

Executive Summary Data Collection Technical Memorandum

Subject: Route 28 Corridor Safety and Operations Study (South of I-66 to Liberia Avenue)
Summary of Data Collection

Date: August 23, 2014

PURPOSE

The purpose of this document is to summarize the data collection effort for the Route 28 Corridor Safety and Operations Study. The study area covers Route 28 from Liberia Avenue on the south end to the Route 29 ramps in the north and along Mathis Avenue from Liberia Avenue to Manassas Drive. All figures summarizing the data are included in the Appendix of the Data Collection Memorandum. Any additional data obtained during the execution of the study will be included in future documentation.

TRAFFIC VOLUMES

Turning movement counts were collected for 33 intersections over a three-hour AM and PM weekday peak period in May 2014. In order to provide a comprehensive set of traffic volumes for the corridor, traffic volumes were balanced across the network.

Average Daily Traffic (ADT) volumes (from 24 hour tube counts) were collected at 8 locations on a weekday in May 2014. Traffic conditions associated with significant congestion in the corridor created a situation whereby vehicles would traverse the tubes very slowly, creating an irregular pattern; thereby improperly classifying & counting some vehicles. To develop daily traffic volumes, the intersection counts were used to develop daily volumes.

In order to determine the level of use of the existing two-way-left-turn-lane (TWLTL) section in the corridor, peak period left turn movements into the 84 driveways were counted. The data indicates that during the AM and PM peak periods (6 hours total):

- 24 driveways had zero inbound left turn vehicles
- 33 driveways had less than 5 inbound left turn vehicles
- 21 driveways had between 5 to 10 inbound left turn vehicles
- 6 driveways had more than 10 inbound left turn vehicles (max observed was 24 vehicles).

ROADWAY GEOMETRICS

Existing roadway geometric information and pedestrian & bicycle facilities were inventoried. Lighting conditions will be evaluated during the analysis portion of this study where crash data warrants. General pedestrian facility observations include:

- Although pedestrian facilities are fairly continuous on the north end of the corridor, north of Bull Run, there are a few missing sections of the multi-use path on the north end of the corridor.

- Although the bridge over Bull Run includes a sidewalk on each side of Route 28, the approaches to the bridge lack space for bicyclists or pedestrians, especially on the south end of the bridge.
- Pedestrian facilities are significantly disjointed and several signalized intersections do not have crosswalks from north of Bull Run to Shoppers Square.
- On the south end of Route 28, sidewalks are fairly continuous with crosswalks at each signalized intersection. Route 28 is more urbanized but there are limited opportunities to cross at a signal.

OBSERVED QUEUE LENGTHS

Queue lengths were collected for 10 intersections with the following general observations:

- Northbound AM queues: extend from New Braddock Road to Manassas Drive
- Southbound PM queues: extend from Compton Road to Upperridge Drive.

TRAFFIC CRASH DATA

Traffic crash data was collected from 2011 to 2013 and summarized. The analysis of the data will be provided in the Existing Analysis Memorandum.

TRAVEL TIME

Travel time data along Route 28 for the entire length of the study corridor was collected during AM and PM weekday peak periods in May 2014. Travel time information indicates that the most congested intersections were New Braddock Road and Manassas Drive in the AM peak and the south end of the corridor in the PM peak.

RELEVANT STUDIES/COMPREHENSIVE PLAN INFORMATION

Local jurisdictions provided relevant studies and comprehensive plan information from the last five years, as listed below. This information will be utilized in the future growth projections.

1. City of Manassas, City of Manassas Park: No studies/plan provided.
2. Fairfax County:
 - a. Route 28 Corridor benefit-cost report
 - b. Route 28 Corridor summary of crash incidents
 - c. Fairfax County's Countywide Transportation Plan Map
3. Prince William County:
 - a. BOCS Approved with Contacts (July 2009 – 2014)
 - b. Route 28 Land Use Cases and Trends
 - c. Parks and Open Space
 - d. Community Design
 - e. Part 507 Yorkshire Final
 - f. Yorkshire Route 28 ROD
4. VDOT: VDOT Traffic Engineering Study (2012/2013)

MULTI-MODAL FUNCTIONS

Multi-modal function data has been inventoried. Although there are a decent amount of stops along Route 28, there are no Metro Direct Service stops north of Yorkshire Lane.

SIGNAL TIMINGS / SYNCHRO FILES

Synchro files, which contain existing geometry and signal timings, were obtained from local jurisdictions and VDOT. Additional intersections within the study area will be combined with these models to provide a comprehensive Synchro model of the entire study corridor.

Technical Memorandum

To: Mr. Tom Fahrney
Virginia Department of Transportation

From: Kristin Belfield
Surendra Omkaram
Tim Rayner
Mark Thompson
Parsons Brinckerhoff, Inc.

Subject: Route 28 Corridor Safety and Operations Study
From South of I-66 to Liberia Avenue
Summary of Data Collection

Date: August 23, 2014

PURPOSE

The purpose of this memorandum is to document and summarize the data collection effort for the Route 28 Corridor Safety and Operations Study. The data collection effort consisted of the following:

- Hourly and daily traffic volumes
- Roadway geometrics
- Observed queue lengths
- Crash analysis
- Travel time runs
- Relevant studies or comprehensive plans for associated jurisdictions
- Multimodal functions
- Signal timing / Synchro files

All figures summarizing the data are included in Appendix A. Additional data obtained during the study will be included in future study documentation. Such data may include, but not be limited to, land use data, travel demand model data, or existing lighting information.

TRAFFIC VOLUMES

The peak period turning movement counts were collected for 33 intersections within the study area, as identified in **Table 1**. Turning Movement Counts (TMC's) were collected on a typical weekday (Tuesday through Thursday) in May 2014 during the school year between the hours of 6:00 AM to 9:00 AM and 3:30 PM to 6:30 PM. Upon examining the TMC's at intersections along the corridor, the overall AM peak hour for the corridor was determined to be 7:30 AM to 8:30 AM, with heavy northbound flow and approximately 7 percent trucks along Route 28. The overall PM peak hour was determined to be 4:45 PM to 5:45 PM, with heavy southbound flow and approximately 3 percent trucks along Route 28.

Table 1. Peak Period Turn Movement Count Locations

1. Route 28 (Centreville Road) and Route 29 Grade Separation (2 Ramp Movements)
2. Route 28 (Centreville Road) and Upperridge Drive (Route 898)/Old Centreville Road
3. Route 28 (Centreville Road) and Machen Road
4. Route 28 (Centreville Road) and New Braddock Road (Route 620)
5. Route 28 (Centreville Road) and Old Mill Road/Green Trails Boulevard
6. Route 28 (Centreville Road) and Tallavast Drive
7. Route 28 (Centreville Road) and Bradenton Drive
8. Route 28 (Centreville Road) and Compton Road/Ordway Road
9. Route 28 (Centreville Road) and Median Opening (North of Bull Run)
10. Route 28 (Centreville Road) and Patton Lane
11. Route 28 (Centreville Road) and Yorkshire Lane
12. Route 28 (Centreville Road) and Rugby Road
13. Route 28 (Centreville Road) and Brooks Lane
14. Route 28 (Centreville Road) and Leland Road
15. Route 28 (Centreville Road) and Oak Street
16. Route 28 (Centreville Road) and Spruce Street
17. Route 28 (Centreville Road) and Birch Street
18. Route 28 (Centreville Road) and Maplewood Drive
19. Route 28 (Centreville Road) and Browns Lane/Shoppers Square North Entrance
20. Route 28 (Centreville Road) and Shoppers Square South Entrance
21. Route 28 (Centreville Road) and Old Centreville Road/Blooms Quarry Lane
22. Route 28 (Centreville Road) and Manassas Drive (Route 213)
23. Route 28 (Centreville Road) and Conner Drive
24. Route 28 (Centreville Road) and Breeden Drive
25. Route 28 (Centreville Road) and Phoenix Drive
26. Route 28 (Centreville Road) and Kinchloe Drive
27. Route 28 (Centreville Road) and Liberia Avenue
28. Mathis Avenue and Liberia Avenue
29. Mathis Avenue and Kincheloe Drive
30. Mathis Avenue and Breeden Avenue
31. Mathis Avenue and Conner Drive
32. Mathis Avenue and Hardees Drive
33. Mathis Avenue and Manassas Drive

Although a peak hour was identified for both the AM and PM peaks, traffic volumes and field observations indicate that the notable peak period extends over several hours. Turning movement volumes were collected using time stamped, video recording equipment at each intersection which was subsequently counted to develop TMC's. Traffic volumes were then checked, discrepancies reconciled and recounted as necessary. Due to the large number of count locations, counts were performed over several days. As a result, traffic volumes varied slightly from day to day between intersections. In order to provide a comprehensive set of traffic volumes for the corridor, traffic volumes were balanced across the network. Balanced traffic volumes are displayed in **Figure 1** in Appendix A.

Average daily traffic (ADT) volumes (24 hour tube counts) were collected at 8 locations within the study area, as identified in **Table 2**. Tube counts were collected for both northbound and southbound movements on Tuesday, May 6, 2014. However, due to the significant congestion in the corridor, vehicles would traverse the tubes very slowly, especially during peak periods. Due to this irregular pattern, vehicle classification was not available. The tube count on Route 28 between I-66 and Route 29 yielded reasonable volumes.

The intersection counts provided comprehensive peak hour data throughout the corridor. In order to validate daily count volumes, 2014 ADT's were calculated from the intersection hourly counts using VDOT's K factor of 0.07 (from their annual published count program) for the corridor. VDOT data also indicates 3 percent daily trucks for the corridor. 2014 ADT's were then compared to VDOT's published 2012 ADT's. The resulting ADT's are displayed in **Figure 2** in Appendix A.

Table 2. 24-Hour Traffic Count Locations	
1.	Route 28 (Centreville Road) between I-66 and Route 29
2.	Route 28 (Centreville Road) between Machen Road and New Braddock Road
3.	Route 28 (Centreville Road) south of Old Mill Road/Green Trails Boulevard
4.	Route 28 (Centreville Road) between Compton Road and Bull Run
5.	Route 28 (Centreville Road) between Yorkshire Lane and Chestnut Street
6.	Route 28 (Centreville Road) between Spruce Street and Birch Street
7.	Route 28 (Centreville Road) between Old Centreville Road and Manassas Drive
8.	Route 28 (Centreville Road) between Breeden Avenue and Phoenix Drive

There is an existing two-way-left-turn-lane (TWLTL) along the south end of the corridor from north of Patton Lane to Maplewood Drive. In order to determine the use of this TWLTL, peak period left turn movements into driveways were counted along this section. Peak period turning movement counts for 84 driveways within the study area were collected on a typical weekday (Tues-Thurs) in May 2014 when school was in session, between the hours of 6:00 AM to 9:00 AM and 3:30 PM to 6:30 PM. Peak period turning movement counts for the driveways are displayed in **Figure 3** in Appendix A. TWLTL usage for driveways along the south end of the corridor is graphically illustrated in **Figure 4**.

The TWLTL data indicates that during the combined AM and PM peak hour periods (6 hours total):

- 24 driveways had zero inbound left turn vehicles
- 33 driveways had less than 5 inbound left turn vehicles
- 21 driveways had between 5 to 10 inbound left turn vehicles
- 6 driveways had more than 10 inbound left turn vehicles (maximum observed was 24 inbound left turn vehicles during the 6-hour period).

ROADWAY GEOMETRICS

Existing roadway geometric information was collected for the study area, which included the number of lanes, pedestrian and bike facilities, intersection geometry and cross section information for the entire corridor. **Figure 5** in Appendix A displays the existing lanes along Route 28 and at intersections throughout the corridor.

Figure 6 in Appendix A displays the existing pedestrian and bicycle facilities throughout the corridor. A comprehensive analysis of pedestrian facilities is included in the Safety Study Technical Memorandum located in Appendix B. Lighting conditions will be evaluated along the corridor during the analysis portion of this study. General pedestrian facility observations are included as follows:

- Although pedestrian facilities are fairly continuous on the north end of the corridor, north of Bull Run, there are a few missing sections of the multi-use path on the north end of the corridor.
- Although the bridge over Bull Run includes a sidewalk on each side of Route 28, the approaches to the bridge lack space for bicyclists or pedestrians, especially on the south end of the bridge.
- Pedestrian facilities are significantly disjointed from north of Bull Run to Brown's Lane/Shoppers Square Entrance (North).
- From Bull Run to Brown's Lane/Shoppers Square Entrance (North), several signalized intersections do not have crosswalks.
- On the south end of the corridor, south of Shoppers Square, sidewalks are fairly continuous with crosswalks at each signalized intersection. However, this section of Route 28 is more urbanized but there are still limited opportunities to cross Route 28 at a signal.

OBSERVED QUEUE LENGTHS

The intersection queue lengths for 10 intersections within the study area were observed within the study area on a typical weekday (Tues-Thurs) in June 2014 when school was in session, between the hours of 6:00 AM to 9:00 AM and 3:30 PM to 6:30 PM. **Table 3** identifies the intersections in which queue lengths were observed. The queue length observation included a sampling and identification of six maximum queue lengths during each of the three-hour peak periods. **Figure 7** in Appendix A displays the results of the queue observations. This information will be utilized in the analysis component of this study to validate the existing traffic analysis models.

General queue observations were as follows:

- Northbound queues extend from New Braddock Road to Manassas Drive during the AM peak period.
- Southbound queues extend from Compton Road to Upperridge Drive during the PM peak period.

Table 3. Queue Length Observation Locations

1. Route 28 (Centreville Road) and Route 29 grade separation, all ramps
2. Route 28 (Centreville Road) and Upperridge Dr. (Rt 898)
3. Route 28 (Centreville Road) and Machen Rd.
4. Route 28 (Centreville Road) and New Braddock Rd. (Rt 620)
5. Route 28 (Centreville Road) and Old mill Rd./Green Trails Blvd.
6. Route 28 (Centreville Road) and Compton Rd./Ordway Rd.
7. Route 28 (Centreville Road) and Old Centreville Rd./Blooms Quarry Ln.
8. Route 28 (Centreville Road) and Manassas Dr. (Rt 213)
9. Route 28 (Centreville Road) and Liberia Ave.
10. Mathis Avenue and Old Centreville Road

TRAFFIC CRASH DATA

Traffic crash data from 2011 to 2013 was collected from VDOT, the City of Manassas, and the City of Manassas Park for the Route 28 (Centreville Road) corridor from the Interstate 66 interchange to Liberia Avenue. Crash data and the crash analysis are included in the comprehensive Safety Study Technical Memorandum, which is located in Appendix B.

TRAVEL TIME

Travel time data along Route 28 (Centreville Road) was collected using Global Positioning System (GPS) technology. A portable GPS tracking device (GeoLogger®) was attached to the test vehicle and the vehicle was driven a number of times through the study area corridor along Route 28 both northbound and southbound, from south of Interstate 66 to Liberia Avenue. In order to remain consistent with the collection of the peak period turning movement counts, travel time data was collected on a typical weekday (Tues-Thurs) in May 2014 when school was in session, between the hours of 6:00 AM to 9:00 AM and 3:30 PM to 6:30 PM.

The GPS device recorded second-by-second location and speed data in the field which was later downloaded to a computer. The data was then processed to provide detailed travel time, speed and delay analysis. The resulting graphs provide an indication of the congested locations along the corridor. **Figure 8** and **Figure 9** in Appendix A provide a summary of the travel time results through the corridor. **Figure 10** provides a summary of a number of travel time measures by run, including average travel time, speed, stops, congested time, level of service (LOS), travel time index (TTI), etc. **Figure 11** provides a summary of travel time measures by checkpoint.

Travel time information will be utilized in the validation of the existing traffic analysis models. Travel time information clearly indicates the primary congested intersections, notable New Braddock Road and Manassas Drive in the AM peak and the south end of the corridor in the PM peak.

RELEVANT STUDIES/COMPREHENSIVE PLAN INFORMATION

The data collection effort includes obtaining information available from each local jurisdiction in order to have an indication of planned developments, infrastructure improvements or other transportation-related changes along the corridor. The local jurisdictions provided relevant studies and comprehensive plan information from the last five years. A summary of the information is listed below:

1. Fairfax County:
 - a. Route 28 Corridor benefit-cost report
 - b. Route 28 Corridor summary of crash incidents
 - c. Fairfax County's Countywide Transportation Plan Map
2. Prince William County:
 - a. BOCS Approved with Contacts (July 2009 – 2014)
 - b. Route 28 Land Use Cases and Trends
 - c. Parks and Open Space
 - d. Community Design
 - e. Part 507 Yorkshire Final
 - f. Yorkshire Route 28 ROD
3. City of Manassas:
 - a. No studies/plan provided.
4. City of Manassas Park:
 - a. No studies/plan provided.
5. VDOT
 - a. VDOT Traffic Engineering Study (2012/2013)

MULTI-MODAL FUNCTIONS

Multi-modal function data was collected in order to determine the operations of multi-modal transportation uses through the corridor. This data includes existing Park & Ride lots, planned Park & Ride lots and transit service. Existing pedestrian and bicycle facility information is included in the Roadway Geometrics section of this memo. The information collected focused on location of the facilities, capacity, operations and levels of utilization. **Figure 12** in Appendix A provides a summary of transit routes and stops along the corridor.

SIGNAL TIMINGS / SYNCHRO FILES

Synchro files for all the intersections in the study area were obtained from VDOT, the City of Manassas, and the City of Manassas Park. These Synchro files contain existing geometry and signal timings (including phasing, clearance times, pedestrian times, maximum split and offset times).

Information from intersections included in these models, as well as the addition of other intersections within the study area, will be combined to provide a comprehensive Synchro model of the entire study

corridor. Models will be reviewed to account for changes in geometric conditions as well as updated traffic volumes in order to analyze the existing conditions along the entire study corridor. Results from the Synchro analysis will be utilized in the Analysis portion of this study.

Route 28 Corridor Safety and Operations Study Summary of Data Collection

Appendix A – Figures

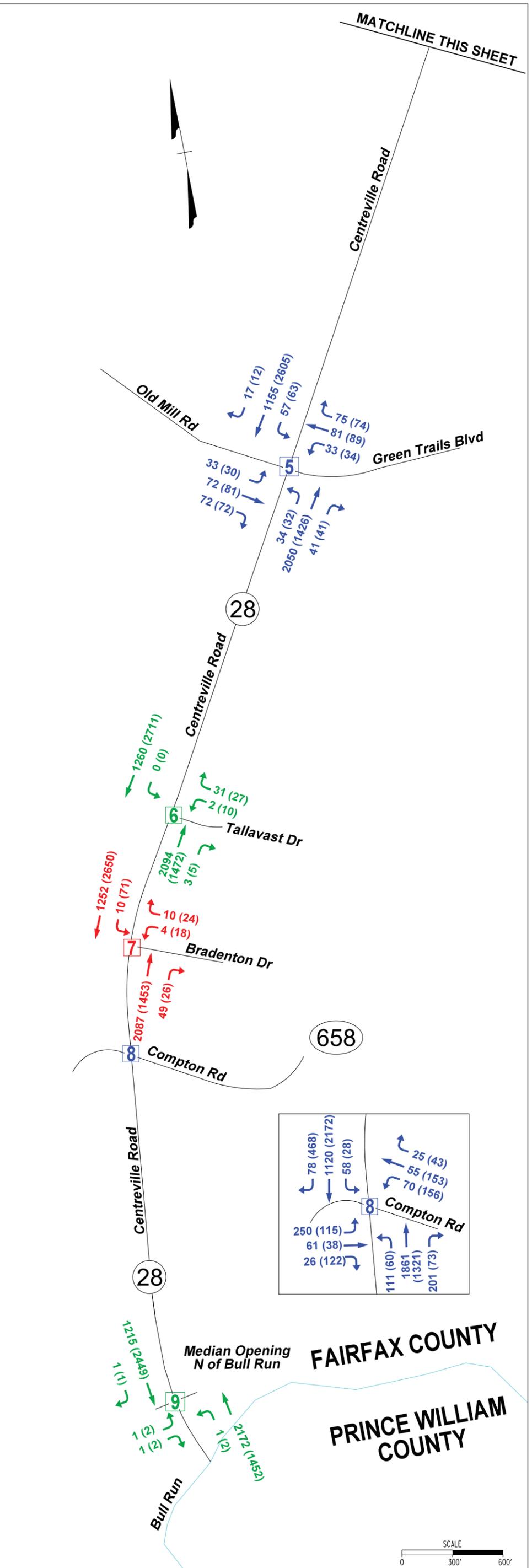
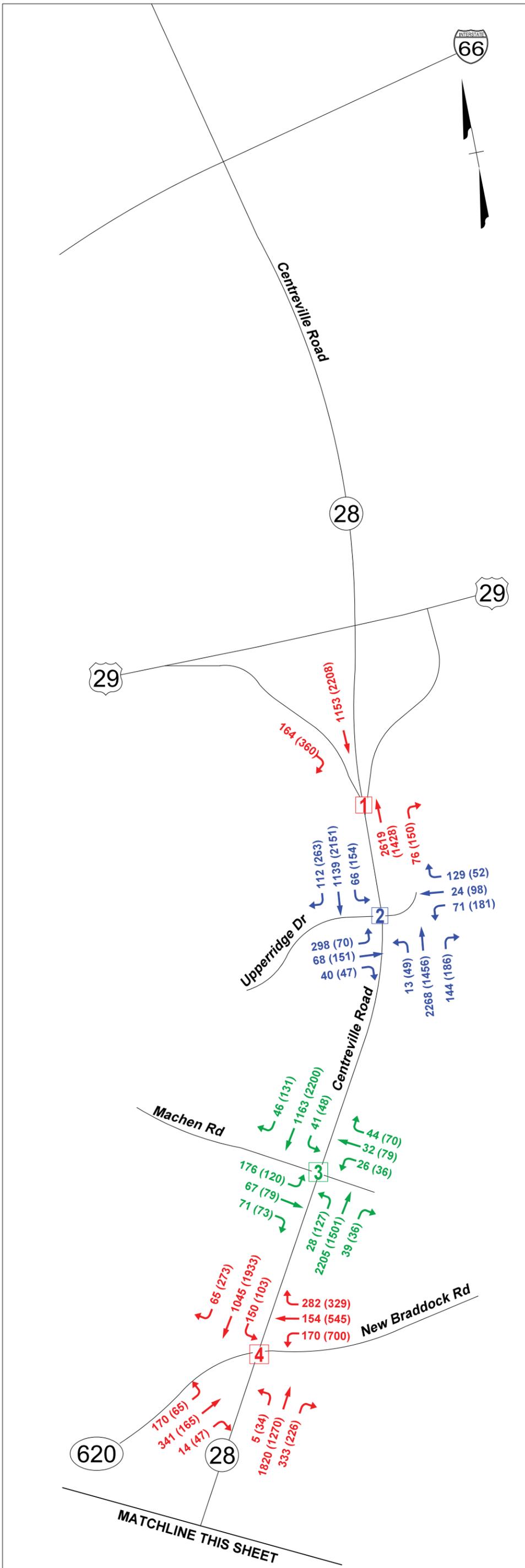


FIGURE 1: PEAK HOUR TRAFFIC VOLUMES (SHEET 1 OF 3)

