTCD standard pedestrian signals at:
  - Ward Avenue

Figure 7 - Recommendations at Nottingham Way/Donald Drive

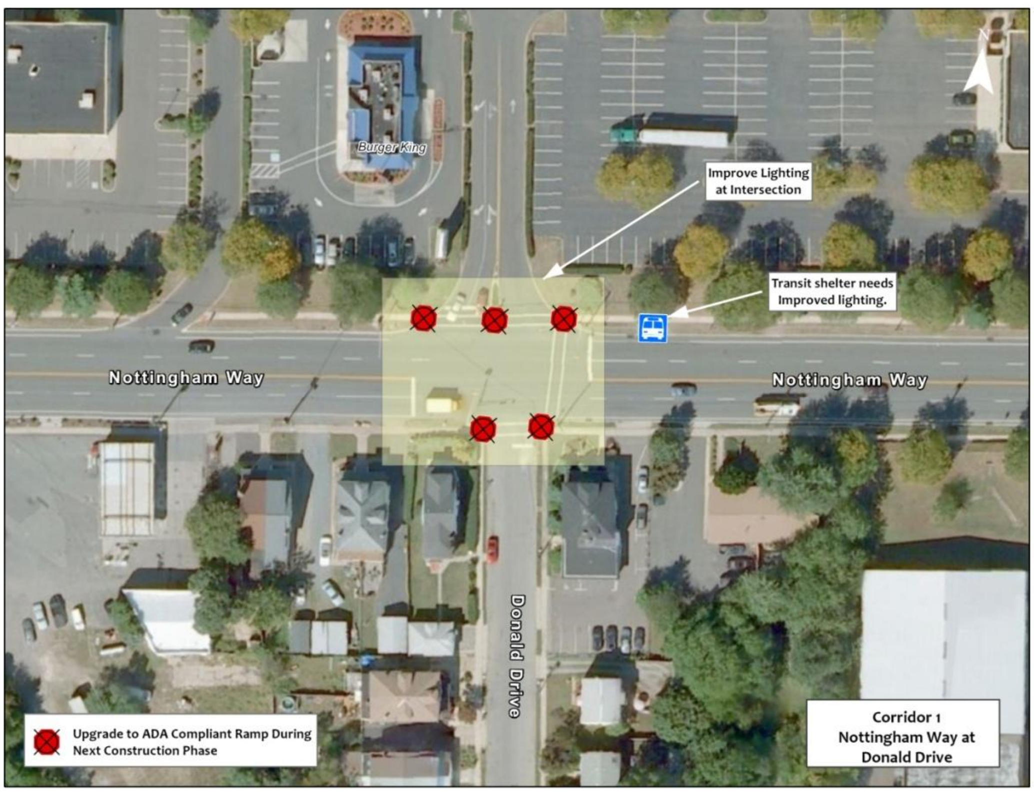


Figure 8 - Recommendations at Nottingham Way/Greenwood Ave

Figure 9 - Recommendations at Nottingham Way/Ward Avenue

Figure 10 - Recommendations at Nottingham Way/Johnston Avenue

Figure 11 – Corridor-wide recommendations - Corridor 1

Corridor 2 – Hamilton Avenue from I-295 to Hamilton-Trenton Border

Short term

- Add crosswalks to:
    - West leg of intersection at Kuser Road
    - South leg of intersection at Liberty Avenue, with protective gore striping
- Add curb ramps at Liberty Avenue intersection on SE and SW corner
- Add ADA-compliant detectable warnings to existing curb ramps at midblock crossing in front of Nottingham High School
- Improve lighting at:
    - Cypress Road/Donald Drive
    - Klockner Avenue
    - Kuser Road/Ward Avenue
    - Liberty Avenue
    - Newkirk Avenue
- Install pedestrian signal heads that meet current MUTCD standards at:
    - Liberty Avenue

Long term

- During next maintenance cycle, add ADA-compliant detectable warnings to existing curb ramps at intersections with:
    - Cypress Lane/Donald Drive
    - Klockner Road
    - Kuser Road/Ward Avenue
    - South Olden Avenue
    - Newkirk Avenue
- As traffic signals are replaced, install current MUTCD standard pedestrian signals at:
    - South Olden Avenue

Figure 12 - Recommendations at Hamilton Ave and Klockner Road

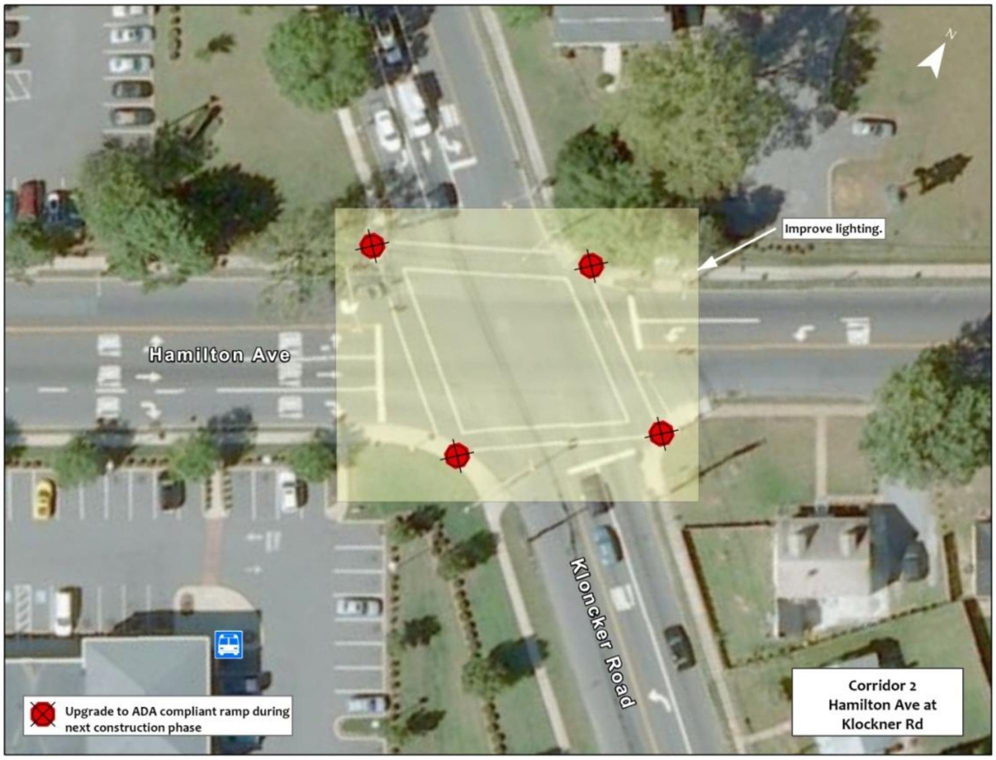


Figure 13 - Recommendations at mid-block crossing in front of Nottingham High School

Figure 14 - Recommendations at Hamilton Ave and Cypress Ln/Donald Dr

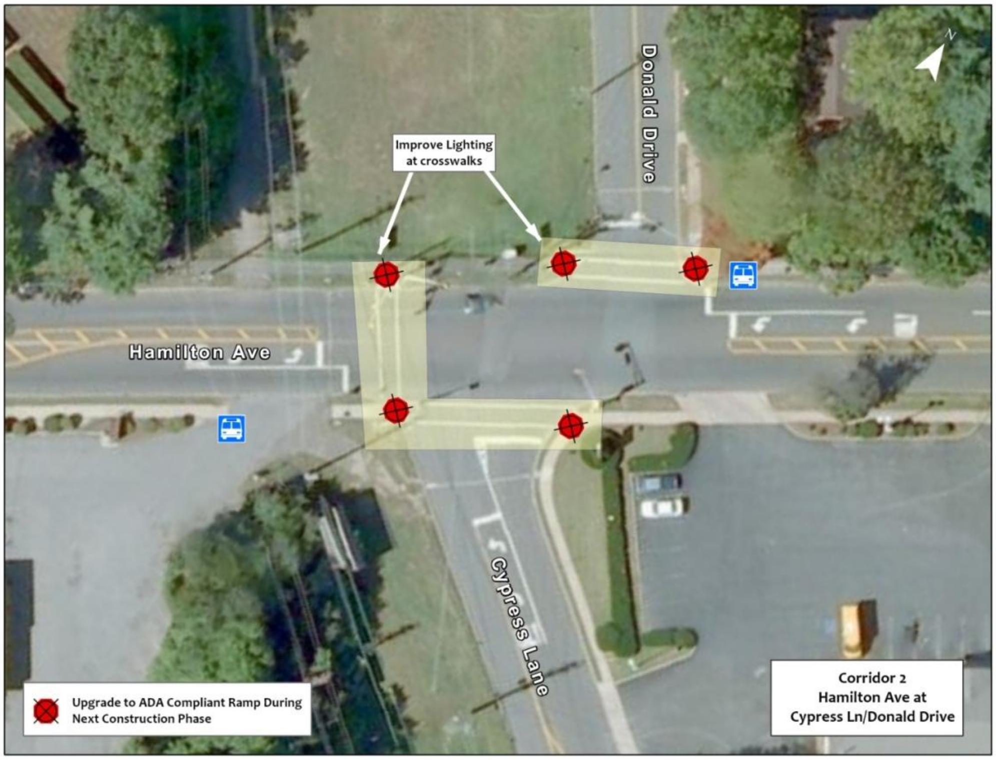


Figure 15 - Recommendations at Hamilton Ave and Kuser Rd/Ward Ave

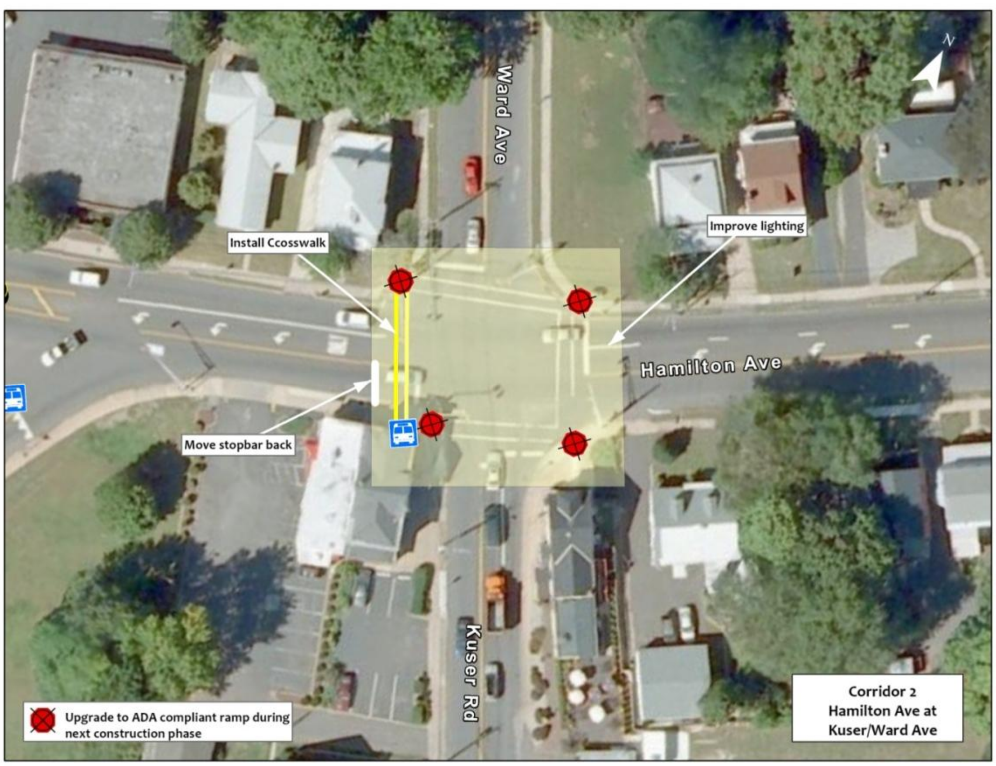


Figure 16 - Recommendations at Hamilton Ave and Liberty Ave

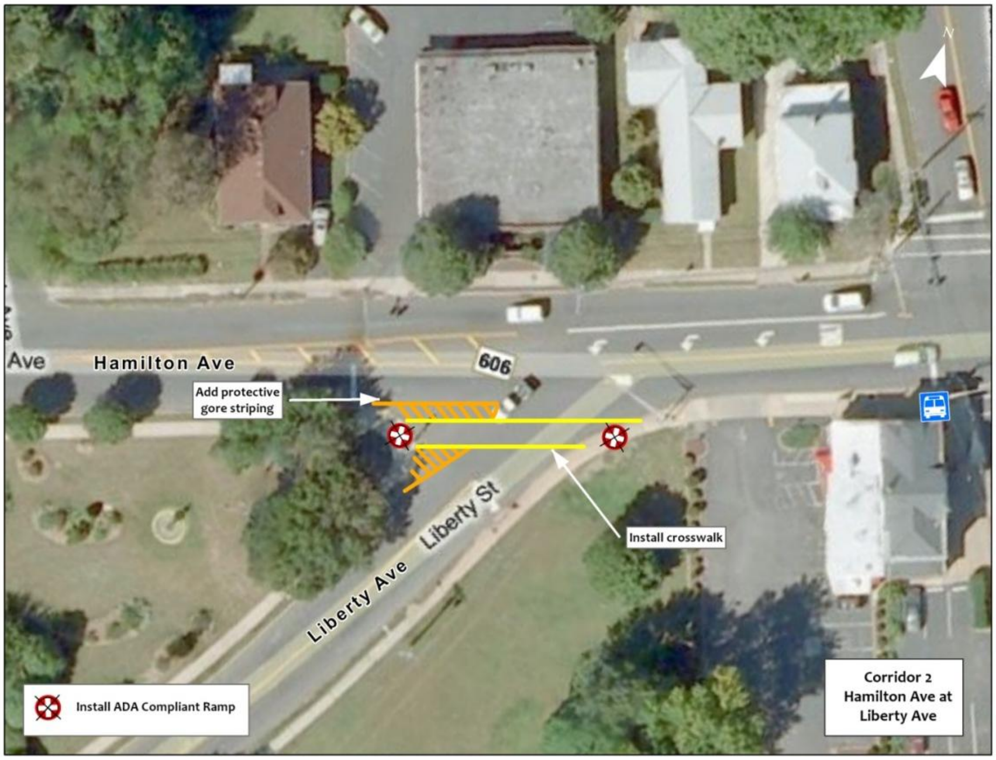


Figure 17 - Recommendations at Hamilton Ave and Newkirk Ave

Figure 18 - Recommendations at Hamilton Ave and South Olden Ave

Figure 19 - Corridor-wide recommendations - Corridor 2

Corridor 3 – Nottingham Way east from Quakerbridge Road to Route 33

Short term

- Add crosswalks to:
  - West leg of Nottingham Way at Quakerbridge Road (not striped after repaving as of 12/20/10)
  - Continental style at midblock crossing near Aberfoyle Drive
  - West leg at George Dye Road
  - North, south and east leg at Route 33 near office plaza
- Add curb ramps at:
  - NE and east corners at Quakerbridge Road/Edinburg Road
  - Both sides at midblock crossing near Sayen Elementary School (existing ramps not flush with pavement)
  - NW and NE corners at Whitehorse Square Road. Relocate utility pole at NW corner to accommodate curb ramp
  - NE corner at Mercer Street/Yardville-Hamilton Square Road(current ramp not flush with street)
  - Both sides at midblock crossing near Aberfoyle Dr
  - All corners at George Dye Road (existing SE ramp not flush with street)
  - N and S side at midblock crossing in front of St Gregory the Great
  - NE and SE corners at Route 33 (near office plaza)
- Improve lighting at intersections with:
  - East side of intersection at Quakerbridge Road/Edinburg Road
  - Paxson Avenue
  - Whitehorse Square Road
  - Mercer Street/Yardville-Hamilton Road
  - Midblock crossing near Aberfoyle Dr
  - George Dye Road
  - Midblock crossing in front of St Gregory the Great
- Fill in sidewalk gaps:
  - Westbound between Sunset Boulevard and Coleman Road
  - Eastbound between South Burtis Avenue and Route 33
  - At SW corner of intersection at George Dye Road
- Install pedestrian signal heads that meet current MUTCD standards at:
  - Quakerbridge Road/Edinburg Road (most crossings, west approach up to date)
  - Route 33

Long term

- During next maintenance cycle, add ADA-compliant detectable warnings to existing curb ramps at intersections with:

- Quakerbridge Road/Edinburg Road
- SE and SW corner at Whitehorse Square Road
- Mercer Street/Yardville-Hamilton Road
- Route 33 (near office plaza)

Figure 20 - Recommendations at Nottingham Way and Quakerbridge Rd/Edinburg Rd

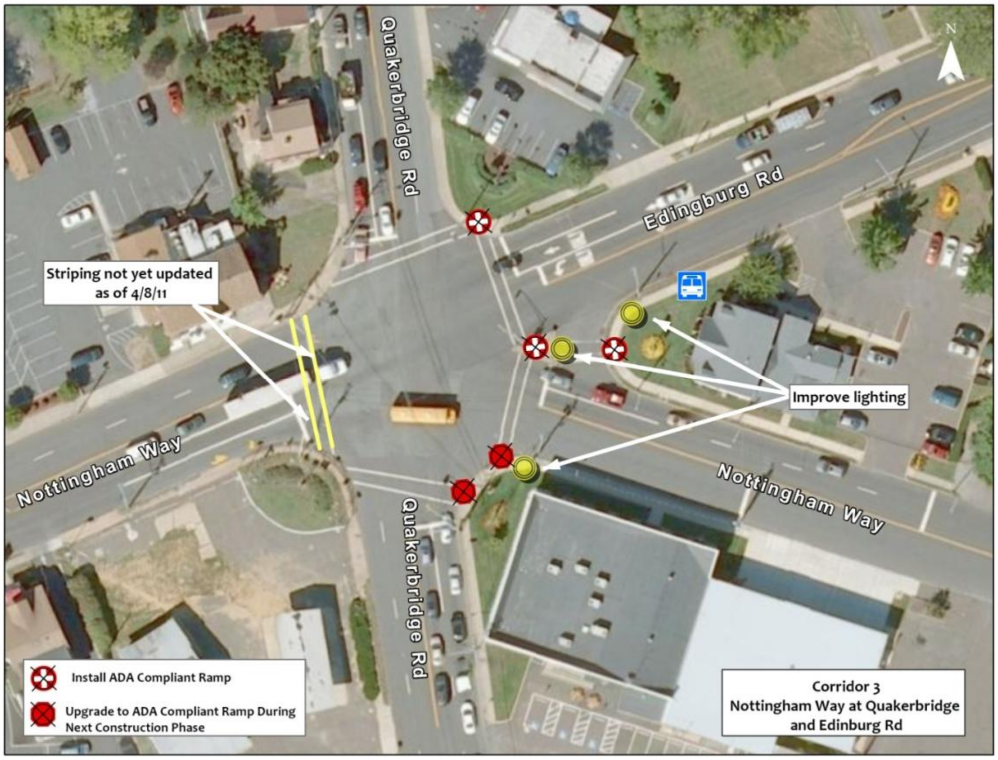


Figure 21 - Recommendations at Nottingham Way and Paxson Ave

Figure 22 - Recommendations at Nottingham Way and Whitehorse Square Rd

Figure 23 - Recommendations at Nottingham Way near Aberfoyle Dr

Figure 24 - Recommendations at Nottingham Way and Mercer St/Yardville Hamilton Square Rd

