

Route 70 (Marlton Pike) Cuthbert Boulevard to Penn Avenue

Pedestrian Road Safety Audit/Assessment

Cherry Hill, New Jersey



Dan Nabors

Frank Gross

VHB

September 15-16, 2008

1. Introduction

A road safety audit (RSA) is a formal safety performance investigation of an existing or future facility conducted by an independent RSA team. The main objective of an RSA is to address the safe operation of roadways and crossings to ensure a high level of safety for all road users. RSAs are not intended to be a review of design standards or policies, but rather a review of site elements that, alone or combined, could contribute to safety concerns. The Federal Highway Administration (FHWA) commissions RSAs and has published the *FHWA Road Safety Audit Guidelines* and *FHWA Pedestrian Road Safety Audit Guidelines and Prompt Lists* that describe this processes.

1.1. Objectives of Study

The objective of this study was to complete a pedestrian road safety audit/road safety assessment (RSA) for Route 70 (Marlton Pike) between Cuthbert Boulevard and Penn Avenue (milepost 1.0 to milepost 2.0) in Cherry Hill, New Jersey (see Figure 1). During the site visit, the RSA team also reviewed the section of Route 70 from Penn Avenue to Haddonfield Road (milepost 2.31) to see how emerging development patterns are reshaping the corridor.

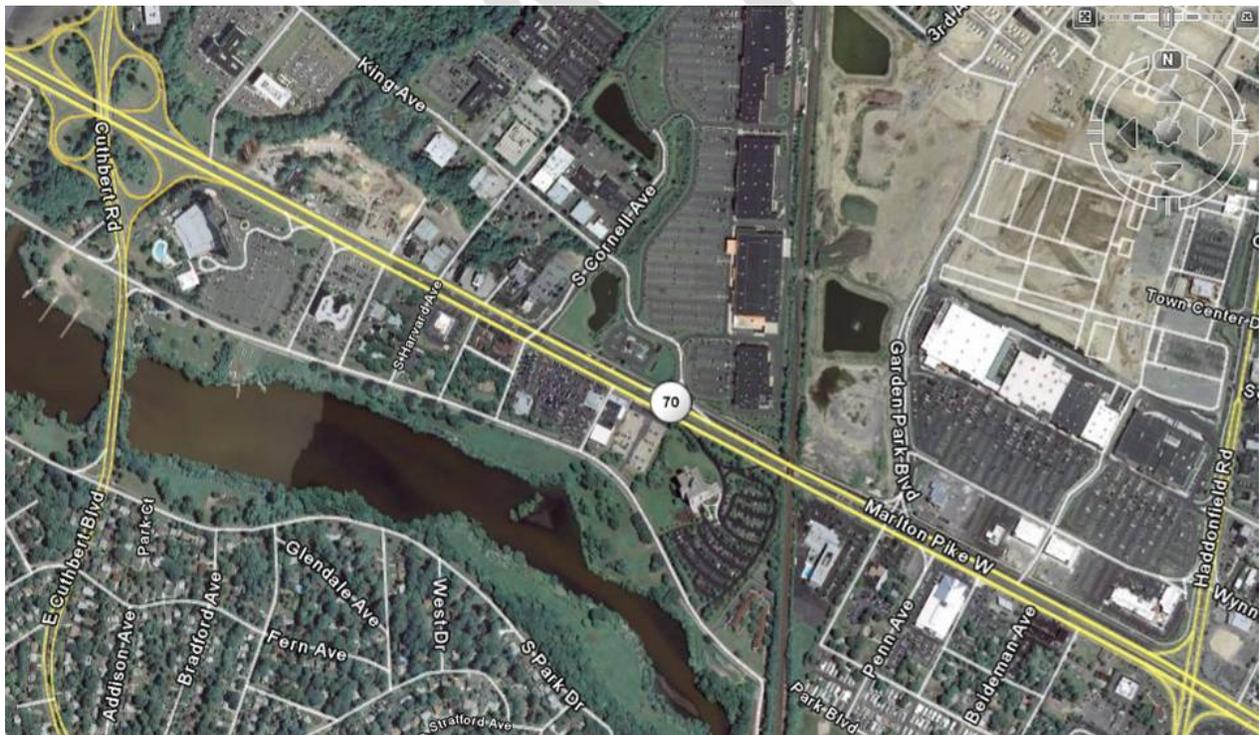


Figure 1. Study Area

1.2. Background

Route 70 is a six-lane, east-west arterial roadway in a mixed land use area in Cherry Hill, New Jersey. This road serves as a major commuter route and also provides access to strip-style commercial developments, high-density residential developments, the Cherry Hill Transit station, and the Cooper River Park Trail. Pedestrian activity in this area is generated by bus stops, commercial developments, residential areas, access to the rail station, and recreational trails.

Five pedestrian crashes were reported in the study area between January 1, 2005, and December 31, 2007. New Jersey is a pedestrian focus State and the New Jersey Department of Transportation (NJDOT) selected this section of Route 70 in Cherry Hill as a target area for reducing pedestrian-vehicle crashes. The purpose of this RSA was to identify safety issues that may be contributing to the observed pedestrian crashes along this corridor and to identify potential measures to mitigate these issues.

The RSA team consisted of members from the Federal Highway Administration (FHWA), NJDOT, Cherry Hill Police Department, Cherry Hill Township, Michael Baker Jr., Inc., and VHB, Inc. The RSA was performed on September 15-16, 2008, during daytime and nighttime hours.

2. Existing Conditions

2.1. Site Characteristics and Pedestrian Accommodations

Route 70 is a six-lane arterial roadway with a median. Sidewalks with curb and gutter are located on both sides of the road through much of the area. The road has a posted speed limit of 45 mph in both directions. There are two traffic signals along the study section of Route 70: at the intersections of Cornell Avenue and Garden Park Boulevard. The RSA team also investigated the signalized intersection of Route 70 and Haddonfield Road, which is adjacent to the study area. Pedestrian countdown signals are installed for the major road crossings at Cornell Avenue, Garden Park Boulevard, and Haddonfield Road. Pedestrian signals are also installed for the minor road crossings at the three signalized intersections, but not all are countdown signals. Marked crosswalks and curb ramps are located at Cornell Avenue, Garden Park Boulevard, and Haddonfield Road; however, not all approaches have marked crosswalks and curb ramps. Some unsignalized intersections within the study area also have marked crosswalks and curb ramps; however most do not. There are four bus stops in the eastbound direction and three in the westbound direction. Appendix A includes a straight line diagram with additional data on the corridor.

2.2. Traffic Data

The average daily traffic (ADT) of the roadway is approximately 53,000 vehicles per day. Pedestrians were observed during both day and night, many of whom were using transit. Bicyclists were observed during all times of the day. Appendix A includes a straight line diagram with ADT data for the corridor.

2.3. Crash Analysis

New Jersey DOT provided pedestrian crash summaries for Route 70 between Cuthbert Boulevard and Penn Avenue from 2005 through 2007. During that period there were five reported pedestrian crashes within the study area (see Appendix A for crash diagram). Three crashes occurred at intersections: one crash occurred at the intersection of Garden Park Boulevard and two crashes occurred at the intersection of Cornell Avenue. The remaining two crashes occurred at midblock locations: one west of the access to Executive Campus (east of Cuthbert Boulevard) and one west of Union Avenue. Of the five crashes, four crashes occurred at night between midnight and 4am. Just one crash occurred during wet weather conditions and only one crash was attributed to driver error. Additional details concerning the pedestrian crashes are provided in Table 1. Crash summaries were also provided for vehicle crashes within the study area. While pedestrian crashes represent just 2.9 percent of the total crashes, they represent 100 percent of the severe injury crashes (see Table 2).

Table 1. Reported Pedestrian Crashes in the Study Area

Event	MP	Severity	Weather	Light Condition	Date	Day	Time	Vehicle Direction
1	1.13	A	CL/DR	Light	6/22/2006	Thur	3:50 PM	EB
2	1.40	A	CL/DR	Dark	7/31/2006	Mon	12:58 AM	WB
3	1.53	A	RN/WT	Dark	3/24/2007	Sat	1:55 AM	EB
4	1.53	B	OC/WT	Dark	5/13/2007	Sun	3:46 AM	EB
5	1.91	A	CL/DR	Dark	4/29/2006	Sat	1:49 AM	WB

Table 2. Comparison of Pedestrian versus All Reported Crashes in the Study Area

Crash Type	2005	2006	2007	Total
Pedestrian	0	3	2	5
Total	36	57	81	174
Percentage	0.0%	5.3%	2.5%	2.9%

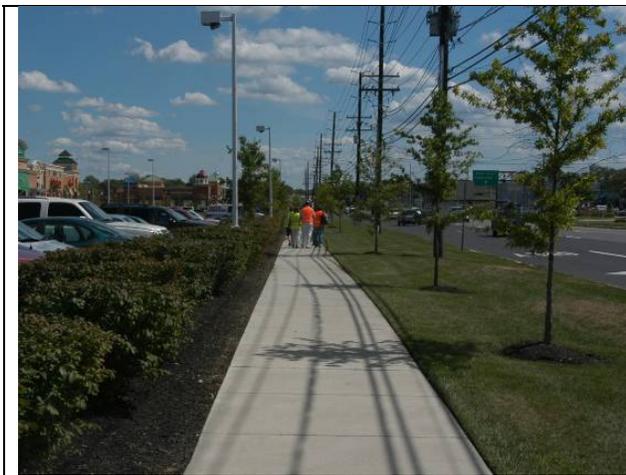
3. Assessment Findings

3.1. Safety Benefits of Existing Roadway Features

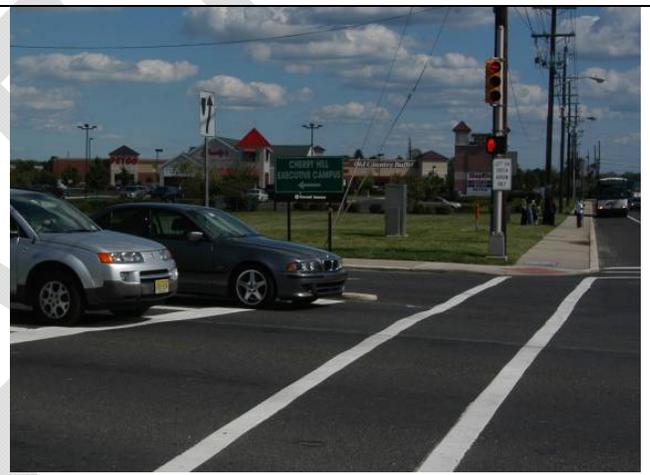
Based on a review of existing site conditions, there are several notable roadway features that enhance pedestrian safety in the study area, namely:

- **Buffer** – A buffer is provided between the sidewalk and the roadway for many locations with sidewalk. A particularly good example of the buffer is along the north side of Route 70 from Garden Park Boulevard to Haddonfield Road.

