

Pedestrian Safety Study



**MD 924 (Main Street and Bond Street) from
Baltimore Pike to Lee Street**
Bel Air, Maryland

Prepared by:

**Pedestrian Safety Study
MD 924 from Baltimore Pike to Lee Street**

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A. INTRODUCTION

As requested by the State Highway Administration (SHA) District 4 Traffic Division, Wallace Montgomery (WM) is hereby providing the results of a comprehensive Pedestrian Safety Study in downtown Bel Air, Maryland. The purpose of this study was to evaluate pedestrian related concerns that were expressed to SHA from the Town of Bel Air in order to improve safety and accessibility within the downtown. Specifically, this study addresses the following items:

- ADA compliancy
- Intersection and corridor geometrics and traffic control measures
- Field observations
- Traffic volumes
- Intersection capacity and operational analyses
- Travel speeds
- Future trail access evaluation
- Recommendations for safety and pedestrian accessibility improvements

B. SITE DESCRIPTION

1. Location

The study area in downtown Bel Air encompasses MD 924 North and South (Main Street and Bond Street) between Lee Street and US 1 Business (Baltimore Pike/Fulford Avenue). The study corridor is approximately 0.72 miles long with four signalized intersections in each direction. In addition, Main Street has two un-signalized intersections and Bond Street has four un-signalized intersections. The immediate land use in the study area is mostly commercial with residential areas to the north and south. **Figure 1** shows the location of the study corridor and surrounding area. The following five signalized intersections along MD 924 were specifically identified to be analyzed in this study:

1. US 1 Business (Baltimore Pike) at NB MD 924 (Main Street)
2. NB MD 924 (Main Street) at WB MD 22 (Churchville Road)
3. NB MD 924 (Main Street) at Courtland Street
4. NB MD 924 (Main Street) at Pennsylvania Avenue
5. SB MD 924 (Bond Street) at WB MD 22 (Churchville Road)

2. Geometry and Control

MD 924 is classified as an Urban Minor Arterial that consists of two roadways: Main Street and Bond Street. Each operate together to accommodate opposite directions of one-way traffic. MD 924 North (Main Street) has two lanes for through traffic between MD 22 (Baltimore Pike/Fulford Avenue) and E Lee Street. MD 924 South (Bond Street) has three lanes for through traffic between E Lee Street and W Courtland Street, and two lanes for through traffic from W Courtland Street to Fulford Avenue.

The posted speed limit within the study area is 25 mph. On-street parking is available along Main Street on both sides of the street between Churchville Road and E Lee Street; however on-street parking is not available along Bond Street. There is one bus stop located in the study area along Main Street between Baltimore Pike/Fulford Ave and Churchville Road.

The five signalized study intersections have a cycle length of 90 seconds during the AM period and 100 seconds during the PM peak period, and they are part of the same Downtown Bel Air coordinated signal system. The clearance intervals (yellow and all-red signal timing) and pedestrian timing (walk and flashing don't walk timing) at each study intersection are sufficient based on geometry and travel speeds in accordance with MD-MUTCD criteria.

Photographs along the study corridor and intersections are provided in **Appendix A**.