LEGEND: AM(PM) PEAK VOLUMES

PARSONS BRINCKERHOFF

**FIGURE 1: PEAK HOUR TRAFFIC VOLUMES
(SHEET 3 OF 3)**

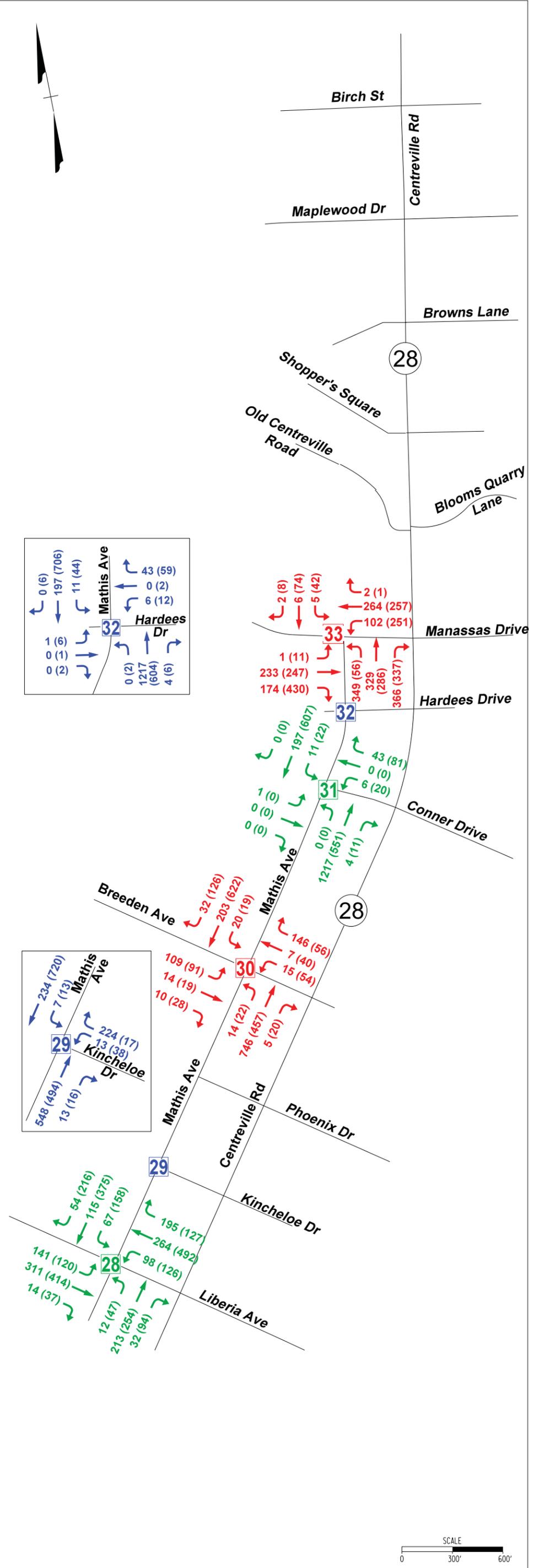
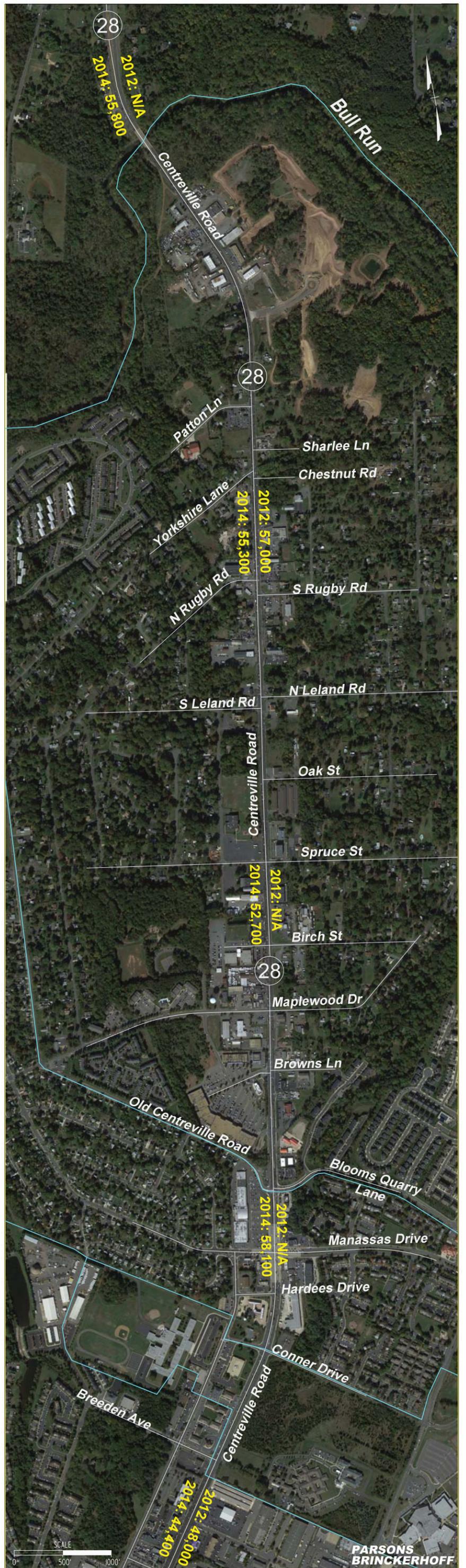
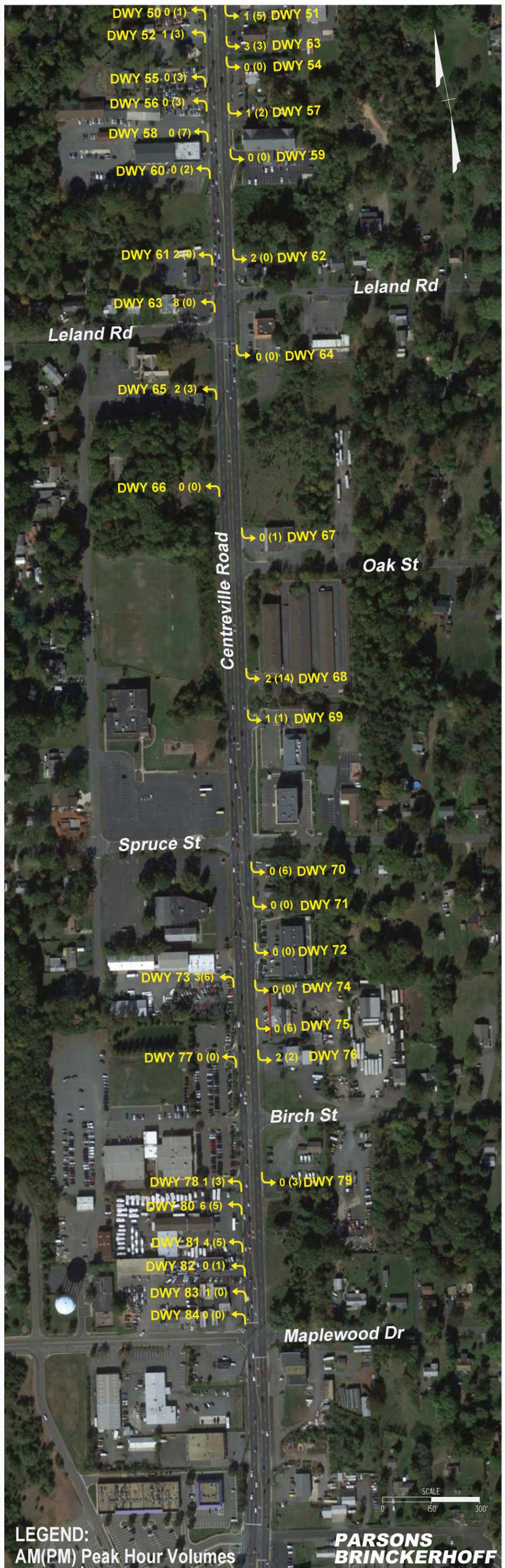
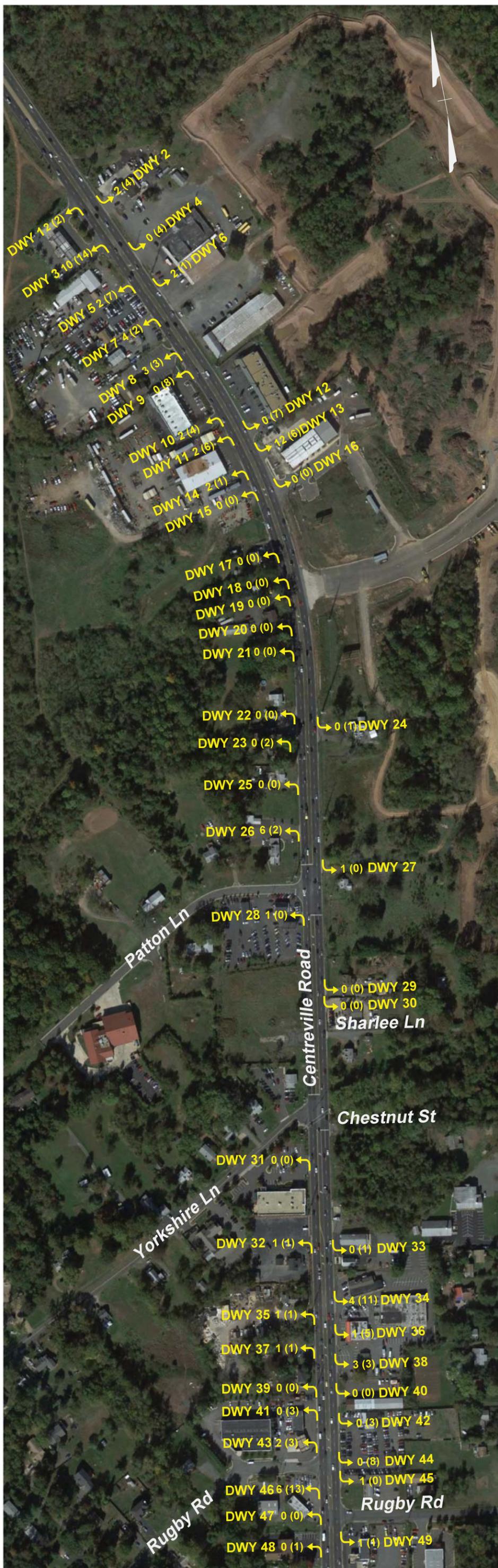




FIGURE 2: ADT VOLUMES



2012: SOURCE-VDOT COUNT INFORMATION
2014: CALCULATED FROM 2014 HOURLY COUNTS



LEGEND:
AM(PM) Peak Hour Volumes

SCALE
0 150' 300'

**PARSONS
BRINCKERHOFF**

FIGURE 3: LEFT TURN MOVEMENTS INTO DRIVEWAYS

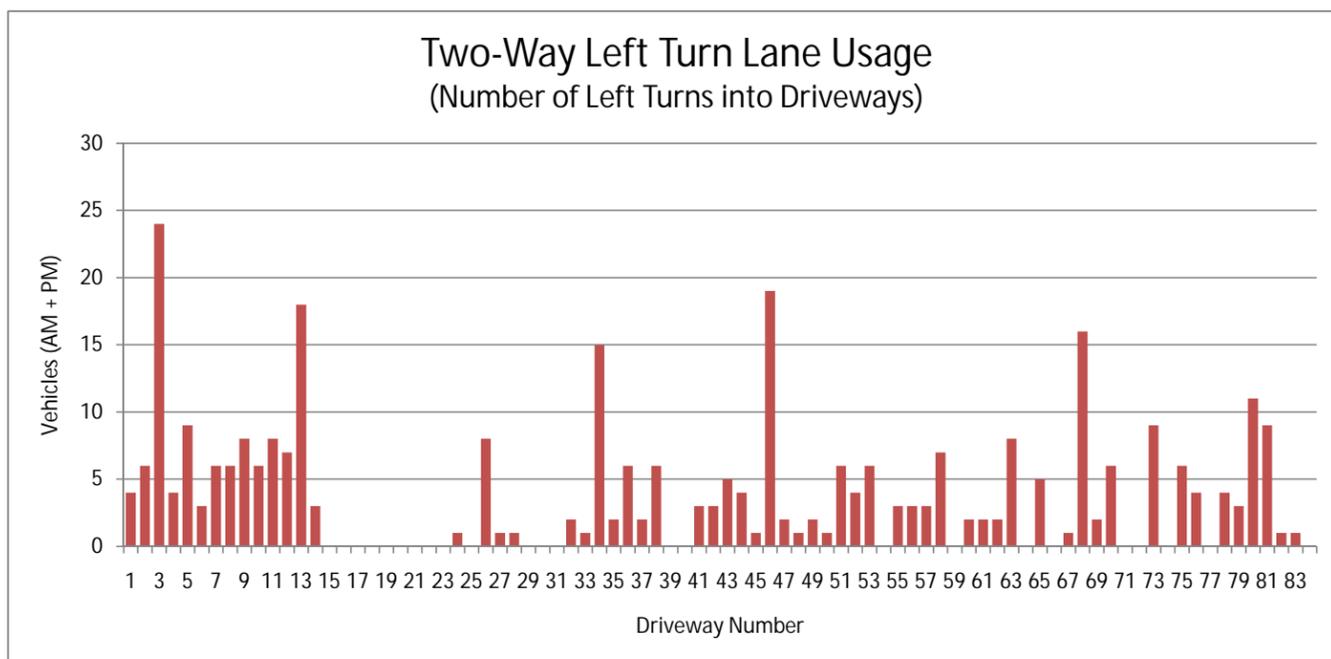
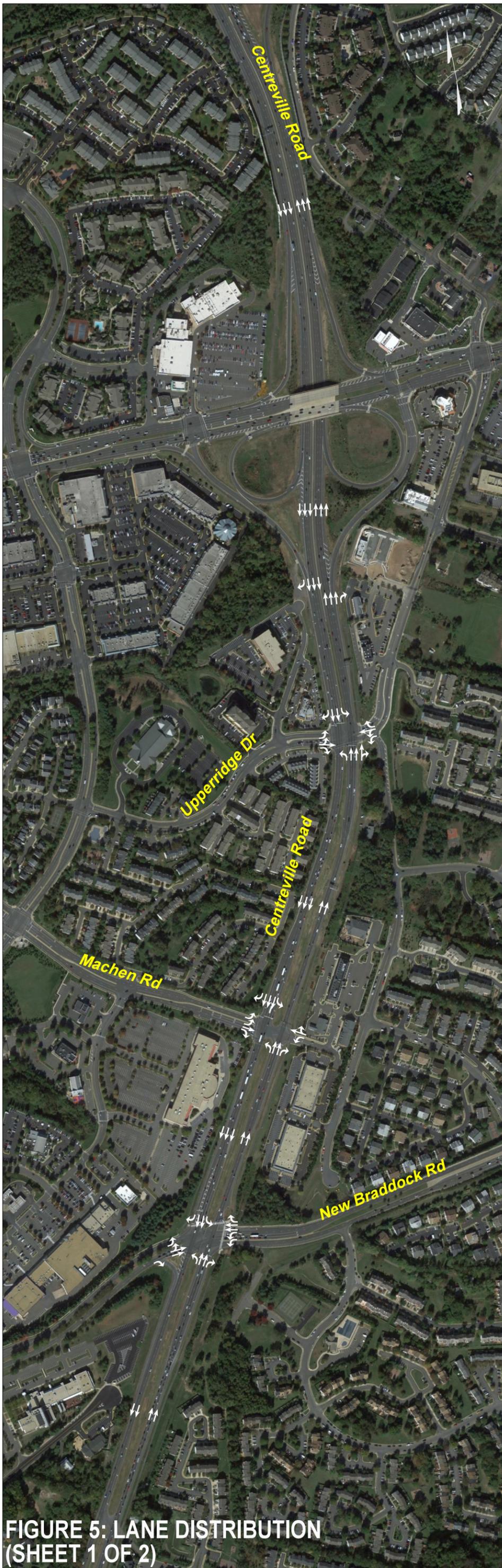


Figure 4: Two Way Left Turn Lane Usage



**FIGURE 5: LANE DISTRIBUTION
(SHEET 1 OF 2)**



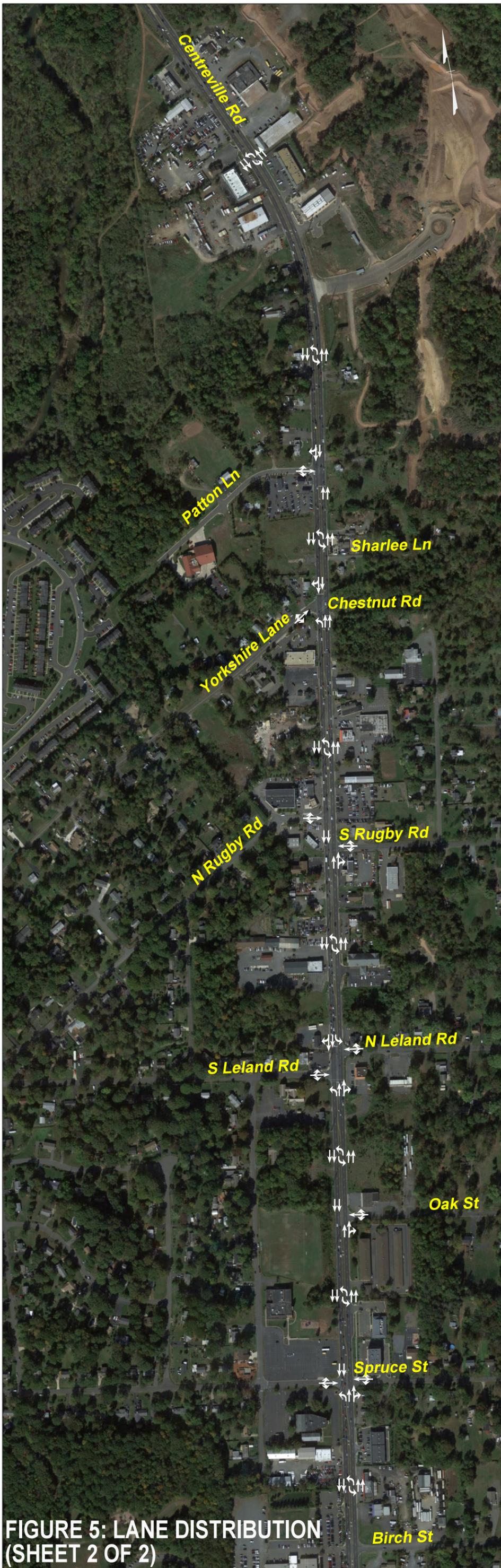
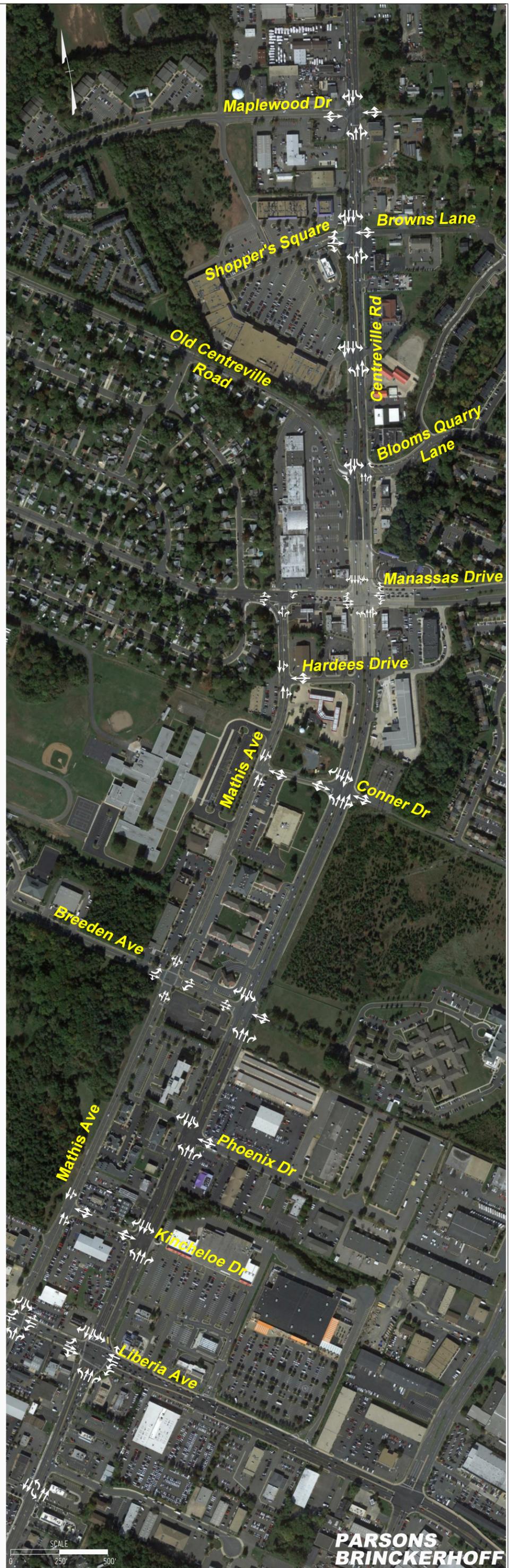


FIGURE 5: LANE DISTRIBUTION
(SHEET 2 OF 2)