- **Streetscaping** – Streetscaping was implemented on the north side of Route 70 from Garden Park Boulevard to Haddonfield Road. Trees are located in the buffer and will help to obstruct the visual distractions from commercial development and further separate pedestrian traffic from vehicular traffic.
- **Crosswalks, Curb Ramps, and Pedestrian Signals** – The intersection of Garden Park Blvd and Route 70 provides relatively good pedestrian accommodation. There are crosswalks on all approaches with curb ramps leading from the sidewalk to the road surface. There are also pedestrian countdown signals to inform pedestrians of the time remaining to cross. Push-buttons and countdown signals are also used at the intersections of Route 70 and Haddonfield Rd. as well as Route 70 and Cornell Ave.
- **Wide Median** – Portions of the roadway segment have a wide median, which serves as a refuge for pedestrians making midblock crossings.



View along Route 70 between Haddonfield Rd and Garden Park Blvd. Photo illustrates the benefits of streetscaping to reduce visual clutter and provide a buffer that separates pedestrians and vehicles.



Intersection at Cornell Avenue. Photo illustrates a proper use of crosswalks, curb ramps, and pedestrian signals to enhance safety for pedestrians. The stop bar is also placed before the crosswalk to separate vehicles from pedestrian traffic.

3.2. Identified Safety Issues and Suggestions for Improvement

Despite the many measures to improve pedestrian safety throughout the RSA corridor, six general issues were identified. The RSA team members prioritized the issues based upon their perceived importance in the study area. These issues and suggestions are summarized in Table 3. A detailed discussion of each issue and suggestion is presented in Appendix B and diagrams illustrating specific issues are presented in Appendices C, D, and E.

Table 3 Summary of Issues and Suggested Safety Measures.

SAFETY ISSUE	SUGGESTIONS
1. Lack of Continuity and Connectivity	
Gaps in sidewalks along Route 70	<p><i>Intermediate-</i> Consider installing sidewalks within existing right-of-way to fill-in gaps along Route 70.</p> <p><i>Long-term-</i> Coordinate with future development to create an urban cross section with sidewalks on both sides of Route 70.</p>
Obstructions on sidewalks: <ul style="list-style-type: none"> • Vegetation • Utility poles 	<p><i>Short-term-</i> Maintain vegetation.</p> <p><i>Intermediate to long-term-</i> Consider widening sidewalk around obstructions or remove/relocate obstructions.</p>
Lack of continuity across side streets: <ul style="list-style-type: none"> • Indirect paths at crossings • Absence of marked crosswalks • Missing curb ramps or cut-throughs • Missing tactile warnings 	<p><i>Short-term-</i></p> <ul style="list-style-type: none"> • Install painted continental or zebra pattern crosswalks. • Ensure traffic control devices are used that separate conflict points between motorists and pedestrians (such as stop bars and signs). • Consider conducting formal ADA evaluation. <p><i>Intermediate-</i></p> <p>Ensure curb ramps and cut-throughs are provided and align with crosswalks and sidewalks and follow direct paths.</p>
Lack of buffer	Consider increasing buffer where existing right-of-way permits.
Inaccessible push-buttons	<ul style="list-style-type: none"> • Relocate inaccessible push-buttons. • Consider upgrading push buttons with palm-activated buttons. • Consider installing push buttons that confirm the press. • Consider installing signs to explain the use of the push button.
2. Potentially Harmful Behaviors	
Midblock crossings	<p><i>Intermediate-</i></p> <ul style="list-style-type: none"> • Consider improving existing crossings to attract pedestrians (e.g., Consider adding crosswalk on west leg of intersection and Cornell Avenue. • Consider relocating bus stops to coincide with crossing locations. <p><i>Long-term-</i> Consider new crossing of Route 70 between Cornell Avenue and Cuthbert Boulevard. Relocate bus stops near Cuthbert Boulevard to coincide with crossing.</p>
Lack of driver yielding	<i>Short-term-</i> Consider enhancing conspicuity of pedestrian crossings through use of signs and pavement markings.

SAFETY ISSUE	SUGGESTIONS
Conflicts with bicycle traffic	<ul style="list-style-type: none"> • Consider creating separated bicycle facilities parallel to Route 70. • Consider tools to promote proper use of bicycle facilities: <ul style="list-style-type: none"> • Wayfinding. • Education (e.g., consider expanding the NJDOT ‘Share the Road’ campaign to bicycles in addition to motorcycles).
3. Lighting	
Gaps and inconsistency in lighting	<p><i>Short-term-</i> Maintain lighting by replacing unlit bulbs.</p> <p><i>Intermediate-</i> Consider lighting enhancements at bus stops and intersections, especially near median.</p> <p><i>Long-term-</i> Consider installing consistent level lighting along the corridor and paths outside corridor.</p>
4. Signage and Pavement Markings	
Lack of guidance for/warning of pedestrians through intersections	<p><i>Short-term-</i> Consider installing painted continental or zebra pattern crosswalks.</p> <p><i>Intermediate:</i> Consider providing direct, continuous, clearly delineated paths for pedestrians across complex intersections.</p> <p><i>Long-term:</i> Consider alternatives to channelized right-turn lanes. Where installed, consider design with steeper angle to reduce vehicle speeds and focus driver attention toward crosswalk.</p>
Signs <ul style="list-style-type: none"> • Faded • Insufficient • Redundant 	Consider conducting a formal sign inventory. <ul style="list-style-type: none"> • Replace faded signs. • Remove unnecessary and outdated signs. • Enhance insufficient signage.
Motorists using shoulder to make right turns	<i>Short-term-</i> Consider installing pavement markings to differentiate the shoulder from the travel lane.
5. Bus Stops	

SAFETY ISSUE	SUGGESTIONS
Bus stops not located near crossings	<p><i>Intermediate-</i></p> <ul style="list-style-type: none"> • Consider relocating bus stops close to pedestrian crossings. • Consider installing additional crossings (e.g., pedestrian crossing on west leg of intersection with Cornell Avenue). <p><i>Long-term-</i> For the eastbound and westbound bus stops near Cuthbert Boulevard, consider installing crossing across Route 70 and move bus stops closer to crossing. Potential crossing types include:</p> <ul style="list-style-type: none"> • Consider HAWK signal. • Consider two-stage crossing. • Consider existing bridge structure to provide pedestrian overpass.
Connectivity to bus stops	<p><i>Short-term-</i> Install sidewalks within existing right-of-way to provide better access to bus stops.</p> <p><i>Long-term-</i> Coordinate facility upgrades with future development.</p>
Unofficial bus stops	<ul style="list-style-type: none"> • Consider education program for transit users. <ul style="list-style-type: none"> ○ Encourage NJ Transit to provide South Jersey bus maps. • Encourage riders to use existing stops. <ul style="list-style-type: none"> ○ Enhance conspicuity of bus stops. ○ Improve amenities at existing bus stop locations.
6. Conflicts at Crossings	
Vehicles make high-speed turns at channelized islands	<p><i>Intermediate-</i></p> <ul style="list-style-type: none"> • Consider enhancements to signing and markings to warn motorists of pedestrians. • Consider improving all driveways by installing stop bars and stop signs per MUTCD standards. <p><i>Long-term-</i> Consider alternatives to channelized right-turn lanes. Where installed, consider design with steeper angle to reduce vehicle speeds and focus driver attention toward crosswalk.</p>
Minimal crossing time	Consider increasing pedestrian intervals based on assumed walking speed of 3.5 ft/s.
7. Drainage	
Drainage	<p><i>Intermediate-</i> Consider replacing drop inlets with ADA compliant designs.</p> <p><i>Long-term-</i> Evaluate the extent of drainage issues during wet weather conditions. Consider drainage improvements during subsequent roadway projects.</p>

4. Conclusions

The objective of this study was to complete a pedestrian RSA for Route 70 between Cuthbert Boulevard and Penn Avenue in Cherry Hill, New Jersey. The RSA team investigated existing issues within the study corridor, but also observed an area adjacent to the study area (Penn Avenue to Haddonfield Road) to identify how recent development may be effecting safety. Seven safety issues have been identified in this in-service RSA. Based on a review of crash data and field observations, continuity and connectivity of pedestrian facilities were determined to be the most critical issues in the study area. The remaining six safety issues are ranked below continuity and connectivity from most to least critical, although many were considered nearly equal in importance. The team noted several positive safety features and one primary safety issue in the adjacent area from Penn Avenue to Haddonfield Road. Suggestions for mitigating issues have been identified and are described in this report.

Beyond engineering measures, road safety can be improved through education and enforcement. These measures are also discussed in the report.

The owners are invited to consider the suggested changes. To complete the RSA process, the owners may prepare a short written response to the issues and options outlined in this report.

5. References

Federal Highway Administration (2003). *The Manual on Uniform Traffic Control Devices (MUTCD)*. Washington, DC. Accessed online October 5, 2008.
(<http://mutcd.fhwa.dot.gov/pdfs/2003r1/pdf-index.htm>).