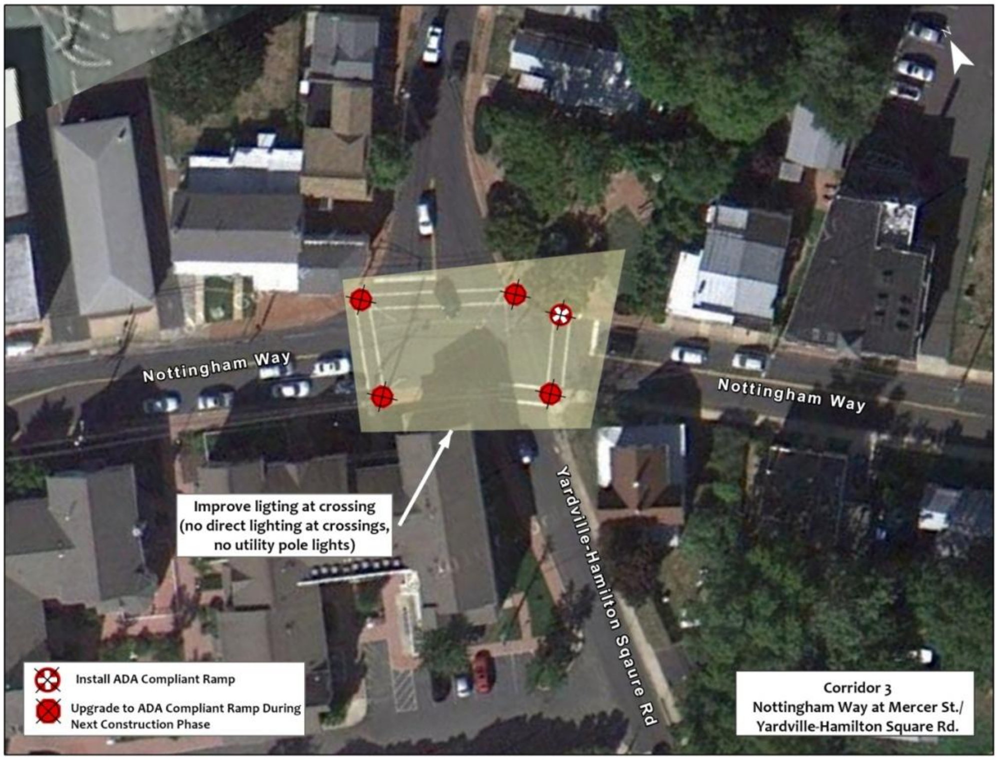


Figure 25 - Recommendations at Nottingham Way and George Dye Rd

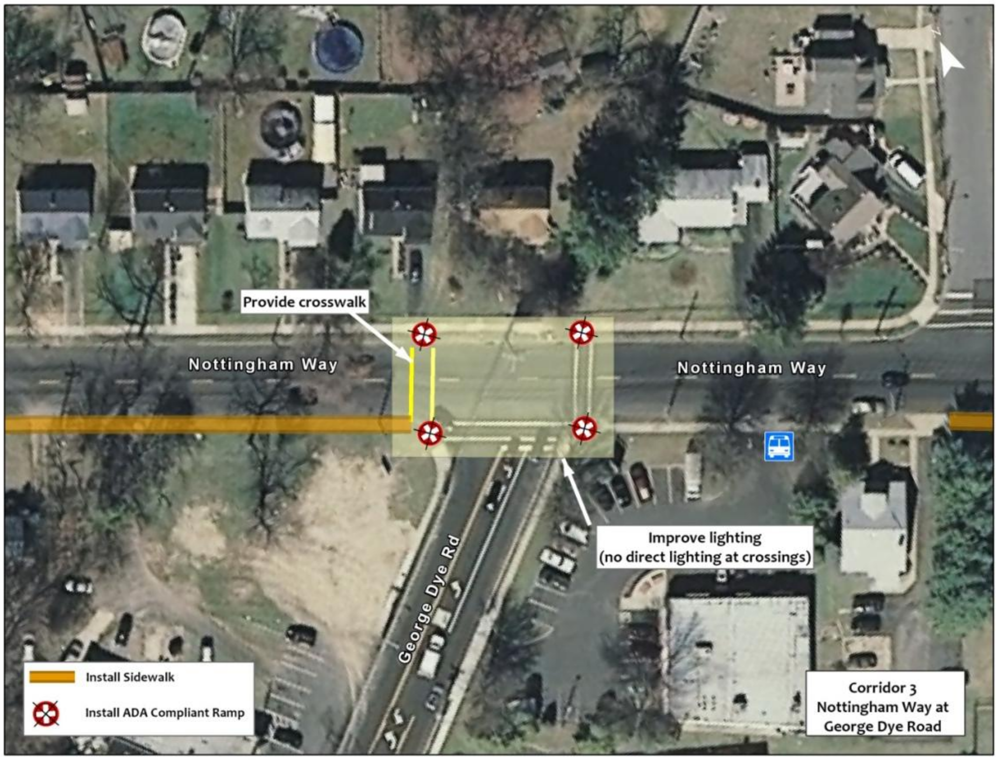


Figure 26 - Recommendations at Nottingham Way near Sayen Elementary School

Figure 27 - Recommendations at Nottingham Way near St Gregory the Great School

Figure 28 - Corridor-wide recommendations - Corridor 3

Corridor 4 – South Broad Street (CR 524) from I-195 to Route 130

Short term

- Add crosswalks to:
    - South and west legs at Route 156
    - East leg at Highland Avenue
    - Realign east leg crosswalk to meet ramp at SE corner
- Add curb ramps at:
    - SW corner at Route 156
    - SW corner at Sunnybrae Blvd/Kim Valley Road
    - NE corner at Highland Avenue
- Improve lighting at intersections with:
    - NW and SE corner at Route 156
    - Sunnybrae Boulevard/Kim Valley Road
    - Highland Avenue
- Fill in sidewalk gaps:
    - Eastbound between Lakeside Boulevard and Winding Way
- Install pedestrian signal heads that meet current MUTCD standards at:
    - Sunnybrae Blvd/Kim Valley Road
    - Highland Avenue (across Highland, South Broad St crossing up to date)

Long term

- During next maintenance cycle, add ADA-compliant detectable warnings to existing curb ramps at intersections with:
    - Route 156
    - Yardville-Hamilton Square Road
    - Sunnybrae Boulevard/Kim Valley Road
- Investigate consolidation of driveways at 7-11 on South Broad Street at Sunnybrae Blvd/Kim Valley Road

Figure 29 - Recommendations at South Broad St and Yardville-Hamilton Square Rd

Figure 30 - Recommendations at Yardville-Allentown Rd and Route 156

Figure 31 - Recommendations at South Broad St and Sunnybrae Blvd/Kim Valley Rd

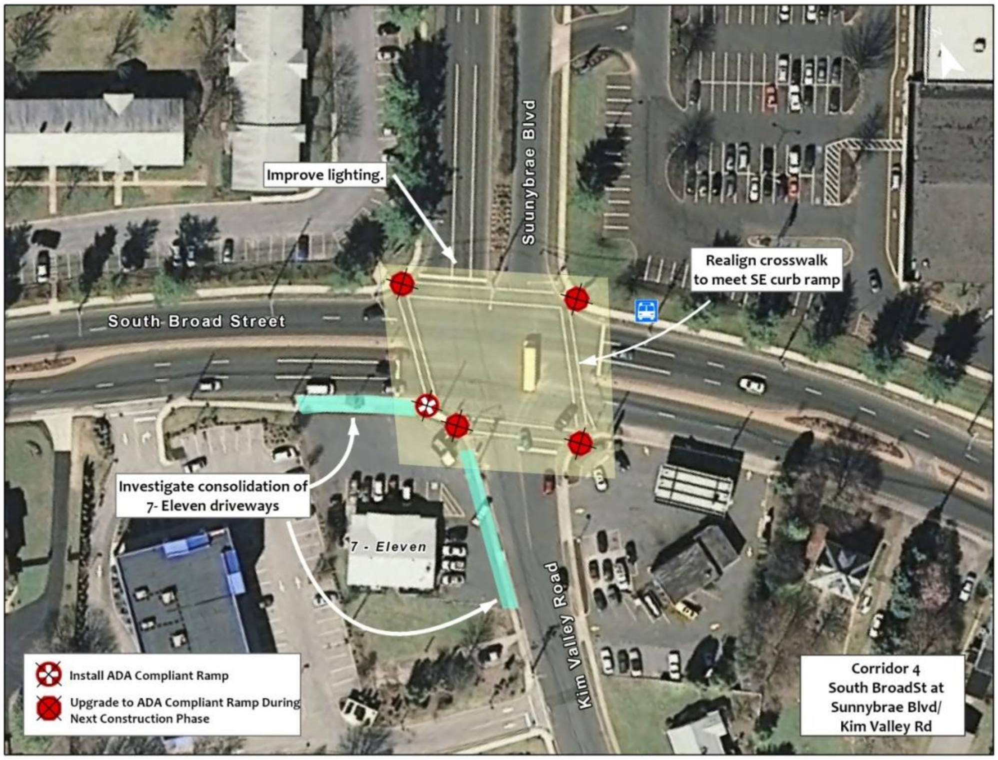


Figure 32 - Recommendations at South Broad St and Highland Ave

Figure 33 - Corridor-wide recommendations - Corridor 4

Corridor 5 – South Broad Street (CR 524/US 206) from I-195 to Hamilton-Trenton Border

Corridor 5a – South Broad Street (CR 524) from I-195 to Whitehorse Circle

<u>Short term</u>

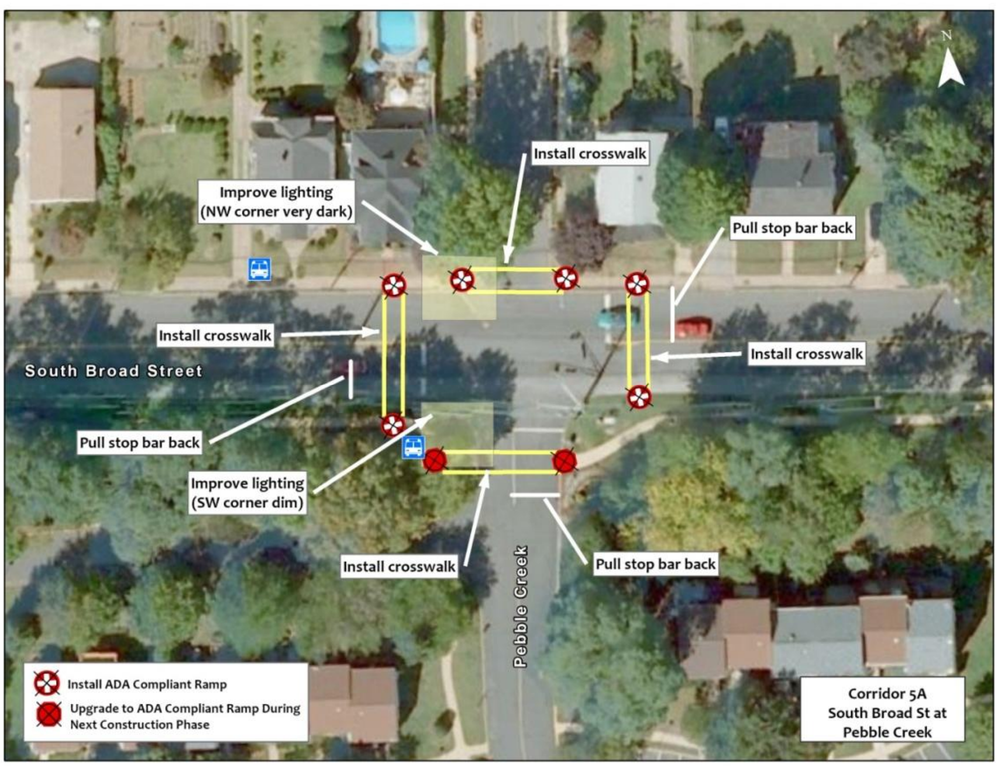
- Add crosswalks to:
  - All legs at Pebble Creek Drive. Along South Broad Street and Pebble Creek Drive this will require pilling stop bars back.
- Fill in sidewalk gaps:
  - From east of Gropp Avenue to I-195
- Add curb ramps at:
  - NW and NE corner at Pebble Creek Drive
  - SW and SE corner at Whitehorse Circle
- Improve lighting at transit shelter on westbound side near Rosario's Pizza
- Install pedestrian signal heads that meet current MUTCD standards at:
  - Hempstead Avenue
  - Pebble Creek Drive

<u>Long term</u>

- During next maintenance cycle, add ADA-compliant detectable warnings to existing curb ramps at intersections with:
  - Hempstead Road
  - Pebble Creek Drive
  - Whitehorse Circle

Figure 34 - Recommendations at South Broad St and Hempstead Rd

Figure 35 - Recommendations at South Broad St and Pebble Creek Dr



Corridor 5b – South Broad Street (CR 524) from Whitehorse Circle to I-295 overpass

Short term

- Add continental style crosswalks to:
  - East and west leg at Homestead Avenue/Hobson Avenue
  - East and west leg at Fetter Avenue/Harcourt Drive
- Improve lighting at
  - Eastbound sidewalk in front of Colonial Memorial Park
  - Between Hobson Road and Redwood Avenue

Long term

- As traffic signals are replaced, install current MUTCD standard pedestrian signals at:
  - Homestead/Hobson Avenues
  - Fetter Avenue/Harcourt Drive

Figure 36 - Recommendations at South Broad St and Homestead/Hobson Aves

Figure 37 - Recommendations at South Broad St and Fetter Ave/Harcourt Dr

Corridor 5c – South Broad Street (CR 524) from I-295 overpass to Hamilton-Trenton border

<u>Short term</u>

- Add continental style crosswalks to:
  - West leg at Chambers Street/Rennie Street
  - East and west leg at West Park Avenue/East Park Avenue
  - East and west leg at Irvington Place/Lafayette Avenue
  - East leg at New Cedar Lane and east leg at Samuel Street
  - East leg at Sewell Avenue
- Restripe crosswalk on south leg at Irvington Place to form standard crosswalk with parallel lines
- Improve lighting at transit shelter on westbound side near Rosario's Pizza

<u>Long term</u>

- During next maintenance cycle, add ADA-compliant detectable warnings to existing curb ramps at intersections with:
  - New Cedar Lane
  - Samuel Street
  - Sewell Avenue
- As traffic signals are replaced, install current MUTCD standard pedestrian signals at:

- Irvington Place/Lafayette Avenue
- E Park/W Park Avenue
- Chambers Street/Rennie Street (except across Chambers Street already up to date)
- Sewell Avenue

Figure 38 - Recommendations at South Broad St and E Park/W Park Aves

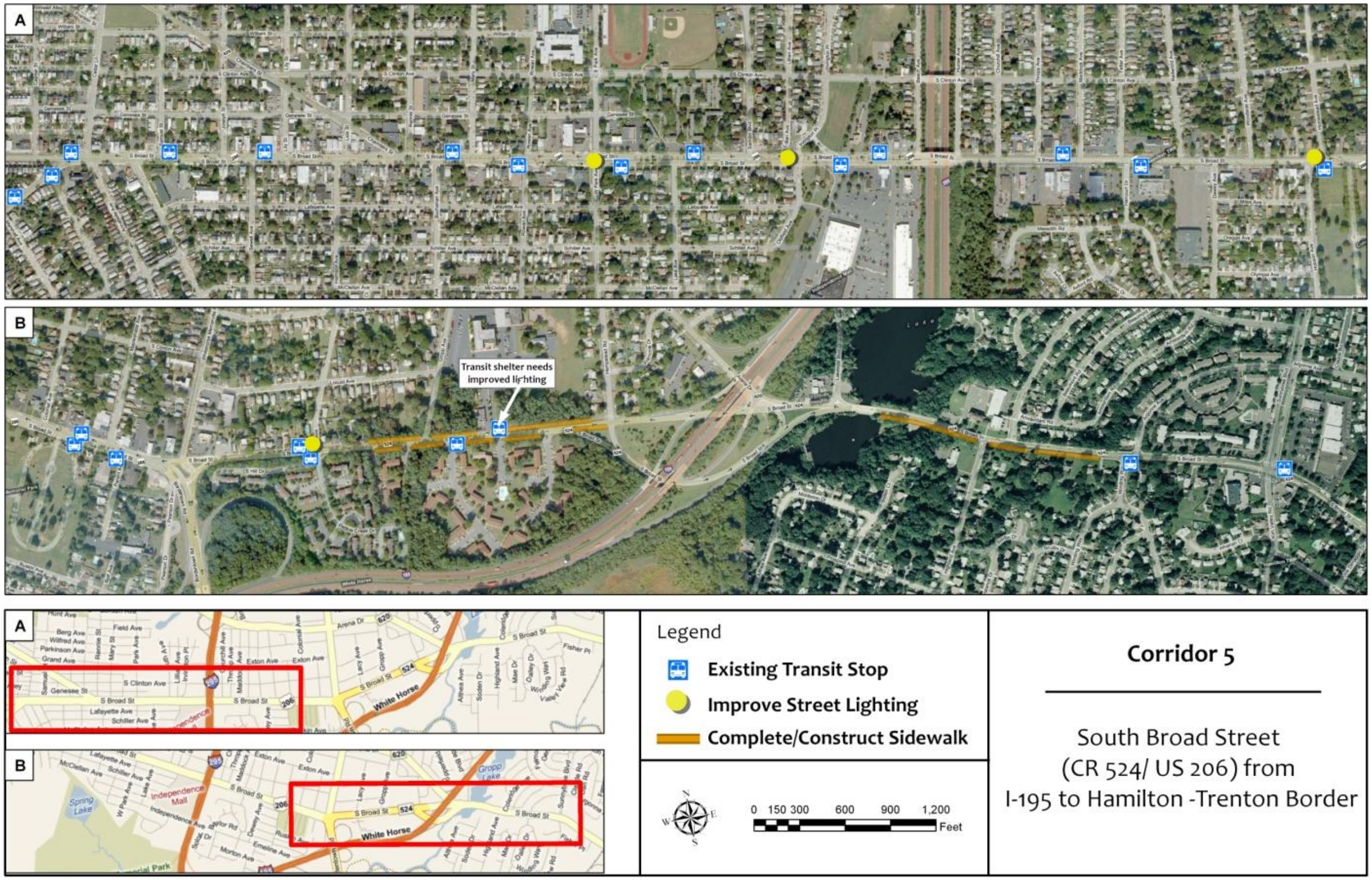
Figure 39 - Recommendations at South Broad St at Irvington Pl/Lafayette Ave

Figure 40 - Recommendations at South Broad St and Chambers St/Rennie St

Figure 41 - Recommendations at South Broad St and New Cedar Lane and Samuel St

Figure 42 - Recommendations at South Broad St and Sewell Ave

Figure 43 - Corridor-wide recommendations - Corridor 5



Corridor 6 – Route 33 from Whitehorse-Hamilton Square Road to Yardville-Hamilton Square Road

Short term

- Add crosswalks to west leg at Whitehorse-Hamilton Square Road
- Fill in sidewalk gaps westbound in front of car dealership
- Improve lighting on westbound side in front of car dealership

Long term

- During next maintenance cycle, add ADA-compliant detectable warnings to existing curb ramps at intersections with:
  - o Yardville-Hamilton Square Road
  - o Whitehorse-Hamilton Square Road

Figure 44 - Recommendations at Route 33 and Whitehorse-Hamilton Square Rd

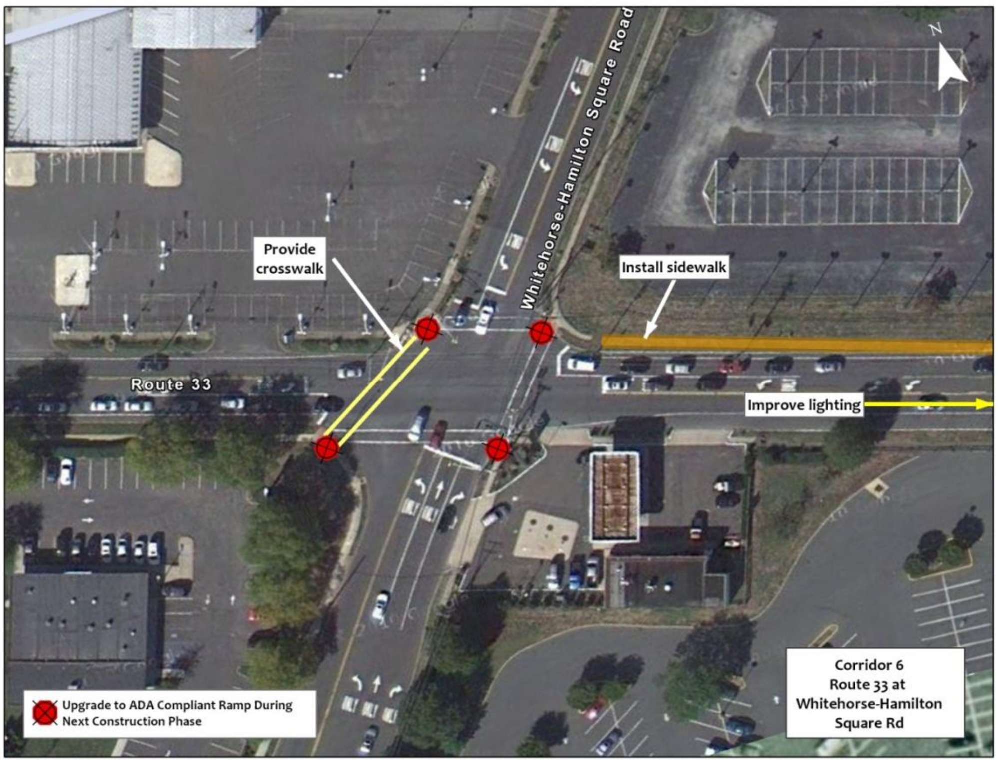


Figure 45 - Recommendations at Route 33 and Yardville-Hamilton Square Rd

Figure 46 - Corridor-wide Recommendations - Corridor 6

Estimated Costs

The final element of the pedestrian analysis is the estimated cost to implement the proposed improvements for the three spot locations and six corridors. These improvements will address critical need at location identified through the crash analysis and review of pedestrian trip generators and attractors.