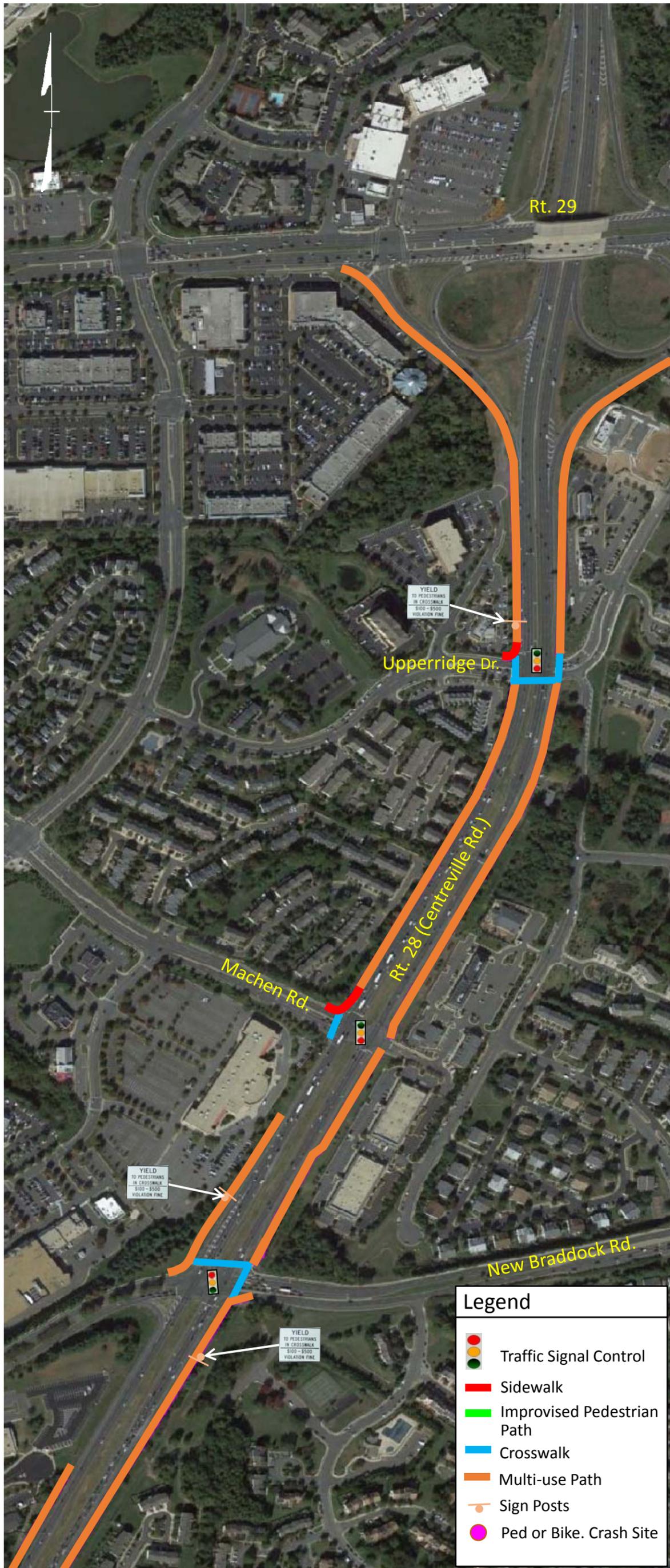
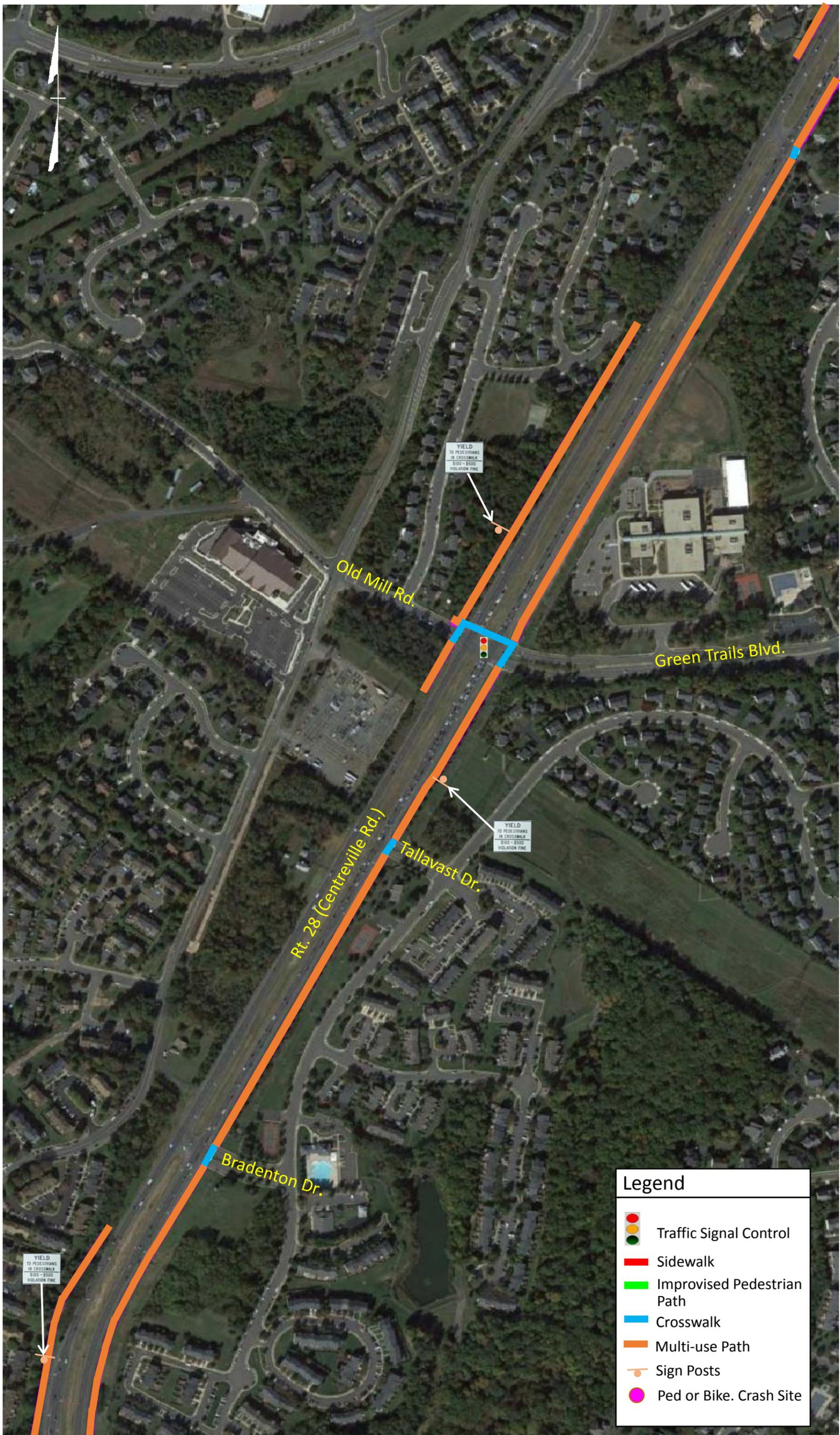


Figure 6: Route 28 Pedestrian and Bicycle Facilities Map
From Rt. 29 to New Braddock Rd. (Sheet 1 of 5)



**Figure 6: Route 28 Pedestrian and Bicycle Facilities Map
From Old Mill Rd. to Bradenton Dr. (Sheet 2 of 5)**



Figure 6: Route 28 Pedestrian and Bicycle Facilities Map From Compton Rd. to Patton Ln. (Sheet 3 of 5)

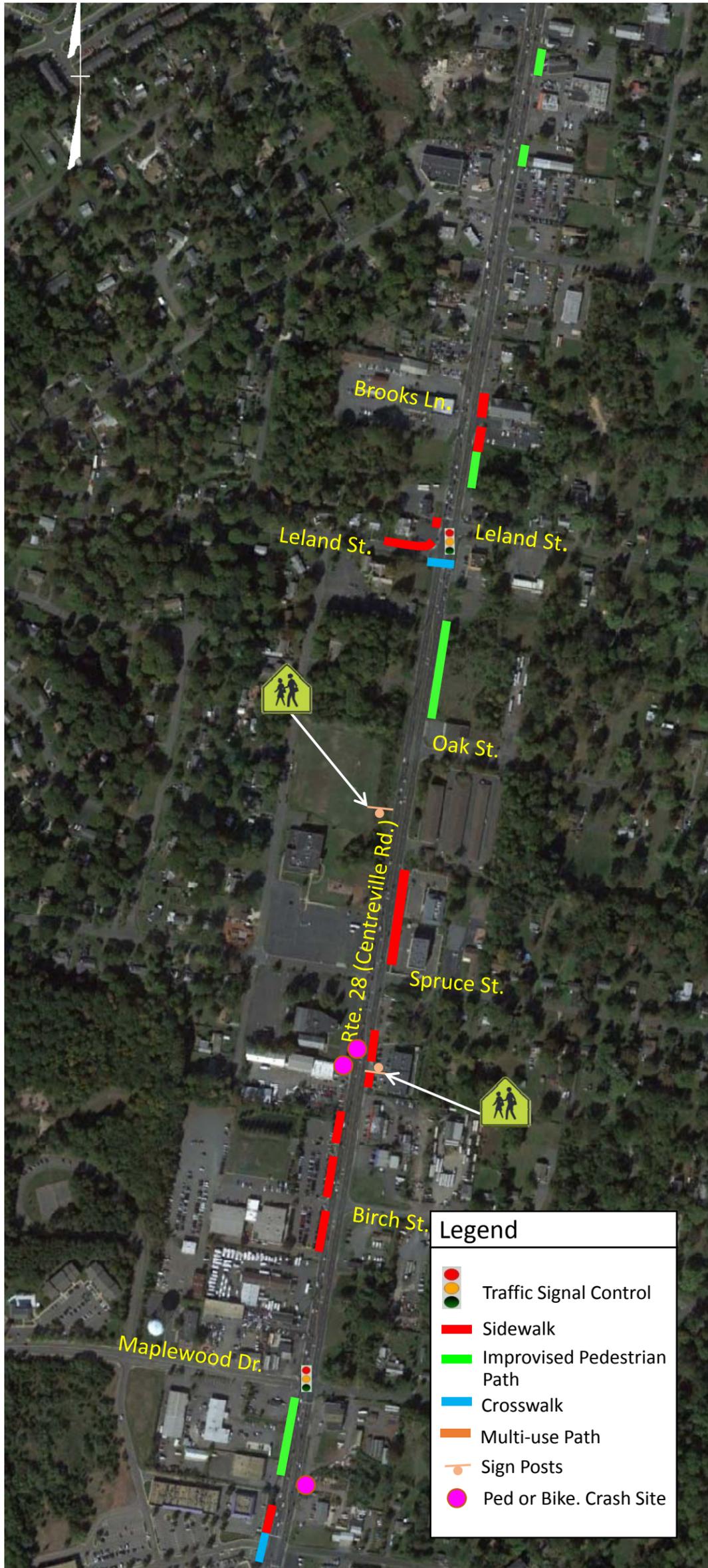
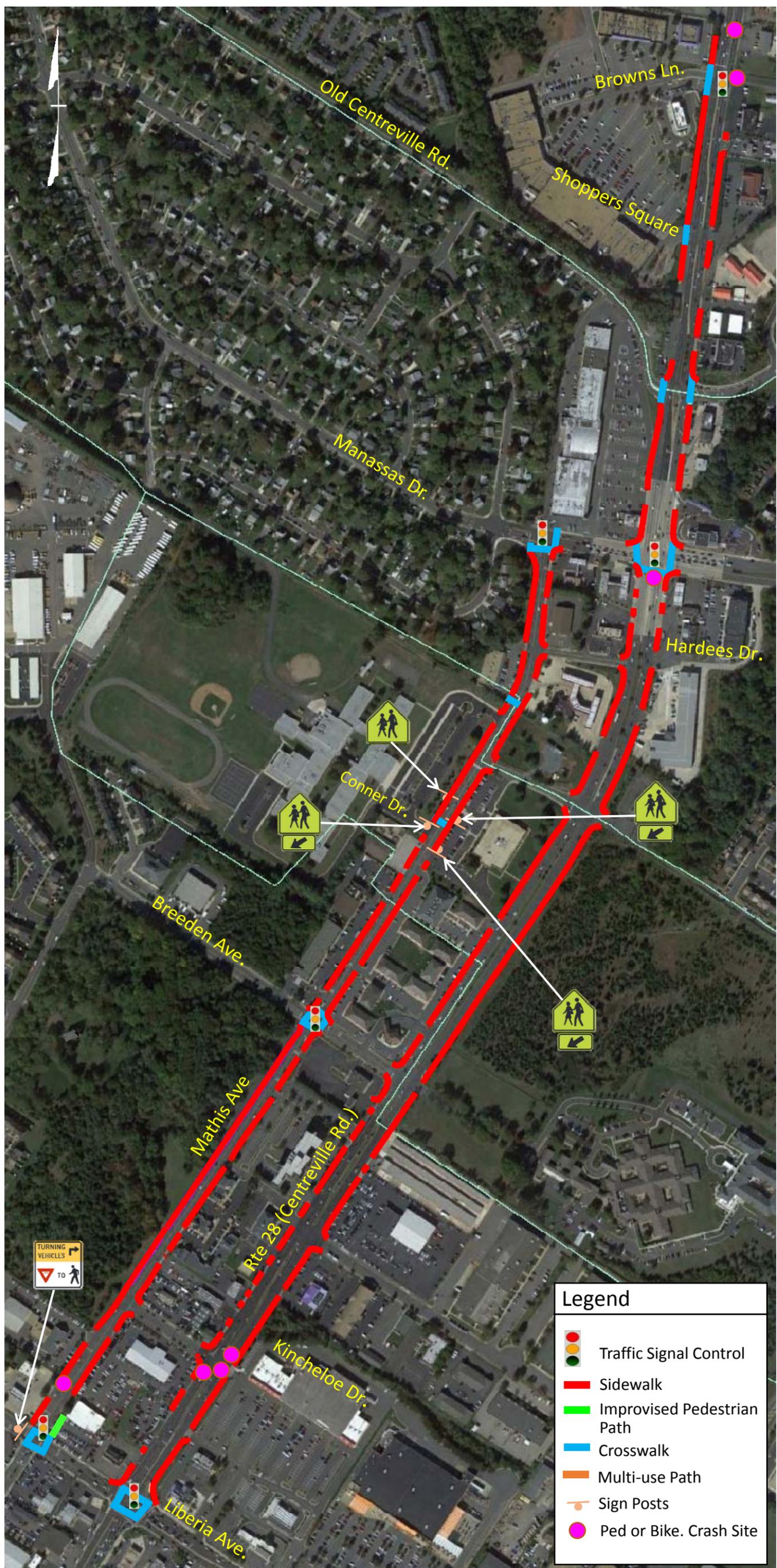


Figure 6: Route 28 Pedestrian and Bicycle Facilities Map From Yorkshire Ln. to Maplewood Dr. (Sheet 4 of 5)



**Figure 6: Route 28 Pedestrian and Bicycle Facilities Map
From Browns Ln. to Liberia Ave. (Sheet 5 of 5)**

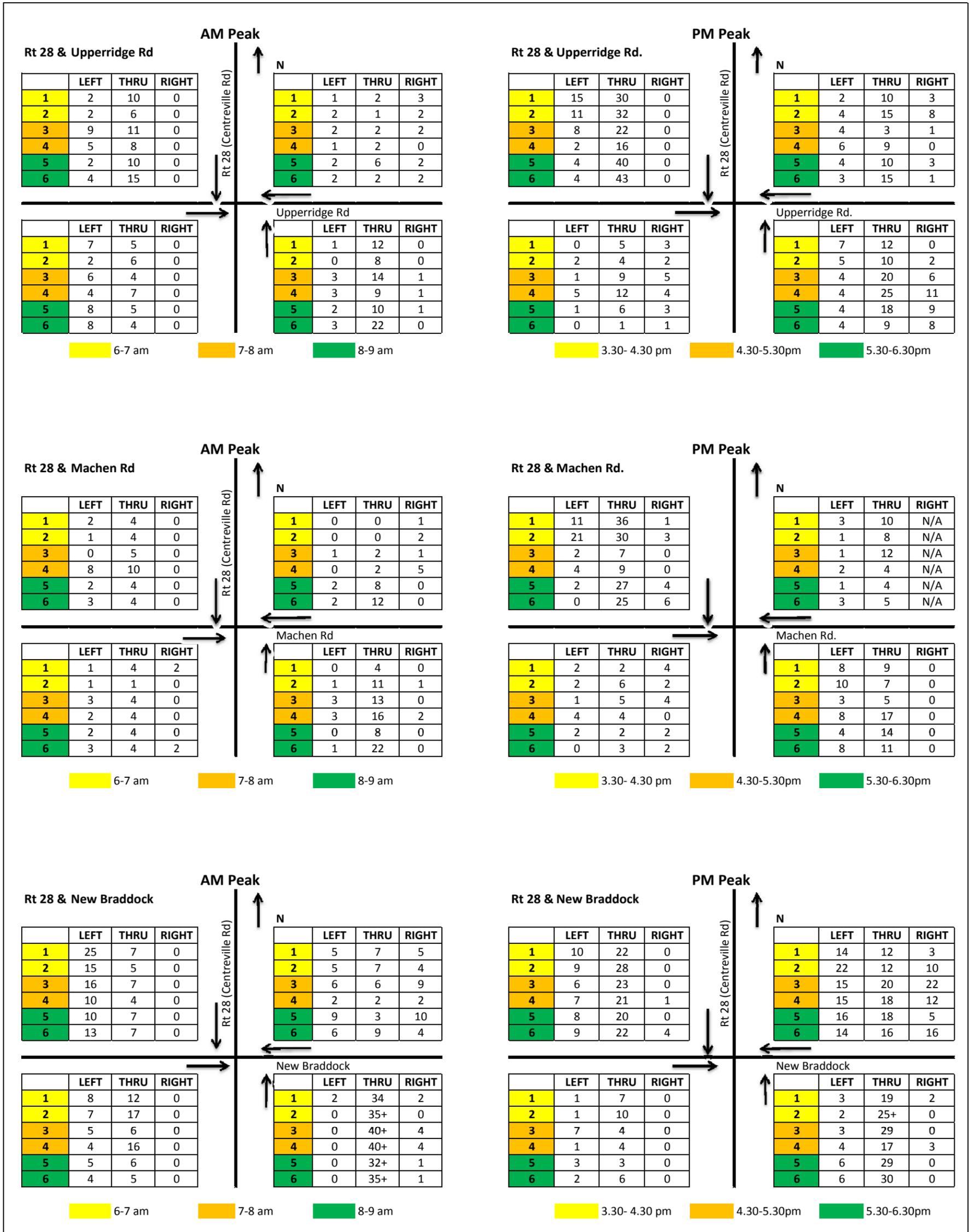


Figure 7: Sample Queues (vehicles) During One Signal Cycle
(Sheet 1 of 3)

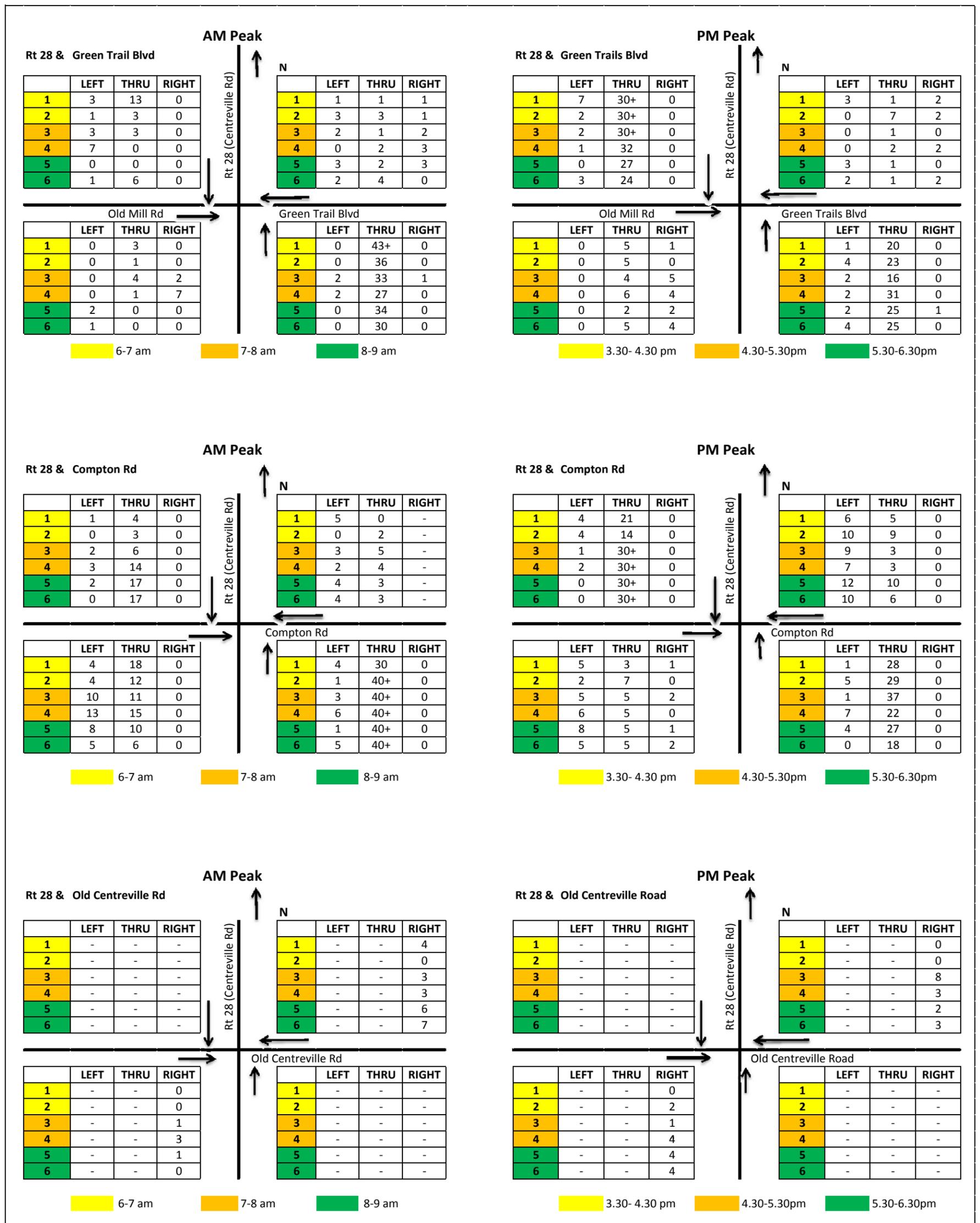


Figure 7: Sample Queues (vehicles) During One Signal Cycle
(Sheet 2 of 3)

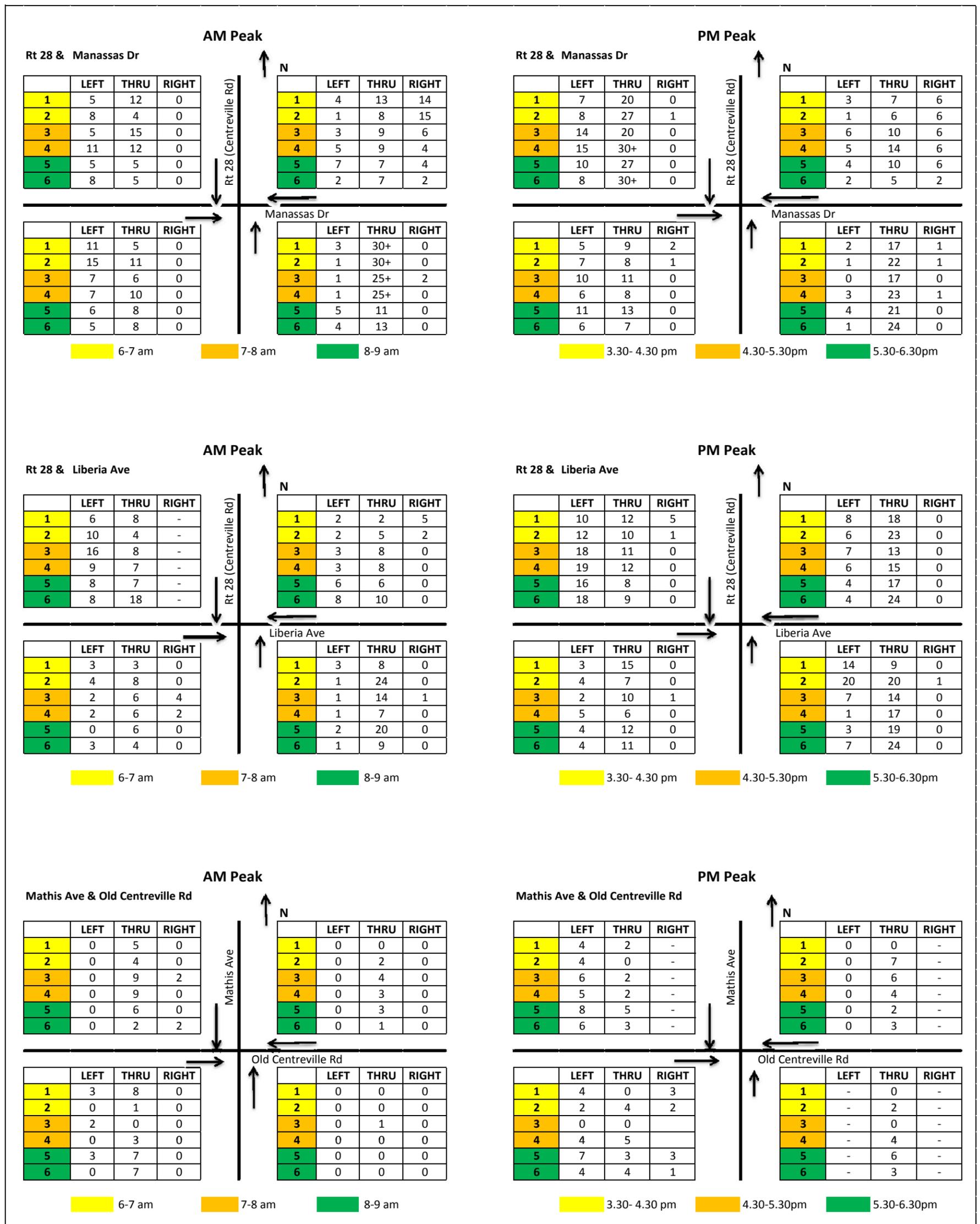


Figure 7: Sample Queues (vehicles) During One Signal Cycle
(Sheet 3 of 3)