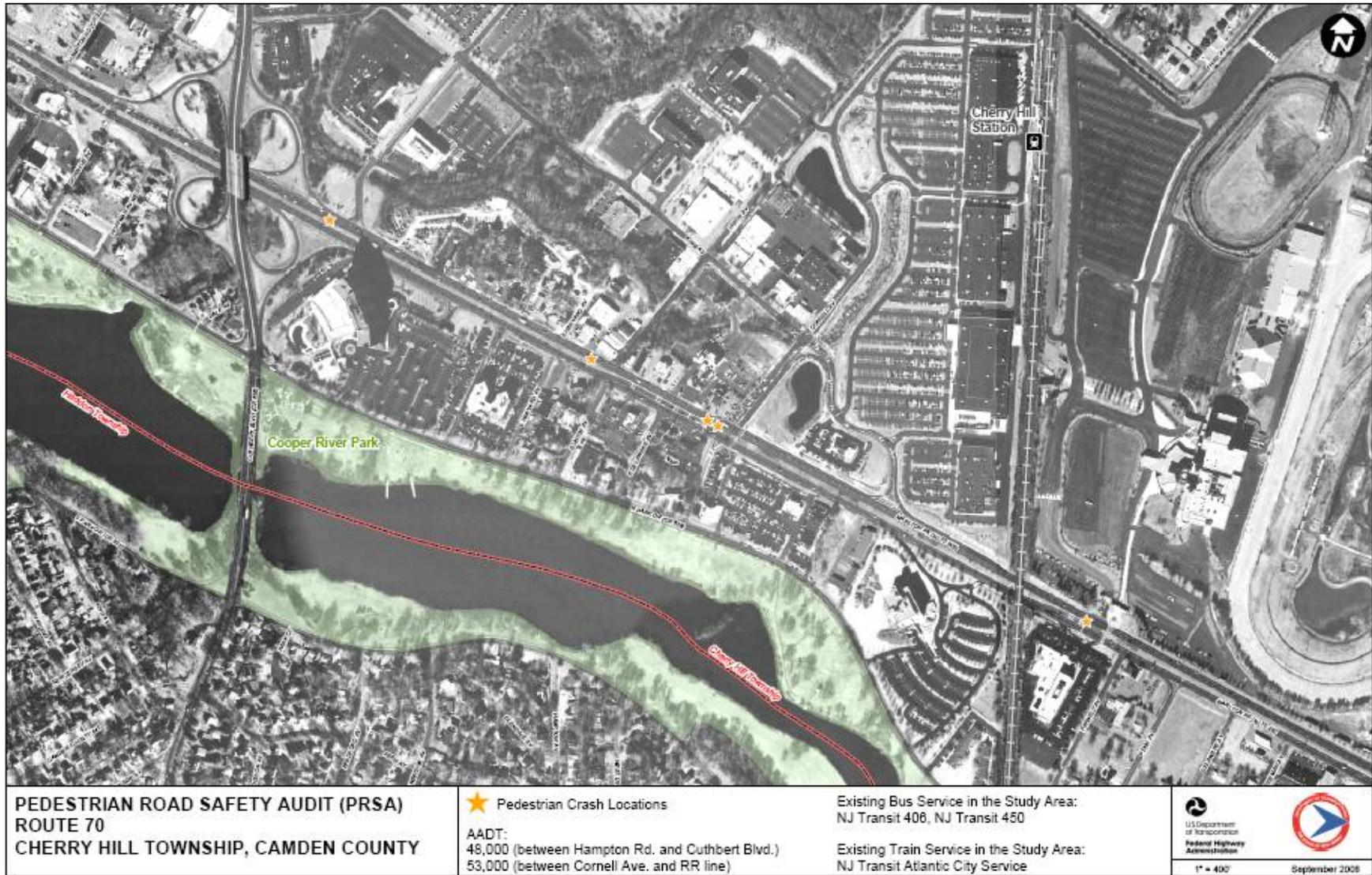
Federal Highway Administration (2008). *Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes*, FHWA-SA-014.

Fitzpatrick, Kay; Shawn Turner; Marcus Brewer; Paul Carlson; Brooke Ullman; Nada Trout; Eun Sug Park; Jeff Whitacre; Nazir Lalani; and Dominique Lord. *Improving Pedestrian Safety at Unsignalized Crossings*. TCRP REPORT 112/NCHRP REPORT 562. Transportation Research Board, Washington, DC, 2006.

Schlossberg, Marc; Asha Weinstein Agrawal; Katja Irvin; and Vanessa Louise Bekkouche. *How Far, By Which Route, and Why? A Spatial Analysis of Pedestrian Preference*. Mineta Transportation Institute, San Jose, CA, June 2007.

Stollof, E.; H. McGee, and K. Eccles (2007). *Pedestrian Signal Safety for Older Persons*. AAA Foundation for Traffic Safety, Washington, D.C.

Appendix A: Data Used in the RSA

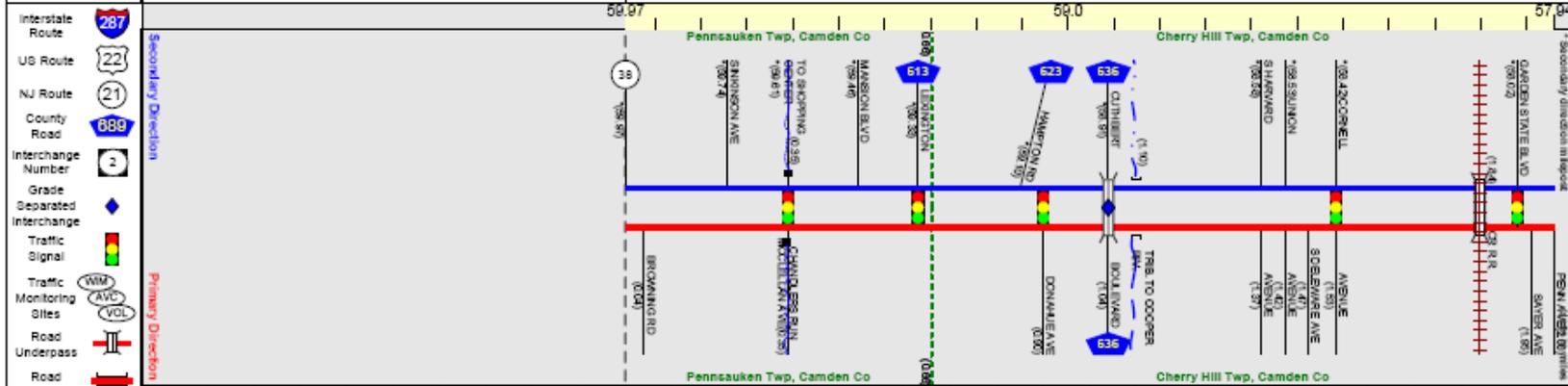


NJ 70 (West to East)

Mile Posts: 0.000 - 2.000



Pavement	36
Shoulder	0
Number of Lanes	3
Speed Limit	45
Street Name	John Davison Rockefeller Memorial Hwy



Street Name	John Davison Rockefeller Memorial Hwy
Jurisdiction	N.J.D.O.T.
Functional Class	Urban Principal Arterial
Federal Aid - NHS By	NHS
Control Section	D413
Speed Limit	45
Number of Lanes	3
Med. Type	Curbed
Med. Width	24
Pavement	36
Shoulder	0
Traffic Volume	48,102 (2005) 53,310 (2005)
Traffic Sta. ID	7-4-827 7-5-134
Structure No.	0413151 0413153 0413155
Enlarged Views	See Enlarged View #24

SRI = 0000070

Date last inventoried: February 2006

Page Created: May 2005

Appendix B: Issues and Suggestions

Issue 1: Lack of Continuity and Connectivity

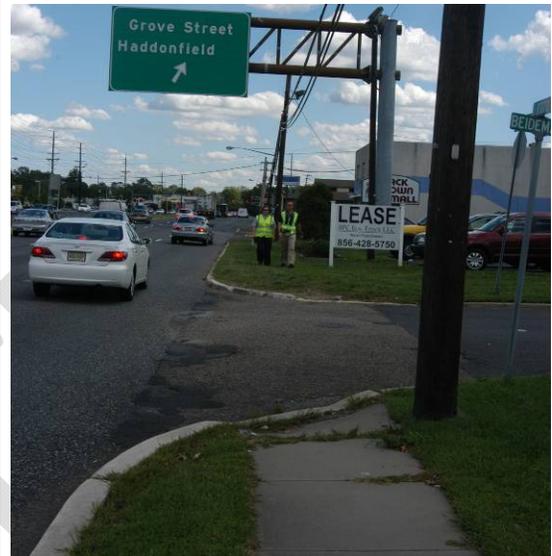
Gaps in sidewalks along Route 70: *Lack of sidewalk and gaps in sidewalk provide limited accessibility for pedestrians along Route 70.* Specific areas with gaps in the sidewalk include the following (see Appendix C for detailed illustration):

- North side of Route 70 from Cornell Avenue to Cuthbert Avenue.
- South side of Route 70 from Washington Avenue to Sayer Avenue.
- South side of Route 70 from Cornell Avenue to Cuthbert Avenue.

Where sidewalk is not installed, pedestrians must travel along driveways, parking lots, and other areas where they may conflict with vehicular traffic.

Suggestions: *Intermediate-* Install sidewalks within existing right-of-way to fill-in gaps along Route 70 between Washington Avenue and Cuthbert Avenue. Where possible, consideration should be given to providing a buffer between the sidewalk and travel way to provide better protection for pedestrians and utilize the full width of the sidewalk (when sidewalk is placed adjacent to the curb, pedestrians rarely use the one and a half foot strip closest to the curb). However, the priority should be to provide a minimum 5-ft wide, unobstructed sidewalk.

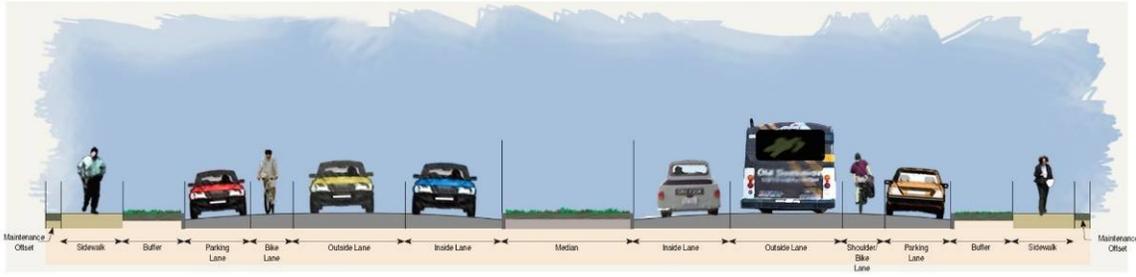
Long-term- All sidewalk upgrades within the study area should consider the urban nature of this section of road and should coordinate with redevelopment such as the Market Place at Garden State Park. Upgrades could include streetscaping projects that would create an urban roadway cross section with sidewalk and curb and no shoulder. An urban cross section may help increase driver expectancy of the presence of pedestrians and control vehicle speeds.



View of sidewalk along Route 70 eastbound near Grove St. Note the gaps in the sidewalk that limit access for pedestrians with mobility restrictions.



View of sidewalk along Route 70 westbound near Cornell Ave. Gaps in the sidewalk limit accessibility for pedestrians.



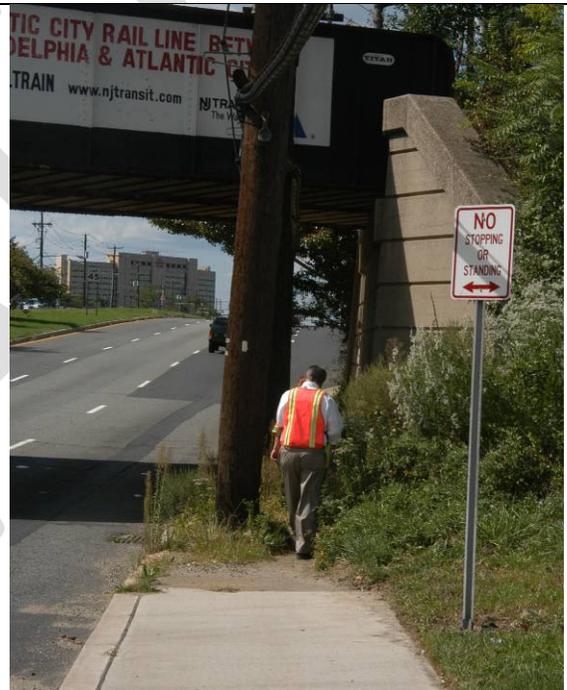
A long-term plan for the corridor should consider features such as continuous sidewalks, buffers between sidewalks and the highway, bike lanes/shoulders, and possibly landscaping in the median to allow refuge areas to be constructed at pedestrian crossings. Trees can be planted in the buffer strip to further buffer pedestrians from traffic.