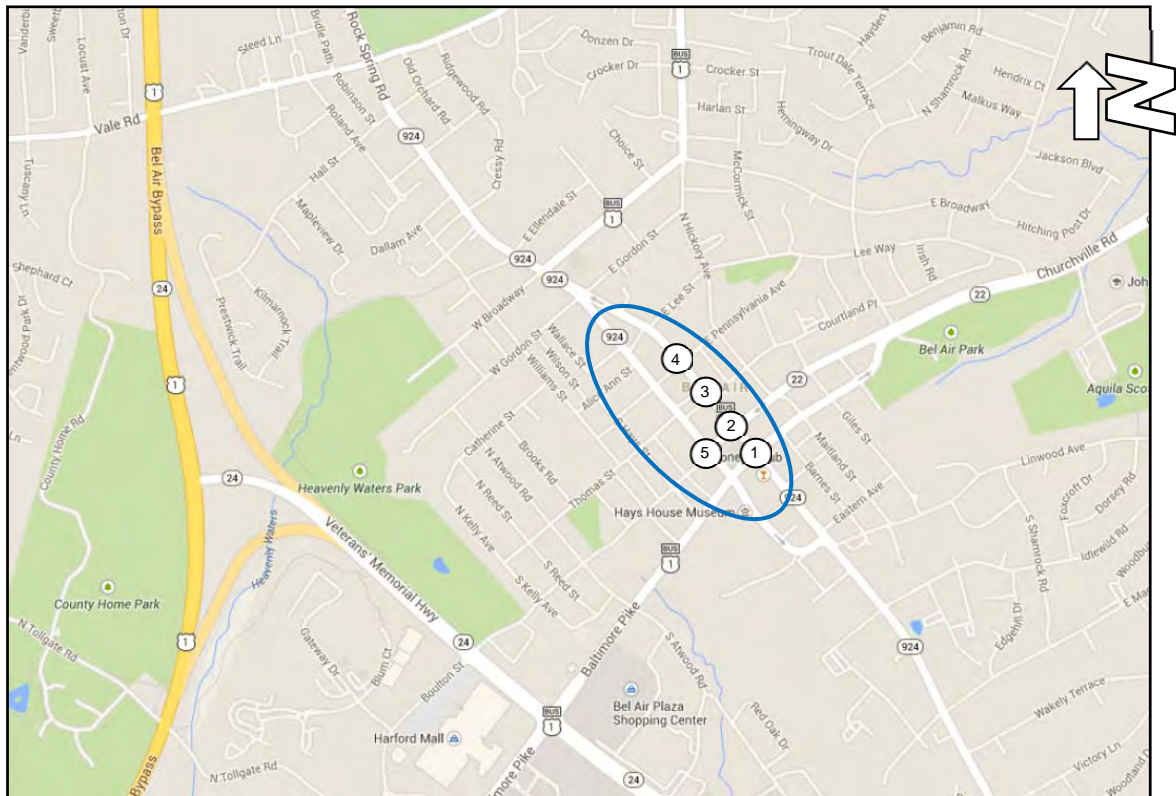


Figure 1. Location Map (Google Maps)

3. Pedestrian Conditions

Sidewalks are present along both sides of Main Street and Bond Street through the entire study area. There are APS/CPS signalized marked crossings at all the signalized intersections within the study area. Uncontrolled marked crossings are present at Main Street at Office Street, Bond Street at Courtland Street and both Lee Street intersections (crossing mainline). Stop-controlled marked crossings are present at both Lee Street intersections (crossing Lee Street) and Bond Street at Alice Ann Street.

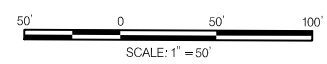
All signing at uncontrolled crossings are up to current standards. However the Lee Street crossing across Bond Street does not have advanced pedestrian warning signs along Bond Street, and neither of the Lee Street uncontrolled marked crossings are hatched.


As part of the streetscape improvements completed in 2008, the sidewalks, crossings and pedestrian signals were made ADA compliant in the downtown area, with some deficiencies still present at some of the intersections. A summary of these deficiencies are identified in **Figures 2 and 3**, and a detailed inventory of all the ADA compliant information at each intersection within the study area is provided in **Appendix B**.

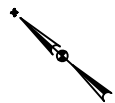


MATCH LINE - SEE SHEET 02

1. RECOMMEND RAMP FLARES INSTEAD OF FULL HEIGHT CURBS AT RAMPS.
2. RECOMMEND RELOCATING APS PEDESTAL POLE FOR NORTH LEG CROSSING TO CLEAR SIDEWALK PATH.
3. RECOMMEND RELOCATING PEDESTRIAN PEDESTAL POLE FOR EAST LEG CROSSING CLOSER TO RAMP.

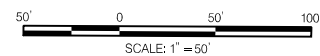


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	FIGURE 2		DATE: OCTOBER 2014	PAGE 03
				SHEET NO. 01 OF 02



MATCH LINE - SEE SHEET 01

1. RECOMMEND RAMP FLARES INSTEAD OF FULL HEIGHT CURBS AT RAMPS.
2. RECOMMEND RECONSTRUCTING DRIVEWAY RAMP SLOPES TO ADA STANDARDS.



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FIGURE 3	SHEET NO. 02 OF 02
DATE: OCTOBER 2014	

The uncontrolled marked crossing at Lee Street across Main Street is located on the north leg between East and West Lee Street. As shown in **Figure 4**, the crosswalk is not hatched and the pedestrian crossing warning signs are obstructed from view of approaching vehicles along Main Street. Providing a marked crossing on the south leg would have a shorter crossing length, no conflicts with right-turning vehicles from West Lee Street, and better sight distance for the pedestrian crossing warning signs.