The total estimated cost of these improvements is approximately $266,000, including $5,500 for the spot locations, $250,500 for the corridors (see Table 2). This includes curb ramps, crosswalks, sidewalks, stop bars, and gore striping. These estimates are based on industry and NJDOT standards for per unit costs, placement, and applicable ADA compliance.

A detailed sheet of cost calculations and assumptions is provided in the Appendix.

Table 2 - Summary of Pedestrian Improvement Costs

Spot Locations	*Cost*
1	$ 2,027
2	$ 1,255
3	$ 2,140
Subtotal	$ 5,422
Corridors	*Cost*
1	$ 8,785
2	$ 7,174
3	$ 42,623
4	$ 53,706
5a	$ 66,692
5b	$ 3,172
5c	$ 8,635
6	$ 13,465
Subtotal	$ 204,252
OVERALL TOTAL	$ *209,674*

Pedestrian Summary and Future Considerations

In this study, PB has presented a methodical evaluation of pedestrian needs and conditions; analysis of crash data and review of pedestrian trip generators and attractors; identification of priority spot locations and corridors; a program of proposed improvements including curb ramps, crosswalks, sidewalks, stop bars, and gore striping; prioritization of short and long term improvements; and a summary of estimated costs.

The goal of this effort has been to improve safety and mobility for all roadway users and to safely accommodate pedestrian travel in Hamilton Township. This effort builds upon and is entirely consistent with improvements already made by the Township and as recommended in the Township-Wide Transportation Study

Similar to the bicycle recommendations, these are low cost improvements that typically involve appropriate striping and minimal construction for curb ramp upgrades and sidewalks only. In almost every case, these recommendations amount to converting existing roadways to “complete streets” at minimal cost to the Township. As such, the recommended improvements should also create a safer travel environment for all roadway users and provide traffic calming benefits on many roadways that are currently much wider than needed.

Furthermore, it is recommended that improvements be made in accordance with scheduled road maintenance, repaving, and reconstruction to further minimize costs and leverage the maximum benefit from the capital improvement program. Future considerations to further improve pedestrian safety and mobility in Hamilton Township should include the following:

- Hamilton’s many cul-de-sacs and dead end roadways limit street connectivity and impede mobility and circulation within and through the Township. It is recommended that bicycle- and pedestrian-only connections and paths be considered at some of these locations to enhance mobility and safety, without connecting any roadways. In this way, adjacent neighborhoods and community facilities can be connected without the controversy of opening streets to vehicular through traffic.
- The land use and sustainability elements of the Master Plan should address the issues of pedestrian safety and mobility and providing supporting facilities and infrastructure, including appropriate pedestrian facilities (i.e. sidewalk and crosswalks) at office buildings, parking lots, shopping centers, and public buildings and facilities.
- A township-wide complete streets policy, resolution, or ordinance should be considered and adopted. This would make the methods and recommendations of this report an everyday part of how Hamilton goes about the business of designing and maintaining its streets, intersections, and bridges, and how proposed development applications are reviewed. In this manner, Hamilton would demonstrate its commitment to multi-modal safety and mobility, and help ensure that existing problems are mitigated and no new problems are created.
- Where applicable, the Township Planning and Zoning Board approval process should seek opportunities to require applicants to complete missing sidewalks on their properties as condition of approval when relief is requested.

Chapter 3 – Pattern Book

Hamilton Township Pattern Book

Introduction

The Hamilton Township Bicycle and Pedestrian Circulation Study presents recommendations on ways to improve the pedestrian and bicycling environment in Hamilton Township. Some recommendations are specific to certain streets, such as the proposed bicycle network, while other suggestions speak to overall mobility improvements.

Chapter 1 of the study examined the existing conditions, and Chapter 2 presented the recommended improvements. The Pattern Book (Chapter 3) provides detailed guidance on pedestrian and bicycle facilities.

The purpose of this *Pattern Book* is to provide guidance on how to design and implement pedestrian and bicycle facilities. Technical specifications such as pavement markings and spacing, dimensions, and signing have been culled from various state, national, and international design manuals and applied to Hamilton's street system.

The Pattern Book includes four sections:

I. Street Typology - examines the general transportation, form, and land use characteristics of the streets found in Hamilton Township

II. Street Connectivity - explains the relationship among streets connectivity and bicycle and pedestrian mobility and safety

III. Bicycle Facility Toolbox - contains details on how to design bicycle facilities along the street and at intersections

IV. Pedestrian Facility Toolbox - contains detailed guidance on the design of pedestrian facilities on the street and at intersections

I. Street Typology

Street Characteristics and Non-Motorized Potential

The following table shows the general transportation, form, and land use characteristics of the streets found in Hamilton Township. For each street type, the potential for pedestrians and cyclists to use each street is ranked on a scale of low to high. The ranking of potential is based upon infrastructure typically seen in Hamilton Township today (e.g. urban avenues in western Hamilton generally have sidewalks). Each street type has a very different feel to the person walking or cycling. The rural road, for example, likely has a shoulder and may be useful for recreational or local cycling. For pedestrians, however, the travel distances between destinations in rural areas is long and vehicle speeds are moderate to high, making it an uncomfortable place to walk. The suburban residential street, which is low-speed, low-volume, and typically has sidewalks, has high potential for both modes.

Street Typology and Characteristics

	Expressway	Rural Road	Suburban Boulevard	Strip Avenue	Office Park, Industrial Collector	Urban Avenue	Suburban Residential Street
Speed Limit	50-55 mph	35-45 mph	45-50 mph	35-40 mph	30-35 mph	25-35 mph	25-30 mph
Vehicle Volume	50K	20K	40K	30K	10K	20K	5K
Travel Lanes	4-6	2	6-8	4-6	2-4	2-4	1-2
Median	yes	no	yes	no	maybe	no	no
Driveways	none	few	some	some	some	few	many
Traffic Signals Spacing	5000’	2000’	2000’	1000’	1000’	500’	none
Land Use	varies	varies	commercial, residential	commercial	commercial	residential, commercial	residential
Building Type & Urban Form	varies	varies	big box, mall	strip shopping centers	office park	row house, storefront	detached houses
Building Setback	far	medium	far	medium	far	near	medium
Density	low	low	medium	medium	low	high	low
Transit Service	limited	none	limited	local	limited	local	some
Pedestrian Potential	N/A	Low	Low	Medium-Low	Medium-Low	High	High
Bicycle Potential	N/A	Medium-Low	Low	Medium-High	Medium-High	High	High

I. Street Connectivity

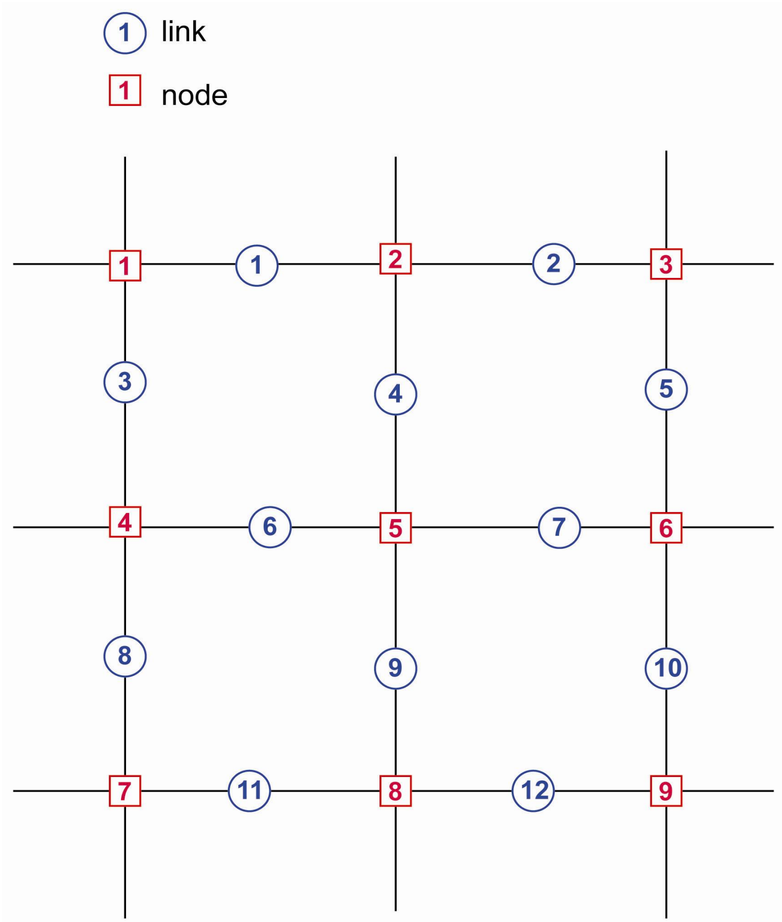
Connectivity refers to the density of connections in path or road networks and the directness of links. Walking and cycling are successful when people can easily get between home and destinations – a disconnected network means a person can only take a walk around the block, whereas a well-connected network lets people walk to the store, to a friend's house, or to work. Well-connected street networks have short links, many intersections, and minimal dead-end streets or cul-de-sacs. High connectivity creates a more accessible and resilient transportation network, because people can take more direct routes between destinations, and people have more route options.

Connectivity can be measured in several different ways:

- Connectivity Index: Ratio of roadway links to nodes. A four-square grid, for example, has a connectivity index of 1.33 (12 links divided by 9 nodes – see example). A nine-square scores 1.5; the higher the value, the better the connectivity. A score of 1.4 is the minimum needed for a walkable community[1]. In compact urban areas, a 1.6 index should be provided.[2] The following definitions are used in calculating Connectivity Index:
    - Segment/Link: a roadway or alley open to general public auto traffic; a street section between intersections and termini
    - Node/Intersection: a junction with three or more segments; the terminus of a street segment, such as a cul-de-sac
- Intersection Density: Number of intersections per square mile; the higher the number, the better the connectivity

[1] Victoria Transport Policy Institute. "Roadway Connectivity." www.vtpi.org/tdm/tdm116.htm. Updated March 16, 2011.
[2] VDOT. "Secondary Street Acceptance Requirements." July 2010.

Connectivity Index



- Accessibility Index: Divide the direct travel distance by the actual travel distance. In an unconnected network with dead ends and long blocks, people travel farther to reach destinations, meaning a higher index. An index of 1.0 is the best rating, meaning there are direct paths. An average value of 1.5 is acceptable.[3]

[3] Victoria Transport Policy Institute. "Roadway Connectivity." www.vtpi.org/tdm/tdm116.htm. Updated March 16, 2011.

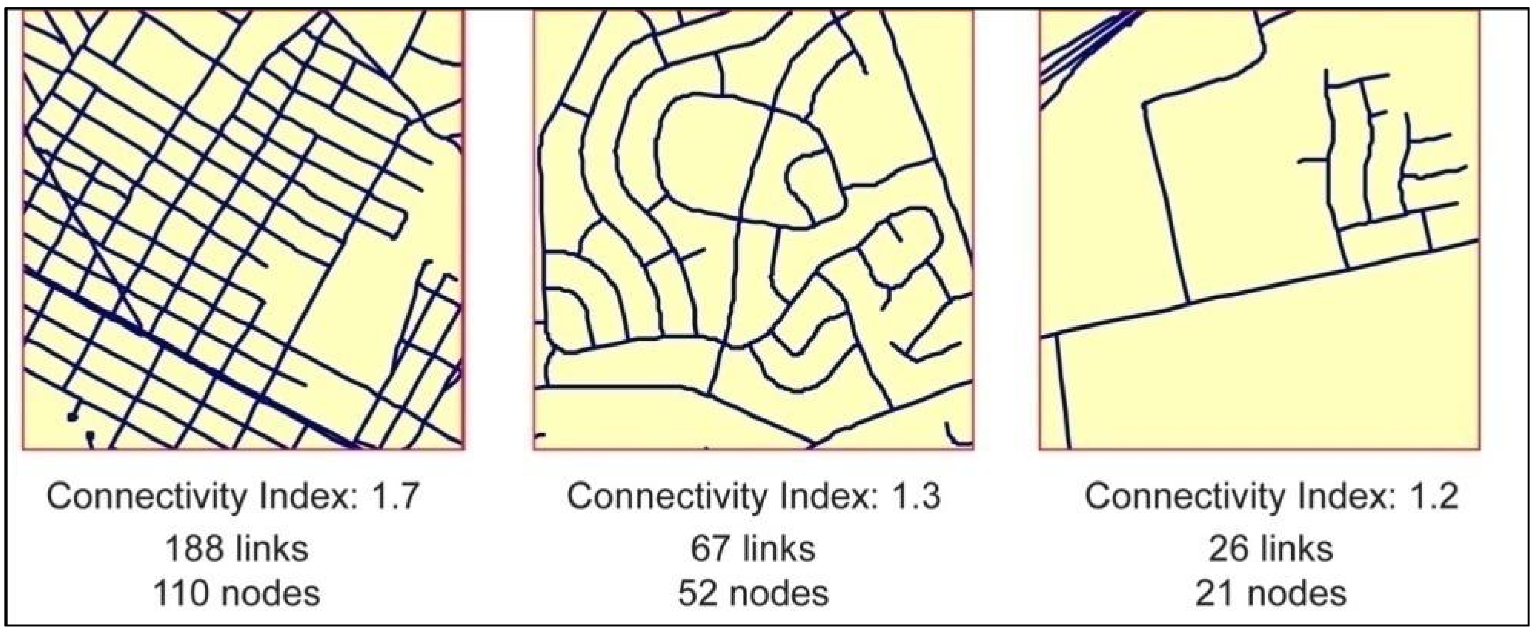
The figure below depicts three street grids from Hamilton Township. All three are at the same scale. The example of the left (western Hamilton) is a well-connected grid. The subdivision-style road network gets a medium score, and the rural eastern portion has low connectivity. The density of intersections shows that the more urban area of Hamilton has twice as many intersections as the suburban example, meaning blocks are short and walking is interesting.

One way to encourage connections is to require "stub outs" with new developments. A stub out is a road segment constructed to connect a development in the future, and is built abutting the neighboring property line. Many municipalities, including Portland, OR, Boulder, CO, and Raleigh, NC, require stub-outs and disallow cul-de-sacs as part of their street standards.

The combination of high street connectivity and high intersection density means that the network requires short blocks and standards for dimensions between roads and crossings. Guidelines for street spacing include:

- Average intersection spacing 200-400 feet
- maximum intersection spacing 600 feet
- maximum spacing for arterial streets 1,000 feet
- Maximum spacing between pedestrian/bicycle connections 350 feet
- maximum block size 5-12 acres

Street Connectivity Examples, Hamilton Township, NJ



II. Bicycle Facility Toolbox

This section contains details on how to design bicycle facilities along the street and at intersections, including examples and guidance for:

- Pavement markings
- Placement and dimensions
- Signing
- Photos and renderings of the elements on typical Hamilton Streets

The table below summarizes the traffic parameters that should be met for each facility type. These parameters were taken from various best practice and design guidance resources, including:

- AASHTO. *AASHTO Guide for the Planning, Design, and Operation of Bicycle Facilities DRAFT*. February 2010.
- CROW. *Design Manual for bicycle traffic*. 2077. This guide was consulted as the Netherlands and New Jersey have similar densities.
- ITE. *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*. 2010.
- ITE. *Innovative Bicycle Treatments*. 2002.
- NACTO. *Urban Bikeway Design Guide*. Web format only: http://nacto.org/cities-for-cycling/design-guide/
- Initiative for Bicycle and Pedestrian Innovation. *Fundamentals of Bicycle Boulevard Planning & Design*. July 2009.
- NJDOT. *Roadway Design Manual: Section 16 Bicycle Facilities*. Final Draft August 2002.
- FHWA. Manual on Uniform Traffic Control Devices. 2009.

These parameters are flexible and facilities can work under a range of conditions.

	Bicycle Boulevard	Sharrows	On-Street Lanes	On-Street Lanes with Buffer	Cycle Tracks adjacent to roadway	Paths and Trails
Speed Limit	< 20 mph	0 – 25 mph	20-35 mph	20-35+ mph	20-50+ mph	n/a
Vehicle Volume	3,000-4,000 ADT Ideally < 1,500 ADT	<2,500 ADT	2,500 - 10,000 ADT	2,500 - 10,000 ADT	2,500 – 10,000+ ADT	n/a
Travel Lanes	One-way to 1+1	One-way to 1+1	One-way to 2+2	One-way to 2+2	One-way to 3+3	n/a
Driveways, Intersections and Crossings	N/A	N/A	N/A	N/A	Driveway volumes < 400 vehicles/day	Few roadway and driveway crossings
Traffic Signals	None; only if necessary at major arterial intersections	N/A	N/A	N/A	Infrequent; Bicycle-only signal phase necessary where motorist turning movements conflict	Infrequent, bicycle signals required at crossings, not at junctions
On-Street Parking	None, Parallel, or Back-in Angled Parking	None, Parallel, or Back-in Angled Parking	None, Parallel, or Back-in Angled Parking	None, Parallel, or Back-in Angled Parking	High parking turnover, double parking observed	n/a

Facilities along the Street

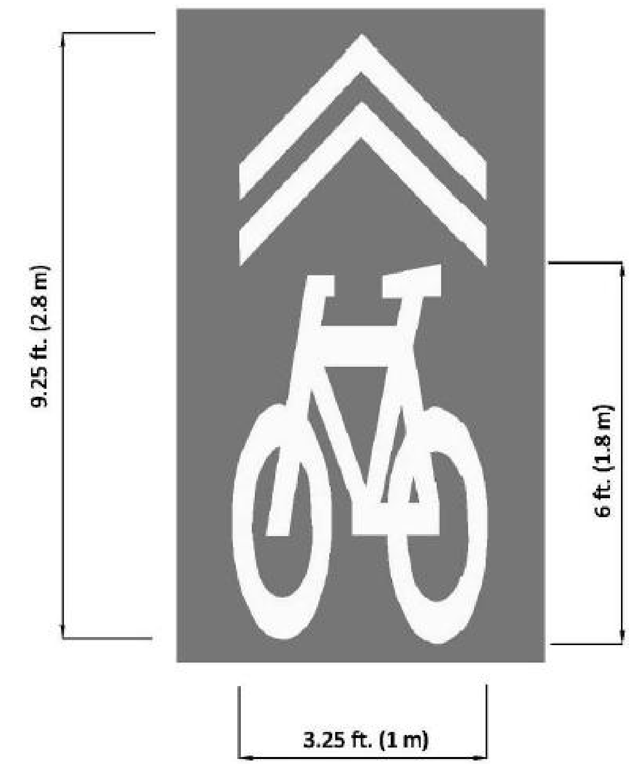
1. Sharrows

Source: www.pedbikeimages.org

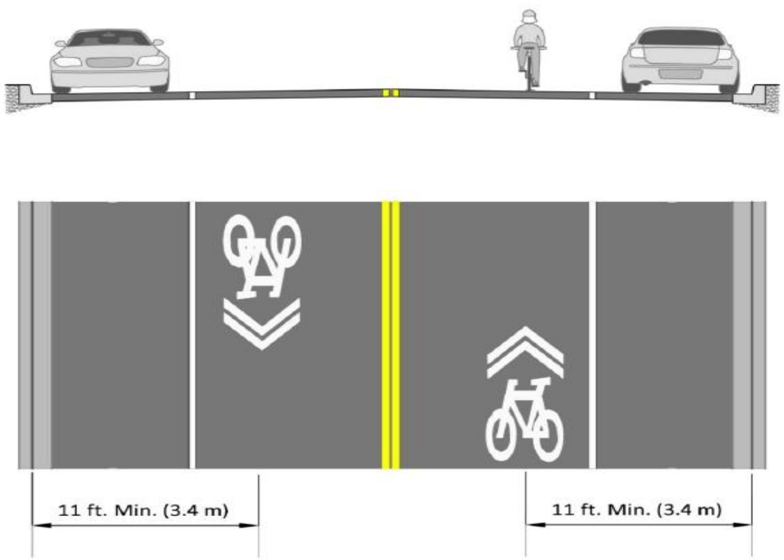
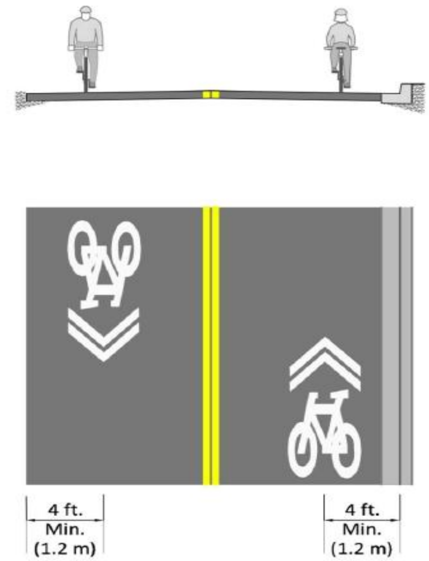
Pavement markings that indicate a shared lane environment for bicycles and automobiles. Shared lane markings, or "sharrows," indicate the presence of a bike route and tell motorists where to expect a bicyclist's travel path. Shared lane markings encourage bicyclists to travel outside the door zone and remind cyclists to ride with traffic, not against it. Sharrows may be utilized where road width is too narrow to accommodate a bicycle lane, within single or multi-lane roundabouts, and along front-in angled parking where a bike lane is undesirable.