Obstructions on sidewalks: Both permanent and temporary obstructions were found on sidewalks in the study area. Obstructions affect all pedestrians, but are particularly hazardous to pedestrians with mobility restrictions who may require additional space to navigate the sidewalk, or to pedestrians with limited vision who may fail to see the obstructions. Sidewalk obstructions may cause people to use the roadway to maneuver around the obstacles, increasing the potential for a conflict with traffic. Obstructions identified by the RSA team include:

- Utility poles in the sidewalk on the north side of Route 70 near the railroad bridge.
- Vegetation overhanging the sidewalk on the north side of Route 70 near the railroad bridge.

Suggestions: *Short-term-* Maintain the vegetation encroaching on sidewalk.

Intermediate to long-term- Consider removing or relocating obstructions, or building an accessible sidewalk around obstructions. The ability to widen the sidewalk will depend on the available right-of-way and existing bridge structure at the railroad crossing.



View of sidewalk on the north side of Route 70 traveling westbound. The photo shows the obstructions (i.e., utility poles and vegetation) on the sidewalk near the railroad crossing. The obstructions make it difficult to pass, particularly for those with mobility restrictions or in a wheelchair.

Lack of continuity across side streets: *Some side street crossings are discontinuous with sidewalks along Route 70. These discontinuities include design elements such as faded or absence of marked crosswalks, missing or outdated curb ramps, pedestrian paths that are not direct at crossings, and designated pedestrian paths that may potentially increase conflicts with vehicles. These conditions may result in the following safety issues:*

- Pedestrians may take unpredictable paths that conflict with vehicular traffic and violate driver expectancy.
- Drivers may not expect pedestrians to be crossing at areas not sufficiently designated as pedestrian crossings.
- Pedestrians with mobility restrictions and older pedestrians may not be able to reach desired destinations.

Suggestions: *Short-term-* Consider installing painted continental or zebra pattern crosswalks at the following cross streets along the corridor:

- Grove Street – eastbound channelized right-turn lane from Route 70
 - Washington Ave. – south leg
 - Beideman Ave. – south leg
 - Penn Ave. – south leg
 - Cornell Ave. – south leg
 - Union Ave. – south leg
 - Harvard Ave. – south leg
- Ensure traffic control devices are used that separate conflict points between motorists and pedestrians (such as stop bars and signs). At channelized right-turn lanes, install crosswalks and appropriate signing to warn motorists of pedestrians (see details in Appendix E).
 - Conduct a formal evaluation of ADA compliance. Address non-compliant designs through maintenance or in coordination with future development projects.



View of crossing on north side of intersection at Union Ave. Note that there is no crosswalk or curb ramp. This is an example of discontinuity and could pose a challenge to those with mobility restrictions. Furthermore, there are no indications to drivers that pedestrians may be crossing.



View of crossing on south side of Route 70 at the intersection with Penn Ave. Note that the crosswalk is almost completely faded across the travel lanes and there is no curb ramp on the opposite side of the intersection. Furthermore, the overhead street sign diverts driver attention away from the crossing and the large corner radius allows vehicles to turn at high speeds.



Curb ramps can be easily retrofitted with ADA compliant truncated domes.

<p><i>Intermediate-</i></p> <ul style="list-style-type: none"> • Ensure curb ramps and cut-throughs are provided along pedestrian paths. • Ensure curb ramps align with crosswalks and sidewalks and follow direct paths. 	
<p>Lack of buffer: <i>Limited or no buffer along sections of existing sidewalk provides little separation between pedestrians and fast moving traffic.</i></p> <p>Suggestions: Consider increasing the buffer where existing right-of-way permits. It is desirable to maintain a minimum of 2-feet between the sidewalk and edge of roadway; given the traffic speeds and volumes on route 70, a 5-6 foot buffer should be considered similar to the buffer between Garden Park Boulevard and Haddonfield Road. For future pedestrian facility upgrades, consider streetscaping as described previously and coordinate improvements with future development.</p>	 <p>View of sidewalk along north side of Route 70 just east of the railroad crossing. The limited buffer between the edge of sidewalk and the travel way may present a hazard to pedestrians walking close to the roadway.</p>
<p>Inaccessible push-buttons: <i>Inaccessible push-buttons were noted in the study area including a push-button located on the back side of a signal pole. Throughout the study area, push-buttons are inconsistent; some are activated by palm (current ADA approved) while others must be depressed by finger (not currently ADA compliant).</i> Push-button locations that are inconspicuous or inaccessible may cause pedestrians to cross against the signal, increasing the chance of pedestrian-vehicle conflicts.</p> <p>Suggestions:</p> <ul style="list-style-type: none"> • Consider upgrading push-buttons with palm-activated buttons and relocating inaccessible push-buttons to more accessible and conspicuous locations. Also consider installing pushbuttons that confirm the press. • Consider installing signs to explain the use of the push-button (e.g., MUTCD R10-3b or R10-4a). Also consider installation of a sign to indicate that the side street will automatically receive a crossing phase. 	 <p>View of signal pole and pedestrian push-button on northeast quadrant at Cornell Avenue. The pedestrian push-button is located on the backside of the signal pole making it difficult to identify and access.</p>

Issue 2: Potentially Harmful Behaviors

Midblock crossings: *There are several unofficial midblock pedestrian crossings along Route 70 (i.e., pedestrians are crossing between intersections where there is no formal pedestrian crossing). Pedestrians are crossing midblock to access bus stops, commercial developments, and residential properties.* Factors that may affect pedestrians' decisions to cross midblock include the following:

- *The location of pedestrian desire lines:* Pedestrian “desire lines” are the preferred paths of pedestrians in a roadway network. Pedestrian desire lines often trace the shortest or most convenient paths between two points. The Cherry Hill police identified the location of a car dealership, which has vehicle lots on both sides of Route 70. The officers noted that sales representatives escort potential buyers across Route 70 between the two vehicle lots.
- *Distance between marked crossings:* As the distance increases between marked crosswalks, pedestrians are more likely to cross mid-block rather than travel out of their way to cross at a designated crossing. A recent study of pedestrian travel preferences supports this behavior. Schlossberg et al. (2007) conducted a spatial analysis of pedestrian travel preferences and found that pedestrians' primary consideration in choosing a route is minimizing time and distance.

This behavior is further supported by a National Cooperative Highway Research Program (NCHRP)/Transit Cooperative Research Program (TCRP) report that looks at improving pedestrian safety at unsignalized crossings. Part of the report addresses the adequacy of pedestrian signal warrants through several research methodologies including an on-street survey. Part of the survey asked pedestrians “if this crossing was not here, would you walk to the next intersection?” At the majority of the sites, only 25 percent of the respondents would walk to a signalized intersection that was located at 550 feet, 950 feet, or 1000 feet.

The distance and associated walking times between intersections are shown in Appendix D. In the study area, there are only two intersections where pedestrians can cross Route 70: Cornell Avenue and Garden Park Boulevard (pedestrians can also cross at Haddonfield Road east of the study area). Within the study area, the greatest distance pedestrians would have to walk to reach a crossing is between Cuthbert Road and Cornell Avenue. The time required to walk this stretch of road is more than 12 minutes, not including the time needed to wait for a gap and cross at intersections. Furthermore, four of the five pedestrian crashes occurred in this stretch of roadway: (two crashes occurred on the western leg of the intersection of Cornell Avenue where there is no crosswalk, one occurred midblock west of the access to Executive Campus and east of Cuthbert Boulevard and one occurred midblock west of Union Avenue).

- *The location of bus stops:* Some bus stops along the corridor are not near a crossing. Pedestrian desire lines from the bus stop to businesses and residential areas on the opposite side of the road increase the likelihood of midblock crossings. From 2005 to 2007, there were three reported midblock pedestrian crashes near bus stops (one west of the access to Executive Campus and two west of Cornell Avenue).
- *Perceived safety of crossings at intersections:* Intersection characteristics that may contribute to this perception include the following:

- *High-speed turning traffic:* Right turn channelized islands are designed so that drivers focus their attention to the left to look for gaps in traffic. This means the drivers will be looking away from pedestrians when they are trying to cross an intersection from the right of the driver. Furthermore, curb radii are large enabling vehicles to make faster right turns.
- *Lack of driver yielding:* Driver behaviour and intersection geometry described above may be factors in this issue.

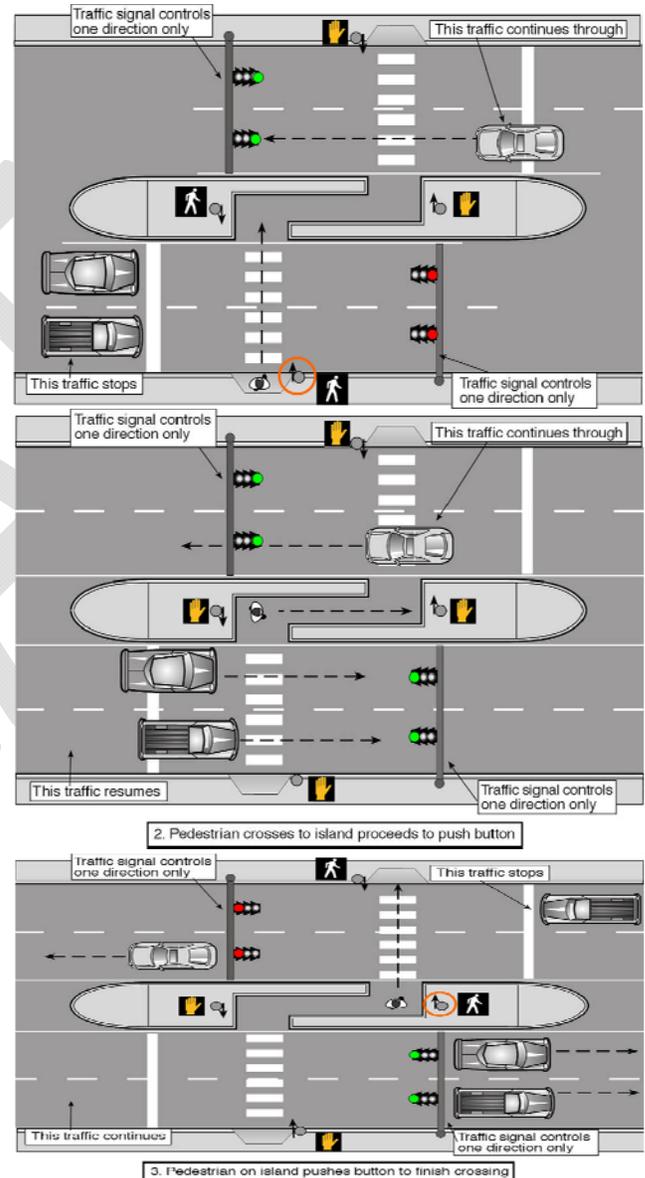
Suggestions:

Intermediate- Consider making improvements to existing crossings at intersections to attract pedestrians to these crossings. These improvements may include reducing conflicts with turning vehicles and providing crossings on all legs of intersections. In particular, at the intersection with Cornell Avenue consider modifying the intersection to permit the addition of a pedestrian crosswalk on the west leg of the intersection (see Appendix D for details).