Figure 4. Main Street Approach to Lee Street

4. Sight Distance Evaluations

In response to the safety concerns of right-turning vehicles not stopping for crossing pedestrians, sight distances at the five study intersections were reviewed to determine if any obstructions are present to the marked pedestrian crossings and turning vehicles. None of the right-turning approaches have obstructions that impede sight lines to the adjacent crossings.

5. Field Observations

The following observations were noted during the site visit on September 15, 2014:

- The stop bar marking on the Office Street approach at Bond Street is in poor condition.
- Pavement markings at the intersection of Bond Street and Pennsylvania Avenue are in poor condition.
- Pedestrians often cross the road against the pedestrian signal.
- The pavement markings (lane markings and crosswalk markings) at several locations along Main Street are in poor condition.
- Vehicles often stop within the crosswalks for a red signal instead of the stop bar.
- Vehicles often turn in the wrong direction (against traffic) to access driveways to the commercial developments along Main Street.

- Observed numerous obstacles (signs, vegetation, seats, etc.) within the sidewalks along Main Street.

C. TRAFFIC VOLUME DATA AND ANALYSIS

1. Traffic Data Collection

Thirteen (13) -hour turning movement and pedestrian counts were conducted on Tuesday, September 16, 2014 at the five study intersections, while Harford County Public schools were in session. **Table 1** summarizes the peak and total pedestrian volumes at each study intersection, **Figure 5** summarizes the peak hour volumes for the five study intersections, and **Table 2** summarizes the number of left-turn movements on red during the traffic count periods. Detailed count data is included in **Appendix C**.

The peak pedestrian traffic occurred from 2:00 to 3:30 PM during school dismissal. The highest pedestrian activity along Main Street occurred between Churchville Road and Pennsylvania Avenue, with the highest number of pedestrians crossing Main Street along the north leg at Courtland Street.

Table 1. Pedestrian Volume Summary

MD 924 Intersection	Time Period	North Leg	South Leg	East Leg	West Leg	Total
1. Baltimore Pk at Main St	Peak AM (PM)	2 (1)	3 (3)	10 (4)	7 (12)	22 (20)
	Total	26	44	103	159	332
2. Main St at Churchville Rd	Peak AM (PM)	15 (5)	19 (8)	27 (14)	29 (20)	90 (47)
	Total	84	154	310	270	818
3. Main St at Courtland St	Peak AM (PM)	78 (50)	35 (22)	24 (42)	23 (66)	160 (180)
	Total	531	324	428	476	1759
4. Main St at Pennsylvania Ave	Peak AM (PM)	8 (22)	1 (2)	13 (28)	32 (20)	54 (72)
	Total	118	77	262	307	764
5. Bond St at Churchville Road	Peak AM (PM)	0 (6)	1 (2)	1 (3)	0 (0)	2 (11)
	Total	62	55	72	23	212