Pavement Markings Guidance (AASHTO and MUTCD):

Size	Spacing
3.25 ft wide by 9.25 ft tall	50-100 ft. along busier streets or discontinuous bicycle routes. Up to 250 ft. or more along low traffic bicycle routes



Pavement Markings Placement (AASHTO & MUTCD):

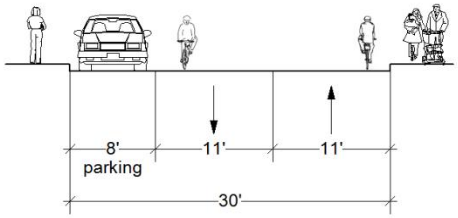
<table>
<tr><th>Streets with On-Street Parking</th><th>Streets without On-Street Parking</th></tr>
<tr><td>Center of marking 11’ from curb face or pavement edge</td><td>Center of marking 4’ from curb face or pavement edge</td></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Signing Guidance

The following signs are standard ways to alert motorists to shared lanes and are included in the national Manual on Uniform Traffic Control Devices (MUTCD).[4]

[4] Additional signage options can be found at http://mutcd.fhwa.dot.gov/pdfs/2009/pdf_index.htm, chapter 9

Cross Section and Plan View:



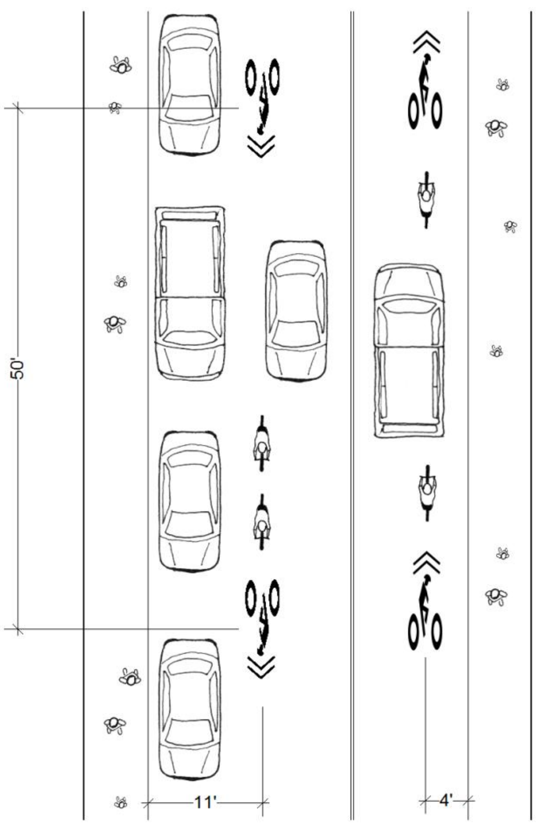


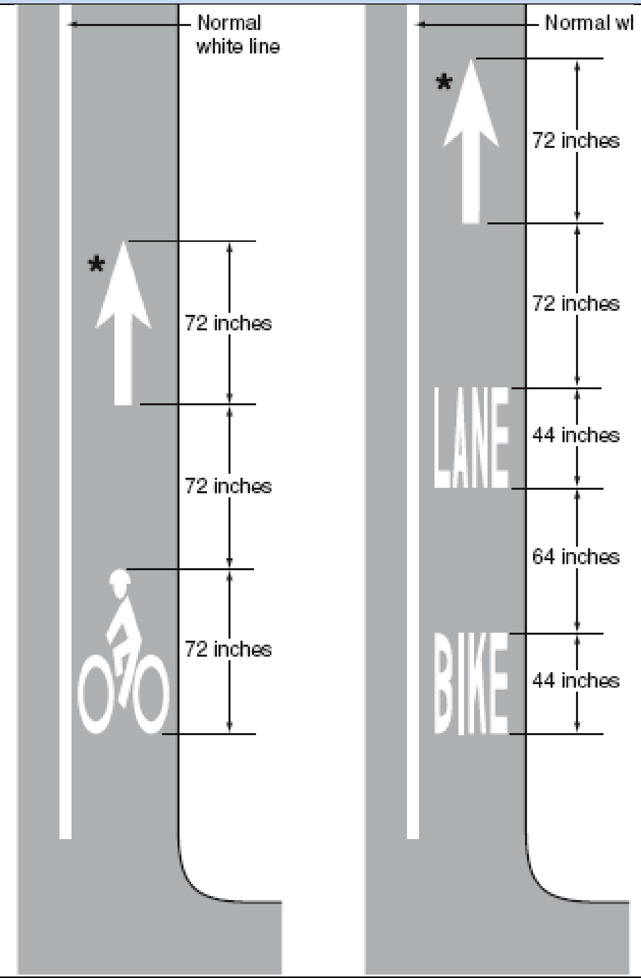
Photo Rendering:

2. On-Street Bicycle Lanes

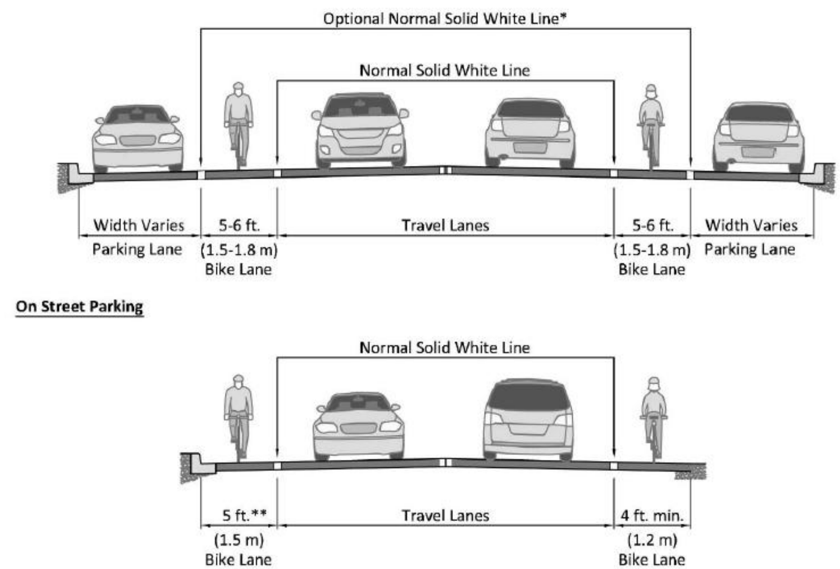
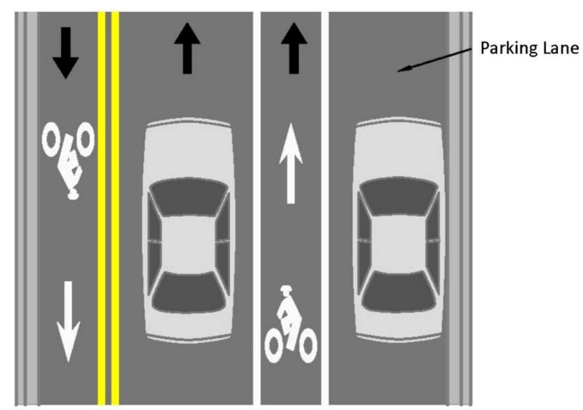
A dedicated bicycle facility delineated by striping, signage and pavement markings adjacent to the motor vehicle travel lane. On-street lanes alert motorists to the presence of a bike route and allow bicyclists to use the street with less interference from traffic. Bike lanes typically run in the same direction as motor vehicle traffic, but may be configured in a contra-flow direction for short distances on low-traffic corridors where bike route connectivity is needed. Lanes typically run along the right-side of the street, but may be placed on the left side of one-way streets to reduce conflicts with parked cars, buses and right-turning vehicles. Two-way bike lanes should be placed on the left side of a one-way street.

Source: www.pedbikeimages.org

Pavement Markings Guidance (AASHTO, MUTCD):

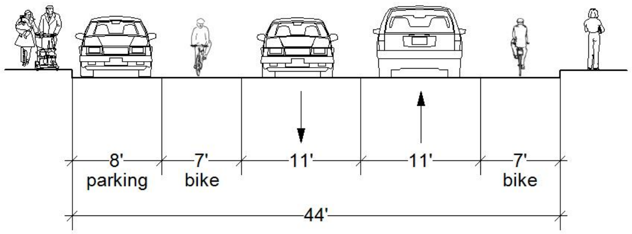
<table>
<tr><th></th><th>Best Practice</th><th>Standard</th><th></th></tr>
<tr><td>Bicycle Lane (with traffic & Contra-Flow)</td><td colspan="2">Striping: 4-6-inch solid white line between bike lane and travel lanes
Marking: Bike lane word, symbol, and/or arrow markings (MUTCD Figure 9C-3) shall be placed to define the bike lane at the beginning of the bike lane, at the approach and far side of all bike path and arterial crossings, and at the beginning and end of bike lane pockets at intersection approaches.
Spacing: Bike lane markings should be placed as frequently as every 100 ft. on corridors with many intersections and driveways, as well as frequent on-street parking turnover and curbside use. On corridors with little curbside activity and few intersections, marking intervals may be as much as 1,000 ft.</td><td rowspan="2">
</td></tr>
<tr><td>Extra Treatments: Contra-Flow Bicycle Lane</td><td>Buffer the striping or add physical separation to provide greater separation between motorists and bicyclists traveling in opposite directions</td><td>Standard double yellow centerline marking between contra-flow bike lane and travel lane to prohibit passing in both directions</td></tr>
</table>

Pavement Markings Dimensions (AASHTO):

Placement	Best Practice	Minimum	Option	
Between travel lane and parking lane	6 ft adjacent to 8 ft parking lane. [5]	5 ft	6-8 ft width is recommended on roadways with high bicycle use, high parking turnover, high-volume or high-speed traffic.	
Between travel lane and curb, street edge or vertical surface (no parking)	6 ft	4 ft [6]	4 ft width permissible on extremely constrained, low-speed roadways without curbs, where preferred bike lane width cannot be achieved despite narrowing all other travel lanes to their minimum widths	
Contra-flow on one-way street	7 ft	5 ft	4 ft permissible (see above conditions)	

[5] Bike lane should be sized so that cyclist can ride 11’ from curb, the same as the sharrow marking. With wider or narrower parking lanes the bike lane grows or shrinks accordingly. When bike lane is wider than 6’, the portion adjacent to the travel lane should be hatched.
[6] Measured from edge of gutter pan.

Cross Section and Plan View:



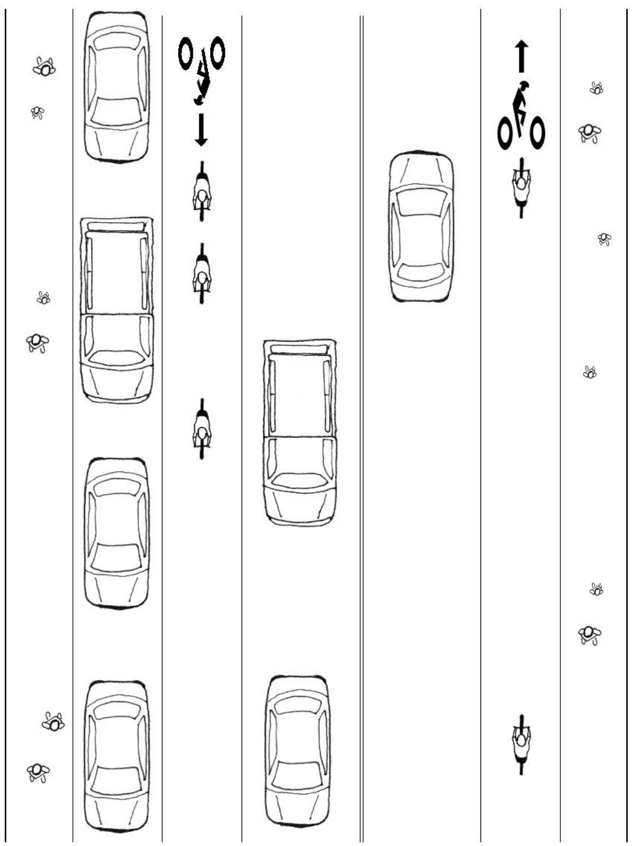


Photo Rendering:

3. On-Street Buffered Bicycle Lanes

A conventional on-street bicycle lane with a designated buffer space separates the bicycle lane from motor vehicle travel lanes and/or parking lane. The buffer provides greater shy distance between bicyclists and passing motor vehicles and encourages bicyclists to travel on towards the left side of the lane which is outside the door zone.[7]

Pavement Markings Guidance:

The combined width of the buffer and bike lane should equal at least the total bike lane width required in the bike lanes section. If a buffer is used, the bike lane can be slightly narrower since the buffer effectively becomes part of the bike lane. Thus a 3 foot buffer can be used next to a 4 foot lane, for a total bike lane width of 7 feet. In areas with a lot of bike ridership, the bike lane should be 7 feet with a 2-3 foot buffer. The buffer must be at least 2 feet wide, as it is impractical to stripe a narrower buffer.

Pavement Marking Dimensions:

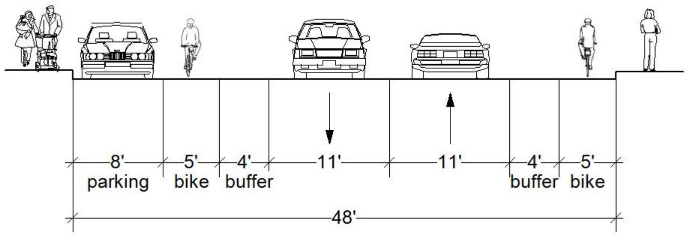
	Buffer Dimensions	
Placement	Best Practice	Standard
Between Bike Lane and Parking Lane	2.5 ft	2 ft
Between Bike Lane and Travel Lane	6 ft	3 ft

Buffered Bicycle Lane

Source: www.pedbikeimages.org

[7] Note: some jurisdictions choose to place buffers between the bike and parking lane; however this guide recommends buffers between the bike and travel lane.

Cross Section and Plan View:



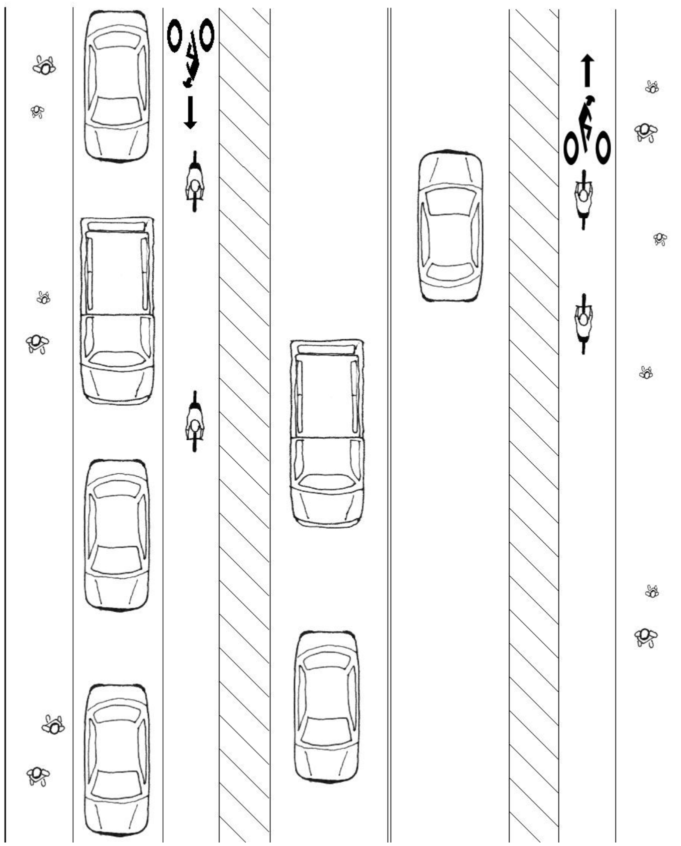


Photo Rendering:

4. Cycle Tracks and Paths Adjacent to Roadway

Bicycle facility that is separated from motor vehicle travel lanes by bollards, parking, curbs and/or medians. Cycle tracks can be one-way or two-way, placed on one or both sides of a street. Two-way bike lanes should be placed on the left side of a one-way street. Where on-street parking is present, the cycle track is placed between the parked vehicles and the sidewalk, reducing the risk of conflict between bicyclists and car doors. Major intersections should be signalized with separate cycle track signal phases and cycle track crossings should be marked to increase their visibility. Cycle tracks should be marked in the same manner as bicycle lanes.

Cycle track buffered by trees

Two-way cycle track

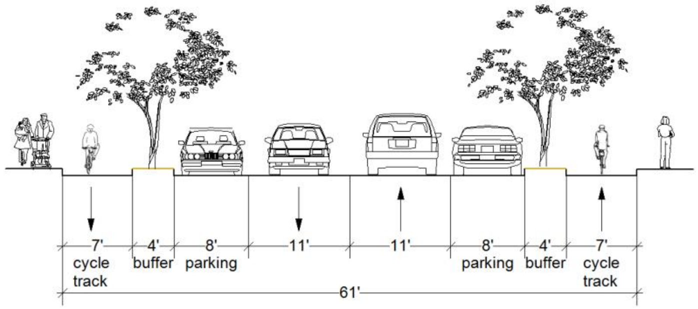
Pavement Markings Guidance and Dimensions (CROW, NACTO, AASHTO):

	Lane Dimensions			Buffer Dimensions		
Type	Best Practice	Standard	Option	Best Practice	Standard	Option
One-way Cycle Track	7 ft (or wider on high-volume corridors)	5 ft	4 ft. minimum width in constrained locations with appropriate warning signage	Wider buffers are desirable to further separate bicyclists from high-speed and high-volume motor vehicle traffic	When protected by a parking lane, 3 ft minimum buffer between cycle track and parking lane to avoid vehicle door collisions	Where distance is less than 5 ft between cycle track and travel lane, a barrier (bollards) or railing should be installed at least 42 inches high
Two-way Cycle Track	12 ft (or wider on high-volume corridors)	12 ft	8 ft. minimum width in constrained locations with appropriate warning signage			

Signage Examples for Bicycle Lanes, Buffered Bike Lanes, and Cycle Tracks

Standard bicycle lane sign. Spacing of signs should be determined based on bicycle volumes, traffic volumes, and distance from intersections. Bike lane signs are used less frequently then bike lane markings; where signs are used, they should be placed adjacent to the pavement marking.	"No Parking" signs to prohibit parking within the bike lane.	A "ONE WAY" sign (MTCD R6-1, R6-2) with "EXCEPT BIKES" plaque shall be posted along the facility and at intersecting streets, alleys, and driveways informing motorists to expect two-way traffic.	
			A "DO NOT ENTER" sign (MUTCD R5-1) with "EXCEPT BIKES" plaque should be posted along the facility to only permit use by bicycles.