- Relocate bus stops to coincide with crossing locations to encourage people riding transit to cross at intersections (see Issue 4).

Long-term- Consider new crossing for pedestrians between Cornell Avenue and Cuthbert Boulevard (and relocate bus stops as described in Issue 5). The raised median presents an opportunity to create a pedestrian crossing with a median refuge. The above mentioned NCHRP/TCRP report concluded the compliance rate for drivers yielding to pedestrians on refuge islands with high-visibility crosswalks was lower for higher-speed roadways. The red signal or beacon devices including midblock signals, half signals and HAWK signals had higher compliance rates. Therefore the potential crossing treatments at a crossing between the two intersections include:

- HAWK signal crossing.
- Two-stage signalized crossing.



Two-stage crossing sequence. (Source: Oregon Bicycle and Pedestrian Plan.)

Lack of driver yielding: Drivers were observed failing to yield the right-of-way to pedestrians in several situations, including pedestrians already in a marked crosswalk. Route 70 serves as a relatively high-speed thoroughfare for commuters. Drivers in the AM and PM peak periods experience traffic delays along this section, which may lead to frustration and lack of courtesy toward pedestrians and other motorists. Also, drivers may not expect pedestrians along a major arterial, which may increase the likelihood of a collision.

Suggestion: *Short-term-* Consider enhancing conspicuity of pedestrian crossings through the use of signs and pavement markings. Consider pedestrian warning signs, advance yield line signs and pavement markings, and high visibility pavement markings at crossings (see also Appendix D for details).



View of Executive Campus Access #1. This photo shows a driver failing to yield the right-of-way to a pedestrian that had entered the crosswalk.

Conflicts with bicycle traffic: The RSA team observed bicyclists riding the wrong way in the road along Route 70 and on sidewalks. This is due in part to the lack of bicycle facilities on Route 70. Without dedicated facilities, bicyclists have to ride in the vehicle travel lanes, on sidewalks, or through parking areas. When bicyclists have no dedicated facilities they travel in unpredictable paths which may lead to frequent and unexpected conflicts with vehicles and pedestrians.

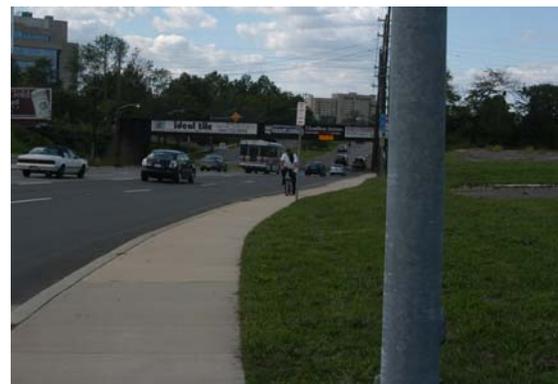
Wrong-way riding on the roadway can be particularly dangerous as motorists turning right out or left into a driveway are focused on finding gaps in vehicular traffic approaching from the opposite direction and may not see a bicyclist traveling in the wrong direction. Potential causes of wrong-way riding may be fewer crossing opportunities to create a convenient network to promote riding in the correct direction and the lack of shoulders, which may discourage bicyclists from biking where they cannot see the potentially conflicting traffic.

Suggestions:

Consider creating bicycle facilities parallel to Route 70. Given traffic volumes and speeds on Route 70, look for opportunities to create paths separated from the roadway. Consider also creating more



View of Route 70 just east of railroad bridge. The bicyclist is traveling the wrong way on a 6-lane divided roadway with no shoulder.



View of Route 70 just west of the railroad bridge. The bicyclist is biking on the sidewalk because of lack of a bikeable shoulder. The sidewalk is not wide enough to accommodate bicyclist and pedestrian traffic.

frequent crossings as described previously in Issue 2. Also, consider the following tools to promote proper use of bicycle facilities (start with existing facilities and update as new facilities are constructed):

- Wayfinding signing to help direct bicyclists to dedicated facilities.
- Education of safe riding practices to increase awareness of hazards (e.g., consider expanding the NJDOT 'Share the Road' campaign to bicyclists in addition to motorcycles).

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Issue 3: Lighting

Gaps and inconsistency in lighting: *A lack of lighting makes it difficult for motorists to see pedestrians, particularly at crossings.* Lighting not only increases driver awareness of pedestrians in the area, it improves security and encourages walking in lighted areas. Lighting from Penn Avenue to Garden Park Boulevard appeared to be continuous; however, lighting was less consistent toward the western end of the study area. This issue is partly due to the fact that some lighting was not in proper working condition. Furthermore, the lighting was poor along the corridor in the roadway median due to the lack of lighting in the median and roadway width (over 100 feet wide in some areas), which decreases the effectiveness of roadside lighting. The importance of lighting is evidenced by the fact that four of the five pedestrian crashes occurred at night.

Suggestions: Overall, improving lighting can reduce nighttime crashes between 20 and 27 percent (see FHWA-SA-014). Specific suggestions are as follows:

Short-term- Maintain existing lighting by replacing unlit bulbs.

Intermediate- Consider enhancing lighting at bus stops and intersections, especially near the median where lighting appears to be at the lowest levels.

Long-term- Consider installing consistent lighting along the corridor and along major pedestrian paths outside the corridor. Consider adding lighting to median for improved consistency.



Photo shows a nighttime view of the intersection at Garden Park Blvd. and Route 70. Despite the presence of intersection lighting, it is difficult to see the pedestrians. Other intersections along the corridor are not lit as well as this intersection, which poses a safety issue for pedestrians walking at night.

Issue 4: Signage and Pavement Markings

Lack of guidance for/warning of pedestrians

across intersections: *Some side street crossings are discontinuous with sidewalks along Route 70, as explained in Issue 1 (lack of continuity across side streets).* At more complex intersections (such as those with right turn channelized islands) there may be additional safety concerns. A lack of guidance or misplaced crossings for pedestrians creates a potential safety issue because pedestrians may cross at inappropriate locations (such as where sight distance is limited) and drivers may not expect pedestrians at these locations. For example, at Haddonfield Road there is no direct path across a channelized right-turn lane, but pedestrians were observed crossing at multiple locations.

Suggestions:

Short-term- Consider installing painted continental or zebra pattern crosswalks at cross streets along the corridor (see Issue 1).

Intermediate- Consider providing direct, continuous, and clearly delineated paths for pedestrians across complex intersections (e.g., intersections with right turn separator islands such as at Haddonfield Road). It may be necessary to install a sidewalk and curb ramps on the island before marking a crosswalk. Place advance yield lines and pedestrian warning signage to alert motorists of the presence of pedestrians.

Long-term- Consider alternatives to channelized right turns. Where channelized right turns are to be installed, consider a design with a steeper angle to reduce vehicle speeds and focus driver attention toward the crosswalk.



View of channelized right-turn lane on southbound approach at Haddonfield Road. The separator island creates a gap in the connection between sidewalks along either side of the intersection.

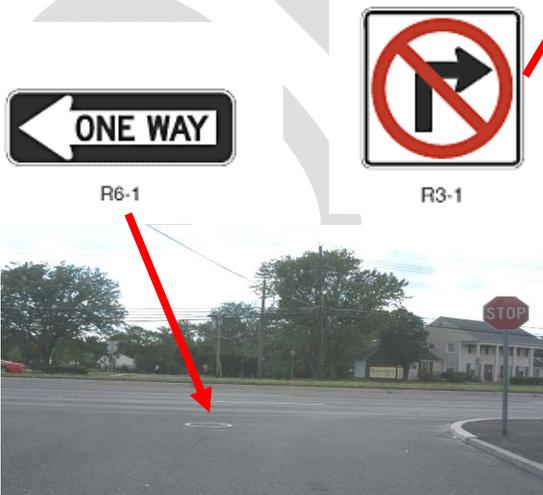


View of channelized right-turn lane and separator island on southbound approach at Haddonfield Road. The RSA team observed pedestrian activity in the area; however, there is no sidewalk or other crossing features in the separator island, resulting in pedestrians crossing at multiple locations.

Signs (Faded/Insufficient/Redundant): The RSA team noted several signage issues within the study area including faded signs, insufficient signs, and redundant signs. Signs are used to provide critical information to motorists and pedestrians. Faded or insufficient signs do not command the respect or provide guidance as intended. At Cornell Avenue., several motorists were observed making illegal prohibited right-turn. The RSA team identified that this lack of respect is likely due to insufficient signing upstream to alert drivers of the appropriate place to make the right-turn. While redundancy can be beneficial, too many signs will increase visual clutter and driver workload.

Suggestions: Conduct a formal sign inventory and consider the following:

- Replace faded signs (e.g., ‘USE CROSSWALK’ sign on northwest quadrant at Cornell Avenue).
- Remove redundant and outdated signs (e.g., ‘RIGHT LANE MUST TURN RIGHT’ signs on northeast quadrant at Garden Park Boulevard).
- Install signage where currently insufficient (e.g., prior to jug handle at Cornell Avenue and install one way sign (R6-1) in median facing Union Avenue).



A view of the median from Union Avenue.



This photo shows an example of a faded sign along the corridor. This sign is located on the northwest quadrant at Cornell Avenue.



The photo above shows a ‘no turn’ sign at the intersection of Cornell Avenue. This sign may be insufficient by itself as it is sometimes disregarded. Consider diagrammatic sign (R3-1) placed on mast arm.



The photo above shows an example of a redundant sign. The sign is not only redundant with the pavement markings, but is also installed in four locations along the intersection approach. The same signs also obstruct the visibility of other signs (e.g., pedestrian crossing sign) as shown in the photo to the right.



Motorists using shoulder to make right turns: *At the intersection with Cornell Avenue westbound motorists were observed using the wide shoulder as a right-turn lane.* This presents a particular issue because there is a bus stop located just east of the intersection and buses use the shoulder to stop out of the travel way.

Suggestions:

Short-term- Consider installing pavement markings to differentiate the shoulder from the travel lane. This may include striping out the shoulder, marking shoulder as a ‘bus only’ lane, or a combination of the two, such as marking out the lane and marking a bus loading zone at the bus stop.