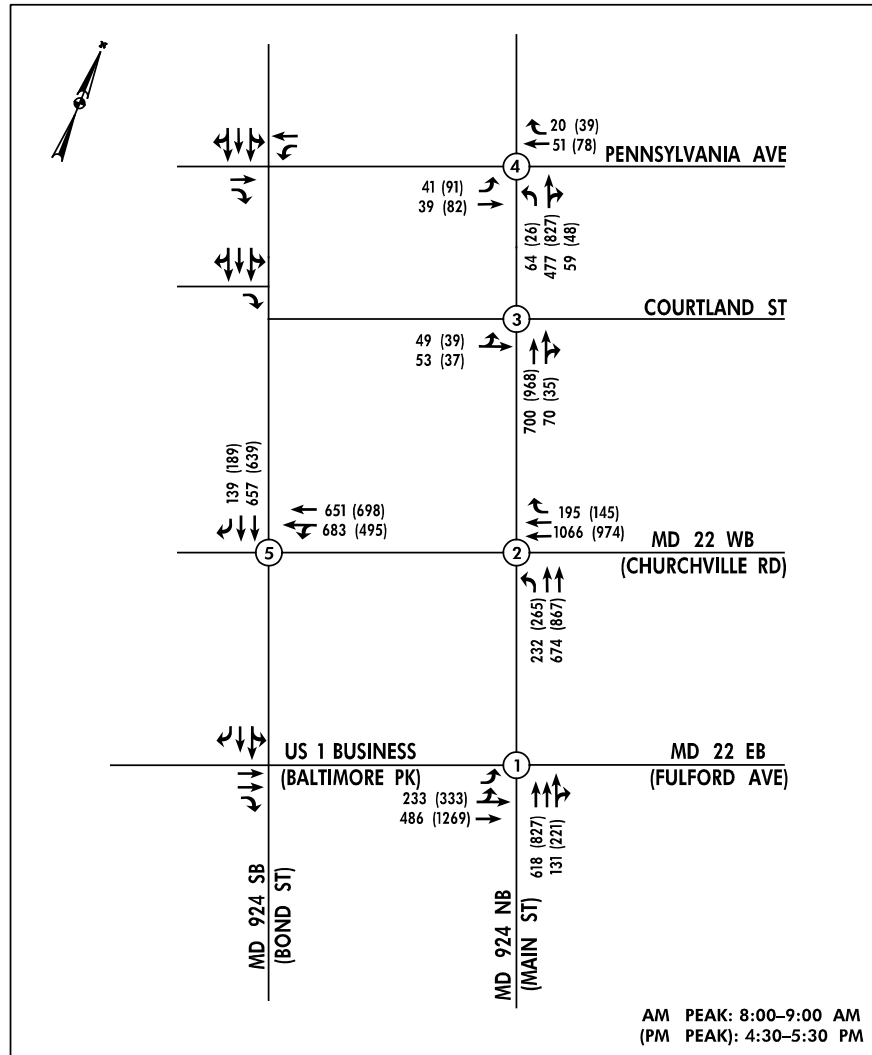


Figure 5. Existing Volume and Lane Configuration Diagram

Table 2. Left-Turn On Red Volume Summary

MD 924 Intersection	AM (6am-10am)	MID (10am-2pm)	PM (2pm-7pm)	Total
1. NB Baltimore Pk to NB Main St	0	2	5	7
3. EB Courtland St to NB Main St	8	6	9	23
5. WB Churchville Rd SB Bond St	1	3	1	5

2. Capacity and Operational Analysis

Capacity analyses were performed on the AM and PM peak hour volumes for the five study intersections in accordance with the SHA recommended Critical Lane Volume Technique (CLV). In addition, operational analyses were developed using the Highway Capacity Manual Technique (HCM) for signalized intersections using the Synchro/SimTraffic modelling

software. Summaries of the peak period analyses are included in **Table 3**, and detailed worksheets are included in **Appendix D**.

The results of the analysis indicate that all of the study intersections currently operate at acceptable level of services.

Table 3. Existing Capacity and Operational Analysis Summary

MD 924 Intersection	Peak Period	HCM														CLV	
		Eastbound			Westbound			Southbound			Northbound			Total		V/C	LOS
		Queue (Ft)	Delay (Sec)	LOS	Queue (Ft)	Delay (Sec)	LOS	Queue (Ft)	Delay (Sec)	LOS	Queue (Ft)	Delay (Sec)	LOS	Delay (Sec)	LOS		
1 Baltimore Pk at Main St	AM	104	8.2	A	-	-	-	-	-	-	165	12.9	B	10.6	B	0.37	A
	PM	104	5.0	A	-	-	-	-	-	-	430	35.8	D	17.2	B	0.66	B
2 Main St at Churchville Rd	AM	-	-	-	357	6.8	A	-	-	-	197	13.9	B	9.7	A	0.48	A
	PM	-	-	-	357	17.8	B	-	-	-	110	7.9	A	12.8	B	0.50	A
3 Main St at Courtland St	AM	97	38.3	D	-	-	-	-	-	-	135	0.7	A	5.1	A	0.33	A
	PM	86	43.5	D	-	-	-	-	-	-	124	0.8	A	3.3	A	0.39	A
4 Main St at Pennsylvania Ave	AM	71	28.1	A	95	38.6	D	-	-	-	90	2.5	A	8.6	A	0.24	A
	PM	121	20.8	B	155	41.0	D	-	-	-	97	2.1	A	8.6	A	0.41	A
5 Bond St at Churchville Rd	AM	-	-	-	342	15.3	B	282	25.8	C	-	-	-	19.3	B	0.68	B
	PM	-	-	-	334	17.0	B	129	10.6	B	-	-	-	14.4	B	0.63	B

Note: Queue lengths based on 95th percentile queues from SimTraffic.

In response to the safety concerns of right-turning vehicles not stopping for crossing pedestrians during red light conditions, the intersection operations were reviewed to evaluate the traffic impacts to prohibit right-turns on red at the study intersections using the HCM analysis. Summaries of the proposed peak period analyses are included in **Table 4**, and detailed worksheets are included in **Appendix E**.