Cross Section and Plan View:



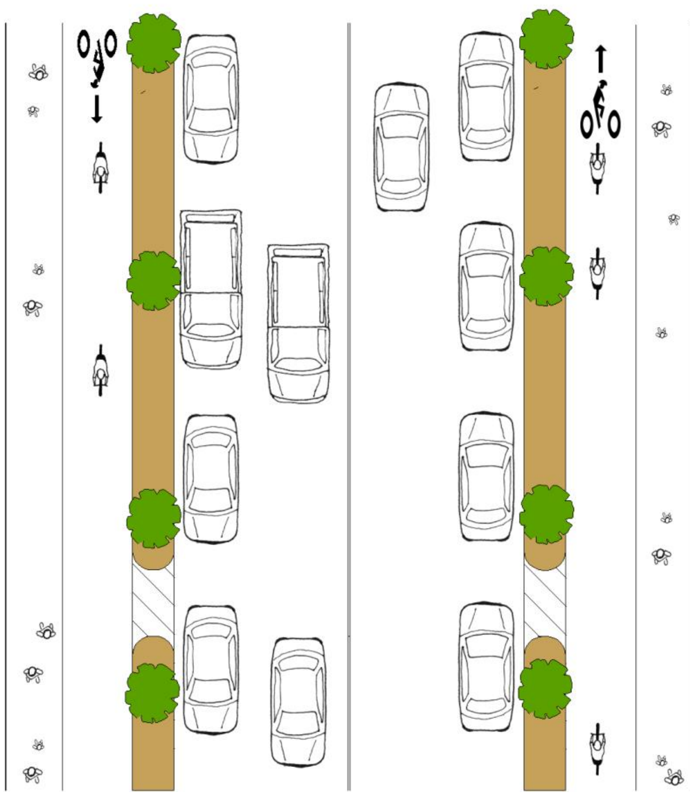


Photo Rendering:

5. Bicycle Boulevards

A roadway that prioritizes bicycle traffic over motor vehicle traffic. Bicycle boulevards are distinguished with uniform signage and pavement markings that identify the street as a shared space. Traffic calming measures are often used to maintain low motor vehicle volumes and speeds. Non-local motor vehicle traffic is discouraged from using bicycle boulevards through diverters, such as partial street closures and forced right-turn treatments, which direct motorists to nearby arterial routes, but allow bicyclists to continue through.

Source: www.pedbikeimages.org

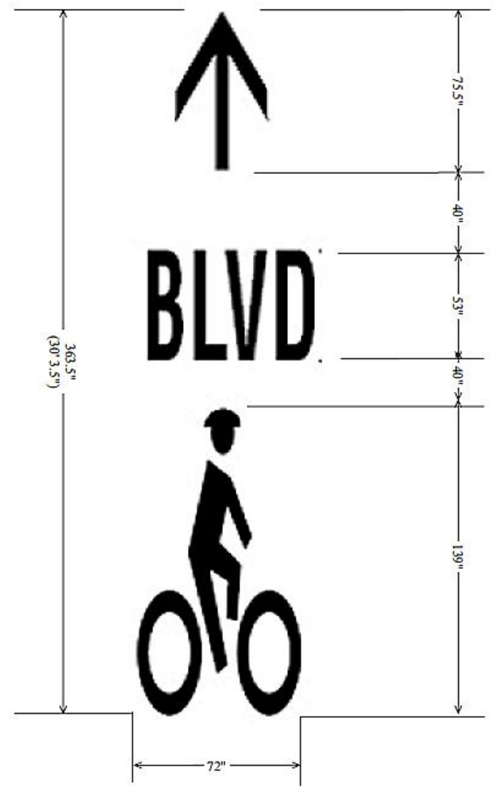
Pavement Markings Guidance:

Install bike boulevard markings after each intersection and at intervals of approximately 200 feet. Sizes range from 1 ft by 2 ft to 6 by 30 feet and can be applied with paint or thermoplastic, which has a longer lifespan.

Pavement Markings Examples:

Source: Bicycle Boulevard Planning & Design Guidebook

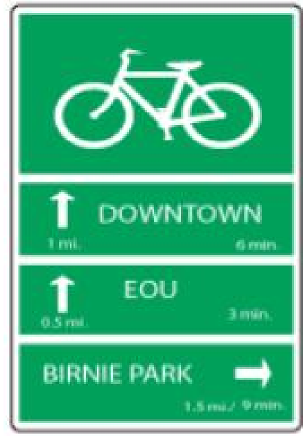
Pavement Markings Dimensions:



Signage Guidelines:

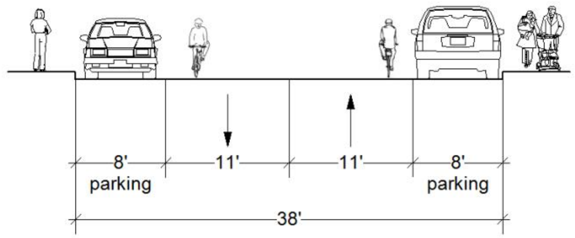
- Identification Signs - place as needed at major intersection to inform all roadway users that the street is a bicycle boulevard
- Wayfinding Signs - place as needed at intersections and mid-block locations to direct cyclists along bicycle boulevard. Also can provide information to major destinations
- Traffic Control (signals and signs) - install as needed to regulate traffic at intersections and to prioritize traffic flow along the bicycle boulevard

Signage Examples:



Source: *Bicycle Boulevard Guidebook*

Cross Section and Plan View:



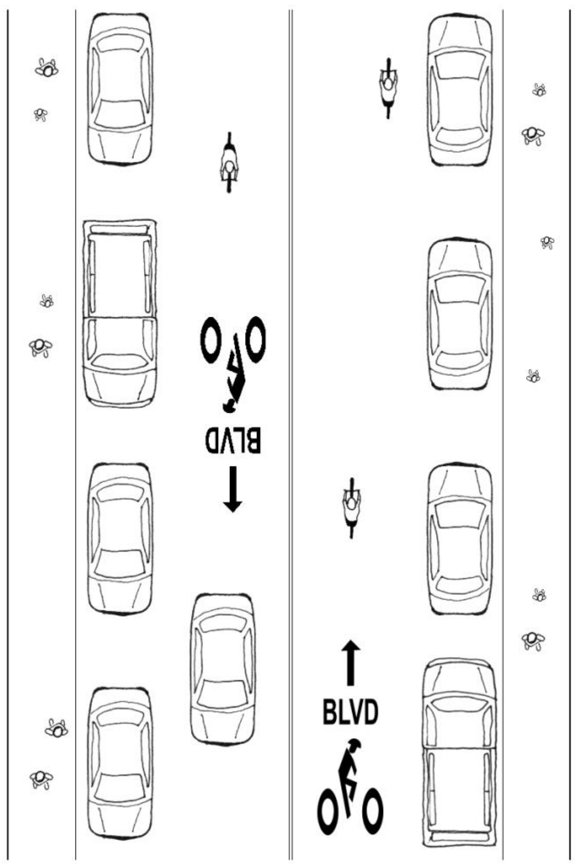


Photo Rendering:

6. Paths and Trails

A bike path or trail[8] is physically separated from motor vehicle travel lanes by an open space or barrier. Paths and trails are typically designed for two-way travel.[9]. Intersections and crossings require specific bicycle treatments such as signals, signs and striping. It is important to establish priority (for cyclists or drivers) in the design of the junctions and to accommodate cyclists riding with traffic and those using the crosswalk to cross.

Source: www.pedbikeimages.org

Since paths are removed from the roadway, they require their own lighting source. Pedestrian-scale lighting is preferred to tall, highway-style lamps. Pedestrian-scale lighting is characterized by shorter light poles (lamps at 15 ft high), lower levels of illumination (except at crossings), closer spacing (to avoid dark zones between luminaires), and high pressure sodium vapor or metal halide lamps. Metal halide lamps produce better color rendition ("white light") than sodium vapor lamps and can facilitate user recognition in areas with high travel volumes of night.

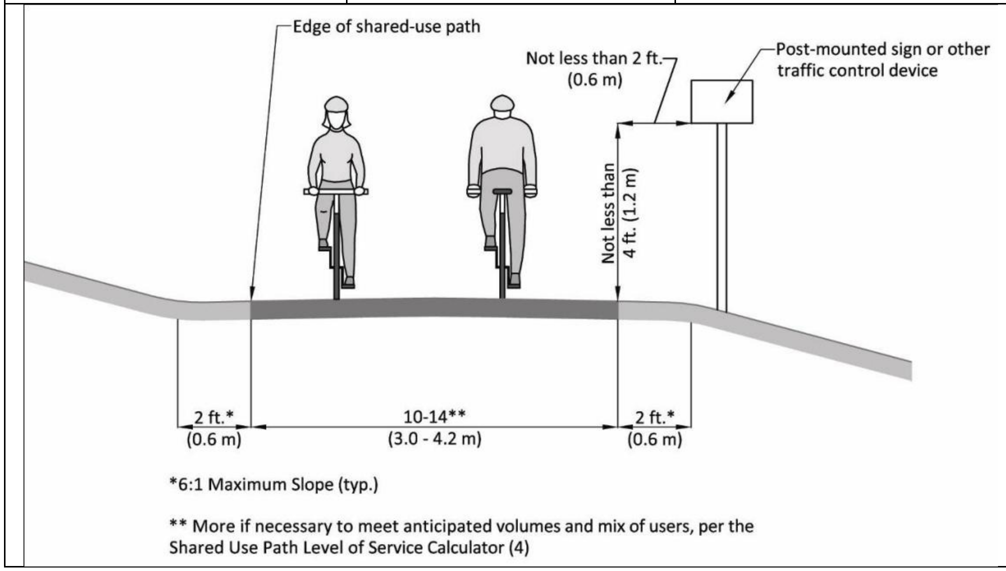
Signage Options for Shared-Use Paths

Following are examples of some regulatory signage.

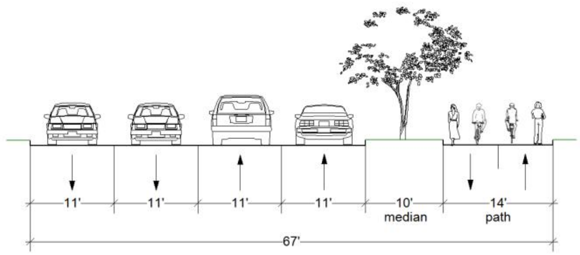
[8] Shared use facility is the name officially used in US documentation to note that these facilities are open to people on bikes, on horses, skateboards, etc.; however common parlance continues to be bike paths and trails.

[9] Paths will almost always be used for two-way travel, regardless of designation, and should be designed accordingly. It is possible to have a one-way path in locations where the opposite direction path is nearby, such as on the other side of a linear park. One-way paths placed on opposite sides of a large roadway force some cyclists to cross the road twice and for this reason should not be used.

Pavement Markings Guidance and Dimensions (AAHSTO):

<table>
<tr><th></th><th colspan="3">Path Dimensions</th><th colspan="3">Distance From Roadway</th></tr>
<tr><th>Type</th><th>Best Practice</th><th>Standard</th><th>Option</th><th>Best Practice</th><th>Standard</th><th>Option</th></tr>
<tr><td>One-way Path</td><td>--</td><td>6 ft</td><td>--</td><td rowspan="3">Wider buffers are desirable to further separate bicyclists and pedestrians from high-speed and high-volume motor vehicle traffic</td><td rowspan="3">5 ft</td><td rowspan="3">Where distance is less than 5 ft, a barrier or railing should be installed at least 42 inches high</td></tr>
<tr><td>Two-way Path</td><td>14 ft</td><td>10 ft</td><td rowspan="2">8 ft minimum width may be used for short distances due to physical constructions such as a bridge abutment, utility structure or fence with appropriate warning signs for the narrow pathway.</td></tr>
<tr><td colspan="3">
</td></tr>
</table>

Cross Section and Plan View:



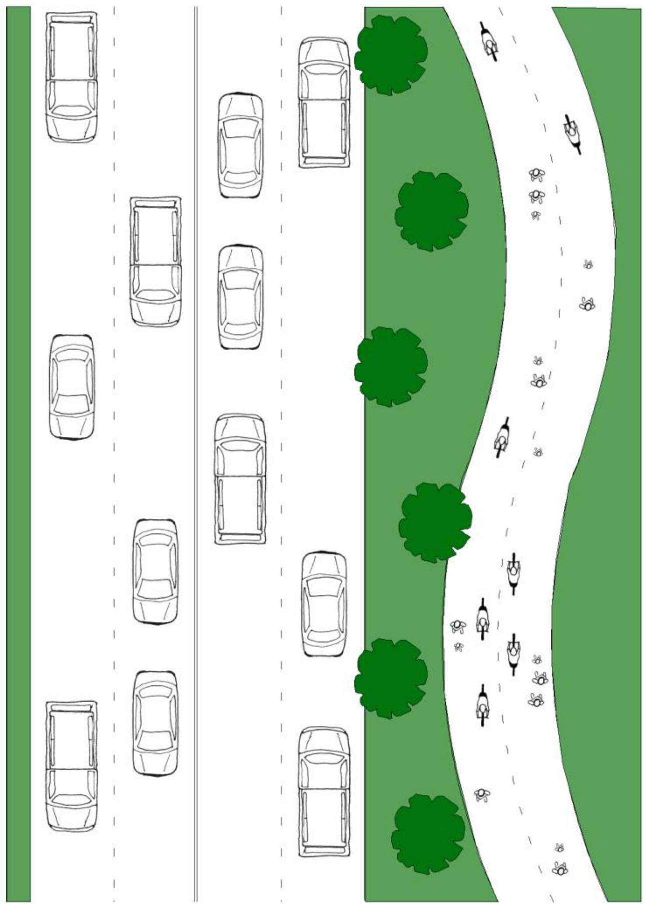


Photo Rendering:

Intersection Treatments

A. At Signals

These treatments facilitate cyclists crossing intersections.

1. Advanced Stop Line/Bike Box

A designated area at a signalized intersection where bicyclists pull in front of waiting traffic during the red signal phase. The bike box is designed to reduce conflicts with motor vehicles by allowing bicyclists to position themselves more visibly and to get a head start through the intersection when the traffic light turns green. If extended across all travel lanes in a given direction, bike boxes can assist bicyclist making left turns and transitioning from a right-side bike lane to a left-side bike lane. Bike boxes can be utilized in conjunction with bike signals.

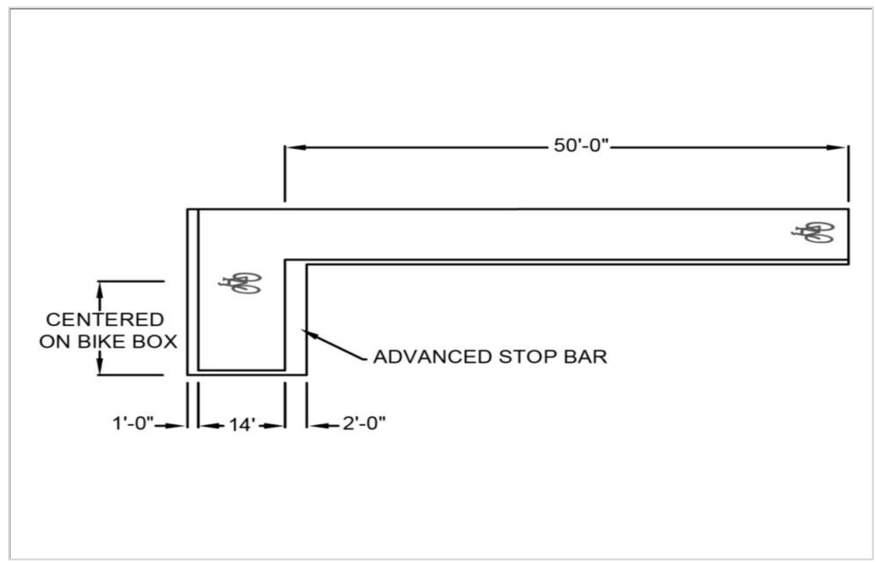
Source: www.pedbikeimages.org

Pavement Markings Guidance

Bicycle Box should be used when:

- At signalized intersections with high volumes of bicycles and/or motor vehicles
- Where there may be right or left-turning conflicts between bicyclists and motorists.
- Where a left turn is required to follow a designated bike route, access a shared-use path, or when the bicycle lane moves to the left side of the street.
- When the dominant motor vehicle traffic flows right and bicycle traffic continues through (such as a Y intersection or access ramp).

Pavement Markings Dimensions

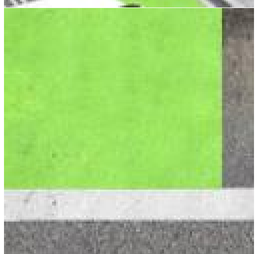


Pavement Markings Guidance (NACTO):

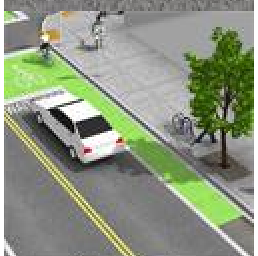
Best Practice

A "Stop Here on Red" sign with "Except Bicycles" plaque should be installed at the vehicle stop line to reinforce the bike box

Use colored pavement for to discourage motorist encroachment



An ingress lane should be used to define the bicycle space. If color is used, length shall be 25 to 50 feet to guarantee bicycle access to the box



An egress lane should also be marked to guide the cyclist through the intersection and back into the bicycle lane

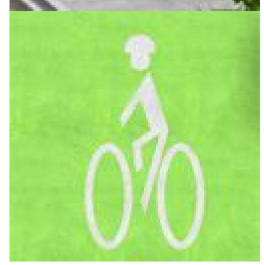
A "Yield to Bikes" sign should be posted in advance and adjacent to the bike box to reinforce cyclist right of way

Standard

Box should be 10-16 ft deep

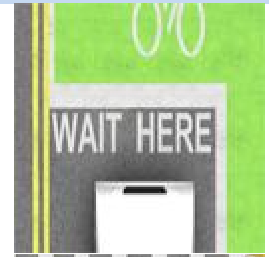
Install “No Right Turn on Red” signage above signal to prevent vehicles from encroaching into the bike box

A bike symbol (MUTCD 9C-3A) or helmeted bicyclist symbol (MUTCD 9c-3B) pavement marking should be centered in the bike box between the crosswalk and stop line



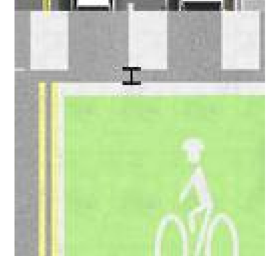
Other Options

“Wait here” marking can be placed on pavement; however, it need not be repainted the following year



The stop line can be pulled back as far as 7 ft from the bike box to limit vehicle encroachment

Leave a small buffer between the crosswalk and the bike box to prevent cyclists from conflicting with pedestrians



Pair bike box with bike signal and Leading Pedestrian Interval

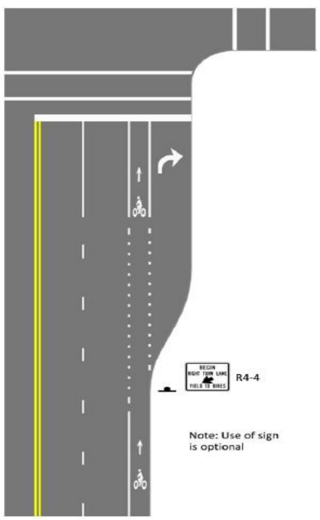
B. Approaching Signals

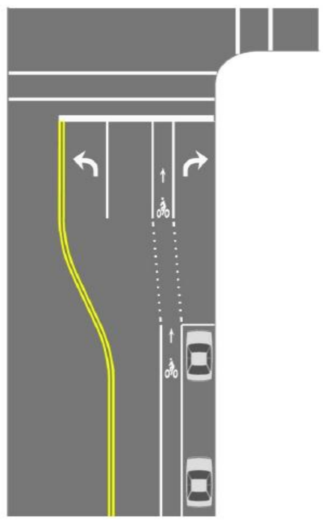
1. Turn Lanes

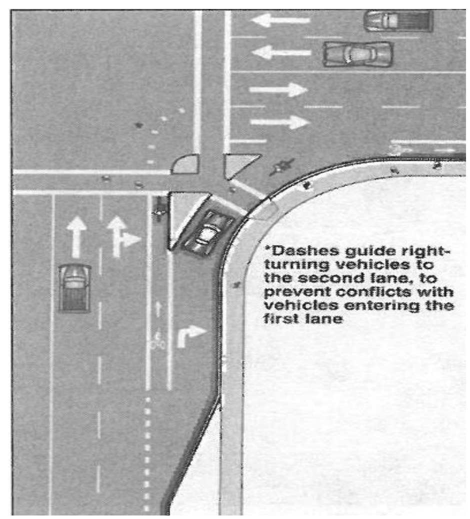
As cyclists approach intersections, facilities should be designed to clearly separate left turning, right turning, and through vehicle and bicycle traffic. The diagrams below show examples of how to channel turning and through cycling traffic. At right turns, the bicycle lane should be dashed to show where vehicles may cross, then continue as solid lines. Cyclists turning right may share the auto right turn lane.

At left turns where there is one through lane, the left turn lane for cyclists may be striped next to the vehicle lane. In cases where there are two or more through lanes, only very experienced cyclists may be able to navigate across multiple lanes of traffic into the turn lane. At these junctions, cyclists may cross with pedestrians in two phases, or experienced cyclists can navigate into the auto left turn lane.