Figure 8: Travel Time Runs (Sheet 1 of 2)

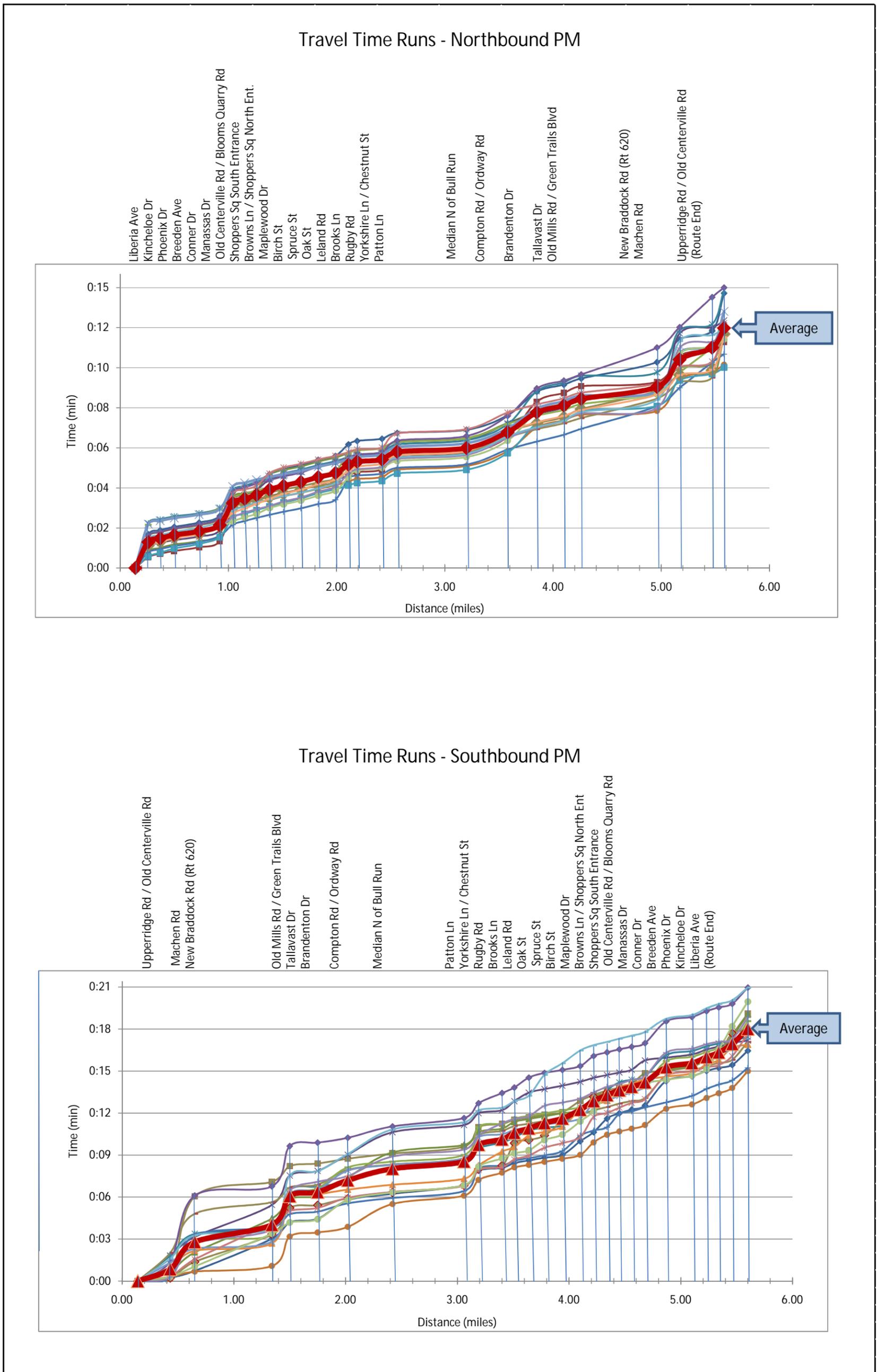
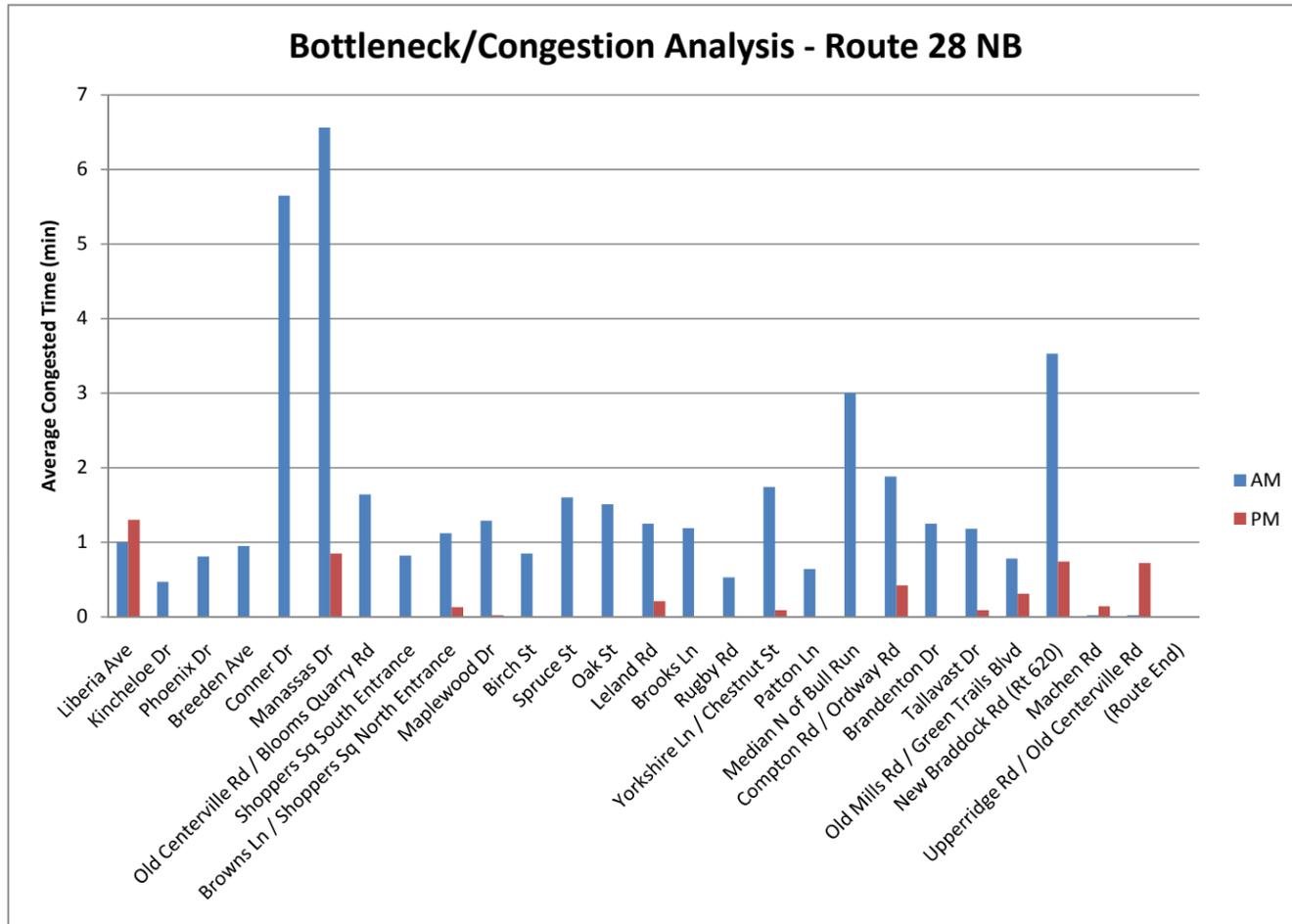
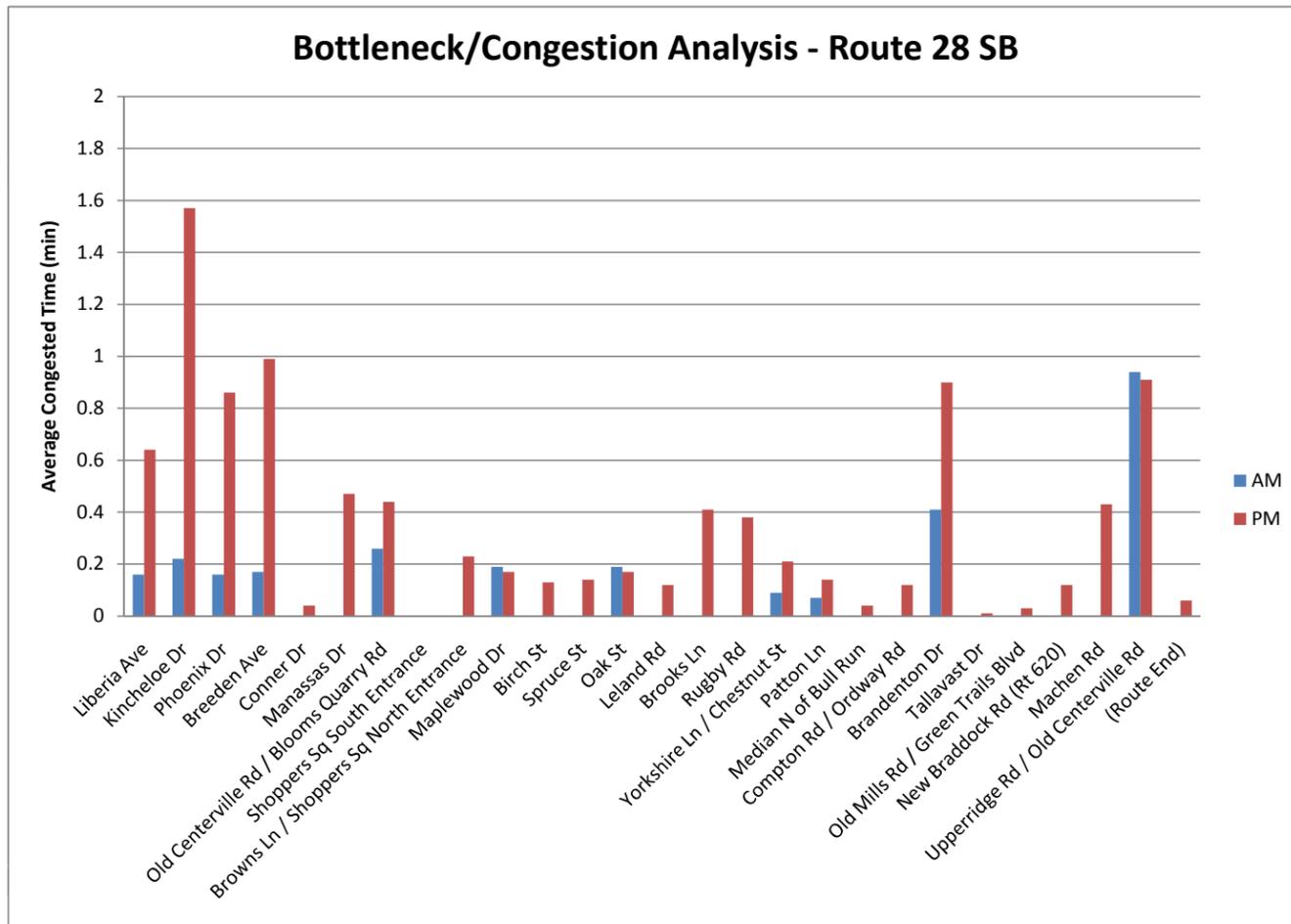


Figure 8: Travel Time Runs (Sheet 2 of 2)



Congested Time = time in which speed is below 20 mph



Congested Time = time in which speed is below 20 mph

Figure 9: Bottleneck / Congestion Analysis

Time	Dir	Run #	Date	Start Time	End Time	Distance (mi)	Travel Time (min)	Avg Speed (mph)	# of Stops	Stopped Time (min)	Congested Time (min)	LOS	TTI Index
AM	Northbound	1	06/10/14	5:59 AM	6:29 AM	5.6	30.2	11.1	29	11.6	24.6	F	4.07
		2	06/04/14	5:59 AM	6:33 AM	5.7	33.4	10.2	36	15.7	26.9	F	4.43
		3	06/10/14	6:09 AM	6:47 AM	5.6	38.0	8.9	33	16.2	34.6	F	5.08
		4	06/04/14	6:10 AM	6:54 AM	5.5	44.3	7.5	39	25.0	39.6	F	6.02
		5	06/10/14	6:45 AM	7:47 AM	5.6	62.2	5.4	81	41.5	57.5	F	8.30
		6	06/04/14	6:49 AM	7:40 AM	5.6	51.1	6.6	63	30.9	46.4	F	6.86
		7	06/04/14	7:11 AM	8:11 AM	5.5	60.3	5.5	42	41.9	55.3	F	8.18
		8	06/04/14	7:57 AM	8:45 AM	5.6	48.7	6.9	38	30.2	42.6	F	6.49
		9	06/10/14	8:02 AM	9:00 AM	5.6	58.2	5.7	59	38.4	53.3	F	7.87
		10	06/04/14	8:25 AM	9:00 AM	5.6	35.1	9.6	29	16.8	29.3	F	4.70
		11	06/10/14	8:31 AM	9:11 AM	5.6	40.6	8.2	47	18.3	37.4	F	5.46
	Avg	---	---	---	5.6	45.6	7.8	45.1	26.0	40.7	F	6.1	
	Southbound	1	06/04/14	5:58 AM	6:10 AM	5.6	11.3	29.6	4	3.0	3.8	B	1.52
		2	06/10/14	6:00 AM	6:09 AM	5.6	8.7	38.3	3	1.4	1.8	A	1.17
		3	06/10/14	6:34 AM	6:44 AM	5.6	10.0	33.7	3	1.4	1.9	B	1.34
		4	06/04/14	6:36 AM	6:48 AM	5.6	12.0	28.2	5	3.3	4.0	B	1.60
		5	06/10/14	6:51 AM	7:02 AM	5.6	11.6	29.1	4	2.2	3.1	B	1.55
		6	06/04/14	7:00 AM	7:10 AM	5.6	10.2	32.9	4	1.8	2.3	B	1.37
		7	06/04/14	7:44 AM	7:56 AM	5.6	11.6	29.1	4	3.1	3.7	B	1.55
		8	06/10/14	7:50 AM	8:01 AM	5.6	10.3	32.5	4	2.0	2.4	B	1.38
		9	06/04/14	8:13 AM	8:25 AM	5.6	11.8	28.5	6	3.1	4.1	B	1.58
10		06/10/14	8:19 AM	8:29 AM	5.6	10.6	31.7	5	1.8	2.6	B	1.42	
Avg	---	---	---	5.6	10.8	31.3	4.2	2.3	3.0	B	1.4		
PM	Northbound	1	06/04/14	3:26 PM	3:41 PM	5.6	15.1	22.2	5	5.5	7.0	C	2.03
		2	06/10/14	3:26 PM	3:41 PM	5.6	15.2	22.1	6	4.8	6.1	C	2.04
		3	06/10/14	3:53 PM	4:05 PM	5.6	11.8	28.5	4	2.3	3.6	B	1.58
		4	06/04/14	4:02 PM	4:12 PM	5.5	10.3	32.2	4	2.0	2.5	B	1.40
		5	06/04/14	4:03 PM	4:18 PM	5.6	15.0	22.5	8	5.1	6.5	C	2.00
		6	06/10/14	4:05 PM	4:15 PM	5.6	10.6	31.4	3	1.6	2.3	B	1.43
		7	06/10/14	4:32 PM	4:45 PM	5.6	12.9	26.2	3	2.8	3.9	C	1.72
		8	06/04/14	4:35 PM	4:47 PM	5.6	11.6	28.8	5	2.9	3.8	B	1.56
		9	06/10/14	4:38 PM	4:51 PM	5.6	12.3	27.1	5	3.5	4.3	C	1.66
		10	06/04/14	4:47 PM	4:59 PM	5.6	12.4	27.2	6	3.0	4.2	C	1.65
		11	06/10/14	5:08 PM	5:21 PM	5.6	13.1	25.7	5	3.7	4.6	C	1.75
		12	06/04/14	5:11 PM	5:24 PM	5.6	12.6	26.5	6	4.4	5.1	C	1.70
		13	06/10/14	5:13 PM	5:27 PM	5.6	13.9	24.0	6	5.2	6.0	C	1.88
		14	06/04/14	5:44 PM	5:57 PM	5.8	13.0	26.6	7	3.2	4.7	C	1.69
		15	06/11/14	5:52 PM	6:04 PM	5.6	12.2	27.3	7	2.1	3.2	C	1.65
		16	06/10/14	6:05 PM	6:19 PM	5.6	13.3	25.2	6	4.2	5.3	C	1.78
		17	06/04/14	6:06 PM	6:19 PM	5.7	13.4	25.3	5	4.5	5.3	C	1.78
		18	06/04/14	6:39 PM	6:53 PM	5.7	13.5	25.1	5	3.9	5.1	C	1.79
	Avg	---	---	---	5.6	12.9	26.3	5.3	3.6	4.6	C	1.7	
	Southbound	1	06/10/14	3:30 PM	3:49 PM	5.6	18.7	18.0	11	6.8	10.5	D	2.50
		2	06/10/14	3:45 PM	4:03 PM	5.6	18.2	18.4	17	6.1	9.3	D	2.45
		3	06/04/14	3:45 PM	4:00 PM	5.6	15.4	21.8	8	3.9	6.5	D	2.06
		4	06/04/14	3:46 PM	4:02 PM	5.6	16.8	20.0	10	5.2	8.0	D	2.26
		5	06/10/14	4:10 PM	4:31 PM	5.7	20.8	16.3	16	8.0	12.5	E	2.76
		6	06/04/14	4:15 PM	4:31 PM	5.6	15.6	21.5	9	4.0	7.3	D	2.09
		7	06/10/14	4:20 PM	4:37 PM	5.6	17.2	19.5	13	6.1	8.8	D	2.31
		8	06/04/14	4:22 PM	4:42 PM	5.6	19.5	17.2	15	8.2	11.2	D	2.61
		9	06/10/14	4:48 PM	5:07 PM	5.6	19.3	17.5	12	7.2	10.7	D	2.57
		10	06/10/14	4:53 PM	5:11 PM	5.6	18.5	18.1	10	6.6	9.5	D	2.48
		11	06/04/14	4:53 PM	5:10 PM	5.6	17.5	19.2	13	6.5	8.8	D	2.35
		12	06/04/14	5:05 PM	5:24 PM	5.6	19.5	17.3	15	7.5	10.3	D	2.60
		13	06/04/14	5:25 PM	5:44 PM	5.6	19.0	17.7	13	7.3	10.2	D	2.55
		14	06/11/14	5:29 PM	5:50 PM	5.6	21.4	15.7	14	8.8	12.4	E	2.86
		15	06/04/14	5:48 PM	6:05 PM	5.7	17.7	19.2	11	6.1	8.5	D	2.34
16		06/04/14	6:02 PM	6:24 PM	5.6	21.3	15.6	16	8.7	12.5	E	2.88	
17		06/04/14	6:20 PM	6:38 PM	5.7	17.9	18.9	13	6.3	9.0	D	2.38	
Avg	---	---	---	5.6	18.5	18.3	12.7	6.7	9.8	D	2.5		

Figure 10. Travel Time Summary by Run

	Checkpoint	# Runs	Avg Distance (mi)	Avg Speed (mph)	Avg Travel Time (min)	Min Travel Time (min)	Max Travel Time (min)	Avg Congested Time (min)
Route 28 NB AM	Liberia Ave	8	0.14	6.8	1.23	0.27	2.02	1
	Kincheloe Dr	11	0.12	11.2	0.64	0.17	3.36	0.47
	Phoenix Dr	11	0.11	8.4	0.79	0.1	4.78	0.81
	Breeden Ave	11	0.13	7.1	1.1	0.18	6.24	0.95
	Conner Dr	11	0.23	2.4	5.72	1.22	13.04	5.65
	Manassas Dr	11	0.19	1.8	6.5	2.26	10.61	6.56
	Old Centerville Rd / Blooms Quarry Rd	11	0.12	4.2	1.7	0.24	6.01	1.64
	Shoppers Sq South Entrance	11	0.11	7.3	0.9	0.19	1.96	0.82
	Browns Ln / Shoppers Sq North Entrance	11	0.11	5.6	1.17	0.26	2.69	1.12
	Maplewood Dr	11	0.12	5.5	1.31	0.48	3.04	1.29
	Birch St	11	0.13	8.6	0.9	0.37	1.83	0.85
	Spruce St	11	0.16	5.7	1.67	0.59	3.49	1.6
	Oak St	11	0.16	6.1	1.56	0.49	3.1	1.51
	Leland Rd	11	0.16	7.4	1.29	0.53	2.09	1.25
	Brooks Ln	11	0.12	5.8	1.25	0.31	2.91	1.19
	Rugby Rd	11	0.08	8.4	0.57	0.22	1.05	0.53
	Yorkshire Ln / Chestnut St	11	0.23	7.2	1.92	0.96	3.39	1.74
	Patton Ln	11	0.14	11.3	0.74	0.25	1.27	0.64
	Median N of Bull Run	11	0.64	10.7	3.58	2.66	4.57	3
	Compton Rd / Ordway Rd	11	0.38	9.9	2.31	1.54	3.42	1.88
	Brandenton Dr	11	0.27	11.0	1.47	0.45	2.26	1.25
	Tallavast Dr	11	0.25	10.9	1.38	0.73	2.09	1.18
	Old Mills Rd / Green Trails Blvd	11	0.16	10.2	0.95	0.46	1.78	0.78
	New Braddock Rd (Rt 620)	11	0.7	9.7	4.34	2.68	6.49	3.53
	Machen Rd	11	0.21	36.1	0.35	0.3	0.47	0.02
	Upperridge Rd / Old Centerville Rd	11	0.3	42.0	0.43	0.39	0.6	0.02
(Route End)	11	0.11	53.0	0.12	0.09	0.14	0	
Route 28 SB AM	Upperridge Dr / Old Centerville Rd	10	0.14	23.6	0.36	0.17	1.17	0.16
	Machen Rd	10	0.29	29.4	0.59	0.33	1.34	0.22
	New Braddock Rd (Rt 620)	10	0.22	28.4	0.46	0.25	1.17	0.16
	Old Mill Rd / Green Trails Blvd	10	0.69	39.7	1.04	0.75	1.57	0.17
	Tallavast Dr	10	0.16	46.1	0.21	0.16	0.28	0
	Brandenton Dr	10	0.25	48.1	0.31	0.26	0.38	0
	Compton Rd / Ordway Rd	10	0.27	26.6	0.61	0.29	1.81	0.26
	Median N of Bull Run	10	0.4	48.5	0.5	0.43	0.56	0
	Patton Ln	10	0.64	46.2	0.83	0.69	0.91	0
	Yorkshire Ln / Chestnut St	10	0.13	21.4	0.36	0.15	0.83	0.19
	Rugby Rd	10	0.21	42.2	0.3	0.22	0.36	0
	Brooks Ln	10	0.11	43.3	0.15	0.13	0.18	0
	Leland Rd	10	0.13	20.9	0.37	0.16	0.91	0.19
	Oak St	10	0.14	42.9	0.2	0.16	0.24	0
	Spruce St	10	0.16	44.3	0.22	0.18	0.25	0
	Birch St	10	0.16	40.3	0.24	0.21	0.28	0
	Maplewood Dr	10	0.12	26.1	0.28	0.16	0.81	0.09
	Browns Ln / Shoppers Sq North Entrance	10	0.12	27.9	0.26	0.16	0.84	0.07
	Shoppers Sq South Entrance	10	0.11	39.8	0.17	0.15	0.2	0
	Old Centerville Rd / Blooms Quarry Ln	10	0.11	37.1	0.18	0.15	0.2	0
	Manassas Dr	10	0.12	11.8	0.61	0.16	1.51	0.41
	Conner Dr	10	0.19	38.1	0.3	0.23	0.34	0
	Breeden Ave	10	0.23	40.1	0.34	0.27	0.42	0
	Phoenix Dr	10	0.13	37.6	0.21	0.15	0.25	0
	Kincheloe Dr	10	0.11	31.2	0.21	0.16	0.27	0
	Liberia Ave	10	0.12	6.5	1.11	0.24	1.86	0.94
(Route End)	8	0.14	42.0	0.2	0.02	0.27	0	