Photo shows the wide shoulder on the westbound approach at Cornell Avenue. As can be seen in the photo, a motorist is using the shoulder as a travel lane. This is a concern because there is a bus stop on this approach (as shown by the red circle).

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Issue 5: Bus Stops

Bus stops not located near crossings: *There are seven bus stops located within the study area and just four are located near official crossings.* For the other three bus stops, the proximity to an official crossing varies. When crossings are not located in close proximity to an official crossing, pedestrians are more likely to cross midblock, increasing the chance for a pedestrian-vehicle conflict. Many of the bus stops are located directly across from each other and not near a crossing, which also increases the likelihood of a midblock crossing such as the eastbound and westbound bus stops near Cuthbert Boulevard. There was one pedestrian crash at this location. At Cornell Avenue, there is an eastbound bus stop located on the southwest quadrant. There are two pedestrian generators (i.e., a pizza parlor and a night club) located on the northwest quadrant with no crossing on the west leg. There were two pedestrian crashes at this location from 2005-2007.

Suggestions (see also Appendix E):

Intermediate- Consider relocating bus stops to be in closer proximity to existing crossings and consider the feasibility of a crosswalk on the west leg of the intersection with Cornell Avenue. It is currently not feasible to provide a crosswalk on that leg because of dual right-turn lanes on the southbound approach that conflict with this crossing. While the RSA team did not observe right-turn volumes that would warrant a dual right-turn, a detailed traffic study should be conducted to determine the feasibility of all the options. Several options include:

- Converting southbound dual right turn to single right turn lane. Right turning traffic could receive a green arrow as an overlap phase with the eastbound left turn phase.
- Converting southbound dual right turn to single right turn lane Encouraging use of alternate paths to head westbound on Route 70.



View of southbound approach at Cornell Avenue showing the dual right-turn configuration.



Photo of the intersection at Cornell Avenue, showing the current location of the eastbound bus stop on the southwest quadrant. The photo shows the absence of a crosswalk at this location, but also illustrates the potential impediments to installing a crosswalk (i.e., wide cross-section and limited median).



Photo shows the bus shelter along westbound Route 70. The closest crossing of Route 70 is located on the east leg of Cornell Avenue over 2500 feet away. Note also the lack of connectivity between existing sidewalks and the shelter.

Long-term- For the eastbound and westbound bus stops near Cuthbert Boulevard, there are multiple options that may be explored (see Issue 2):

- Consider relocating the bus stops further east and providing some type of signalized crossing if warranted. Signal considerations may include:
 - Pedestrian-activated push-buttons to minimize disruptions in traffic.
 - A two-stage crossing (which would stop traffic in only one direction at a time).
 - A HAWK signal. This signal will likely be included in the next edition of the MUTCD. The HAWK signal appears blank in rest mode, so the traffic signal only operates when activated by a pedestrian.

Connectivity to bus stops: *Some of the bus stops identified along the corridor may be inaccessible to pedestrians with mobility restrictions.* These stops are not connected by sidewalks or surfaces that are easily traversable. These conditions may lead to the following issues:

- Pedestrians may take paths that conflict with vehicular traffic.
- Pedestrians with mobility restrictions and older pedestrians may not be able to reach desired destinations.

Suggestions:

Intermediate- Install sidewalks within existing right-of-way to provide better access to bus stops.

Long-term- Future pedestrian facility upgrades within the study area may be coordinated with redevelopment activities to provide better connectivity and continuity throughout the area.



View of bus shelter along Route 70 just east of Garden Park Blvd. Note the lack of connectivity between the existing sidewalks and the shelter.

Unofficial bus stops: *Unofficial bus stops were identified along the corridor. At these locations, pedestrians were observed waiting for the bus and were eventually picked-up.* Unofficial stops can lead to safety issues for motorists if they are not expecting the bus to stop. This can also lead to increased midblock crossings if there is not a crossing near the location where pedestrians are picked-up or dropped-off.

Suggestion: Consider a transit user education program through the transit agency to discourage unofficial stops. Also, encourage NJ Transit to provide South Jersey bus maps. To increase the use of official bus stops, consider the following:

- Enhance the conspicuity of bus stops by providing consistent signage and lighting.
- Improve amenities at existing bus stop locations including landing pads, schedule and fare information, benches, and potentially shelters.



Photo shows a sign for the train station. Pedestrian is waiting at this location for the bus, but this is not an official bus stop.

Issue 6: Conflicts at Crossings

Vehicles make high-speed turns at channelized right-turn lanes: While channelized right-turns can enhance pedestrian safety by providing pedestrians with a refuge island, there are channelized turn lanes in the corridor where wide corner radii enable vehicles to make high-speed right turns. This can expose pedestrians to conflicts with high-speed traffic and make it more difficult for pedestrians to determine when it is safe to cross. Right turn channelized islands are designed so that drivers focus their attention to the left to look for gaps in traffic. This means the drivers will be looking away from pedestrians when they are trying to cross an intersection from the right of the driver.

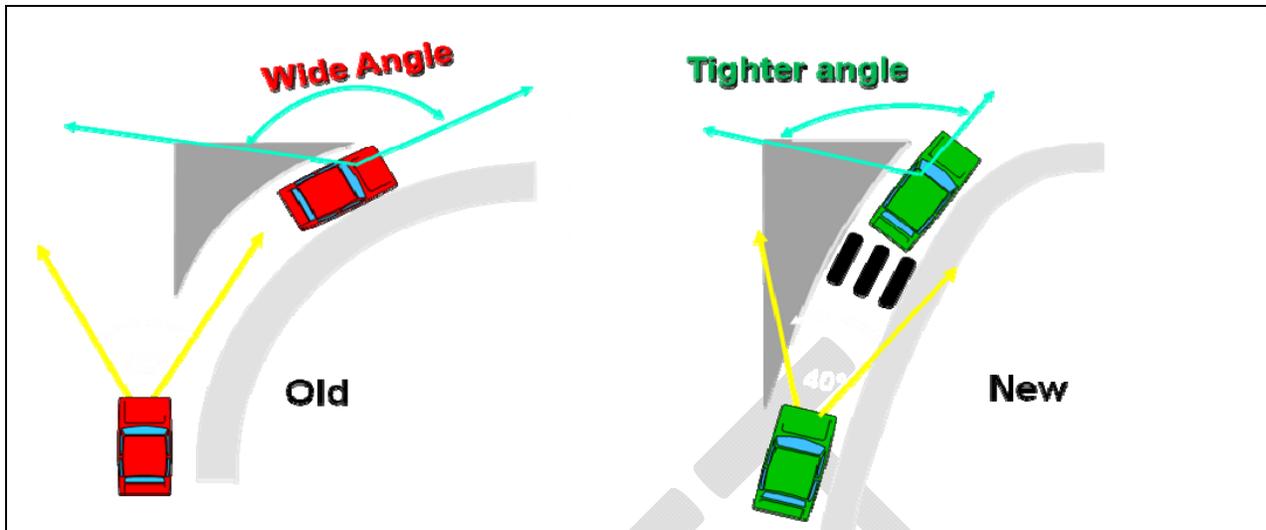
Suggestions:

Intermediate: Consider enhancements in signing and markings to warn motorists of pedestrians. Identify the level of pedestrian activity at Haddonfield Road to determine the need for a crosswalk and other pedestrian features as discussed in Issue 1 (lack of continuity across side streets). For channelized right-turn lanes that lead into an exclusive or acceleration lane, place pedestrian warning signs and advance yield lines prior to the pedestrian crossing. In addition, consider improving all driveways by installing stop bars and stop signs per MUTCD standards.

Long-term: Consider alternatives to channelized right-turn lanes. Where channelized right-turn lanes are to be installed, consider a design with a steeper angle to reduce vehicle speeds and focus driver attention toward the crosswalk.



View of channelized right-turn lane on southbound approach at Haddonfield Road. The wide radius allows vehicles to make high-speed turns, which creates a potential safety issue for pedestrians turning to cross the street.



Minimal crossing time: The RSA team noted locations in the study area where there is minimal time allotted for pedestrians crossing Route 70. The time required for a pedestrian to cross the street depends on the crossing distance and pedestrian walking speed. While the time is adequate based on an assumed walking speed of 4 ft/s, the time may not be sufficient for pedestrians with mobility restrictions or those with small children. If pedestrians do not have time to complete a crossing in a single stage, they may be stranded in the median island or try to complete the crossing, which increases the chance of a pedestrian-vehicle conflict.

Suggestions: Consider increasing the pedestrian intervals based on an assumed walking speed of 3.5 ft/s. The Manual on Uniform Traffic Control Devices (MUTCD) currently recommends a walking speed of 4.0 feet/second. However, the National Committee on Uniform Traffic Control Devices (NCUTCD) recommends reducing the assumed walking speed to 3.5 feet/second. Recent research, including the AAA Pedestrian Signal Safety for Older Persons study, supports this research.

Issue 7: Drainage

Drainage: The RSA team noted evidence of drainage issues in the right-most eastbound travel lane near Cornell Avenue. Additionally, the drainage inlets in the study area are not bicycle-friendly. Improper drainage can lead to hydroplaning or icy roadway conditions. The drainage inlets have openings that are parallel to the travel way, which creates a hazard for bicyclists (i.e., front tire dropping into drainage inlet).

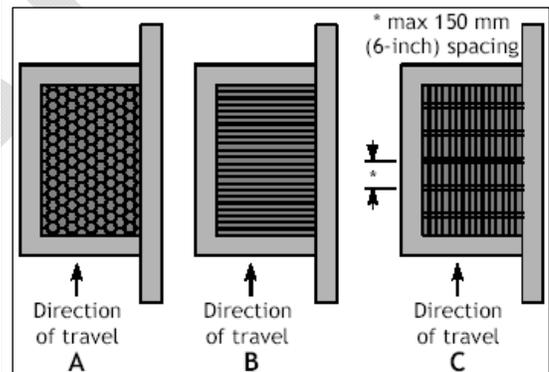
Suggestions:

Intermediate- Consider replacing drop inlets with ADA compliant designs. ADA indicates that gratings located in walking surfaces shall have spaces no greater than 0.5 inches wide in one direction and gratings have elongated openings shall be placed so that the long dimension is perpendicular to the dominant direction of travel. The figure to the right illustrates a few examples of bicycle-friendly designs.

Long-term- Evaluate the extent of drainage issues during wet weather conditions. If drainage issues are evident, consider improving the cross-slope to provide better drainage during subsequent roadway projects.



The photo above shows the sidewalk on the north side of Route 70 just prior to Cornell Avenue. The photo shows evidence of drainage issues where sediment has been deposited.



Source: Oregon Bicycle and Pedestrian Plan
This figure illustrates examples of drainage grates that are bicycle-friendly.