Right Turn Lane Options







Left Turn Lane Options

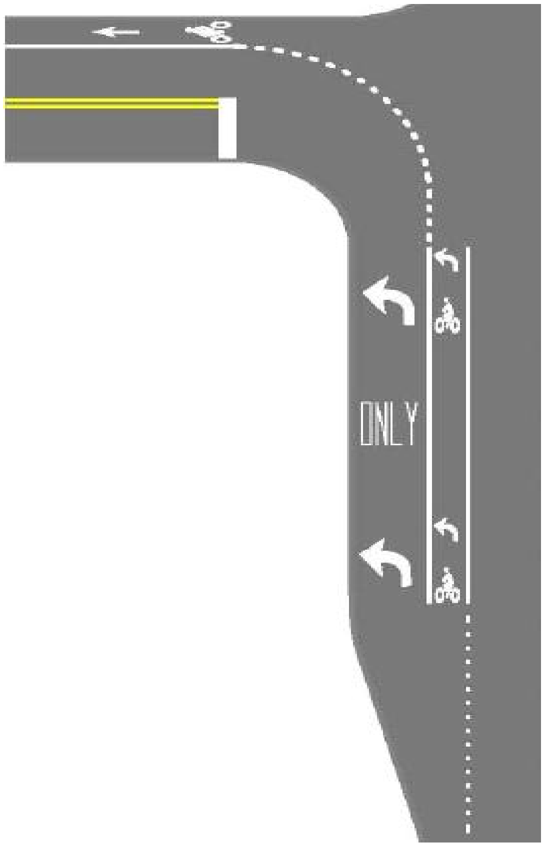


Photo Rendering: Left Turn Lane Markings

2. Colored Lanes

Coloring can be applied in bicycle lanes and cycle tracks to increase visibility of the facility and reinforce the presence of bicyclists. Colored or painted pavement can be applied to the entire length of bicycle facilities, but is more often used to highlight potential conflict areas, including intersections and driveways where motorists are expected to yield right of way. Limiting color to conflict points is more economical, as well.

Benefits:

- Promotes the multi-modal nature of a corridor.
- Increases the visibility of bicyclists.
- Discourages illegal parking in the bike lane.
- Increases bicyclist comfort though clearly delineated space.
- Helps reduce bicycle conflicts with turning motorists.

Usage:

- Across turning conflict areas such as vehicle right turn lanes.
- Across intersections, particularly through wide or complex intersections where the bicycle path may be unclear.
- Across driveways and Stop or Yield-controlled cross-streets.
- Color may be applied along an entire corridor, with gaps in coloring to denote crossing areas.

Design Guidance:

- Standard white bike lane lines should be used on either side of the pigmentation
- Maintaining the bike lane markings should be prioritized

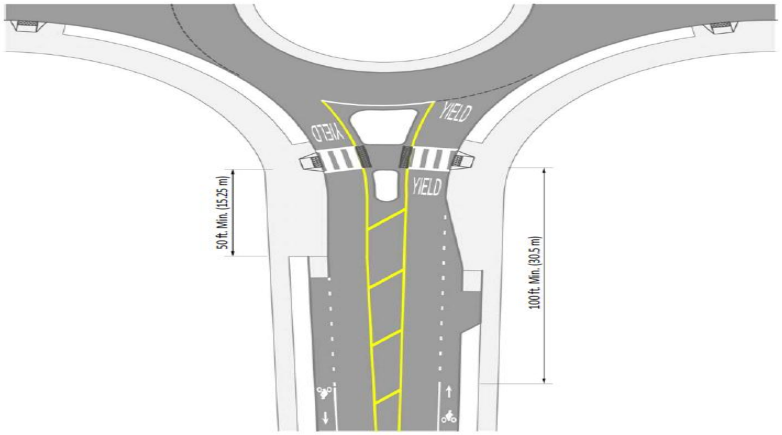
Photo Rendering

C. Roundabouts

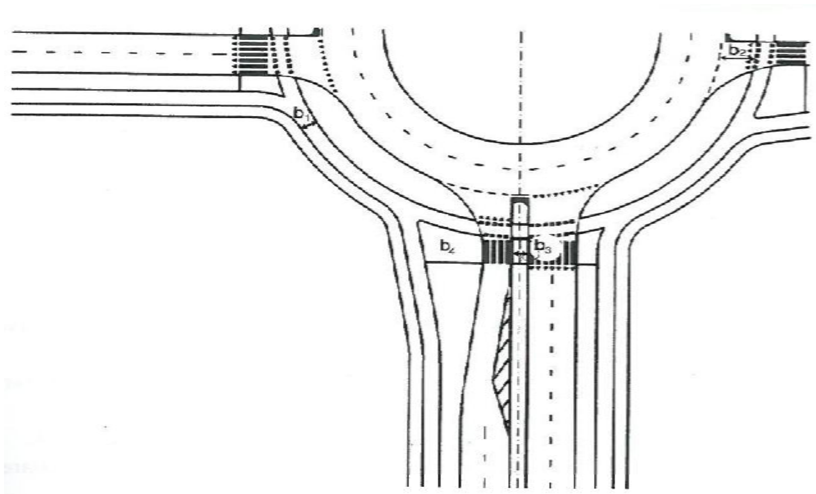
To avoid turning conflicts at entrances and exits, bicycle lanes should not be placed in the circulatory roadway of roundabouts. On the roundabout approach, bicycle lanes should be tapered to merge bicycle traffic with motor vehicle traffic prior to entering the circulatory roadway of a roundabout. It is recommended that bicycle lanes be tapered at a rate of 7:1 to accommodate a design speed of 20 mph. (e.g. a 40 foot long taper is recommended for a 5 to 6 foot wide bicycle lane). To encourage bicyclists to merge into traffic at a convenient opportunity, the bicycle lane should be dotted for 50 to 200 ft in advance of the taper.

At roundabouts with 2 or more circulating lanes, a cycle track should be provided outside the roundabout (b_1). Distinct crossing facilities are required adjacent to the crosswalks.

1. One-Lane Roundabout (AASHTO)



2. Two-Lane Roundabout (CROW)



III. Pedestrian Facility Toolbox

This section contains detailed guidance on the design of pedestrian facilities on the street and at intersections.

A. Pedestrian Facilities by Street Type

The table below shows the elements that should be included during design and implementation based upon the traffic and land use characteristics of each street type. For example, a Rural Road probably doesn't need waiting areas as there would be no transit service; however, it still requires a throughway and crosswalks. Refuge islands should be considered on wide roads like Suburban Boulevards, but likely aren't needed on low-speed and low-volume Residential Streets.

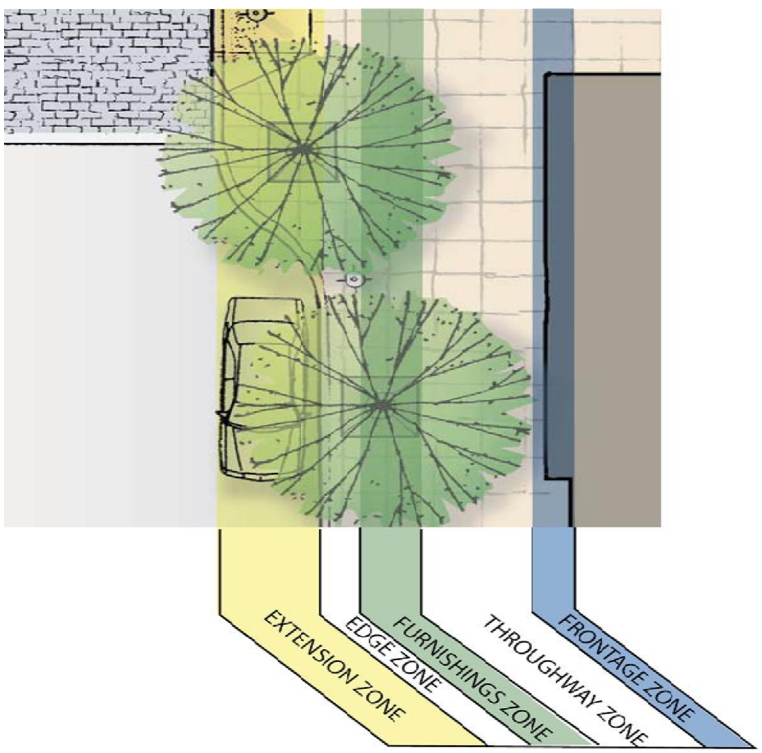
	A	B	C	D	E	F	G
	Expressway	Rural Road	Suburban Boulevard	Strip Avenue	Office Park, Industrial Collector	Urban Avenue	Suburban Residential Street
Frontage	X (if path exists)	X	X	X		X	
Throughway		X	X	X	X	X	X
Edge/Furnishing				X	X	X	X
Waiting Areas				X	X	X	X
Crosswalks		X	X	X	X	X	X
Refuge Island		X	X	X			
Pedestrian Signals		X	X	X	X	X	X
HAWK				X		X	X
Signing		X	X	X	X	X	X
Pedestrian Potential	1	1	1	2	3	4	4

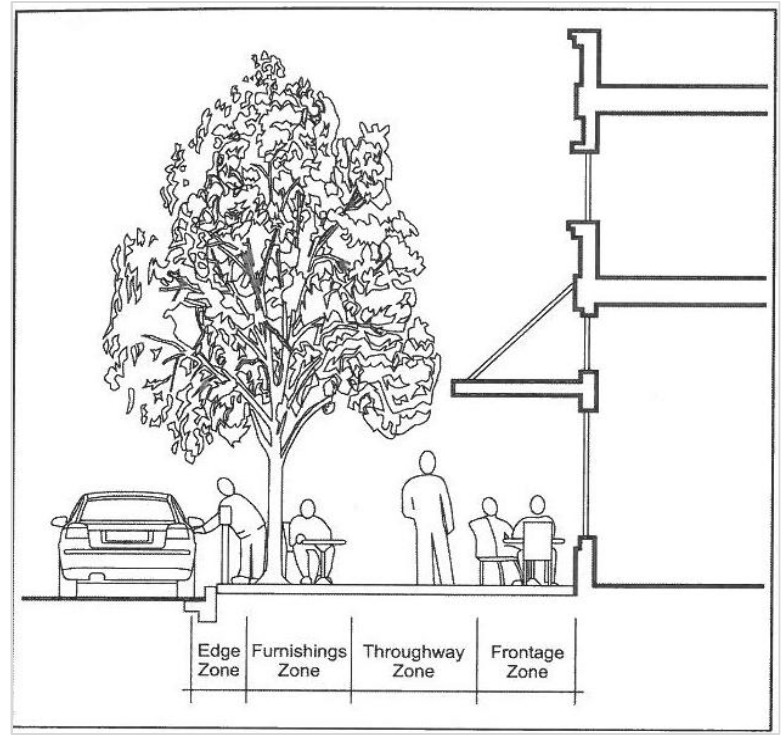
Several best practices and design guides were consulted in creating this toolbox, including:

- AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities*. July 2004.
- ITE. *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*. 2010.
- FHWA. *Designing Sidewalks and Trails for Access*. 2001.
- New York City Department of Transportation. *Street Design Manual*. 2010.

Facilities along the Street

The sidewalk corridor includes not just where a concrete sidewalk is present, but also the entire width from the curb or road edge to the property line. The graphic below shows the different areas of the pedestrian realm according to the “zone system.” When installing new pedestrian facilities or upgrading existing ones, ensure compliance with the Americans with Disabilities Act. All design standards in this section meet or exceed ADA. Pedestrian facilities should always be installed on both sides of the street, except it applications where people are expected to walk in the street (aka shared space) such as a residential cul-de-sac, park roadway, or commercial pedestrian mall that has occasional service traffic.





The following is an overview of the dimensions of each zone. Note that these dimensions can vary based on particular conditions at each site, which is discussed in detail below.

	Residential	Standard	Commercial (Retail)
Extension Zone	If on-street parking is present – 5-8 ft		
Edge/Curb Zone	0.5 ft	0.5 ft	2 ft
Furnishings Zone	4.5 ft	3 ft	5 ft
Throughway Zone	6 ft	5 ft	10 ft
Frontage Zone	4 ft*	1.5 ft	3 ft
Total Sidewalk Corridor	**15 ft**	**10**	**20 ft**

** Frontage is likely wider than 1 ft, expanding sidewalk corridor*

Extension Zone

This area includes the on-street parking lane, which can become a pedestrian facility at intersections and midblock crossings – to be discussed in the intersections section.

Edge/Curb Zone

This area is the interface between the traveled way and the furnishing zone. It is part of the road drainage system and separates vehicle and pedestrian traffic. For those with visual impairments, the curb indicates the border between the sidewalk and the roadway. It provides space for the clearance of bus and truck mirrors as well as space for vehicle overhang when people are parking. When on-street parking is present, room in the edge zone should be left for passengers to open car doors, or in the case of back-in-angle parking, for the rear of the vehicle to hang over the curb.

	Dimension
Minimum	6 inches
On-Street Parking	1.5 ft
Back-in Angle Parking	2.5 ft

Furnishing Zone

The furnishing zone, also known as the furniture zone, is the place where pedestrian amenities and street infrastructure are placed. This zone can be paved or planted. When right-of-way is available, the furniture zone should be increased beyond the standard size.

Furniture/Planting Zone Variations	
Standard	2 ft
Residential Area	2.5 ft
On-Street Parking Present	3 ft-can overlap some with Edge Zone
Commercial with Ground Floor Retail	3.5 ft
Areas with a lot of snow	6 ft

Furnishing Zone Infrastructure Examples:

- Fire hydrant
- Traffic Signs
- Light poles and Utilities

Furnishing Zone Pedestrian Amenity Examples:

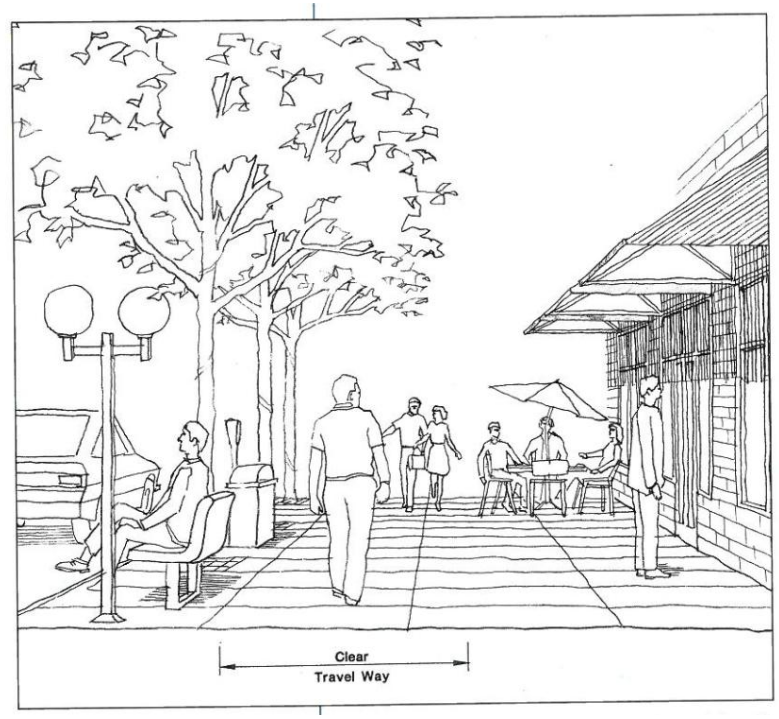
- Bench
- Wayfinding signage
- Trash Cans
- Taxi Stands
- Bus stop and shelter
- Trees and Landscaping
- Newspaper Boxes
- Pay Phone

Throughway Zone

The throughway zone is the place for pedestrian travel. It should be completely free of obstacles and protruding objects, and should be at least 5 ft wide with enough space for two pedestrians to walk side by side comfortably. In commercial zones, the throughway zone should be 6 feet wide. The pedestrian zone should never be less than 3 feet; this is the width required to meet ADA guidelines for the "minimum needed for accessible travel."[10]

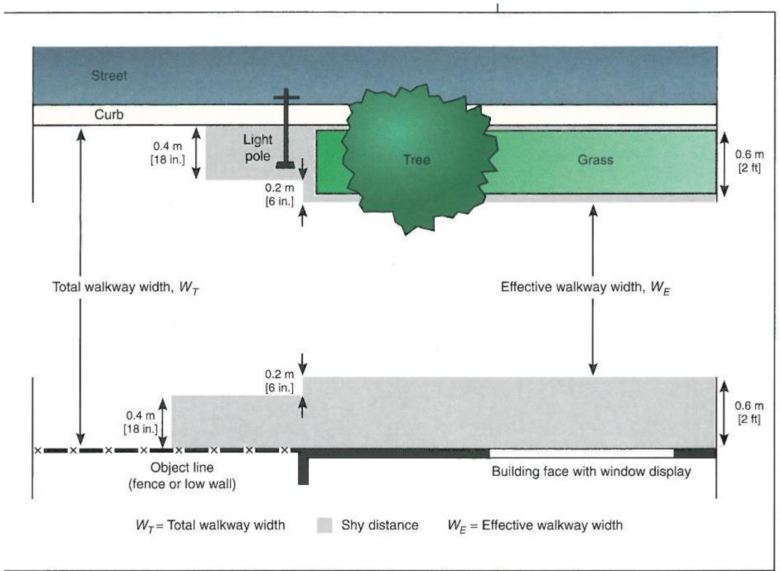
Effective Width

An important concept of the throughway zone is the effective width of the traveled way. People do not walk right up against a tree or a building, thus the useable portion of the sidewalk is net of the "shy distance" people leave between themselves and objects in the furnishing and frontage zones.



[10] Full text of ADA can be found at : http://www.access-board.gov/prowac/guide/PROWGuide.htm#3_2_1

Effective Width Dimensions



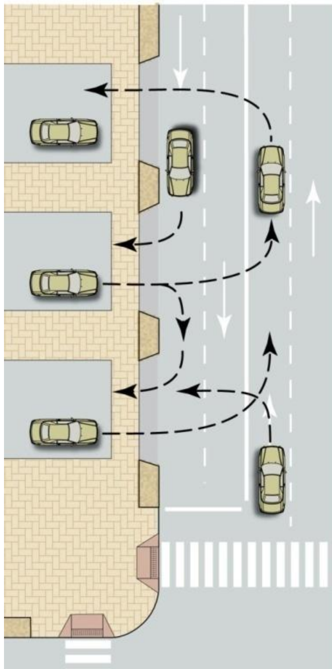
Building shy distance

Driveways and Curb Cuts

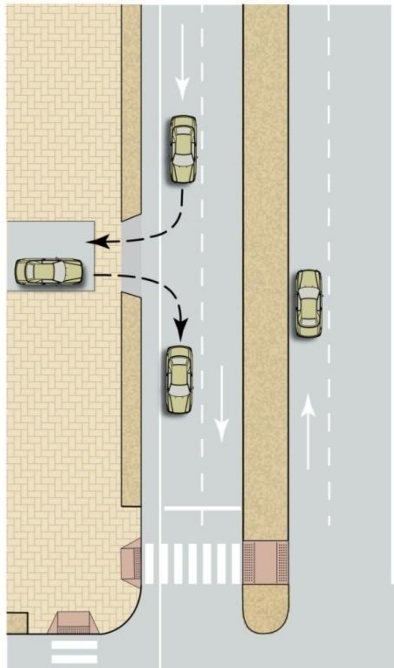
Driveways provide access in and out of private property. The driver is required to yield to pedestrians; however, that does not always happen, in large part due to the design of driveways. The number of driveways should be minimized, with one driveway providing access to several businesses. This is a concept called “access management.” Driveways should not be located near intersections or at bus stops. The New Jersey Department of Transportation recommends driveways at a minimum of 100 feet from the curb cut in the vicinity of signalized intersections on a 35 mph speed limit road.[11] When driveways are installed, the sidewalk material should be dominant over driveway material, as shown below. The area should also be maintained at sidewalk level so that people do not have to walk up and down and so that drivers are slowed by the ramp as they enter the driveway. This is consistent with ADA guidance.[12]

[11] NJ State Highway Access Management Code. Title 16, Chapter 47, Page 26,
[12] ADA states that cross-slope should be no more than 1:48 or 2 percent. Steep cross slope forces people to expend energy that should be used in forward motion into fighting the perpendicular force pulling them toward the road.

Access Management Principles



This driveway is sloped and dominant over the sidewalk



This driveway ramps up to sidewalk level & uses sidewalk material

Frontage Zone

The frontage or door zone is the space between the edge of the throughway zone and the property line. The frontage zone might contain stoops, shop displays, restaurant seating, or landscaping. The shy distance from buildings should also be included in the frontage zone. In more suburban areas, often times the frontage zone is quite large due to the wide building setback. Some areas have begun to create frontage zone maximums in order to encourage more street-fronting development.