The results of the analysis indicate that all of the study intersections would continue to operate at acceptable level of services with the right-turns restricted on red.

Table 4. Proposed Operational Analysis Summary

MD 924 Intersection	Peak Period	HCM													
		Eastbound			Westbound			Southbound			Northbound			Total	
		Queue (Ft)	Delay (Sec)	LOS	Queue (Ft)	Delay (Sec)	LOS	Queue (Ft)	Delay (Sec)	LOS	Queue (Ft)	Delay (Sec)	LOS	Delay (Sec)	LOS
1 Baltimore Pk at Main St	AM	118	8.2	A	-	-	-	-	-	-	188	13.1	B	10.7	B
	PM	116	5.0	A	-	-	-	-	-	-	524	36.8	D	17.6	B
2 Main St at Churchville Rd	AM	-	-	-	415	7.3	A	-	-	-	200	13.0	B	9.7	A
	PM	-	-	-	356	18.1	B	-	-	-	124	7.4	A	12.7	B
3 Main St at Courtland St	AM	114	38.3	D	-	-	-	-	-	-	117	0.7	A	5.1	A
	PM	72	43.5	D	-	-	-	-	-	-	114	0.8	A	3.3	A
4 Main St at Pennsylvania Ave	AM	69	27.9	C	95	39.0	D	-	-	-	77	2.6	A	8.8	A
	PM	118	20.5	C	157	41.6	D	-	-	-	127	2.8	A	9.2	A
5 Bond St at Churchville Rd	AM	-	-	-	353	15.4	B	260	21.8	C	-	-	-	17.8	B
	PM	-	-	-	347	16.9	B	121	12.5	B	-	-	-	15.1	B

Note: Queue lengths based on 95th percentile queues from SimTraffic.

D. SPOT SPEED STUDY

Speed studies were conducted along northbound MD 924 (Main Street) on Tuesday, September 30, 2014. The speed study was completed just north of Pennsylvania Ave from 1:30 PM to 2:00 PM. The results of the analyses are summarized in **Table 5**. The analysis indicates that the 85th percentile speed as vehicles leave the signalized corridor was above the 25 mph posted speed limit at 30 mph.

Table 5. Speed Study Summary

Date:	9/30/2014		
Location:	Main St. - N. of Pennsylvania Ave		
Speed Limit:	25 mph		
Start Time:	1:30 pm		
End Time:	2:00 pm		
Speed	No. of Vehicles	Cumulative	Percent of Veh
25	28	28	36.36%
26	18	46	59.74%
27	7	53	68.83%
28	6	59	76.62%
29	4	63	81.82%
30	3	66	85.71%
31	4	70	90.91%
32	2	72	93.51%
33	1	73	94.81%
34	2	75	97.40%
38	2	77	100.00%
85th Percentile Speed (mph)		30	

E. TRAIL ACCESS

The Town of Bel Air is planning to extend the existing hard surface Ma & Pa Trail, which is located just west of the study area, to cross MD 924 north as shown in the *2013 Town of Bel Air Bicycle and Pedestrian Plan*. Pedestrian crossings were evaluated to determine feasible locations to safely cross MD 924 near the proposed trail extension.

The current proposed alignment in the *Bicycle and Pedestrian Plan* has the trail crossing MD 924 at Cressy Road and mid-block just west of Ellendale Street. Trail way-finding signs to direct vehicles to the current trail location are present at the Ellendale Street intersection (see **Figure 6**). Both Cressy Road and Ellendale Street are un-signalized intersections with stop control on the minor street approaches. An existing signalized marked crossing across the north leg at Broadway is located approximately 500 feet south of the current proposed alignments.



Figure 6. Existing Ma & Pa Trail Sign

A revised proposed alignment crossing the north leg of Ellendale Street was evaluated with the current proposed alignments. The current and revised proposed trail alignments are shown in **Figure 7**. Both Cressy Road and Ellendale Street intersections have adequate sight distances (Cressy Road is slightly better) and are feasible locations that can directly connect the existing trail to the proposed alignment to install an un-controlled crossing. The MD 924 crossing should include hatched crosswalk markings and pedestrian crossing signs in advance and at the un-controlled crosswalk. The signalized crossing at Broadway would be a safest means to cross MD 924; however this location does not provide a direct path to the proposed alignment.