Figure 11. Travel Time Summary by Checkpoint (Sheet 1 of 2)

	Checkpoint	# Runs	Avg Distance (mi)	Avg Speed (mph)	Avg Travel Time (min)	Min Travel Time (min)	Max Travel Time (min)	Avg Congested Time (min)
Route 28 NB PM	Liberia Ave	18	0.14	5.7	1.49	0.57	2.47	1.3
	Kincheloe Dr	18	0.12	34.1	0.21	0.18	0.24	0
	Phoenix Dr	18	0.11	36.2	0.18	0.15	0.22	0
	Breeden Ave	18	0.13	38.5	0.2	0.17	0.26	0
	Conner Dr	18	0.23	39.6	0.35	0.31	0.49	0
	Manassas Dr	18	0.19	10.0	1.14	0.31	2.16	0.85
	Old Centerville Rd / Blooms Quarry Rd	18	0.12	31.7	0.23	0.2	0.26	0
	Shoppers Sq South Entrance	18	0.11	32.0	0.21	0.16	0.3	0.01
	Browns Ln / Shoppers Sq North Entrance	18	0.11	21.6	0.31	0.15	0.83	0.13
	Maplewood Dr	18	0.12	32.0	0.23	0.16	0.39	0.02
	Birch St	18	0.13	38.2	0.2	0.17	0.25	0
	Spruce St	18	0.16	37.2	0.26	0.21	0.32	0
	Oak St	18	0.16	41.4	0.23	0.2	0.29	0
	Leland Rd	18	0.16	21.8	0.44	0.19	0.96	0.21
	Brooks Ln	18	0.12	39.9	0.18	0.14	0.38	0.01
	Rugby Rd	18	0.08	40.6	0.12	0.1	0.16	0
	Yorkshire Ln / Chestnut St	18	0.23	30.0	0.46	0.31	0.84	0.09
	Patton Ln	18	0.14	39.4	0.21	0.18	0.25	0
	Median N of Bull Run	18	0.64	43.8	0.88	0.77	1.08	0
	Compton Rd / Ordway Rd	18	0.38	24.4	0.94	0.44	1.9	0.42
	Brandenton Dr	18	0.27	43.5	0.37	0.3	0.47	0
	Tallavast Dr	18	0.25	36.0	0.42	0.3	1.31	0.09
	Old Mills Rd / Green Trails Blvd	18	0.16	17.7	0.54	0.19	1.45	0.31
	New Braddock Rd (Rt 620)	18	0.7	24.1	1.74	0.86	3.23	0.74
	Machen Rd	18	0.21	27.4	0.46	0.25	1.63	0.14
	Upperridge Rd / Old Centerville Rd	18	0.3	15.8	1.14	0.35	2.27	0.72
(Route End)	18	0.11	45.7	0.14	0.11	0.18	0	
Route 28 SB PM	Upperridge Dr / Old Centerville Rd	17	0.14	10.0	0.84	0.19	2	0.64
	Machen Rd	17	0.29	8.9	1.96	0.39	5.89	1.57
	New Braddock Rd (Rt 620)	17	0.22	10.7	1.24	0.4	2.58	0.86
	Old Mill Rd / Green Trails Blvd	17	0.69	20.0	2.07	0.8	3.76	0.99
	Tallavast Dr	17	0.16	33.5	0.29	0.19	0.64	0.04
	Brandenton Dr	17	0.25	17.8	0.84	0.33	1.51	0.47
	Compton Rd / Ordway Rd	17	0.27	19.3	0.84	0.35	1.8	0.44
	Median N of Bull Run	17	0.4	47.0	0.51	0.43	0.61	0
	Patton Ln	17	0.64	31.6	1.22	0.85	2	0.23
	Yorkshire Ln / Chestnut St	17	0.13	20.1	0.39	0.18	0.99	0.17
	Rugby Rd	17	0.21	26.8	0.47	0.31	1.62	0.13
	Brooks Ln	17	0.11	20.7	0.32	0.16	0.83	0.14
	Leland Rd	17	0.13	20.2	0.39	0.19	1.5	0.17
	Oak St	17	0.14	25.7	0.33	0.17	1.02	0.12
	Spruce St	17	0.16	15.4	0.62	0.22	1.25	0.41
	Birch St	17	0.16	15.3	0.63	0.29	1.44	0.38
	Maplewood Dr	17	0.12	16.9	0.43	0.19	1.25	0.21
	Browns Ln / Shoppers Sq North Entrance	17	0.12	20.4	0.35	0.18	0.96	0.14
	Shoppers Sq South Entrance	17	0.11	26.7	0.25	0.18	0.45	0.04
	Old Centerville Rd / Blooms Quarry Ln	17	0.11	20.3	0.32	0.21	0.75	0.12
	Manassas Dr	17	0.12	6.7	1.08	0.2	1.74	0.9
	Conner Dr	17	0.19	37.2	0.31	0.24	0.47	0.01
	Breeden Ave	17	0.23	32.2	0.43	0.29	0.65	0.03
	Phoenix Dr	17	0.13	23.2	0.34	0.16	1.41	0.12
	Kincheloe Dr	17	0.11	10.9	0.61	0.18	1.67	0.43
	Liberia Ave	17	0.12	6.6	1.09	0.19	1.78	0.91
(Route End)	17	0.14	33.0	0.25	0.12	0.94	0.06	

Figure 11. Travel Time Summary by Checkpoint (Sheet 2 of 2)

Notes:

- There are no Metro Direct Service stops on Rte 28 north of Yorkshire Ln.
- OmniLink bus service will travel up to ¼ mile off its route to pick up/discharge passengers on-demand.

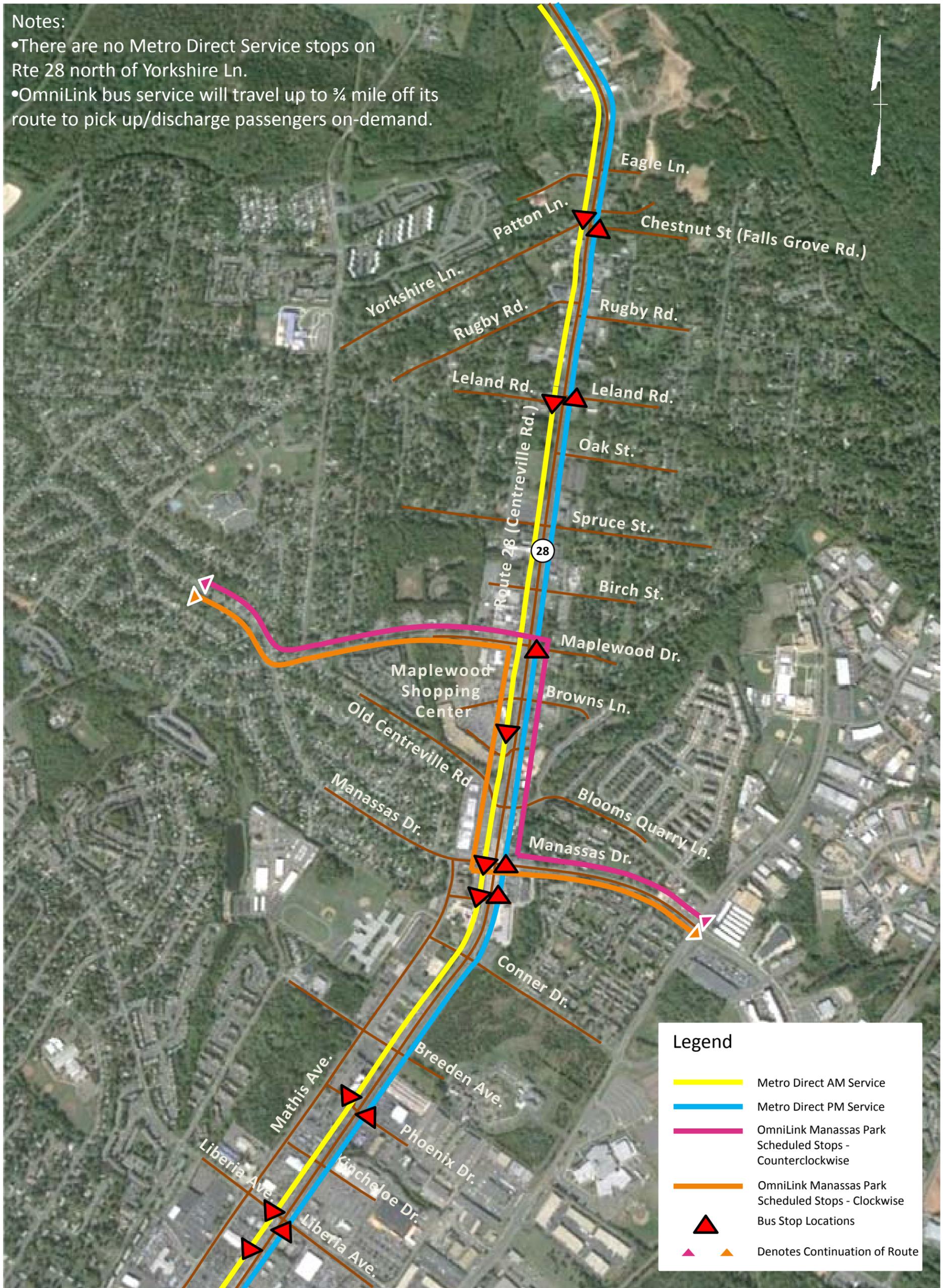


Figure 12: Route 28 Bus Routes & Bus Stop Information

**Route 28 Corridor Safety and Operations Study
Summary of Data Collection**

**Appendix B –
Crash Report & Safety Study**



TECHNICAL MEMORANDUM

T3 Design Corporation
10340 Democracy Lane #305
Fairfax, Virginia 22030-2422
Phone 703.359.5861
Fax 703.359.5863

INTRODUCTION

This technical memorandum describes the safety and multimodal analysis of about 6 miles along Route 28 (Centreville Road) and a 0.75-mile segment of Mathis Avenue as a part of the Route 28 Corridor Safety and Operations Study project. The project limits on Route 28 start just south of I-66 and end at Liberia Avenue. The Mathis Avenue study segment is between Manassas Drive and Liberia Avenue. Figure 1 presents the limits of the study corridor and the study intersections in both Fairfax and Prince William Counties, Virginia.

The safety analysis involved a review of the most recently available crash data for the study segments for the three-year period from January 1, 2010 to December 31, 2012. Specific crash rates in the study area were calculated and compared with the project critical crash rate to determine high frequency crash locations identified as “hot spots.” These hot spots were further examined to determine if there were any contributing factors along the study corridor that could be mitigated.

The multimodal analysis involved collecting existing roadway data for pedestrian, bicycle and transit facilities, including an inventory of sidewalks, crosswalks, pedestrian and bicycle related signs, and bus stop locations. This assessment included identifying geometric deficiencies and safety issues along the corridor.

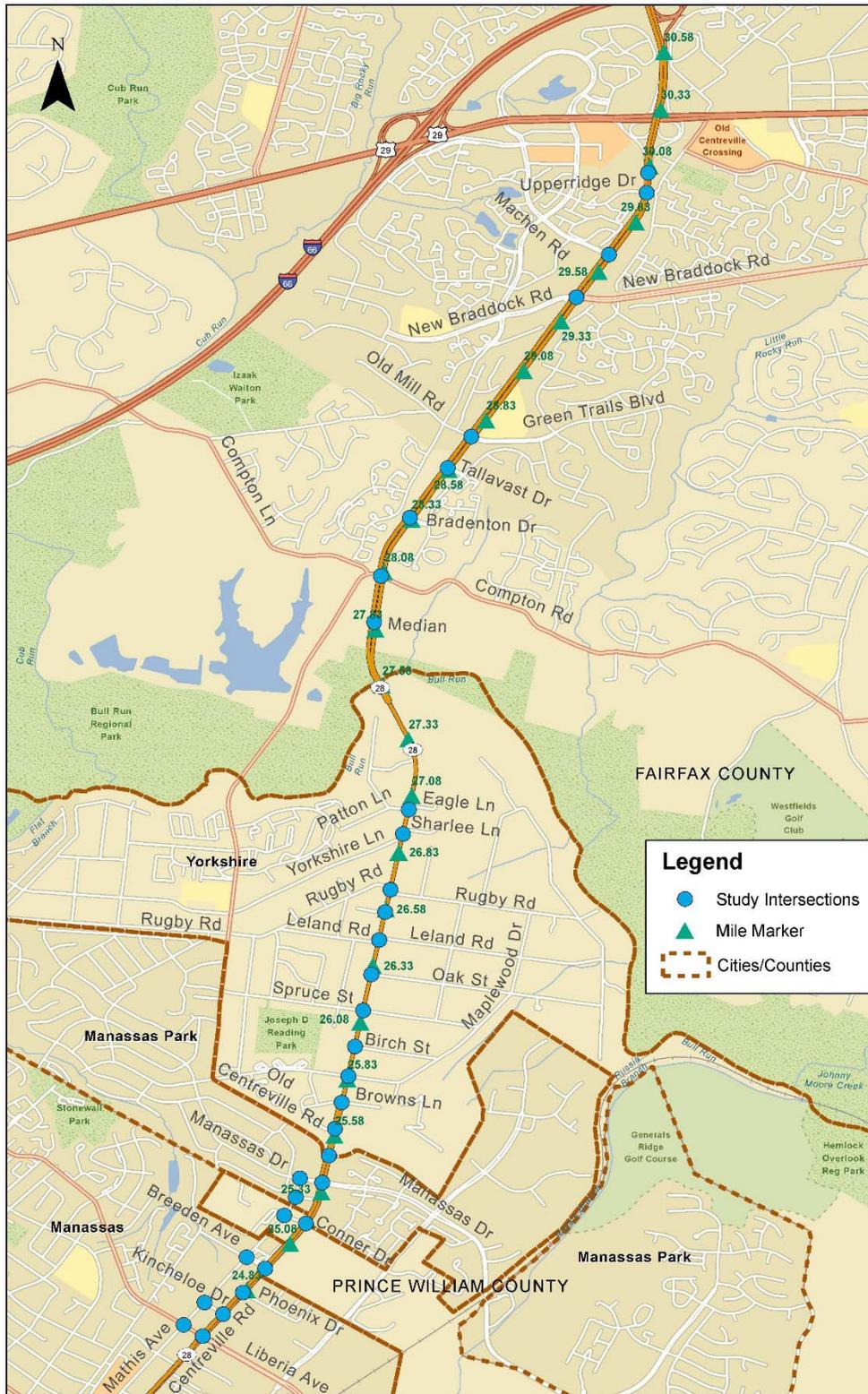
STUDY ROADWAY OVERVIEW

Route 28 (Centreville Road) is a multilane divided urban principal arterial that runs north to south within the study limits through parts of Fairfax County, the City of Manassas Park, the City of Manassas, and Prince William County. Within the study limits, Route 28 is a four-lane divided road, except to the north of Machen Road where Route 28 had three southbound lanes. The cross-section includes a two-way left-turn lane for a two-mile segment south of Compton Road, starting about 700 feet north of Orchard Bridge Drive and extending to Browns Lane. The posted speed limit is 45 mph between the Route 29 ramps and Old Centreville Road, and the posted speed reduces to 35 mph between Old Centreville Road and Liberia Avenue. There are dedicated left and right turn auxiliary lanes at all major intersections along the corridor.

According to the Average Annual Daily Traffic (AADT) volumes published by VDOT, the AADT along Route 28 ranges from 55,000 vehicles per day (vpd) to 49,000 vpd between Route 29 and the Prince William County line, and it reduces to 31,000 vpd between the Prince William County line and Liberia Avenue. The land use along Route 28 is primarily residential between Route 29 and Compton Road. To the south of Compton Road, the land use is primarily commercial.

Mathis Avenue is a four-lane, undivided local road with a posted speed limit of 25 mph, and it provides access to several commercial developments within the area. The 2012 AADT is 9,700 vpd between the Manassas north city line and the south city line of Manassas Park.

Figure 1: Study Location



SAFETY ANALYSIS

Data Collection and Analysis Methodology

The Virginia Department of Transportation (VDOT) provided three years of crash data from January, 2010 to December, 2012. Individual crash reports were not provided, but the data contained crash information by location, date and time of the day, type, severity, and other major factors. Crash data was plotted in ArcGIS Version 10.2, and crashes within 150 feet of a study intersection were considered to be intersection-related.

For the roadway segments, the crash data was aggregated by 0.25-mile roadway segments or the total length of the segment if the segment length was less than a quarter mile. Crash rates were calculated for each segment and for each intersection, and then they were compared to the statistical mean and 95th percentile confidence interval for the overall corridor. Locations with a higher crash rate than the 95th percentile confidence interval (statistical mean, or average, plus two standard deviations) for the overall study corridor were identified to be “hot spots.” In addition, an overall average crash rate, injury rate and fatality rate for the study corridor was calculated and compared with statewide and districtwide average crash rates.

For this study, the Route 28 corridor was divided into two segments:

1. Route 29 ramps to Old Centreville Road
2. Old Centreville Road to Liberia Avenue.

The first segment of Route 28 from Route 29 to Old Centreville Road is maintained by VDOT, so the safety analysis for this segment was conducted using crash data obtained from VDOT. The second segment of Route 28 from Old Centreville Road to Liberia Avenue, as well as Mathis Avenue are maintained by the City of Manassas and the City of Manassas Park. The crash data obtained from VDOT was compared with the crash summary report obtained from the City of Manassas Police Department, and it was found that the total number of crashes reported by the police department were significantly higher than the total number of crashes reported in the VDOT database.

For Mathis Avenue and for the segment of Route 28 between Old Centreville Road and Liberia Avenue, the crash analysis presented in this report is based on the crash data provided by VDOT. Additional crash data for these two segments will be requested from the police departments for the cities of Manassas and Manassas Park in the later phase of this project, and the report will be updated at that time to include the additional safety analyses.

Crash History – Route 28 from Route 29 to Old Centreville Road

In the three-year period from 2010 to 2012, there were a total of 627 crashes on Route 28, from the Route 29 ramps to Old Centreville Road. A summary of crash statistics during the three years study period is presented below, and an accompanying table reflecting a summary of all the crash statistics for each study segment and intersection is included at the end of the report.

- The crashes per year are as follows:
 - 188 (30%) in 2010
 - 227 (36%) in 2011
 - 212 (34%) in 2012.

- The most prevalent crash type involved rear-ends. The breakdown is as follows:
 - Rear-end: 413 (66%)
 - Angle: 129 (21%)
 - Sideswipe: 28 (4%)
 - Fixed object off-road: 19 (3%)
 - Head-on: 10 (2%)
 - Other: 21 (3%)
- There were 5 pedestrian crashes and 2 bicycle crashes.
- Of the total 627 crashes, 358 (57%) were property damage crashes only, and 266 (42%) were injury crashes that involved 366 injuries.
- There were three fatalities that included two pedestrian fatalities.
- Crashes by time of day:
 - 115 (18%) in the AM peak period
 - 184 (29%) in the PM peak period
 - 325 (52%) in off-peak hours
- Crashes by light conditions:
 - Daylight: 428 (68%)
 - Darkness: 170 (27%)
 - Dawn/Dusk: 26 (4%)
- Crashes by surface conditions:
 - Dry: 523 (83%)
 - Wet: 99 (16%)
 - Wet/Icy: 3 (1%)

The predominance of rear-end and angle crashes is typical of an urban corridor like Route 28 that has closely-spaced intersections, both signalized and unsignalized, and overall heavy traffic volumes. Rear-end crashes are common at signalized intersections when vehicles slowing down or stopping at the red light are struck from behind due to drivers' inattention or following too closely. These crashes are even more common during peak periods and traffic congestion when queues are maximized. Rear-end crashes are also typical at unsignalized intersections when vehicles slowing down to turn onto a side street or a driveway are struck from behind. This scenario is more common where dedicated left or right turn auxiliary lanes are not present.

At signalized intersections, angle crashes are primarily due to either red light violations or left turns from the mainline during a "permissive" signal mode when drivers making the left turn misjudge the speed of oncoming through traffic. At unsignalized intersections, angle crashes occur when drivers either enter from the side streets or turn left from the mainline and either misjudge available gaps in the opposing traffic stream or misjudge the speed of oncoming traffic.

There were a total of 28 sideswipe crashes, 18 (64%) of which occurred during either the AM or PM peak periods. Sideswipes are often attributed to traffic congestion when a motorist attempts to make a sudden lane change without properly checking for an available gap to complete the maneuver.

Of the 19 total fixed object off-road crashes, 6 (32%) occurred during wet or icy surface conditions. Seven out of 19 (37%) occurred along Route 28 between Patton Lane and just south of the Bull Run bridge. In this area, Route 28 has a horizontal curve alignment with a regulatory speed of 45 mph. The fixed object off-road crashes can most likely be attributed to the curved roadway alignment combined

with drivers exceeding the posted speed limit and losing control of the vehicle. There is no “curve” (W1-2) warning sign along Route 28 in advance of this segment to alert drivers for the change in roadway alignment.