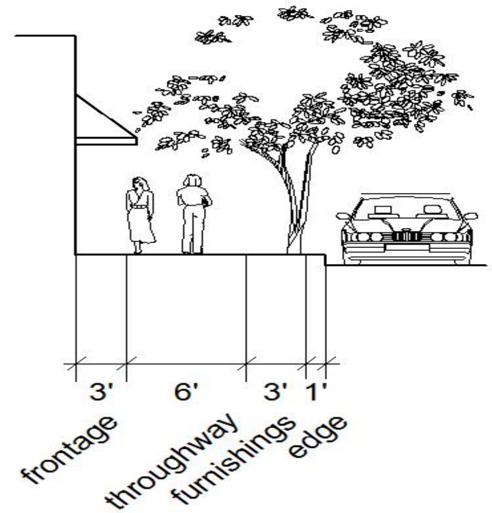
Frontage Zone Variations	
Residential Area	1 ft
Commercial with Ground Floor Retail	2 ft
If 2.5 ft of open space is available between the sidewalk corridor and property line	No frontage zone required

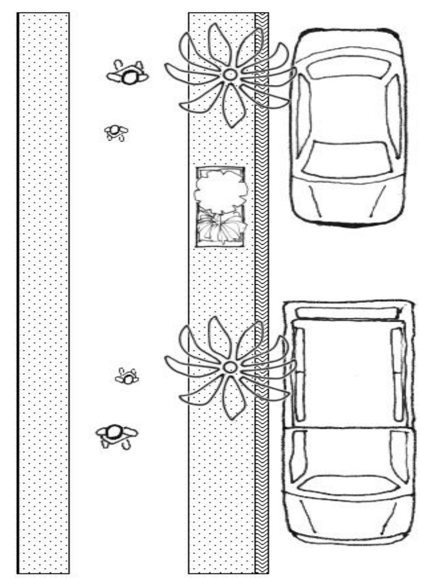
Frontage zone where property line abuts sidewalk

Wider frontage zone in more suburban areas

Sidewalk zones in Hamilton

Cross Section & Plan View:





Waiting Areas

Great places invite people to linger by providing a safe, secure, and comfortable environment. Amenities for pedestrians include:

- Information – signage and wayfinding
- Lighting – pedestrian-scaled (15 foot lamps spaced every 50 feet) using white light or LED
- Places to sit
- Trees – every 20-30 feet[13]
- Landscaping

Bus Stop s

When bus stops are present, enough space in the edge and furnishing zones must be allocated to allow space for passengers to wait, a shelter if possible, and an ADA compliant wheelchair lift clearance area. At the same time, the minimum throughway zone must be maintained. The boarding area can also be provided by extending the curb into the extension zone.

Bus stop accessibility

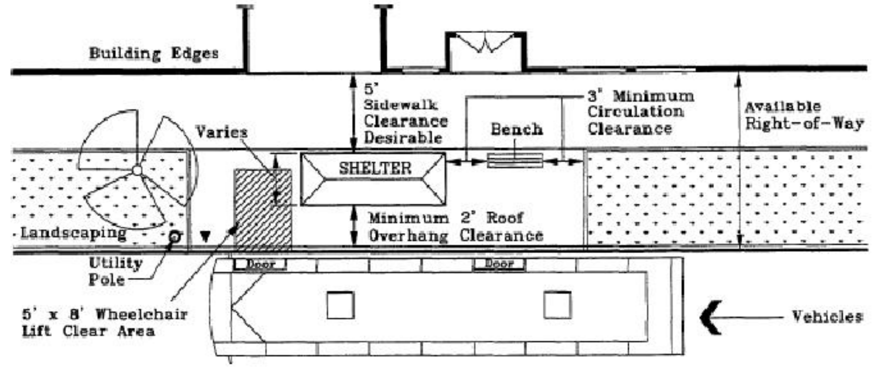
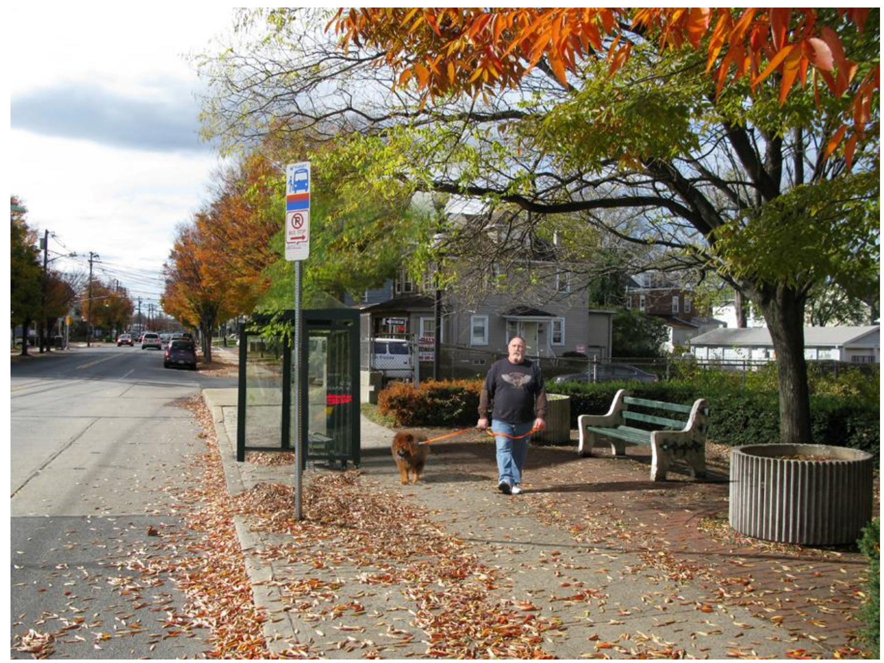


Photo rendering



[13] The NJDOT Roadway Design Manual: Section 15 Pedestrian Facilities draft from 2002 states that street trees should be no closer than 30 feet apart. Other research, such as Reid Ewing's "Pedestrian and Transit Friendly Design; A Primer for Smart Growth" recommends trees spacing of *no more than* 30 feet. The closer the tree spacing, the fuller the canopy effect. Trees may be planted closer together then 30 feet depending on the species. Street trees should have a mature height of 50-70 feet, with a canopy starting 15 feet above the ground. See www.epa.gov/smartgrowth.pdf/ptfd_primer.pdf, page 13.

Intersection Treatments

At intersections, pedestrians are exposed to vehicle traffic as they cross the street. This exposure time, either temporally or spatially is the point at which pedestrian and vehicle crashes occur. The design of all junctions and crossings should seek to minimize this exposure time. In doing so pedestrians, as the most vulnerable road user, are prioritized.

1. Crosswalks

Crosswalks are the portion of the roadway designated for pedestrian use while crossing the street. Crosswalks are implied, whether they are striped or not. Crossings can take place at an intersection or midblock.

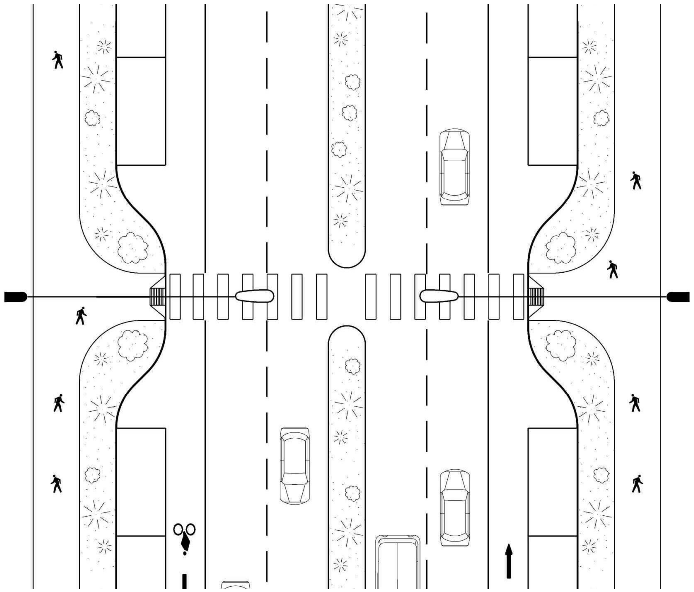
Pavement Marking Guidance:

Ladder style crosswalks have been shown to be the most visible to motorists. While lines are striped at a 90 degree angle to the crossing line. The crossing lines should be aligned with the most direct pedestrian crossing. Each line should be 6-24 inches wide and spaced 12-24 inches apart. The line length should be at least 6 feet minimum at all locations and 10 feet in commercial areas or places with high levels of pedestrian activity. Other styles included in the MUTCD are parallel lines and zebra markings. Crosswalks should not be used at uncontrolled locations where speeds are 40 mph or greater. Crosswalk striping should always be white. Vehicle stop lines should be set back at a minimum of 4 feet and optimally at least 10 feet from the end of the crosswalk at signalized locations. At uncontrolled multi-lane locations, stop lines should be set back 20 to 50 feet. The vehicle stop line should be painted at a width of 1 to 2 feet wide across all approach lanes. Align with sidewalk.

Source: www.pedbikeimages.org

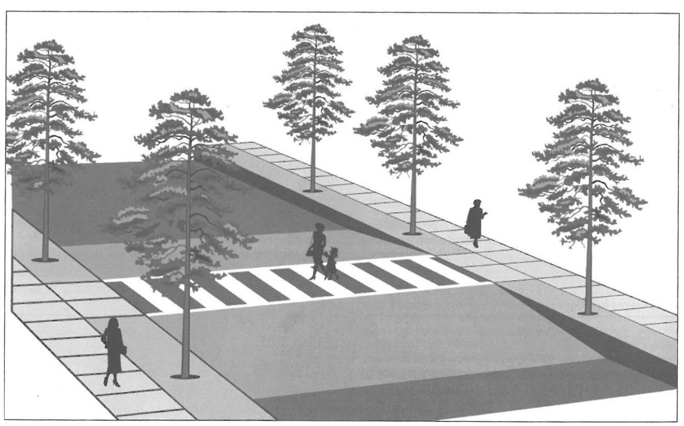
Midblock Crosswalk

When destinations are across from each other or when block lengths are long, midblock crossings may be required. Since midblock crossings may be counter to driver expectance, simply marking a crosswalk at a midblock location without supplementary signs or signals is not sufficient. Advance warning, overhead pedestrian crossing signs, and traffic signals are some of the devices that can enhance safety at a midblock crossing. In areas with on-street parking, restrict parking near the crosswalk, install curb extensions, and use highly visible crosswalk markings. Illumination should be provided at 1.5 to 2 times more than the normal roadway lighting level. Pedestrians should be provided with a crossing opportunity every 200 to 400 feet.



Raised Crosswalk

Raised crosswalks are typically used at midblock crossings, though they could be used at intersections as well.



Curb Ramps

Curb Ramps provide the transition from the sidewalk to the street, and benefit all users, especially those in wheelchairs, people pushing strollers or luggage, and children on bicycles. There are four basic elements to curb ramp design.

www.pedbikeimages.org

Curb Ramps

The grade should not exceed 8.33 percent except in special cases, with a cross slope no greater than 2 percent. The ramp itself (not counting the flared sides) should be 4 feet wide if possible and no narrower than 3 feet. A detectable truncated dome warning strip 2 feet wide must be placed along the full width of the ramp.[14]

Gutters

This is the point where the ramp meets the street. The counter slope may not exceed 5 percent.

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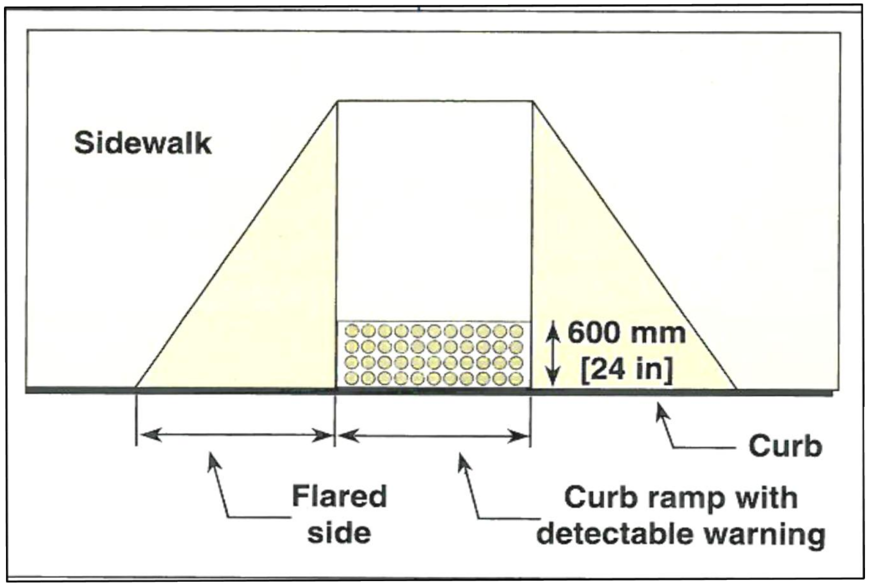
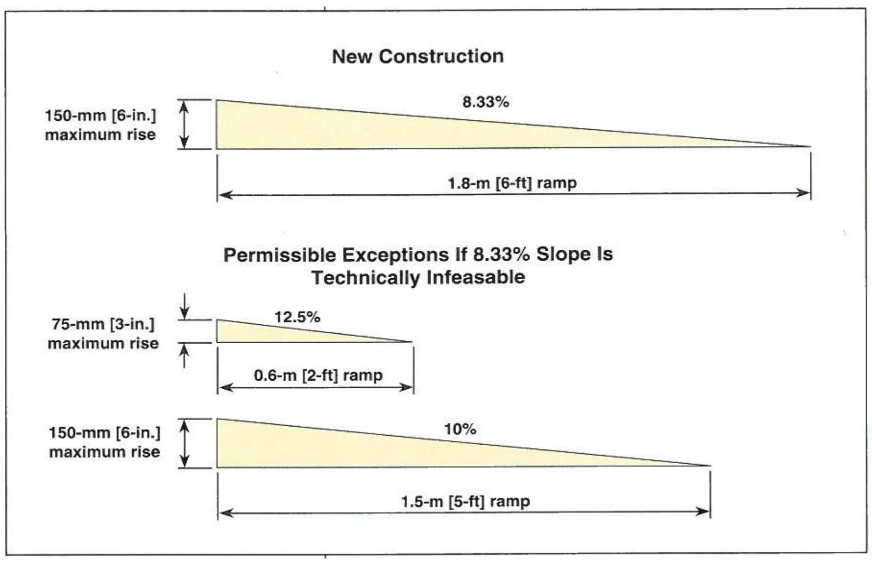
[14] Detailed guidance on curb ramp design in different situations can be found at http://www.ada.gov/pcatoolkit/chap6toolkit.htm

Landings

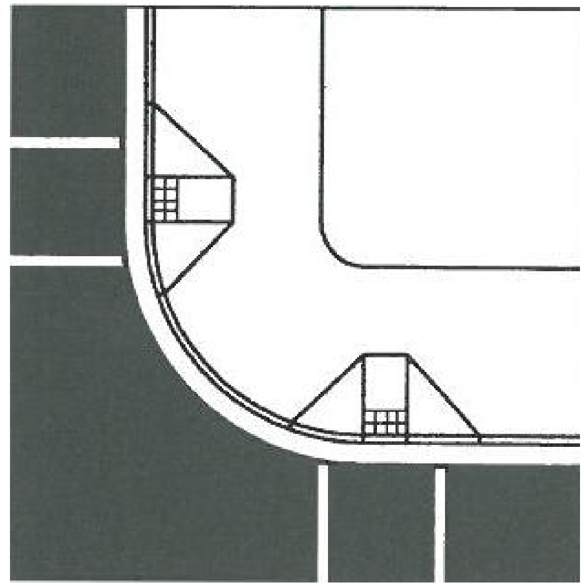
This is a level area for people to wait, maneuver into the ramp, or bypass it.





Flares

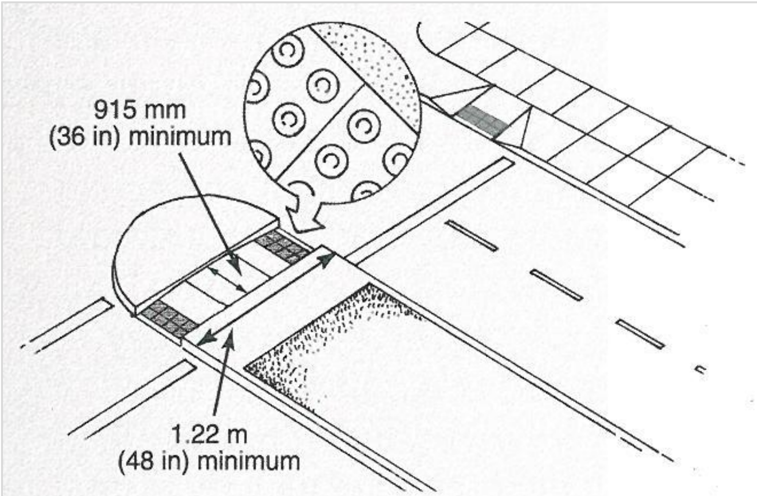
This is the section of the ramp that is a graded transition from ramp to sidewalk, and is not intended as a wheelchair route as it is typically steeper than the curb ramp. For pedestrians with visual impairments, however, the flare can be a cue to identify the curb ramp and street edge.



Curb ramps should be placed such that they direct people's movement into the crosswalk, meaning each corner should have two ramps. Corners with just one ramp on the diagonal are directing people into the flow of vehicle traffic.

At crossings through pedestrian refuge islands or medians, at least 36 inches of through space must be maintained. Two feet of detectable warning should be placed at each end of the crossing.

Median guidance



Right turn islands

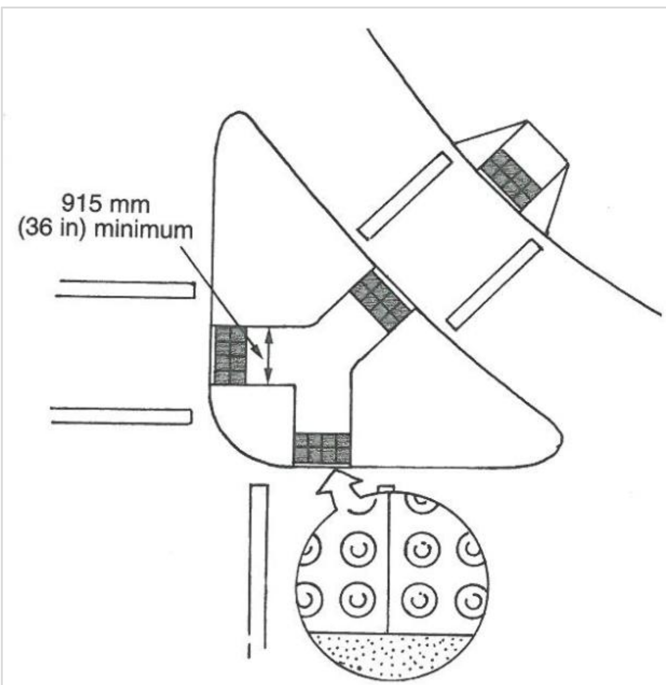
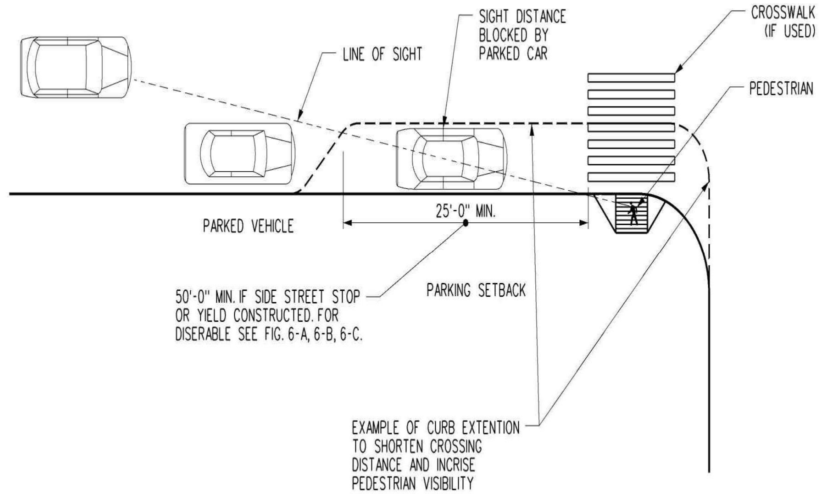


Photo Rendering

Pedestrian Refuge & Curb Extensions

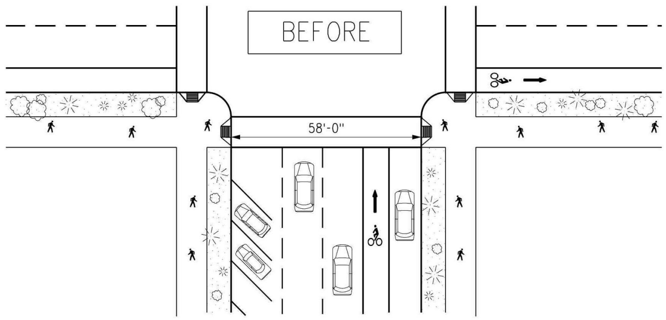
Pedestrian refuge and curb extensions are tools that shorten the pedestrian crossing and decrease the amount of time that someone walking is exposed to someone driving. Curb extensions should be used whenever on-street parking is present. Pedestrian refuge can take the form of medians running down the length of the road or as crossing islands. Both tools can be used at intersections or midblock. Curb extensions provide several benefits, including increasing the visibility of pedestrians waiting to cross. Medians and refuge islands should be at least 8 feet wide, with a minimum of 6 feet, but only after other cross-section elements (lane widths, on-street parking) have been reduced or eliminated.