Figure 7. Ma & Pa Trail Proposed Alignments

F. SUMMARY AND RECOMMENDATIONS

Downtown Bel Air provides aesthetic accommodations along MD 924 (Main Street and Bond Street) for pedestrians. The results of the pedestrian safety evaluation to address safety concerns from Baltimore Pike to Lee Street indicated the following:

- Sight lines to marked crossing are adequate.
- The signalized intersections will operate at acceptable levels if right-turn-on-red restrictions were implemented.
- There are a number of minor ADA deficiencies that are less critical to address such as roadway cross slopes, sidewalk widths along the minor streets, ramp slopes just above the minimum criteria.

- There are a number of locations with worn pavement markings.
- The locations to directly cross MD 924 for the Ma & Pa Trail extension would require well marked and signed uncontrolled crosswalks.

The following improvements are recommended along MD 924:

1. Pedestrian crossing improvements

- a. Install advanced Pedestrian Crossing warning signs (W11-2) along Bond Street in advance of the Lee Street uncontrolled crossing. The Lee Street uncontrolled crossing along Main Street currently has advanced pedestrian warning approach signing.
- b. Install hatching or stamped brick treatment to both Lee Street uncontrolled crossing to improve driver awareness, which would be consistent with other uncontrolled crossings in the area.
- c. Consider relocating or installing a new marked crosswalk crossing Main Street along the south leg at Lee Street. This location would provide a better pedestrian desire line, shorter crossing, no conflict points with right-turning traffic from West Lee Street, and better sight distances from approaching Main Street traffic. See **Figure 8** for the proposed alignment.

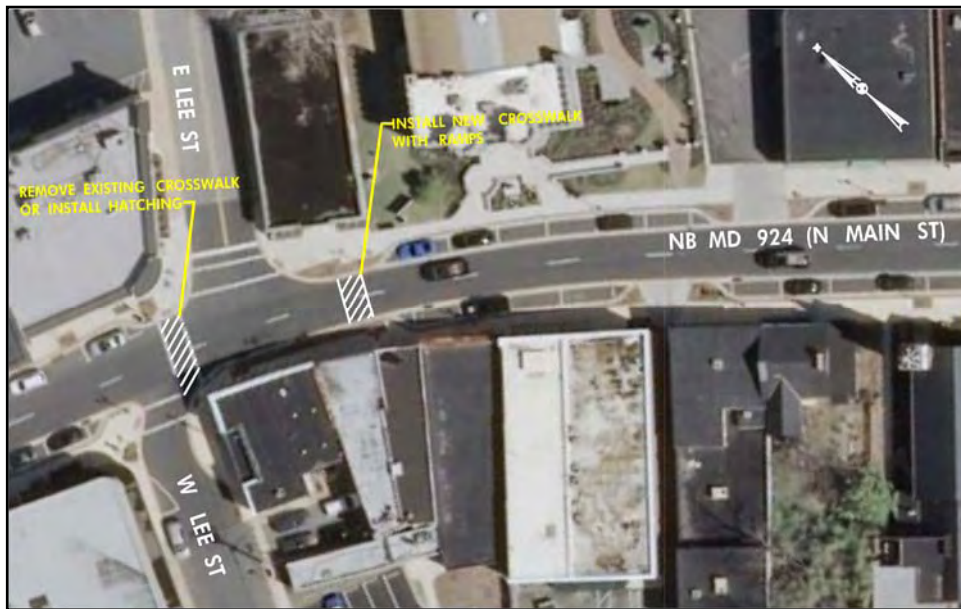


Figure 8. Proposed Lee Street Crosswalk

2. ADA improvements

- a. Consider reconstructing sidewalk ramps that currently have full-height curbs adjacent to the ramp with properly designed flares to eliminate tripping hazards at the following locations (see **Figure 9** as sample hazard at Courtland Street):
 - Main Street at Courtland Street
 - Main Street at Pennsylvania Avenue
 - Bond Street at Courtland Street
 - Bond Street at Office Street



Figure 9. Ramps With Full-Height Curbs Creating Tripping Hazard

- b. Reconstruct ramp in the NE corner of the Main Street at Churchville Road intersection to place the landing area closer to the pedestrian pole.
 - c. Relocate the APS pole in the NE corner of the Main Street at Courtland Street intersection to clear the sidewalk path along NB Main Street (see **Figure 8**).
 - d. Reconstruct driveway flare slopes along WB W. Lee Street to ADA standards.
3. General roadway improvements
- a. Refresh all faded pavement markings within the downtown area.