A detailed crash map depicting crash types is provided at the end of the report.

Crash Rate Comparison

Table 1 presents a comparison of the overall crash, injury, and fatality rates with the statewide and districtwide rates for primary roadways.

Table 1: Route 28 Crash Rate

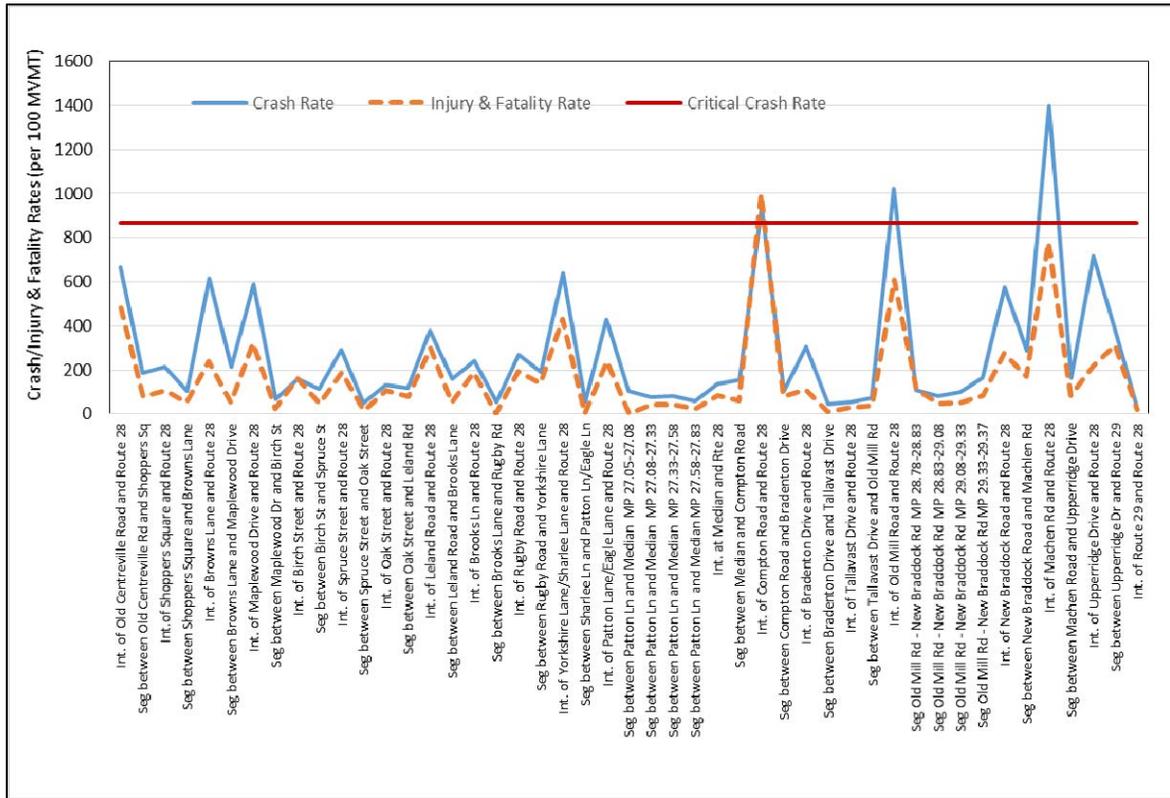
Crash Rates (Per 100 Million Vehicle Miles Traveled)	Crash Rate	Injury Rate	Fatality Rate
Route 28	226.21	132.05	1.08
Statewide	104.94	59.93	1.05
Districtwide	128.21	72.08	0.54

This comparison shows that the crash and injury rates for the study segment of Route 28 is about twice the statewide and districtwide crash and injury rates. The fatality rate along Route 28 is just slightly higher than the statewide fatality rate, but it is two times higher than the districtwide fatality rate.

Hot Spot Identification

Based on the methodology stated previously, the critical crash rate was calculated to be 867 crashes per 100 Million Vehicles Miles Traveled (MVMT). Figure 2 presents a graph of the crash and injury and fatality rates for each location, along with a straight line for the critical crash rate.

Figure 2: Route 28 Crash, Injury & Fatality Rates Vs. Critical Crash Rate



There are three locations where the crash rate is higher than the line for the critical crash rate, so these three locations are identified as hot spots:

1. Intersection of Route 28 at Compton Road
2. Intersection of Route 28 at Old Mill Road
3. Intersection of Route 28 at Machen Road

A detailed crash analysis of each hot spot location is discussed below.

Hot Spot 1 (Intersection of Route 28 at Compton Road)

A summary of crash statistics for the intersection of Route 28 and Compton Road is presented in Table 2.

Table 2: Hot Spot 1 Crash Statistics – Route 28 at Compton Road

Crash Type								Crash Severity						Time of the Day				Lighting Cond.					Surface Cond.						
Angle	Rear End	Sideswipe	Fixed Object	Head On	Pedestrian	Bicyclist	Miscellaneous/ Other	Crash Totals	Property Damage Only	Injury	Injury Count	Fatality	Fatalities	Injuries and Fatalities	AM Peak	PM Peak	Off Peak	Not Stated	Darkness - Hwy Lighted	Darkness - Hwy not Lighted	Dawn	Daylight	Dusk	Not Stated	Dry	Icy	Snowy	Wet	Other
16	15	1	0	2	0	0	0	34	14	19	35	1	1	36	10	10	14	0	8	5	0	21	0	0	30	0	0	4	0

A total of 34 crashes occurred at the signalized intersection of Route 28 and Compton Road during the three-year study period. The number per year was fairly consistent, with 12 per year in 2010 and 2012 and 10 occurring in 2011. Angle crashes were the most predominant type, accounting for 16 out of 34 (47%). Rear-end crashes were almost as prevalent, accounting for 15 out of 34 (44%). In addition, there were 2 head-on collisions and 1 sideswipe crash.

A majority of the angle crashes at this intersection involved vehicles turning left from Route 28 onto Compton Road. The crashes occurred when drivers turning left failed to yield to oncoming traffic during the “permissive” mode. During a permissive signal phase, the traffic signal indication for left turns is a green ball that permits vehicles to turn left when there is an adequate gap. Crashes occur when those drivers either misjudge available gaps in the opposing traffic stream or misjudge the speed of oncoming traffic.

The traffic signal at the intersection of Route 28 and Compton Road has recently been upgraded and signal phasing for the mainline left turn movements has been modified to “protected” only phasing, instead of the previous “protected/permissive” phasing. It is expected that the protected only phasing will reduce the number of left turn crashes at the intersection.

Rear-end crashes accounted for 44 percent of the crashes at this hot spot. Rear-end crashes are typical at signalized intersections when vehicles slowing down or stopping at a red light are struck from behind due to drivers’ inattention or following too closely. This is usually exacerbated by heavy traffic congestion and queues. Since rear-end collisions are prevalent at all of the hot spot locations in this report, recommended countermeasures to mitigate them are presented at the end of this section.

Of the 34 crashes, 14 (41%) were property damage crashes, 19 (56%) were injury crashes that involved 35 injuries, and one was a fatality crash. The majority of the crashes occurred during off-peak periods, accounting for 14 of 34 (41%), with another 10 (29%) in each of the AM and PM peak periods. Most occurred during daylight, including 21 of 34 (62%). In addition, a majority of the crashes, 30 out of 34 (88%), occurred during dry surface conditions, with just 4 (12%) involving wet surface conditions.

A fatal crash at this intersection occurred on Monday, December 17, 2012 at 6:50 PM. The crash occurred when a vehicle turning left from southbound Route 28 onto eastbound Compton Road failed to yield to a northbound vehicle. The crash occurred after dark with dry surface conditions.

Hot Spot 2 (Intersection of Route 28 at Old Mill Road)

A summary of crash statistics for the intersection of Route 28 and Old Mill Road is presented in Table 3.

Table 3: Hot Spot 2 Crash Statistics – Route 28 at Old Mill Road

Crash Type								Crash Severity						Time of the Day				Lighting Cond.				Surface Cond.							
Angle	Rear End	Sideswipe	Fixed Object	Head On	Pedestrian	Bicyclist	Miscellaneous/ Other	Crash Totals	Property Damage Only	Injury	Injury Count	Fatality	Fatalities	Injuries and Fatalities	AM Peak	PM Peak	Off Peak	Not Stated	Darkness - Hwy Lighted	Darkness - Hwy not Lighted	Dawn	Daylight	Dusk	Not Stated	Dry	Icy	Snowy	Wet	Other
11	20	2	0	1	0	0	3	37	23	14	22	0	0	22	3	13	20	0	9	2	0	26	0	0	29	0	0	7	1

A total 37 crashes occurred at the signalized intersection of Route 28 and Old Mill Road during the three-year study period. Out of the 37 crashes, 11 (30%) occurred in 2010, 17 (46%) occurred in 2011, and 9 (24%) occurred in 2012. The most prevalent crash type at this intersection was rear-end crashes, accounting for 20 out of 37 (54%). In addition, there were 11 angle crashes (30%), one head-on collision, two sideswipe crashes, and three crashes in the miscellaneous category.

Again, rear-end crashes are typical at signalized intersections when vehicles slowing down or stopping at a red light are struck from behind due to drivers’ inattention or following too closely. At this hot spot, there are advance “signal ahead” (W3-3) warning signs along Route 28 in advance of the Old Mill Road intersection. Crash mitigation measures for rear-end crashes along Route 28 are presented at the end of this section.

Most of the crashes involved property damage only, accounting for 23 of 37 (62%), as well as 14 (38%) injury crashes that included 22 injuries. There were no fatalities at this intersection. Of the 37 crashes, 3 (8%) occurred in the AM peak period, 13 (35%) occurred in the PM peak period, and 20 (54%) occurred during the off-peak period. Most of the crashes were during daylight, or 26 of 37 (70%). In addition, a majority, 29 out of 37 (78%), occurred under dry surface conditions.

Hot Spot 3 (Intersection of Route 28 at Machen Road)

A summary of crash statistics for the intersection of Route 28 and Machen Road is presented in Table 4.

Table 4: Hot Spot 3 Crash Statistics – Route 28 at Machen Road

Crash Type								Crash Severity					Time of the Day				Lighting Cond.					Surface Cond.							
Angle	Rear End	Sideswipe	Fixed Object	Head On	Pedestrian	Bicyclist	Miscellaneous/ Other	Crash Totals	Property Damage Only	Injury	Injury Count	Fatality	Fatalities	Injuries and Fatalities	AM Peak	PM Peak	Off Peak	Not Stated	Darkness - Hwy Lighted	Darkness - Hwy not Lighted	Dawn	Daylight	Dusk	Not Stated	Dry	Icy	Snowy	Wet	Other
8	33	2	1	0	0	0	1	45	28	17	25	0	0	25	5	14	26	1	14	1	1	27	1	1	36	0	0	9	0

A total of 45 crashes occurred at the signalized intersection of Route 28 and Machen Road during the three-year study period. Out of the 45 crashes, 9 (20%) occurred in 2010, 19 (42%) occurred in 2011, and 17 (38%) crashes occurred in 2012. Rear-end crashes were the most predominant type, accounting for 33 of 45 (73%). In addition, there were 8 (18%) angle crashes, one fixed object off-road crash, two sideswipes and one crash in the miscellaneous category.

As described earlier, rear-end crashes are common at signalized intersections when vehicles slow down or stop at the red light and are then struck from behind due to drivers’ inattention or following too closely. Rear-end crashes are even more common during periods of traffic congestion when queues are maximized. Out of the 33 rear-end crashes at this intersection, not quite half, or 14 of 33 (42%) occurred during either the AM (6:00 – 10:00 AM) or PM (3:00 – 7:00) peak period.

Most of the crashes involved property damage only, accounting for 28 of 45 (62%), along with 17 (38%) injury crashes that included 25 injuries. There were no fatalities at this intersection. Out of 45 crashes, 5 (11%) crashes occurred during the AM peak period, 14 (31%) occurred during the PM peak period, and 26 (58%) crashes occurred during the off-peak period. Most were during daylight, composing 27 of 45 crashes (60%). In addition, the majority of crashes, 36 out of 45 (80%), occurred under dry surface conditions, with 9 crashes (20%) during wet surface conditions.

Hot Spot Mitigation recommendations

The segment of Route 28 from the Route 29 ramps to Compton Road is a heavily-traveled corridor with closely spaced signalized intersections and high traffic volumes. Rear-end crashes were highly represented at each of the three hotspot location.

Because Route 28 is a wide road with wide grass medians and the alignment is fairly straight and level, the roadway design speed allows drivers to exceed the speed limit. A spot speed check was conducted in July, 2014, to record free flow vehicle speeds at mid-day on northbound and southbound Route 28 between Old Mill Road and Compton Road and to the south of Compton Road. The 85th percentile speed for the samples ranged from 50 to 54 mph at these locations, which is 5 to 9 mph higher than the 45 mph posted speed limit. Speeding is likely to be a contributing factor to the number of rear-end crashes along the study segment.

In addition, the southbound approach of Route 28 at Compton Road is on a downgrade that may be causing a sight distance limitation to the vehicles approaching the intersection. Speeding combined with reduced sight distance are likely contributing factors to rear-end crashes at the intersection. Installation of a “Be Prepared To Stop” (W3-4) sign with flashing beacons combined with the “signal ahead” warning sign is recommended to alert drivers to the presence of a traffic signal and to reduce the vehicle approach speeds.

The following additional countermeasures are recommended for the three hot spot locations:

- Optimize the signal timing and coordination to increase the throughput of the corridor and reduce queue spillback. Clearance times should also be evaluated to ensure they meet the latest VDOT guidance and are sufficient for the conditions. Appropriate yellow and all-red times will minimize drivers that break suddenly for red lights that cause a chain reaction of rear end accidents.
- Install advance street name signs in advance of all major intersections to provide guidance to the drivers for the side streets. This will also help alert drivers to the presence of vehicles stopping or slowing down at the intersections.
- There are a “signal ahead” (W3-3) warning signs on Route 28, in advance of the Compton Road and Old Mill Road intersection. It is recommended to also install “Be Prepared To Stop” (W3-4) signs with flashing beacons downstream of the signal ahead signs to alert drivers of stopped traffic at the traffic signals.

Pedestrian Crashes

Five pedestrian crashes occurred along Route 28 between the Route 29 ramps and Old Centreville Road at the following locations:

- One crash on northbound Route 28 between Browns Lane and Maplewood Drive
- Two crashes on northbound Route 28 between Birch Street and Spruce Street
- One crash on northbound Route 28 at its intersection with Yorkshire Lane
- One crash on northbound Route 28 to the south of Copco Lane

Out of the five pedestrian crashes, three resulted in injuries and two resulted in fatalities. Two out of five crashes occurred during the daylight, and three crashes occurred after dark.

One pedestrian fatality occurred on March 9, 2012 at 6:50 PM on northbound Route 28 between Birch Street and Spruce Street. It occurred when a vehicle merging from the two-way left-turn lane into the northbound Route 28 through lane hit another vehicle, which in turn struck a pedestrian crossing Route 28 at that location. The crash occurred in darkness, and this segment of Route 28 was not lighted at the time of the crash.

The other pedestrian fatality occurred on February 22, 2010 at 7:30 PM to the south of Copco Place when a pedestrian crossing Route 28 from east-to-west entered the path of a vehicle traveling on northbound Route 28 and was struck by the vehicle. The crash occurred in darkness, but this segment of Route 28 was lighted at the time of the crash.

All five pedestrian crashes occurred within a two-mile segment of northbound Route 28 between Old Centreville Road/Blooms Quarry Lane and Copco Place. There are several pedestrian generators within this

segment and a little further south, including retail shops and fast food and sit-down restaurants. The Manassas Park Shopping Center is located in the southwest corner of the Old Centreville Road intersection, a Giants Food store is located in the northeast corner of the Liberia Avenue intersection. In addition, there are 10 to 12 bus stops along Route 28 between Yorkshire Lane to Liberia Avenue. A new residential development is located on the east side of Route 28 south of Sharlee Lane, and another new residential development is on the east side of Route 28 to the south of Copco Place.

Although there are many potential pedestrian generators within this two-mile segment, there are few pedestrian facilities to provide safe accommodation to the pedestrians. There are few sections of sidewalk and evidence of informal pedestrian paths located sporadically on both sides of Route 28, but there are only two crosswalks at major intersections to cross Route 28. One crosswalk is provided on the south leg of the Yorkshire Lane/Falls Grove Drive intersection that provides access to the new residential development, and another is across the south leg of the Leland Road intersection. However, there are no curb ramps or sidewalks at either end of this crosswalk.

Further detailed analysis of the pedestrian facilities is provided in the multimodal analysis section of this report.

Bicycle Crashes

Two bicycle crashes were reported along Route 28 between the Route 29 ramps and Old Centreville Road during the three-year study period. One bicycle crash occurred at the intersection of Route 28 and Browns Lane on June 7, 2011 at 10:45 AM. The crash occurred when driver of a vehicle on the eastbound approach of the intersection attempted to make a right turn onto southbound Route 28 and struck a bicyclist in the crosswalk.

Another bicycle crash occurred at the intersection of Route 28 and Bradenton Drive on September 26, 2011 at 9:30 AM. This crash occurred on the east side of the intersection when the driver of a vehicle on the westbound approach of Bradenton Drive attempted to make a right turn onto northbound Route 28 and struck a bicyclist in the crosswalk.

Both crashes involved injuries to the bicyclists.

Crash History – Route 28 from Old Centreville Road to Liberia Avenue

Based on the crash data provided by VDOT for the three-year period from 2010 to 2012, there were a total of 223 crashes on Route 28 from Old Centreville Road to Liberia Avenue. A summary of the crash data within the study period is presented below, and an accompanying table reflecting a summary of all the crash statistics for each study segment and intersection is included at the end of the report.

- The crashes per year are as follows:
 - 73 (33%) in 2010
 - 81 (36%) in 2011
 - 69 (31%) in 2012.
- The most prevalent crash type involved rear-ends. The breakdown of crash types is as follows:
 - Rear-end: 97 (43.5%)
 - Angle: 95 (43%)
 - Sideswipe: 11 (5%)

- Fixed object off-road: 7 (3%)
- Head-on: 2 (1%)
- Other: 7 (3%)
- There were 2 pedestrian crashes and 2 bicycle crashes.
- Of the total 223 crashes, 116 (52%) were property damage only, and 107 (48%) were injury crashes that involved 161 injuries.
- There were no fatality crashes along this segment.
- Crashes by time of day:
 - 41 (18%) in the AM peak period
 - 53 (24%) in the PM peak period
 - 129 (58%) in off-peak hours
- Crashes by light conditions:
 - Daylight: 153 (69%)
 - Darkness: 57 (26%)
 - Dawn/Dusk: 12 (5%)
- Crashes by surface conditions:
 - Dry: 178 (80%)
 - Wet: 41 (18%)
 - Wet/Icy/Other: 4 (2%)

The predominance of rear-end and angle crashes along this segment of Route 28 can be attributed to the presence of closely-spaced signalized and unsignalized intersections, as well as driveways to commercial developments. Rear-end crashes are common at signalized intersections when vehicles slowing down or stopping at the red light are struck from behind due to drivers' inattention or following too closely. These crashes are even more common during peak periods and traffic congestion when queues are maximized. Of the total 97 rear-end crashes, 54 (56%) crashes occurred at the signalized intersection of Route 28 and Liberia Avenue that has heavy traffic volumes during both peak and off-peak periods.

Rear-end crashes are also typical at unsignalized intersections when vehicles slowing down to turn onto a side street or a driveway are struck from behind. This scenario is more common where there are no dedicated left or right turn auxiliary lanes that would allow turning traffic to move out of the through lanes while decelerating.

The high number of angle crashes along this segment can be attributed due to the ingress and egress of vehicles from developments on both sides of the road. Out of 95 angle crashes, 67 (71%) occurred at the unsignalized intersections of Route 28 with Kincheloe Drive, Phoenix Drive, Breeden Avenue and Conner Drive. All these intersections provide direct access to commercial developments.

There were a total of 11 sideswipe crashes, 5 (45%) of which occurred during either the AM or PM peak periods. During peak periods, sideswipes are likely due to traffic congestion when a motorist attempts to make a sudden lane change without properly checking for an available gap to complete the maneuver. There were 6 (55%) sideswipe crashes that occurred during the off-peak period which are likely to occur due to the sudden lane changes made by a driver to turn into a driveway

Of the 7 total fixed object off-road crashes, 3 (43%) occurred during wet or icy surface conditions.

A detailed crash map depicting crash types along Route 28 between Liberia Avenue to Old Centreville Road is presented at the end of the report.

Crash Rate Comparison

Table 5 presents a comparison of the overall crash, injury, and fatality rates with the statewide and districtwide rates for primary roadways.

Table 5: Route 28 Crash Rate – (From Liberia Avenue to Old Centreville Road)

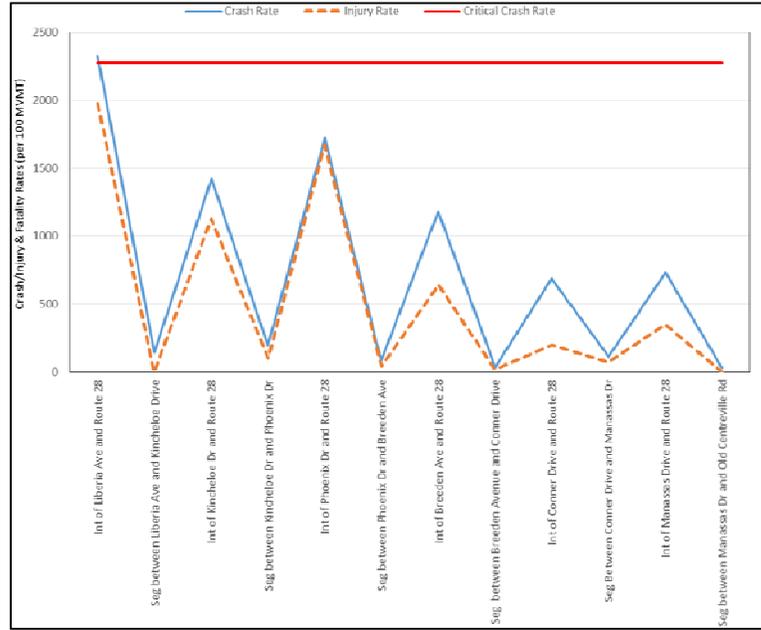
Crash Rates (Per 100 Million Vehicle Miles Traveled)	Crash Rate	Injury Rate	Fatality Rate
Route 28 (From Liberia Ave. to Old Centreville Rd.)	616.4	445	0
Statewide	104.94	59.93	1.05
Districtwide	128.21	72.08	0.54

This comparison shows that the crash rates for the segment of Route 28 between Old Centreville Road to Liberia Avenue is five to six times higher than the statewide and districtwide crash rates. The injury rate along this segment is six to seven times higher than the statewide and districtwide rates.

Hot Spot Identification

Based on the methodology stated previously, the critical crash rate was calculated to be 2,273 crashes per 100 Million Vehicles Miles Traveled (MVMT). Figure 3 presents a graph of the crash and injury and fatality rates for each location, along with a straight line for the critical crash rate.