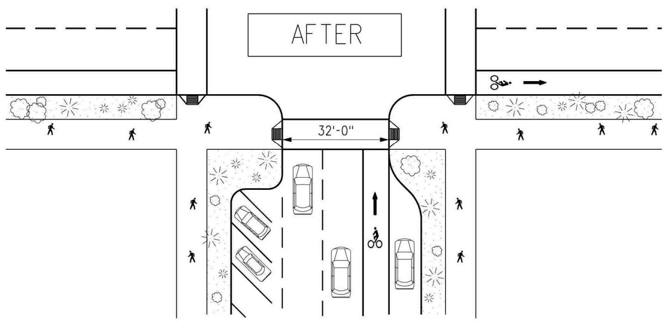
As shown in the following example, parked cars block an approaching driver's line of vision. For this reason New Jersey Statutes prohibit motor vehicle parking "within 25 feet of the nearest crosswalk or side line of a street or intersecting highway," and within 50 feet of a stop sign.[15] By installing curb extensions, the parking setback distance can be reduced.



[15] (Title 39:4-138) Refer to Section 6-03.4 for desirable setback

Curb extensions reduce crossing distance





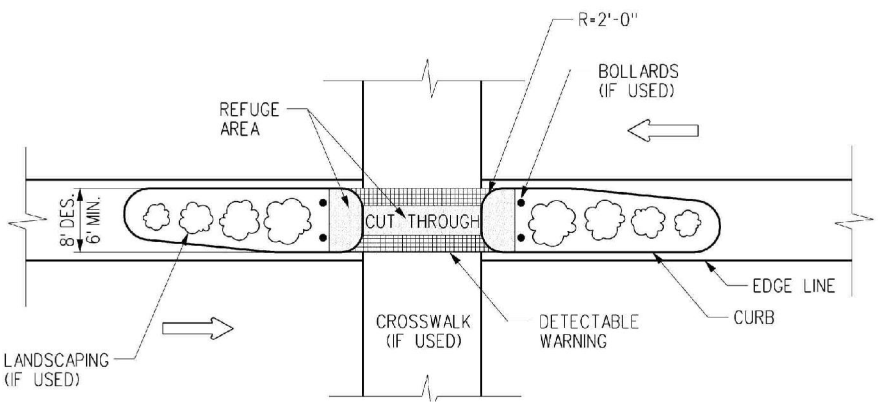


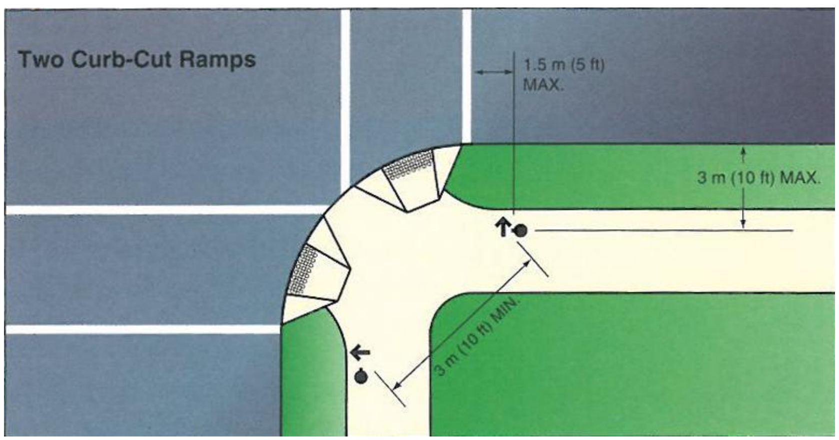
Photo Rendering

2. Pedestrian Signals

Pedestrian signals, like vehicle signals, tell people when to cross the street, when to not cross the street, and when the signal is about to change. Pedestrian signals should be installed at all vehicle signals in tandem with crosswalks. In some cases, signals for pedestrians only may be warranted. In high-volume locations, a new traffic signal may be warranted due to pedestrian volumes.

Detection

The pedestrians signal can either be fixed to go to WALK with the vehicle green cycle, or the signal can be actuated with a push button. Fixed-time signals are preferred. If the signal must be actuated, the push buttons should be located as follows.



Symbol

Traditional pedestrian signals entail WALK, Flashing Don't Walk, and Don't Walk hand signs and walk signs. Many communities are switching to countdown signals, which tell pedestrians how many seconds they have left to cross. By providing more information to pedestrians, people are able to make more informed decisions.

Timing

Per MUTCD, the crossing time for pedestrians should allow a person walking 3.5 feet per second to cross at their normal walking speed.

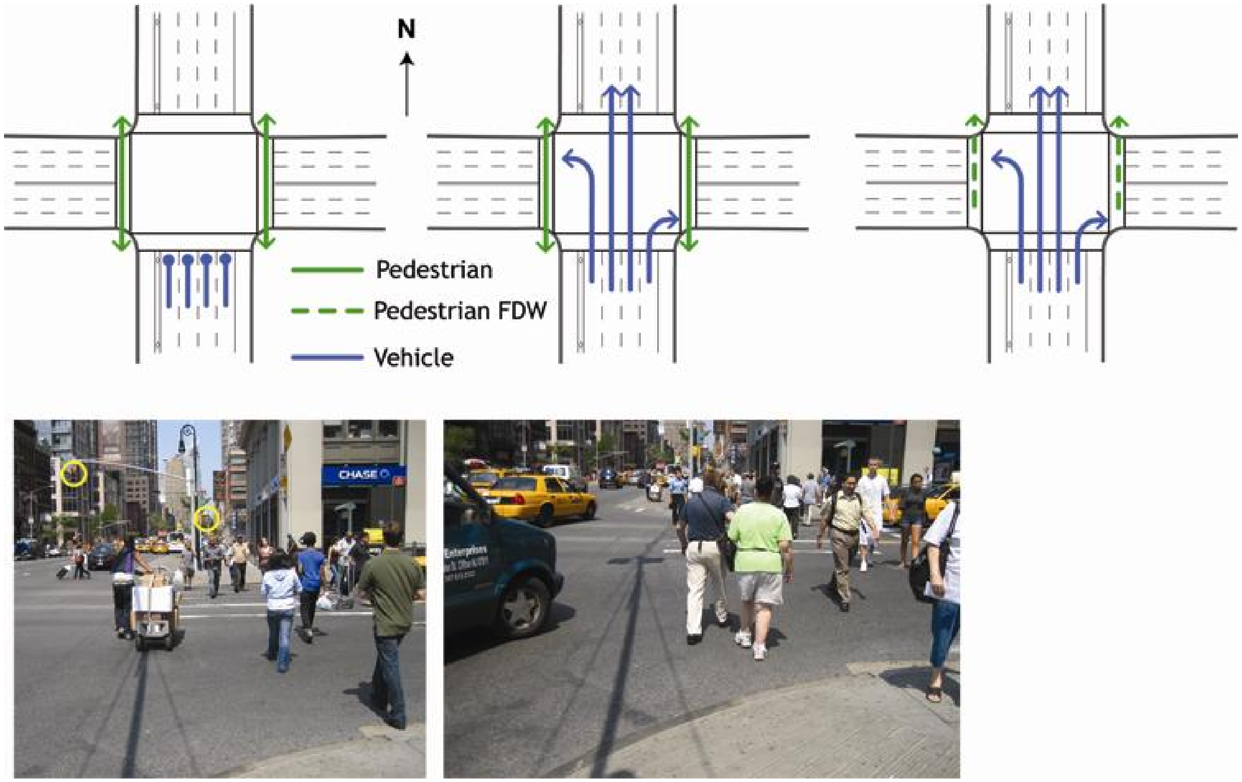
Warrants

The MUTCD details eight traffic and pedestrian warrants for new signals. Warrants 4 and 5 directly relate to pedestrians. These state that if pedestrian volumes crossing a major street at an intersection or midblock is either 100 people per hour during any four-hour period (meaning 100 people observed from noon to 1 PM during the observation period 11 AM-3 PM), or 190 per hour during any single hour, a signal is warranted.

Leading Pedestrian Interval

Crashes between vehicles and pedestrians are often caused when drivers make turning movements. Leading Pedestrian Intervals, or LPIs, build in five or more seconds of WALK time at the beginning of each cycle so pedestrians can establish themselves in the crosswalk and reinforce vehicle yielding behavior.

The following diagram shows how an LPI works for the northbound vehicle movement at the intersection photographed. In the photo on the left, the pedestrian WALK sign has gone on, but the vehicle signal remains red. In the second image, drivers turning right yield to pedestrians in the crosswalk. Once pedestrians clear, turning drivers are clear to go.


N
Pedestrian
Pedestrian FDW
Vehicle
CHASE

3. HAWK Signals

HAWK is a special subset of the signal set called a "pedestrian hybrid" signal. It is a signal actuated by a pedestrian, but unlike traditional actuated signals, the pedestrian receives immediate confirmation that her presence has been detected. The images below show how the HAWK signal operates to both drivers and pedestrians. The signal warrant for a HAWK is much lower than for a full signal. A HAWK is warranted if volumes of 20 pedestrians per hour are observed during the pedestrian peak time.

HAWK Operations

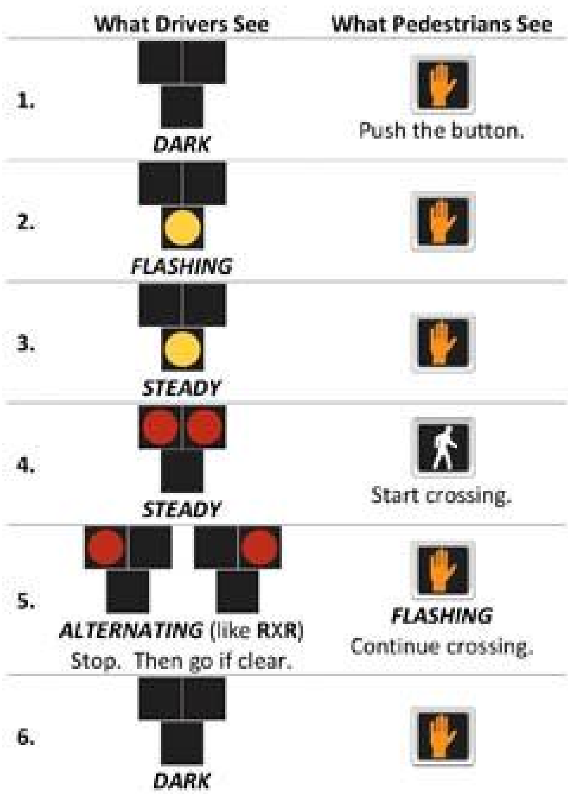
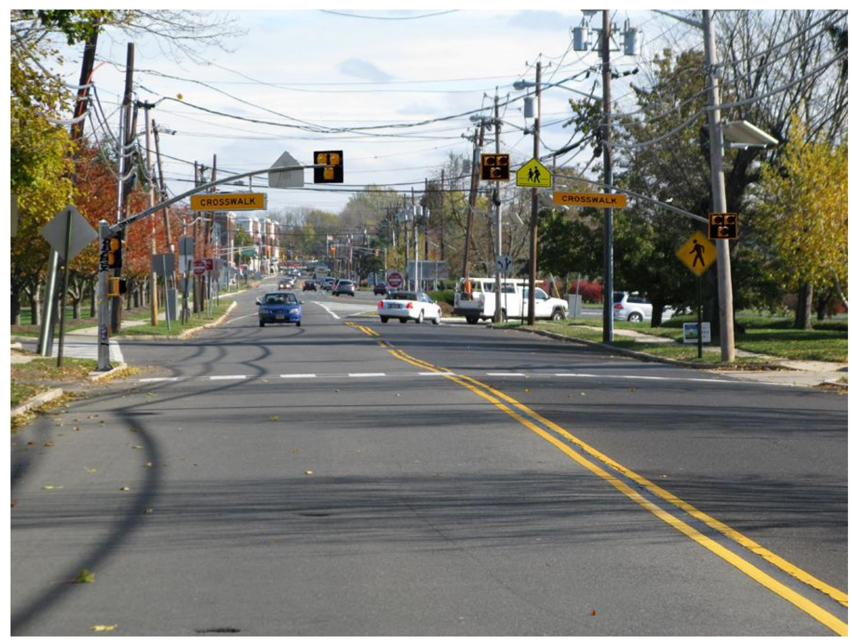
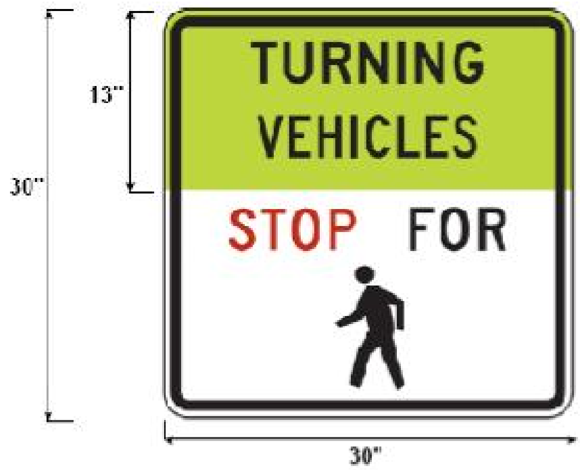


Photo Rendering



Signing Examples

MUTCD has a variety of regulatory and warning signage to alert motorists to the presence of pedestrians. As of April 2010, the law in New Jersey required motorists to stop for pedestrians in crosswalks. Signage that is being used by NJDOT is shown below. These signs should be placed liberally to educate motorists and enforce the new behavior.



Appendix

Item No	Description	Unit	Quanity	Unit Cost
606012P	CONCRETE SIDEWALK, 4" THICK	S.F.		$25.00
606084P	DETECTABLE WARNING SURFACE	S.Y.		$240.00
607018P	9" X 16" CONCRETE VERTICAL CURB	L.F.		$18.00
610003M	TRAFFIC STRIPES, LONG LIFE, EPOXY RESIN 4"	L.F.		$1.40
610009M	TRAFFIC MARKINGS, THERMOPLASTIC	S.F.		$5.50
702039M	PEDESTRIAN SIGNAL HEAD	UNIT		$900.00
702042M	PUSH BUTTON	UNIT		$200.00

	Bulk Unit Costs
Upgraded ramp - 3' x 3' Detecable Warning Surface, 9sf or 1sy	240
New ramp - 3' x 3' Detectable warning surface, 10 ' Vertical curb, 5' x 5' (2.7 SY) sidewalk	532
Crosswalk - 40' of markings, 8" wide, 2 lines (53.6sf)	295
Continental crosswalk - 40' (480"), 24" x 36" (6 SF) every 24", 20 total or 120 sf	660
Sidewalk - per linear foot	25
Stop Bar - 24" wide x 20' (40 sf)	220
Gore Striping - 24" x 24" (4sf) every 24", 40' (20 total)= 80 sf, 8" striping around gore, 40 lf ($112)	552

Assumptions

Spot Locations	Cost
1	$ 2,027
2	$ 1,255
3	$ 2,140
	$ 5,422
Corridors	Cost
1	$ 8,785
2	$ 7,174
3	$ 42,623
4	$ 53,706
5a	$ 66,692
5b	$ 3,172
5c	$ 8,635
6	$ 13,465
	$ 204,252
OVERALL TOTAL	$ 209,674

Quanity	Items	Cost		
5	Upgraded ramps	$	1,200	
1	new Ramp	$	532	
1	crosswalk	$	295	
		$	2,027	total

Spot Location 01

Quanity	Items	Cost	
4	upgraded ramps	$ 960	
1	crosswalk	$ 295	
		$ 1,255	total

Spot Location 02

Quanity	Items	Cost	
4	crosswalks	$ 1,180	
4	upgraded ramps	$ 960	
		$ 2,140	total

Quanity	Items	Cost	
17	upgraded ramps	$ 4,080	
1	crosswalk	$ 295	
1	continental crosswalk	$ 660	
150	sidewalk	$ 3,750	
		$ 8,785	total

Quanity	Items	Cost	
22	upgraded ramp	$ 5,280	
1	new ramp	$ 532	
2	crosswalks	$ 590	
1	stop bar	$ 220	
1	gore striping	$ 552	
		$ 7,174	total

Quanity	Items	Cost	
10	upgraded ramps	$ 2,400	
14	new ramps	$ 7,448	
2	crosswalks	$ 590	
1	continental crosswalk	$ 660	
1261	sidewalk	$ 31,525	
		$ 42,623	total

Quanity	Items	Cost	
9	upgraded ramps	$ 2,160	
3	new ramps	$ 1,596	
2	crosswalks	$ 590	
1	continental crosswalk	$ 660	
1948	sidewalk	$ 48,700	
		$ 53,706	total

Quanity	Items	Cost	
4	upgraded ramps	$ 960	
6	new ramps	$ 3,192	
4	crosswalks	$ 1,180	
3	stop bars	$ 660	
2428	sidewalk	$ 60,700	
		$ 66,692	total

Quanity	Items	Cost	
1	new ramp	$ 532	
4	continental crosswalks	$ 2,640	
		$ 3,172	total

Quanity	Items	Cost	
10	upgraded ramps	$ 2,400	
1	crosswalk	$ 295	
9	continental crosswalks	$ 5,940	
		$ 8,635	total

Quanity	Items	Cost	
8	upgraded ramps	$ 1,920	
1	crosswalk	$ 295	
450	sidewalk	$ 11,250	
		$ 13,465	total

	Distance (Miles)		Cost ($)
	Compatible Roadways	Non-Compatible	Striping and Signing
Bike Lanes	24.6		$ 440,152
Sharrow	13.1		$ 242,790
Bikes on Shoulder or Shared Lane	6.8		$ 5,670
Not Compatible		0.3	
Total Proposed	44.5	0.3	$ 688,612
Existing Bike Lanes	3		
Total Network	47.5	0.3	

Summary Table

Assumption for Bicycle Improvements - Cost, Dimensions, Placement

		unit	unit cost
Bike Sharrow signs: spacing, cost	spacing between signs, feet	2640	$ 264.36
Sharrow Markings, cost		per lf	$ 1.66
Bike Lane markings, cost		per lf	$ 1.66
Regulatory signs, cost (BIKE LANE- R3-17, 24"x18", 3sf)	size, sf	3	$ 30.00
	spacing between signs, feet	2640	
Warning signs (W11-1-, 24"x24", 4sf, Share the Road- W16-1P, 18" x 24", 3sf - 7sf total)	size, sf	7	$ 30.00
	spacing between signs, feet	2640	

	UNITS			
	ft	BOTH SIDES OF THE ROADWAY	Compatible Roadways	Not Compatible
Bike lanes and/or shoulder	129892.31	259784.62	24.6	
Sharrow	68988.80	137977.61	13.1	
Bikes use Shoulder	32218.29	64436.58	6.1	
Shared Lane	3649.19	7298.39	0.7	
Not Compatible	1566.88	NA		0.3

	UNITS	BOTH SIDES OF THE ROADWAY	COST	
	ft			
Bike lanes and/or shoulder	129892.31	259784.62	$ 431,242.47	
Total number of regulatory signs	each	99		
	sf	297	$ 8,910.00	
	mi	49.2	$ 440,152.47	Total

	UNITS	BOTH SIDES OF THE ROADWAY		
	ft		COST	
Sharrow	68988.80	137977.61	229042.83	
Total number of Sharrow signs	each	52	13746.72	
			$ 242,789.55	Total

	UNITS	BOTH SIDES OF THE ROADWAY		
	ft		COST	
Bikes use Shoulder	32218.29	64436.58		
Shared Lane	3649.19	7298.39		
total	35867.49	71734.97		
Total number of warning signs	each	27		
	sf	189	$ 5,670.00	Total

Shoulder use or Shared lane