Opportunities Beyond Engineering

Public safety can be improved through education and enforcement measures as well as engineering. There are at least two opportunities to improve safety through these measures.

Public Outreach:

Transit Operation and Ridership: There are several bus stops along this corridor, which is one of the pedestrian generators. The RSA team observed several potential safety issues related to bus stops, operation, and rider behavior. There is an opportunity to provide education through the local transit agency to help mitigate some of these issues as described in the report.

Enforcement:

Cherry Hill Police Department: The Cherry Hill Police Department was represented on the RSA team by two officers. The officers indicated that they would like to apply for a grant to increase enforcement along the corridor, particularly to help mitigate unsafe pedestrian behavior.

The Cherry Hill police officers also indicated that vehicles often queue in the westbound travel lane to access the gas station and car wash located west of Union Avenue. In addition, the car wash is noted for discharging their run-off onto the street. The traffic queuing in the travel lane increases the chance of rear-end collisions because drivers may not expect the sudden stop in traffic. The run-off from the car wash includes soap and wax, which significantly reduces the pavement friction and increases the likelihood of rear-end collisions. Consider education and enforcement opportunities at local businesses. Educate the business owners about their responsibility to maintain a safe environment for their customers. Enforce violations with fines to encourage compliance with drainage regulations.

For more information, look at the education and enforcement measures included in the following publications:

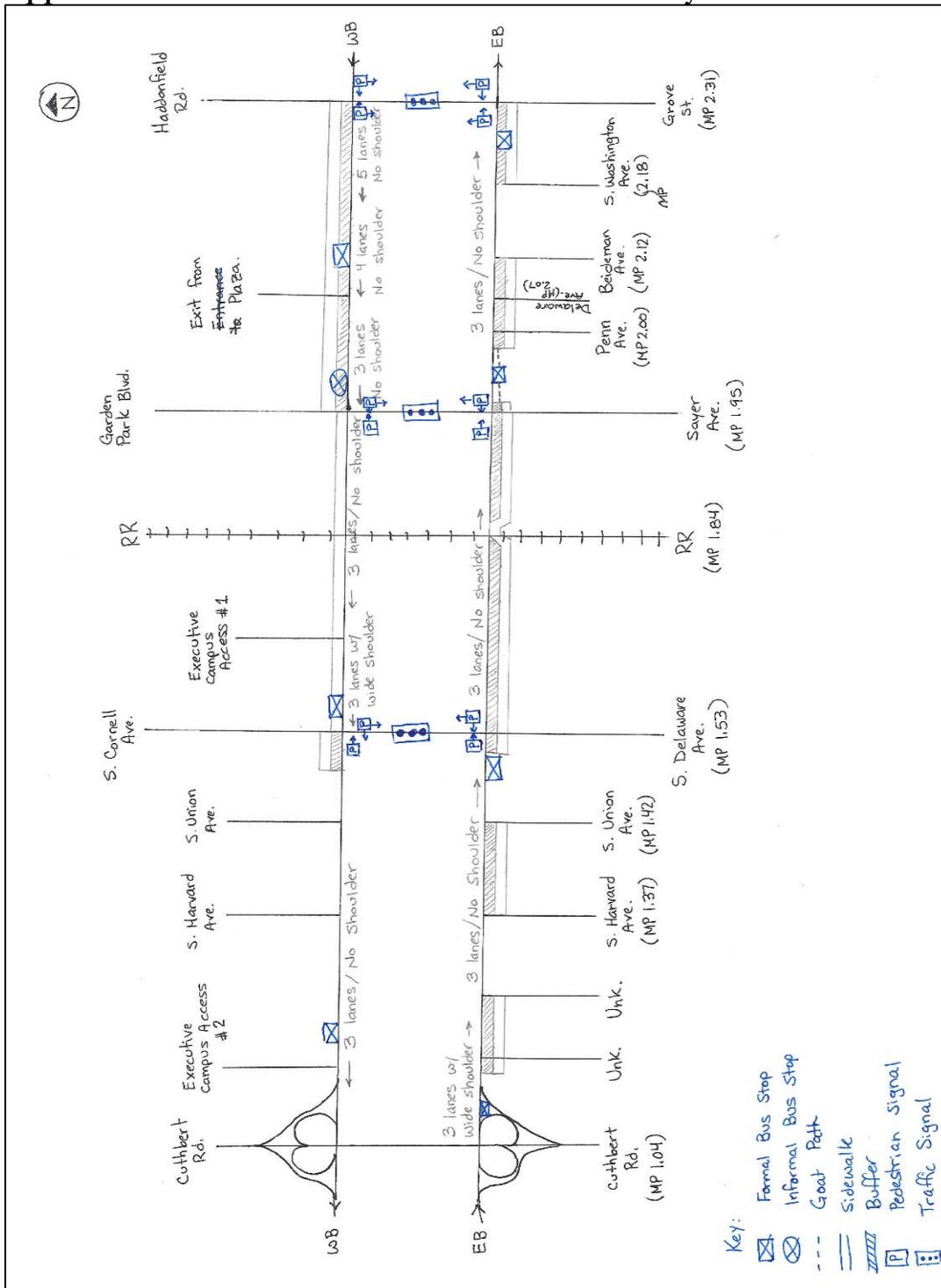
How to Develop a Pedestrian Safety Action Plan (FHWA-SA-05-12)

<http://drusilla.hsrc.unc.edu/cms/downloads/howtoguide2006.pdf>

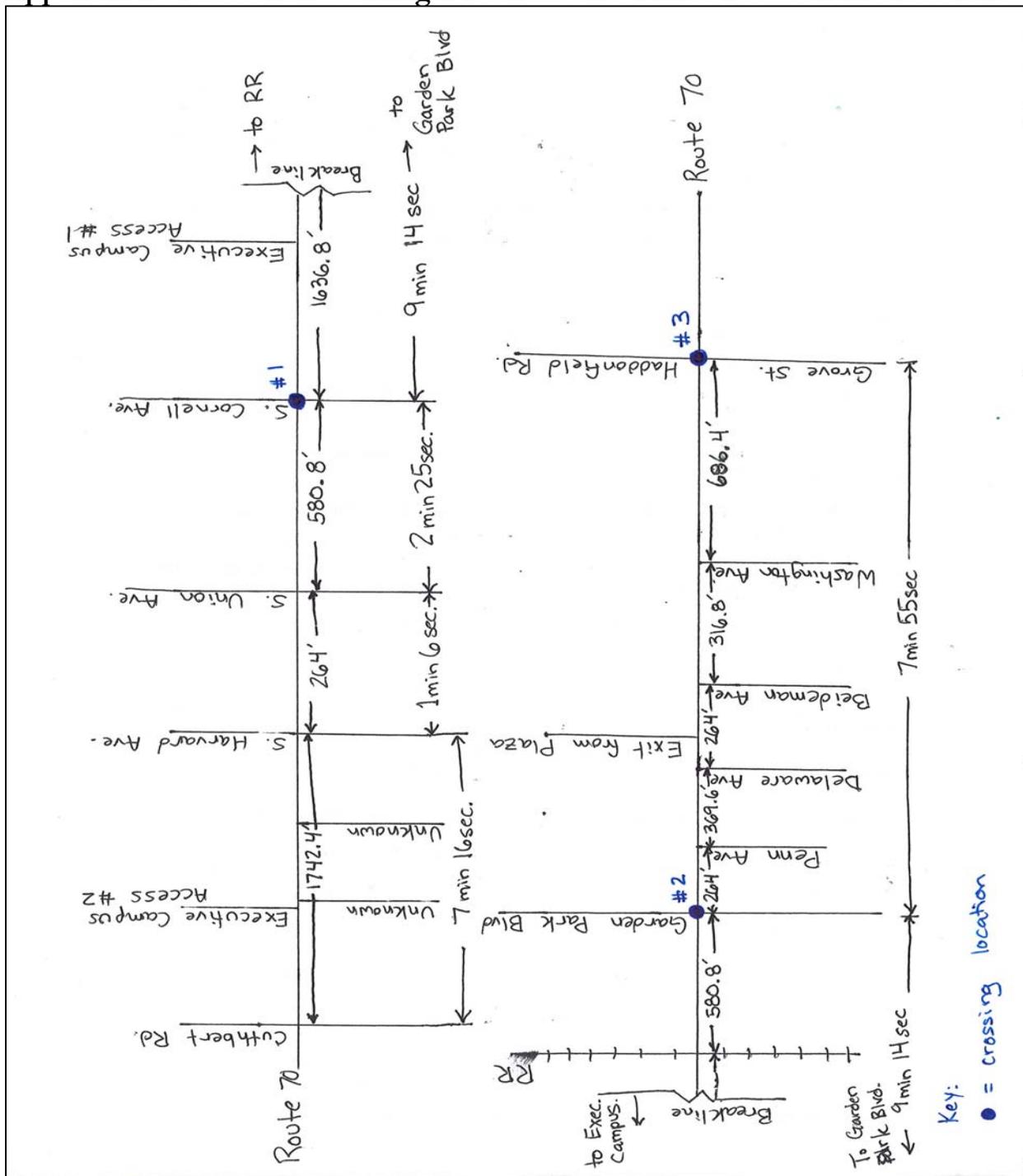
A Resident's Guide for Creating Safe and Walkable Communities (FHWA-SA-07-016)