Figure 3: Route 28 Crash Rate Comparison (From Liberia Avenue to Old Centreville Road)



The crash rate for the intersection of Route 28 and Liberia Avenue is above the critical crash rate and it is therefore identified as the only hot spot within this study segment. A detailed crash analysis of the intersection of Route 28 and Liberia Avenue is discussed below.

Hot Spot (Intersection of Route 28 at Liberia Avenue)

A summary of the crash data for the intersection of Route 28 and Liberia Avenue is presented in Table 4.

Table 4: Hot Spot Crash Statistics – Route 28 at Liberia Avenue

Crash Type									Crash Severity					Time of the Day			Lighting Condition				Surface Condition								
Angle	Rear End	Sideswipe	Fixed Object	Head On	Pedestrian	Bicyclist	Miscellaneous/ Other	Crash Totals	Property Damage Only	Injury	Injury Count	Fatality	Fatalities	Injuries and Fatalities	AM Peak	PM Peak	Off Peak	Darkness - Hwy Lighted	Darkness - Hwy not Lighted	Dawn	Daylight	Dusk	Not Stated	Dry	Icy	Snowy	Wet	Oil/Other	Other
15	54	3	4	1	0	0	2	79	35	44	67	0	0	67	14	17	48	23	0	2	50	3	1	59	1	1	17	1	0

A total of 79 crashes occurred at the signalized intersection of Route 28 and Liberia Avenue during the three-year study period. The number per year was fairly consistent but increasing each year, with 24 in 2010, 26 in 2011 and 29 occurring in 2012. Rear-end crashes were the most predominant type, accounting for 54 out of 79 (68%). In addition, there were 15 (19%) angle crashes, 3 sideswipe crashes, 4 fixed object off-road collisions and 1 head-on collision.

Rear-end crashes are typical at signalized intersections when vehicles slowing down or stopping at a

red light are struck from behind due to drivers' inattention or following too closely. This is intensified by heavy traffic congestion and queues.

The intersection of Route 28 at Liberia Avenue is closely spaced with the signalized intersections of Manassas Drive located 0.8 miles to the north and Sudley Road located 0.5 miles to the south. The posted speed limit along this segment of Route 28 is 35 mph, so the speeds of approaching vehicles should not be a factor leading to rear-end crashes. Recent (June 2014) turning movement counts collected at the intersection of Route 28 and Liberia Avenue indicates heavy traffic movements at all approaches of the intersection during both the AM and PM peak periods, so this is more likely the primary cause, due to stop-and-go conditions.

To mitigate the higher number of rear-end crashes at this hot spot intersection, it is recommended to optimize the signal timing and coordination of this intersection with the adjacent intersections to increase the throughput of the corridor and reduce queue spillback. It is also recommended to evaluate clearance times to ensure they meet the latest VDOT guidance and are sufficient for the conditions. Appropriate yellow and all-red times will minimize drivers that break suddenly for red lights that cause a chain reaction of rear end accidents.

Of the 79 crashes at this location, 35 (44%) were property damage only, and 44 (56%) were injury crashes that involved 67 injuries. There were no fatality crashes at the intersection. The majority of the crashes occurred during off-peak periods, accounting for 48 of 79 (61%), with another 14 (18%) in the AM peak period and 17 (22%) in the PM peak period. Most occurred in daylight, including 50 of 79 (63%), as would be expected for congestion-related crashes. In addition, a majority of the crashes, 59 out of 79 (75%), occurred under dry surface conditions, with 17 (22%) involving wet surface conditions.

Wet surface conditions accounted for 13 rear-end and 3 fixed object off-road crashes, so pavement resurfacing is recommended to improve traction.

Pedestrian Crashes

Two pedestrian crashes occurred along Route 28 between Old Centreville Road and Liberia Avenue. Both crashes resulted in pedestrian injuries.

One pedestrian crash occurred at the intersection of Route 28 and Kincheloe Drive when a pedestrian standing in the median walked in front of a vehicle traveling on northbound Route 28. The crash occurred after dark, and this segment of Route 28 was not lighted at the time of the crash. Pedestrian destinations in the area include a few fast food restaurants as well as the Manassas Junction shopping center on the east side of Route 28 to the north and south sides of Kincheloe Drive. There are sidewalks on both sides of Route 28 adjacent to the Kincheloe Drive intersection, but there are no crosswalks to connect them.

The second pedestrian crash occurred at the intersection of Route 28 and Manassas Drive when a vehicle in the northbound right turn lane struck a pedestrian crossing the intersection. The traffic was stopped at the red light, and there was a large truck in the adjacent lane. A detailed description of this crash is not provided in the database, but it is likely that the truck in the adjacent lane restricted the visibility of the pedestrian for the right turning vehicle. The crash occurred in daylight and dry surface conditions. There are crosswalks with pedestrian phases on all four legs of the intersection and it appears from the description that the pedestrian was crossing with the light.

Bicycle Crashes

Two bicycle crashes were reported along Route 28 between Old Centreville Road and Liberia Avenue during the three-year study period. Both crashes occurred at the intersection of Route 28 and Kincheloe Drive. One crash occurred in daytime when a bicyclist turning left from southbound Route 28 into the Manassas Junction shopping center driveway was struck by a vehicle traveling northbound on Route 28. This crash resulted in property damage only.

The second bicycle crash occurred at dawn when a bicyclist on southbound Route 28 attempting to merge into the left turn lane at the Kincheloe Drive intersection was struck by another vehicle traveling southbound on Route 28. This crash involved an injury to the bicyclist.

Crash History – Mathis Avenue from Manassas Drive to Liberia Avenue

The analysis for Mathis Avenue is based on crash data provided by VDOT from 2010 to 2012. All crashes reported to the City of Manassas and Manassas Park police departments are not included in the VDOT database and are therefore not evaluated in this report. During the three-year period, there were a total of 69 crashes on Mathis Avenue from Manassas Drive to Liberia Avenue. A summary of crash data is presented below, and an accompanying table reflecting a summary of all the crash statistics for each study segment and intersection is included at the end of the report.

- The crashes per year are as follows:
 - 21 (30%) in 2010
 - 31 (45%) in 2011
 - 17 (25%) in 2012.
- The most prevalent crash type involved angle crashes. The breakdown is as follows:
 - Angle: 35 (51%)
 - Rear-end: 23 (33%)
 - Sideswipe: 4 (6%)
 - Head-on: 1
 - Non-Collision: 1
 - Other: 4 (6%)
- There was 1 pedestrian crash and no (0) bicycle crashes.
- Of the total 69 crashes, 25 (36%) were property damage only, and 44 (64%) were injury crashes that involved 63 injuries.
- There were no fatality crashes along this segment.
- Crashes by time of day:
 - 9 (13%) in the AM peak period
 - 26 (38%) in the PM peak period
 - 34 (49%) in off-peak hours
- Crashes by light conditions:
 - Daylight: 58 (84%)
 - Darkness: 10 (14.5%)
 - Dawn/Dusk: 1 (1.5%)
- Crashes by surface conditions:
 - Dry: 55 (80%)
 - Wet: 14 (20%)

The predominance of angle crashes along Mathis Avenue, 35 out of 69 (or 51%), is most likely attributed to the number of closely spaced commercial driveways and signalized intersections, when vehicles turning into and out of the driveways are struck by vehicles slowing down or stopping at the red light. This is more likely at unsignalized or mid-block locations without auxiliary lanes to provide acceleration/deceleration for turning vehicles out of the path of through vehicles.

In addition, there were 23 (33%) rear-end crashes, which are typical at signalized intersections when vehicles slowing down or stopping at the red light are struck from behind due to drivers' inattention or following too closely. Rear-end crashes also occur at the driveways when the vehicles slow down in a through lane in order to turn into a driveway and are struck from behind. Again, this scenario is more common when dedicated left and right turn auxiliary lanes are not provided at the driveways.

Crash Rate Comparison

Table 6 presents a comparison of the overall crash, injury, and fatality rates on Mathis Avenue with the statewide and districtwide rates for secondary roadways.

Table 6: Mathis Avenue Crash Rate

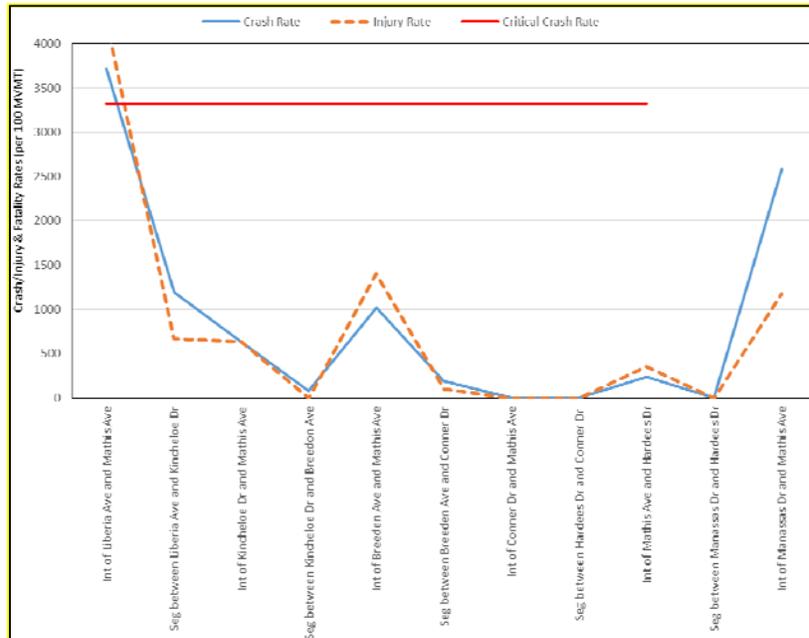
Crash Rates (Per 100 Million Vehicle Miles Traveled)	Crash Rate	Injury Rate	Fatality Rate
Mathis Avenue	775.61	708.17	0
Statewide	241.49	126.62	2.06
Districtwide	235.98	127.07	0.89

This comparison shows that the crash rate for Mathis Avenue is about three times greater than the statewide and districtwide rates, and the injury rate along Mathis Avenue is 5.5 times higher than the statewide and districtwide rates. The fatality rate is lower than both the statewide and districtwide rates.

Hot Spot Identification

Based on the methodology previously described, the critical crash rate was calculated as 3,329 crashes per 100 Million Vehicles Miles Traveled (MVMT). Figure 4 shows a graph of the crash, injury and fatality rates for each location, along with a straight line for the critical crash rate.

Figure 4: Mathis Avenue Crash Rate Comparison



The crash rate for the intersection of Mathis Avenue and Liberia Avenue is above the critical crash rate and is therefore identified as the only hot spot. A detailed crash analysis of this hot spot is discussed below.

Hot Spot (Intersection of Mathis Avenue at Liberia Avenue)

A summary of crash data for the intersection of Route 28 and Liberia Avenue is presented in Table 4.

Table 4: Hot Spot Crash Statistics – Mathis Avenue at Liberia Avenue

Crash Type										Crash Severity					Time of Day			Lightness		Surface Condition			
Angle	Rear End	Sideswipe	Fixed Object	Head On	Pedestrian	Bicyclist	Miscellaneous/ Other	Non-Collision	Crash Totals	Property Damage Only	Injury	Injury Count	Fatality	Fatalities	Injuries and Fatalities	AM Peak	PM Peak	Off Peak	Daylight	Darkness - Hw Lighted	Dusk	Dry	Wet
13	13	1	0	0	0	0	1	0	28	6	22	32	0	0	32	6	10	12	24	4	0	21	7

A total of 28 crashes occurred at the signalized intersection of Mathis Avenue and Liberia Avenue during the three-year study period. There were 5 crashes in 2010, 16 in 2011 and 7 occurred in 2012. Rear-end and angle crashes were the most predominant types with 13 (46%) rear-end crashes and 13 (46%) angle crashes. There were also 1 sideswipe crash and 1 other crash type.

Rear-end crashes are typical at signalized intersections when vehicles slowing down or stopping at a red light are struck from behind due to drivers’ inattention or following too closely. Rear-end crashes are also common at signalized intersections where there are no dedicated left or right turn auxiliary lanes, when vehicles slowing down to turn onto the side streets are struck from behind by the drivers

not expecting to stop at a green light. At the Mathis Avenue and Liberia Avenue intersection, a majority of rear-end crashes occurred on the eastbound and westbound approaches on Liberia Avenue where dedicated right-turn lanes are not provided.

The high number of angle crashes at this intersection occurred can be attributed to the closely-spaced 7-Eleven driveway on the southbound approach that is 150 feet away and an auto shop driveway that is 100 feet away on the eastbound approach. Some of the angle crashes at this intersection occurred when drivers turning left failed to yield to oncoming traffic during the “permissive” mode. During a permissive signal phase, the traffic signal indication for left turns is a green ball that permits vehicles to turn left when there is an adequate gap. The intersection of Mathis Avenue and Liberia Avenue has multiple lanes on each approach. Also, the stop bar for the left turning lanes are approximately 45 feet behind the edge of the curb on each approach. This means that drivers turning left have to see across a large distance to detect oncoming vehicles. Crashes occur when those drivers either misjudge available gaps in the opposing traffic stream or misjudge the speed of oncoming traffic.

To mitigate the number of rear-end crashes at this intersection, optimizing the signal timing is recommended to increase the throughput of the corridor and reduce queue spillback. It is also recommended to evaluate clearance times to ensure they meet the latest VDOT guidance and are sufficient for the conditions. Appropriate yellow and all-red times will minimize drivers that brake suddenly for red lights that cause a chain reaction of rear end accidents.

To reduce the number of angle crashes during the “permissive” mode, optimizing the signal timings for the left turning phase is recommended and increasing the “protected” green time if applicable to allow higher number of left turns to clear the intersection.

Of the 28 crashes, 6 (21%) were property damage only, and 22 (79%) were injury crashes that involved 32 injuries. There were no fatality crashes at the intersection. The majority occurred during the AM and PM peak periods, accounting for 16 of 28 (57%), with another 12 (43%) occurring in the off-peak period. Most crashes occurred in daylight, accounting for 24 of 28 (79%). In addition, a majority occurred under dry surface conditions, 21 out of 28 (75%), with 7 (25%) involving wet surface conditions.

Pedestrian Crashes

One pedestrian crash resulting in one pedestrian injury occurred on southbound Mathis Avenue between the Kincheloe Drive and Liberia Avenue intersections. It occurred when a pedestrian crossing midblock was struck by a vehicle slowing down for the end of queue stopped at a red right light at the Liberia Avenue intersection. Since the crash occurred outside the 150 foot radius of the Liberia Avenue intersection, it was not counted as an intersection-related crash. It occurred during the PM peak period with dry surface conditions, adjacent to the 7-Eleven driveway that is around 100 feet away from the intersection. There are continuous sidewalks along Mathis Avenue and Liberia Avenue adjacent to the 7-Eleven driveway. High visibility, laddered crosswalks are provided on all four legs of the signalized intersection closest to the 7-Eleven.

Bicycle Crashes

No bicycle crashes were reported on Mathis Avenue during the three-year study period.

MULTIMODAL ANALYSIS

Pedestrian and Bicycle Facilities

Route 28 from Compton Road to Liberia Avenue

The segment of Route 28 from Compton Road to Liberia Avenue has varied geometry and land uses. From Compton Road to 400 feet south of the Bull Run Bridge, Route 28 is a four-lane road with a grass median. Continuing south of the Bull Run Bridge to the Shopping Square north entrance, the four-lane roadway is divided by a two-way-left-turn lane, and from the Shoppers Square entrance to Liberia Avenue, the roadway has a raised grass median. The regulatory speed limit changes from 45 mph to 35 mph south of the Shopping Center/Browns Lane.

The land uses along this segment of Route 28 are a mix of residential and commercial developments, with residential developments primarily on the northern half and commercial developments on the southern half. There are a few single family residential units on both sides of Route 28 between Compton Road and Bull Run that have direct access onto Route 28. There are also two new residential developments on the east side of Route 28 south of Bull Run. One is located to the south of Copco Lane and has direct access onto Route 28. The other is between Patton Lane and Yorkshire Lane, with access via the signalized intersection at Yorkshire Lane.

The southern end of the segment is more commercial, including retail shops, auto shops, gas stations with convenience stores, and fast food and sit-down restaurants. The Manassas Park Shopping Center is located in the southwest corner of the Old Centreville Road intersection. There is a business center in the northwest corner of Route 28 at Mathis Breeden Avenue, and Giant Food grocery store is located in the northeast corner of Route 28 at Liberia Avenue. All of these business sites have direct access to Route 28.

The developments along Route 28 between Compton Road and Liberia Avenue are potential pedestrian generators. In addition, there are twelve bus stops on both sides of Route 28 that serve the Metro Direct bus service, and there are scheduled and non-scheduled bus stops for the OmniLink Manassas Park bus service.

The three-year crash history (January 1, 2010 to December 31, 2012) reported one bicycle-related crash and seven pedestrian crashes along this segment, including two pedestrian fatalities. The pedestrian and bicycle crashes reported on the segment of Route 28 from Old Centreville Road to Liberia Avenue are based on the VDOT database only. Additional data is expected from the cities of Manassas and Manassas Park, so this total may rise when further crash details are obtained in the next stage of this study.

The details of the pedestrian facilities and the locations of pedestrian and bicycle crashes are discussed below:

- There are intermittent pedestrian facilities on both sides of Route 28 between Compton Road and Old Centreville Road/Blooms Quarry Lane.
- There is a sidewalk on the east of Route 28 that starts at Route 29 at the northern end of the project and ends 0.3 miles south of Compton Road.
- There are no sidewalks or pedestrian paths on the west side of Route 28 from Compton Road to Birch Street.
- On the east side of Route 28, there are sections of informal pedestrian paths worn in the grass that indicate pedestrian activity.

- On the east side of Route 28, there are sections of sidewalk on the north and south sides of the entrance to the new residential development about 300 feet south of Copco Lane. The intersection of the development entrance with Route 28 is signalized with a crosswalk and pedestrian signals on the east leg of the intersection. One pedestrian fatality crash was reported in the proximity of this intersection when a pedestrian crossing Route 28 from east-to-west entered the path of a vehicle traveling on northbound Route 28 and was struck by the vehicle.
- There are sections of sidewalk in the northeast and southeast corners of Route 28 at Yorkshire Lane/Fall Grove Drive. Falls Grove Drive provides access to a new residential development. There are crosswalks and pedestrian signals and push buttons to cross the east and south sides of the intersection. A pedestrian injury crash was reported at this intersection when a northbound vehicle struck a pedestrian standing in the middle of the left turn lane.
- There is a crosswalk with pedestrian signals and push buttons on the south leg of the Route 28 and Leland Road intersection, but there are no sidewalks or curb ramps on either side of that crosswalk.
- There is a section of sidewalk on the east side of Route 28 which begins in the southeast corner of the Casablanca Restaurant and ends in the northeast corner of Spruce Street. Further south, there are short sections of sidewalk on the northeast and southeast corners of the Song Plaza driveway.
- The Emmanuel Elementary School and Emmanuel Baptist Church are located in the southwest corner of the Spruce Street intersection, but no pedestrian facilities are provided along that road segment. “Schoolchildren crossing” (S1-1) warning signs are installed on the east and west sides of Route 28 in the vicinity of the elementary school.
- One pedestrian injury crash and one fatality crash were reported on the segment of Route 28 approximately 400 feet north of Birch Street.
 - The fatality occurred when a vehicle in the two-way-left-turn merging into the northbound through lane struck a pedestrian crossing Route 28.
 - The pedestrian injury crash occurred when a vehicle traveling on northbound Route 28 struck a pedestrian crossing the road.
- On the west side of Route 28, a section of sidewalk begins to the north of the Ram car dealership entrance, approximately 550 feet south of Spruce Road, and ends at the south entrance of the same dealership.
- A small section of informal pedestrian path can be seen on the west side of Route 28 that begins past the parking lot for Kline’s Freeze on the southwest corner of the Maplewood Drive intersection and extends about 200 feet south to the next commercial driveway.
- On the east side of Route 28, sidewalk begins in the southeast corner of the Columbus Grill driveway located south of Browns Lane, and it continues all the way south to Liberia Avenue.
- On the west side of Route 28, sidewalk begins 150 feet north of the Shoppers Square intersection located south of Browns Lane and continues all the way south to Liberia Avenue.
- A crosswalk crosses the west leg of the Shoppers Square/Brown Lane intersection, but there are no pedestrian signals. One bicycle crash occurred at this intersection when an eastbound right turn vehicle struck a bicyclist in the crosswalk.
- There is a crosswalk on the west leg of the unsignalized intersection at the south driveway to Shoppers Square.
- There are crosswalks crossing the east and west legs of the unsignalized Old Centreville Road/Blooms Quarry Lane intersection.
- At the Manassas Drive intersection, crosswalks are on the east, west and south legs, and all include pedestrian signals and push buttons. One pedestrian crash occurred at this intersection when a vehicle approaching in the northbound right turn lane struck a pedestrian.

- One pedestrian crash occurred at the intersection of Kincheloe Drive when a vehicle traveling on northbound Route 28 struck a pedestrian standing in the median. There are no crosswalks present at the Kincheloe Drive intersection, and there is no pedestrian refuge in the median. The median is approximately 10 feet wide.
- There are high visibility, laddered crosswalks on all four legs of the Liberia Avenue intersection with pedestrian signals and push buttons on all four corners.
- There are no separate bicycle lane facilities along this segment of Route 28.

Route 28 from the Route 29 Ramps to Compton Road

The segment of Route 28 from I-66 to Compton Road is a heavily-traveled corridor with closely-spaced signalized intersections. This segment provides access to I-66 and Route 29 and is operated to maximize vehicular through-put. The land uses along this segment are primarily residential, but there are some commercial developments that include fast food and sit-down restaurants, the Centre Ride Market Place Shopping Center and the Centreville Multiplex Cinemas.

The commercial developments are located on both sides of Route 28 between Route 29 and New Braddock Road, and they are accessible from Route 28 via signalized intersections of Route 28 with Old Centreville Road/Upperridge Drive, Machen Road, and New Braddock Road. The intersections in this area include sidewalks, crosswalks, and pedestrian signals at the intersections to provide access for pedestrians from the neighborhood residential areas to the commercial establishments.

The following pedestrian facilities are present along the segment of Route 28 between the Route 29 ramps and Compton Road:

- There is an asphalt sidewalk on the west side of Route 28 from the Route 29 ramps to the northwest corner of the Machen Road intersection.
- There is a section of asphalt sidewalk on the west side of Route 28 that begins 450 feet south of the Machen Road intersection and ends in the northwest corner of the New Braddock Road intersection.
- There is an asphalt sidewalk on the east side of Route 28 from the Route 29 ramps to the Compton Road intersection and then continues 0.3 miles further south of Compton Road.
- At the Old Centreville Road/Upperridge Drive intersection, crosswalks are provided on the south, east, and west legs with pedestrian signals and pushbuttons.
- At the Machen Road intersection, a crosswalk crosses the west leg with pedestrian signals and pushbuttons.
- At the New Braddock Road intersection, high visibility ladder crosswalks are on the east and north legs with pedestrian signals and pushbuttons.
- At the Old Mill Road intersection, high visibility crosswalks are on the north, east, and west legs with pedestrian signals and pushbuttons on all four corners.
- At the Compton Road intersection, high visibility crosswalks are on the south, east, and west legs, as well as the northbound and southbound channelized right turn lanes. Pedestrian signals and pushbuttons are present in all four corners of the intersection. In addition, there are “pedestrian crossing” (W11-2) warning signs with supplemental “Ahead” (W16-9P) plaques located approximately 200 feet in advance of the crosswalk at the southbound and northbound channelized right turns. At the crosswalk for the channelized right turns, there are additional “pedestrian crossing” (W11-2) warning signs combined with a supplemental downward arrow (W16-7P) pointing to each crosswalk.