http://safety.fhwa.dot.gov/PED_BIKE/ped/ped_walkguide/residentsguide.pdf

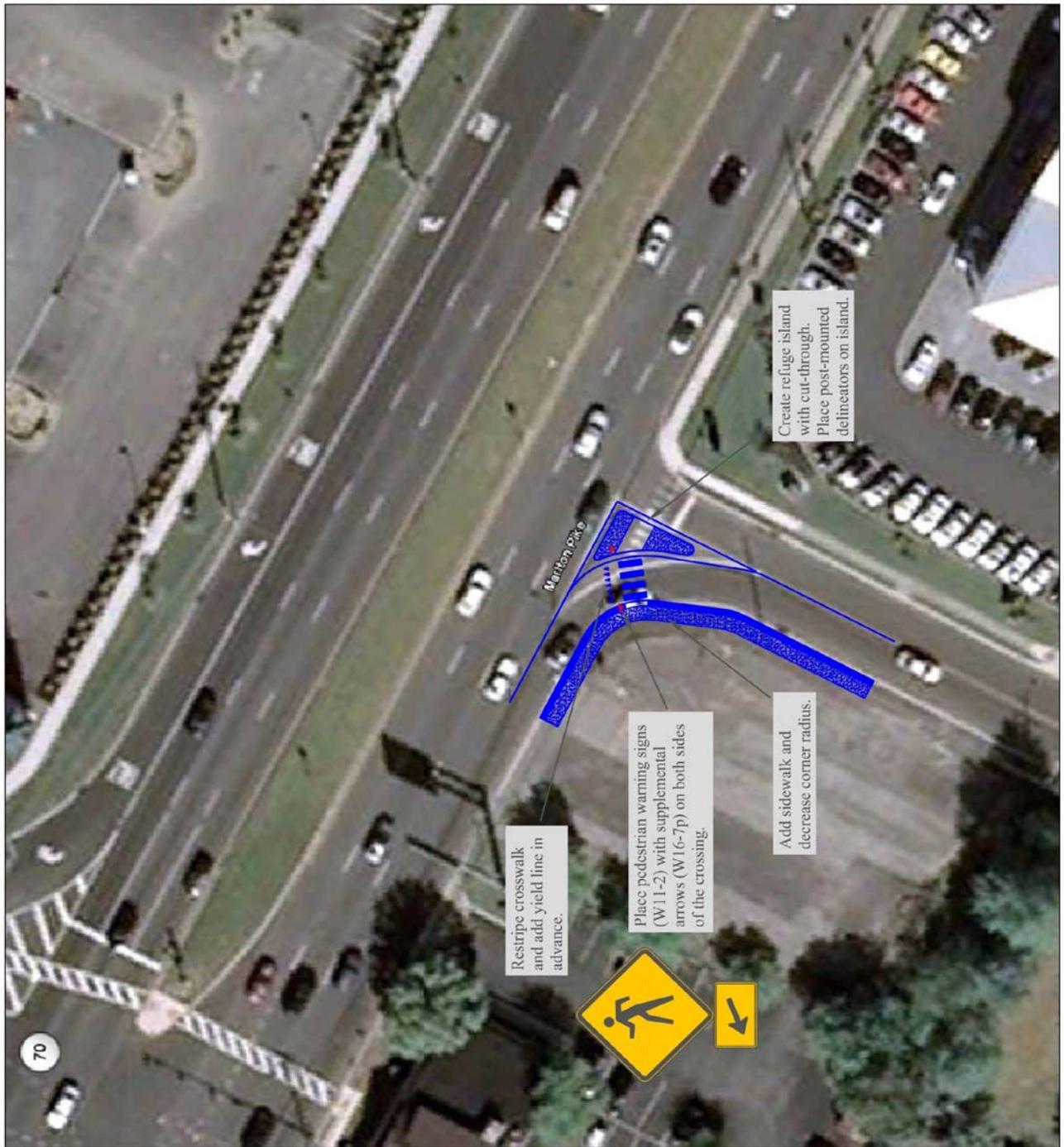
Appendix C: Pedestrian Facilities within the Study Area

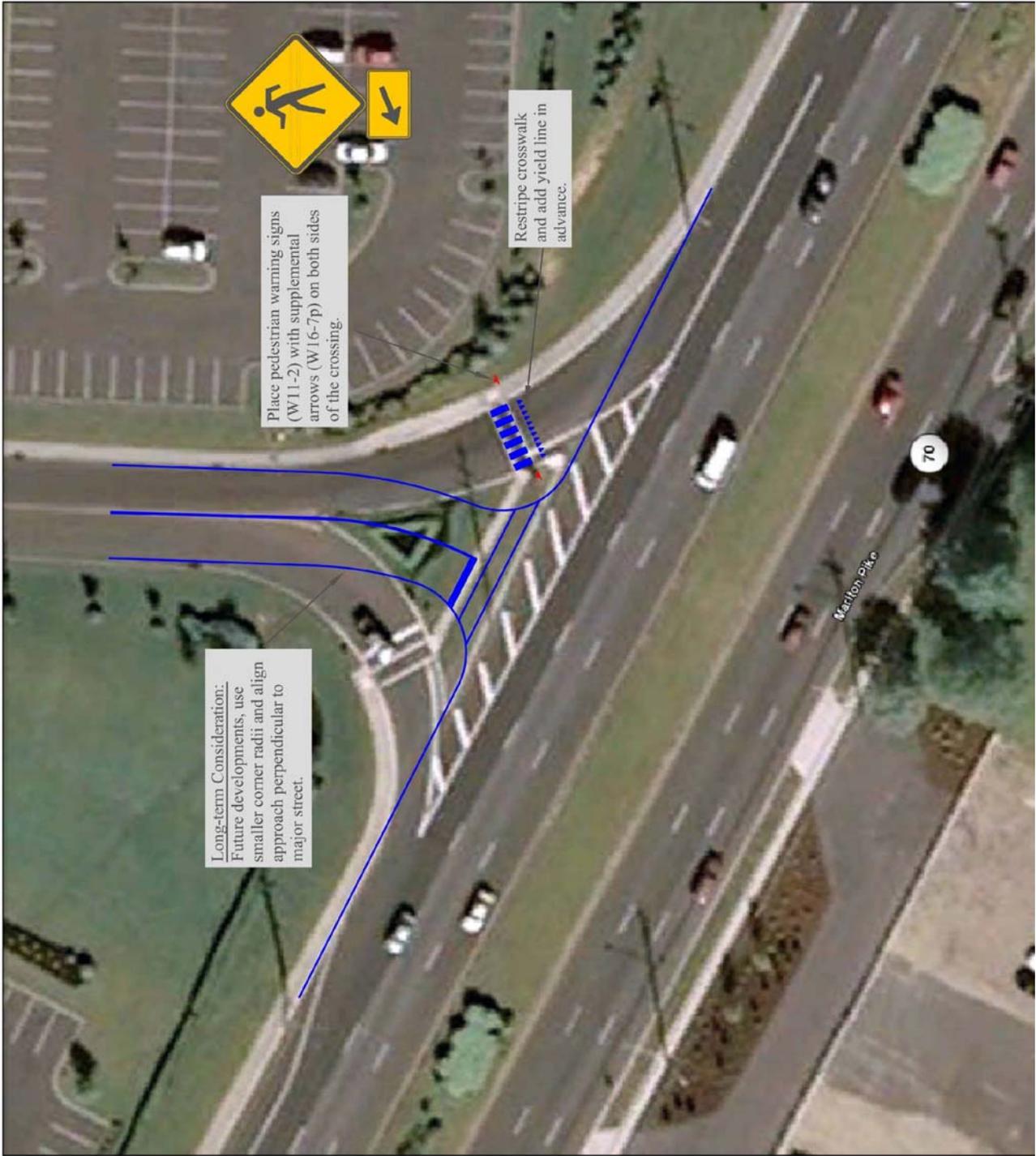


Appendix D: Pedestrian Walking Distances and Times Between Intersections



Appendix E: Improvement Concepts



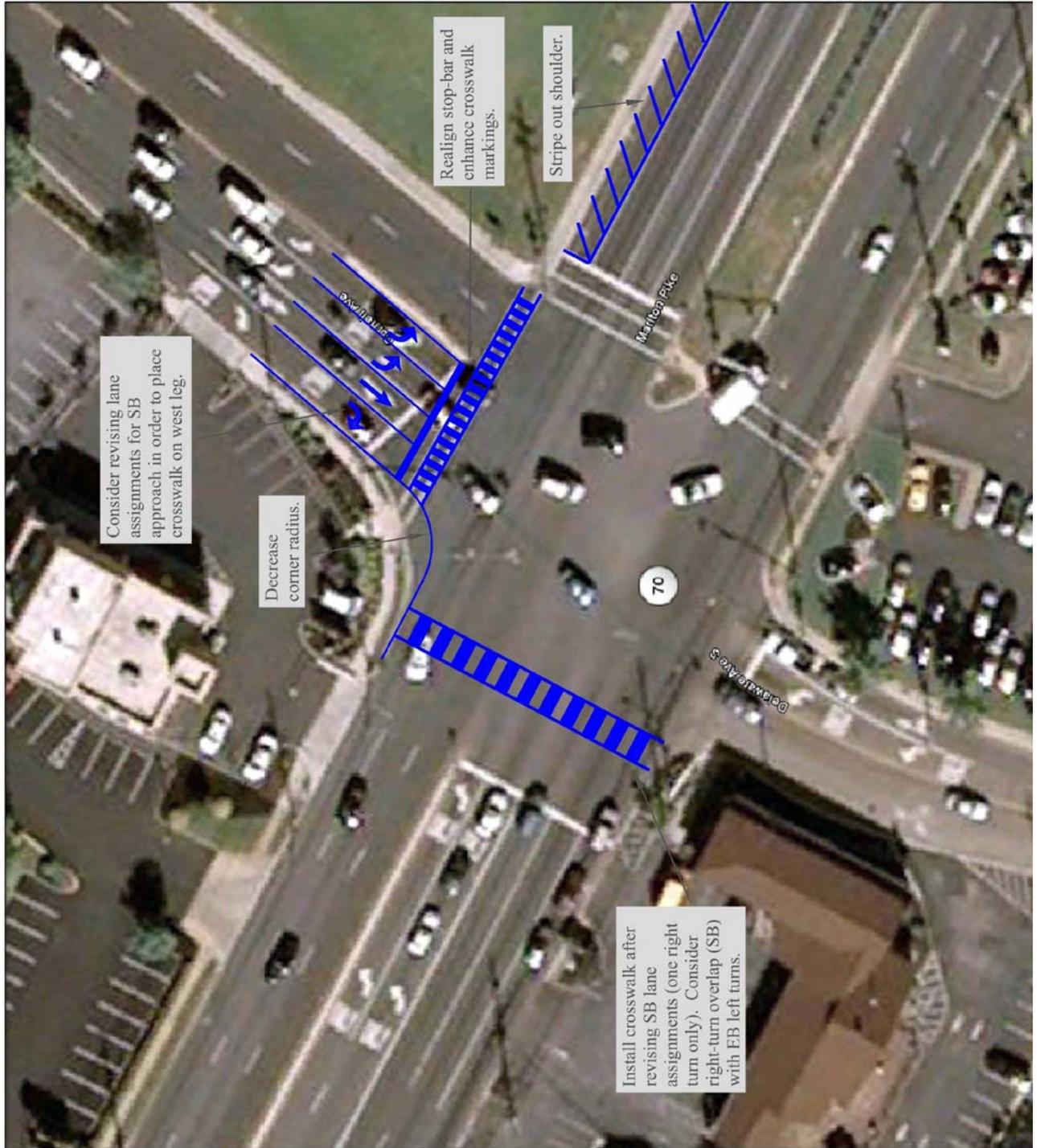


Long-term Consideration:
Future developments, use smaller corner radii and align approach perpendicular to major street.

Place pedestrian warning signs (W11-2) with supplemental arrows (W16-7p) on both sides of the crossing.

Restripe crosswalk and add yield line in advance.







Move bus stop east to avoid pedestrian-vehicle conflicts at ramp OR consider pedestrian crossing enhancements at ramp.

Install HAWK or two-stage signalized crossing.