- Crosswalks are present on the east side of Route 28 at the Bradenton Drive, Tallavast Drive, and Darkwood Drive crossovers, and they connect with the asphalt sidewalk on either side to provide continuous accommodations for pedestrians.
- There are single-track bike trails that begin just south of the Centreville Elementary School on the east side of Route 28 that then follow the power lines from the southeast corner of Green Trails Boulevard and heading east away from Route 28 to Union Mill Road.
- There are no separate bicycle lane facilities along this segment of Route 28.

No pedestrian crashes were reported on this segment during the three-year study period. One bicycle crash occurred on the westbound approach the Bradenton Drive intersection when the driver of a vehicle attempted to make a right turn onto northbound Route 28 and struck a bicyclist in the crosswalk.

Mathis Avenue from Liberia Avenue to Manassas Drive

Mathis Avenue is a four-lane local road with a posted speed limit of 25 mph and an AADT of 9,700 vpd. There are commercial and institutional developments on both sides of the corridor that have direct access to Mathis Avenue. These include gas station/convenience stores on the east side of Mathis Avenue and south of Manassas Drive, as well as auto shops and offices, and fast food and sit-down restaurants. The Parkside Middle School is on the west side of Mathis Avenue between Hardees Drive and Breeden Avenue.

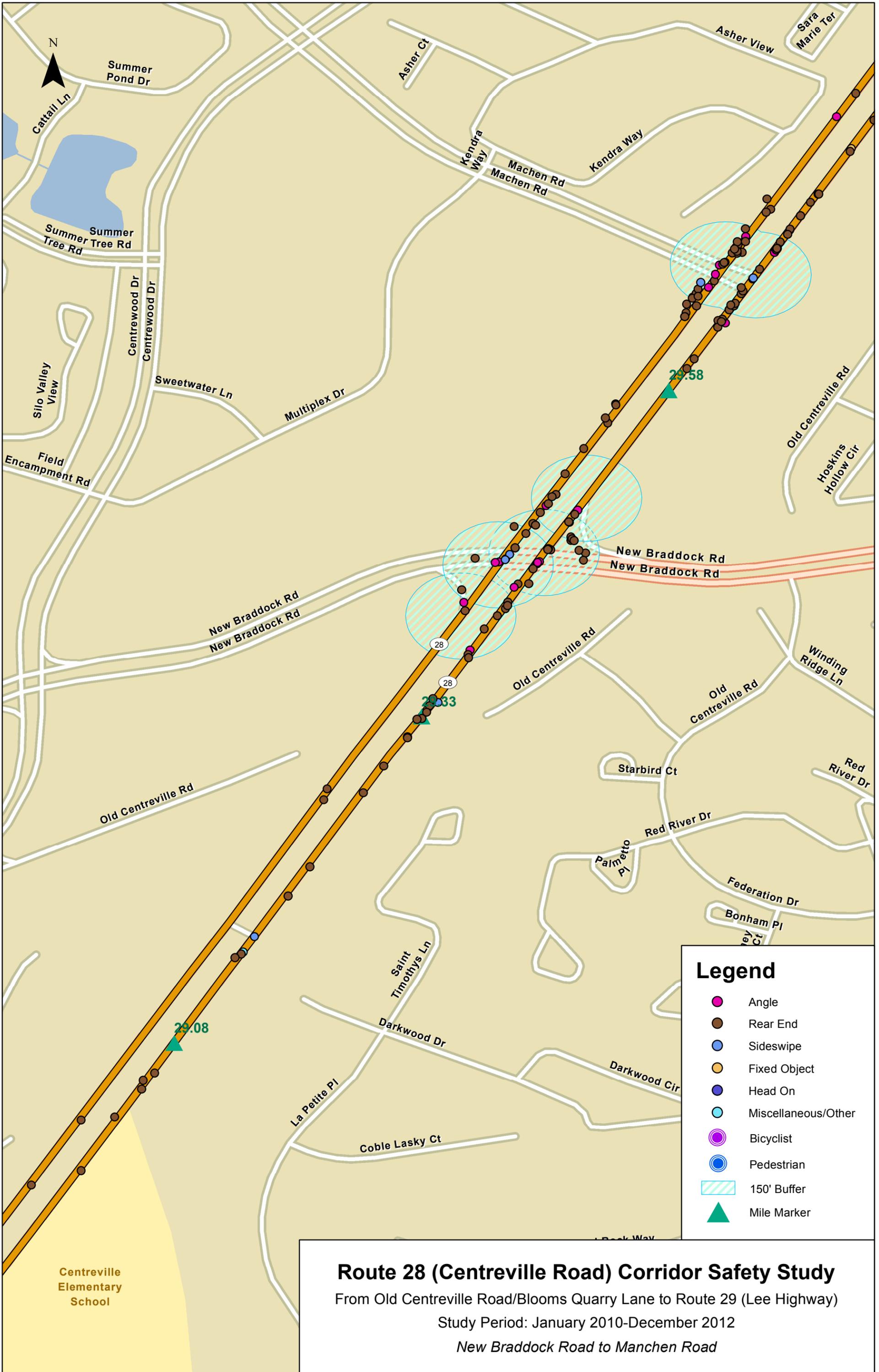
According to the VDOT crash database, one pedestrian crash was reported on Mathis Avenue adjacent to the Kincheloe Drive intersection when a vehicle slowing down in traffic struck a pedestrian that walked in front of the vehicle.

The following pedestrian facilities are identified along Mathis Avenue:

- Sidewalks extend on both sides of Route 28 from Manassas Drive to Liberia Avenue.
- At the Manassas Drive intersection, crosswalks are on the east and south legs with pedestrian signals and pushbuttons.
- At the Conner Drive intersection, a high visibility, laddered crosswalk is on the south leg. “School children crossing here” (S1-1) signs combined with a diagonal downward arrow plaque (W16-7P) are installed at the crosswalk on both sides of Mathis Avenue. The “school children crossing ahead” (S1-1) warning signs are also installed in advance of the crosswalk.
- At the Breeden Drive intersection, high visibility, laddered crosswalks are provided on all four legs with pedestrian signals and push buttons.
- At the Liberia Avenue intersection, high visibility, laddered crosswalks are on all four legs with pedestrian signals and push buttons on all four corners.
- There are no separate bicycle lanes along Mathis Avenue.

A detailed map showing existing pedestrian and bicycle facilities is provided in Appendix A of this report.



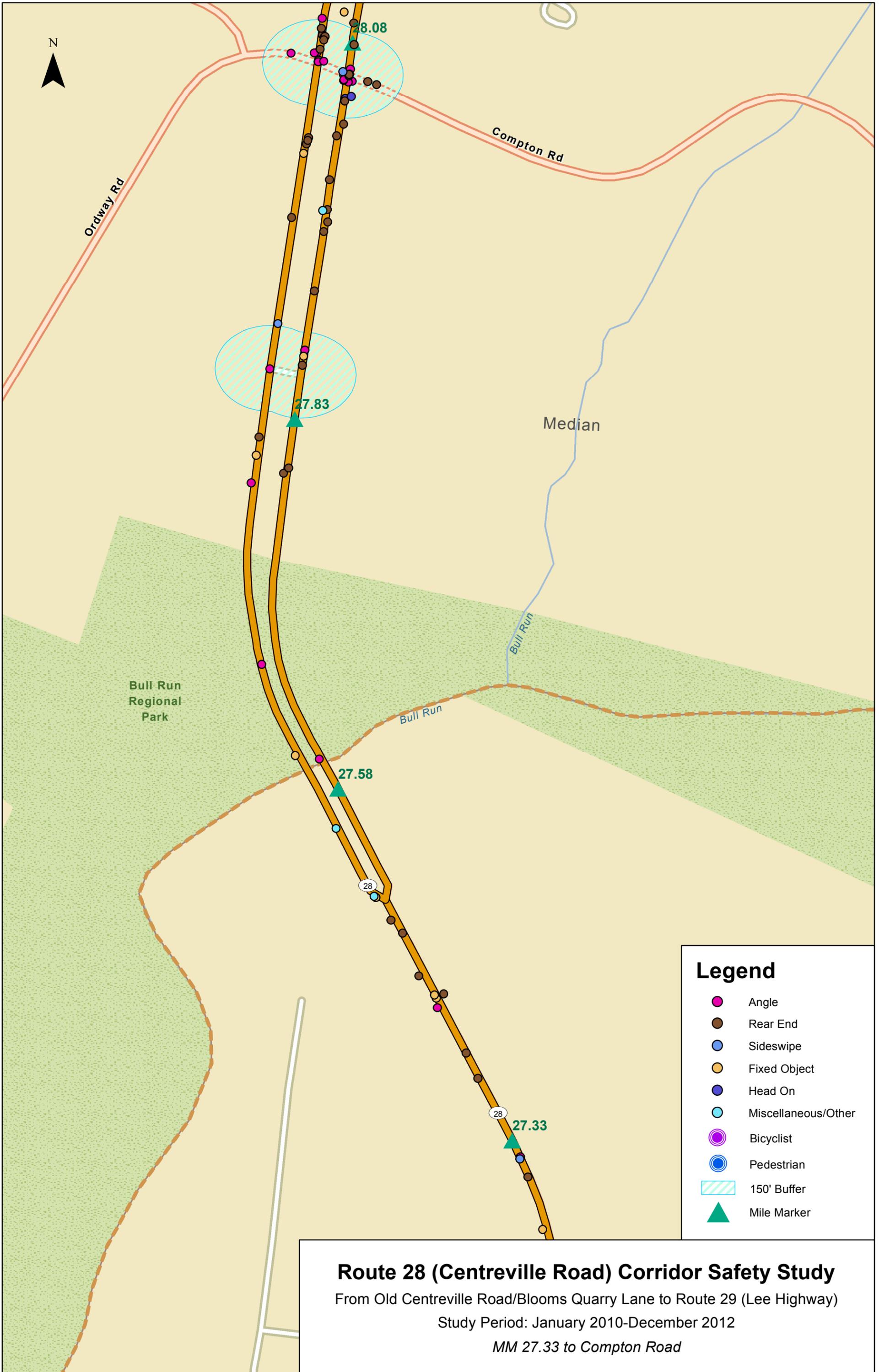


Route 28 (Centreville Road) Corridor Safety Study

From Old Centreville Road/Blooms Quarry Lane to Route 29 (Lee Highway)

Study Period: January 2010-December 2012

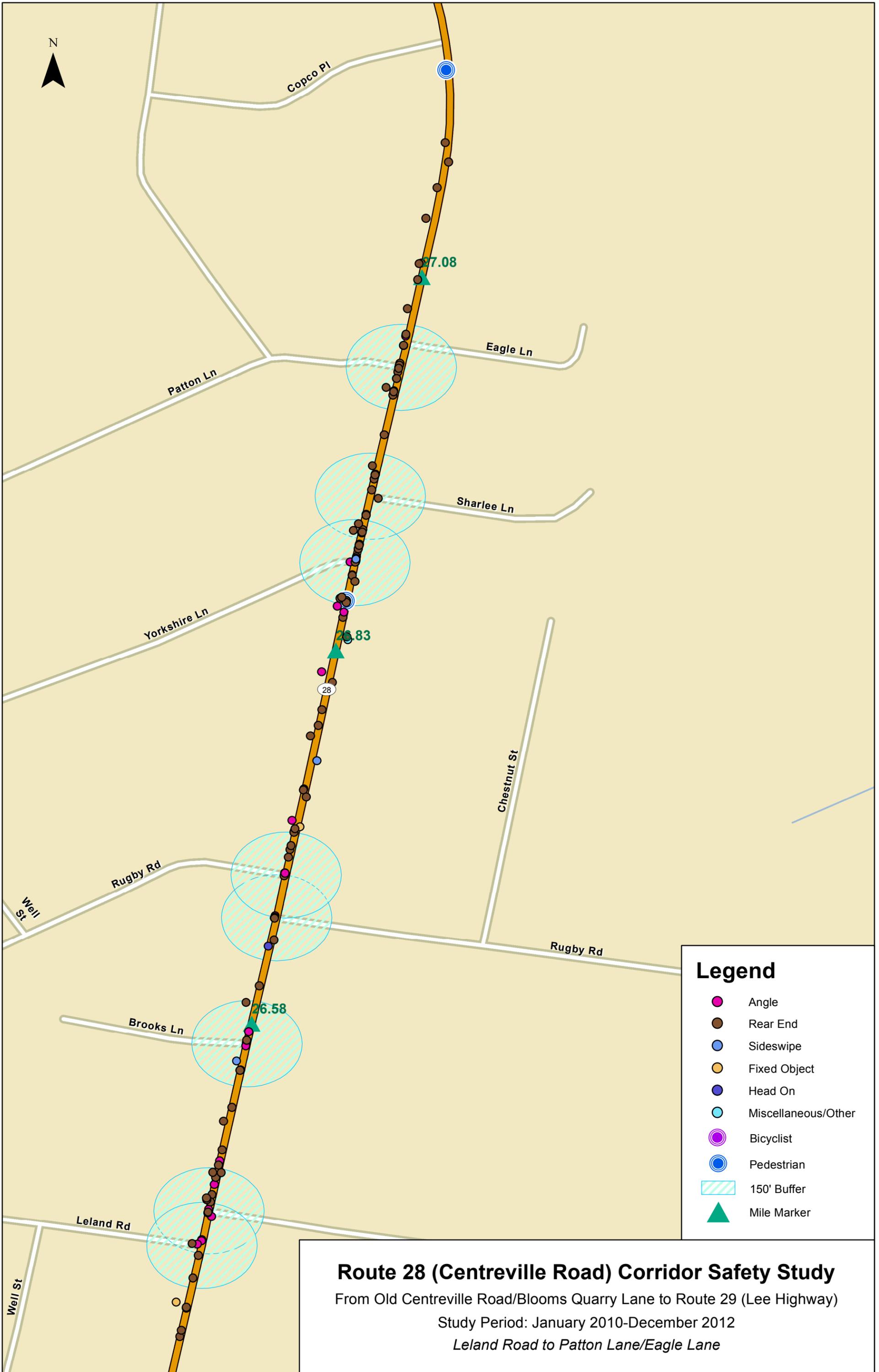
New Braddock Road to Manchen Road



Legend

- Angle
- Rear End
- Sideswipe
- Fixed Object
- Head On
- Miscellaneous/Other
- Bicyclist
- Pedestrian
- 150' Buffer
- ▲ Mile Marker

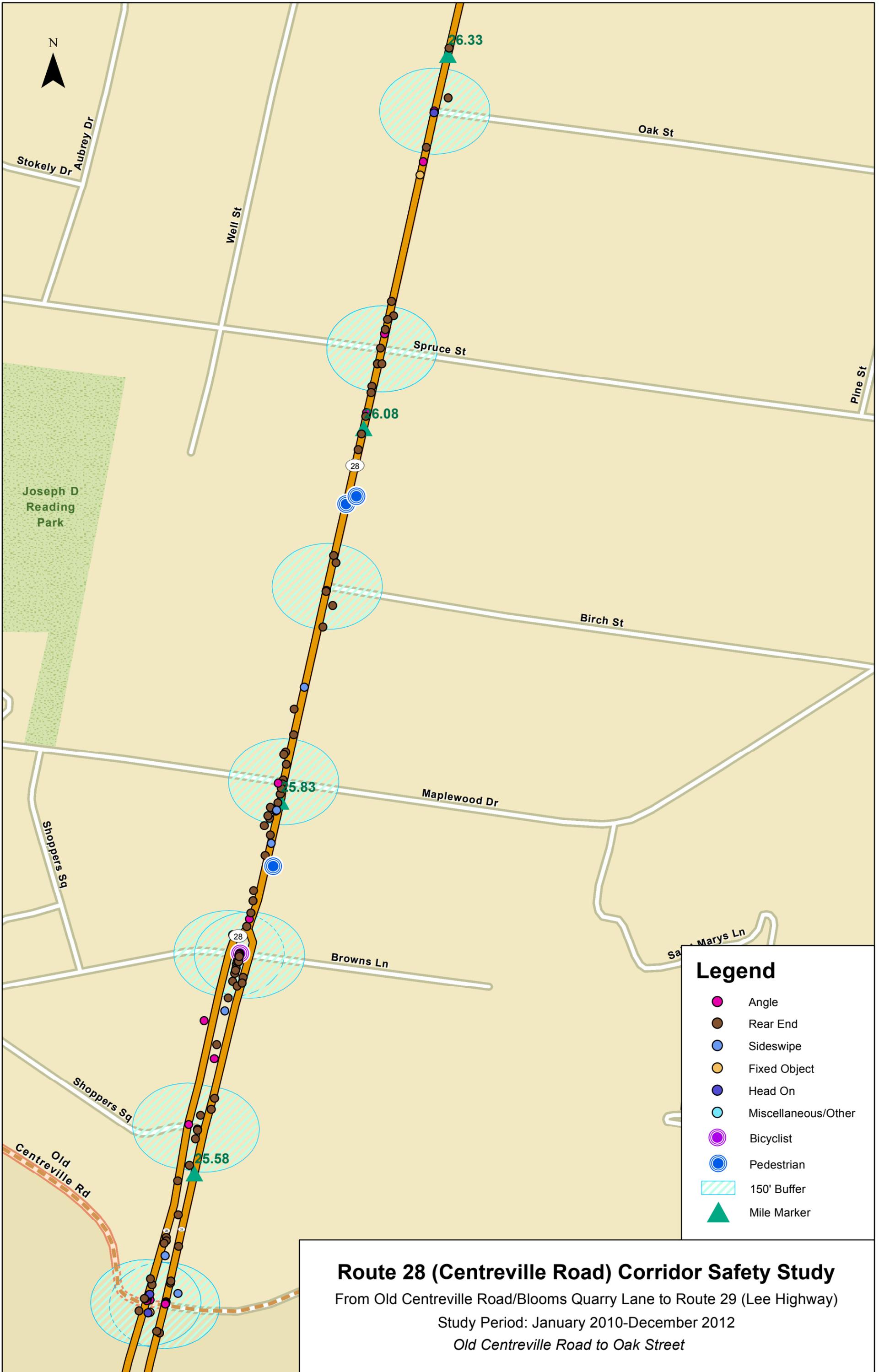
Route 28 (Centreville Road) Corridor Safety Study
 From Old Centreville Road/Blooms Quarry Lane to Route 29 (Lee Highway)
 Study Period: January 2010-December 2012
MM 27.33 to Compton Road

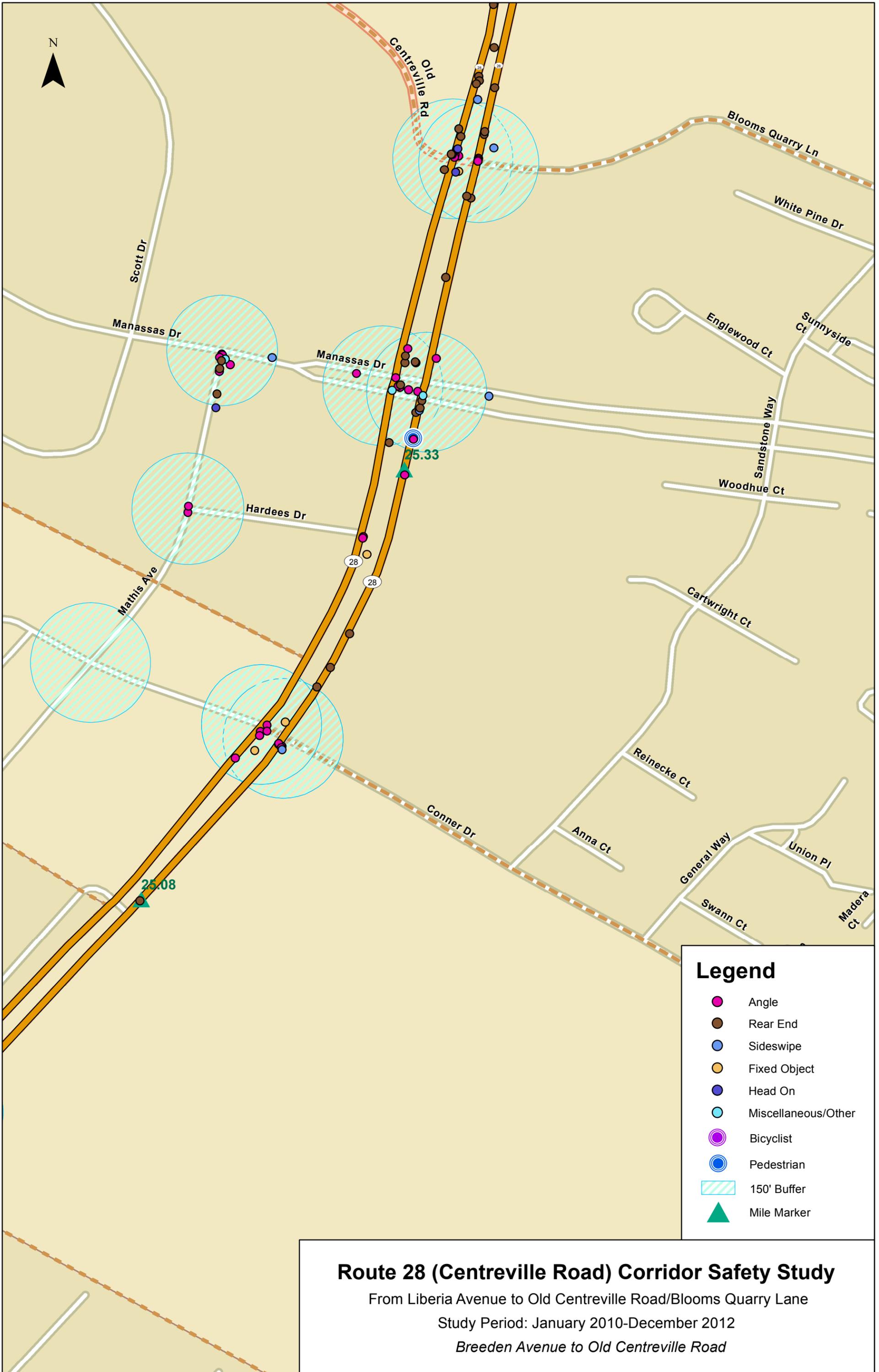


Legend

- Angle
- Rear End
- Sideswipe
- Fixed Object
- Head On
- Miscellaneous/Other
- ⊙ Bicyclist
- ⊙ Pedestrian
- 150' Buffer
- ▲ Mile Marker

Route 28 (Centreville Road) Corridor Safety Study
 From Old Centreville Road/Blooms Quarry Lane to Route 29 (Lee Highway)
 Study Period: January 2010-December 2012
Leland Road to Patton Lane/Eagle Lane





N

Old Centreville Rd

Blooms Quarry Ln

White Pine Dr

Scott Dr

Manassas Dr

Manassas Dr

Englewood Ct

Sunnyside Ct

Hardees Dr

Woodhue Ct

Mathis Ave

28

28

Cartwright Ct

Reinecke Ct

Conner Dr

Anna Ct

General Way

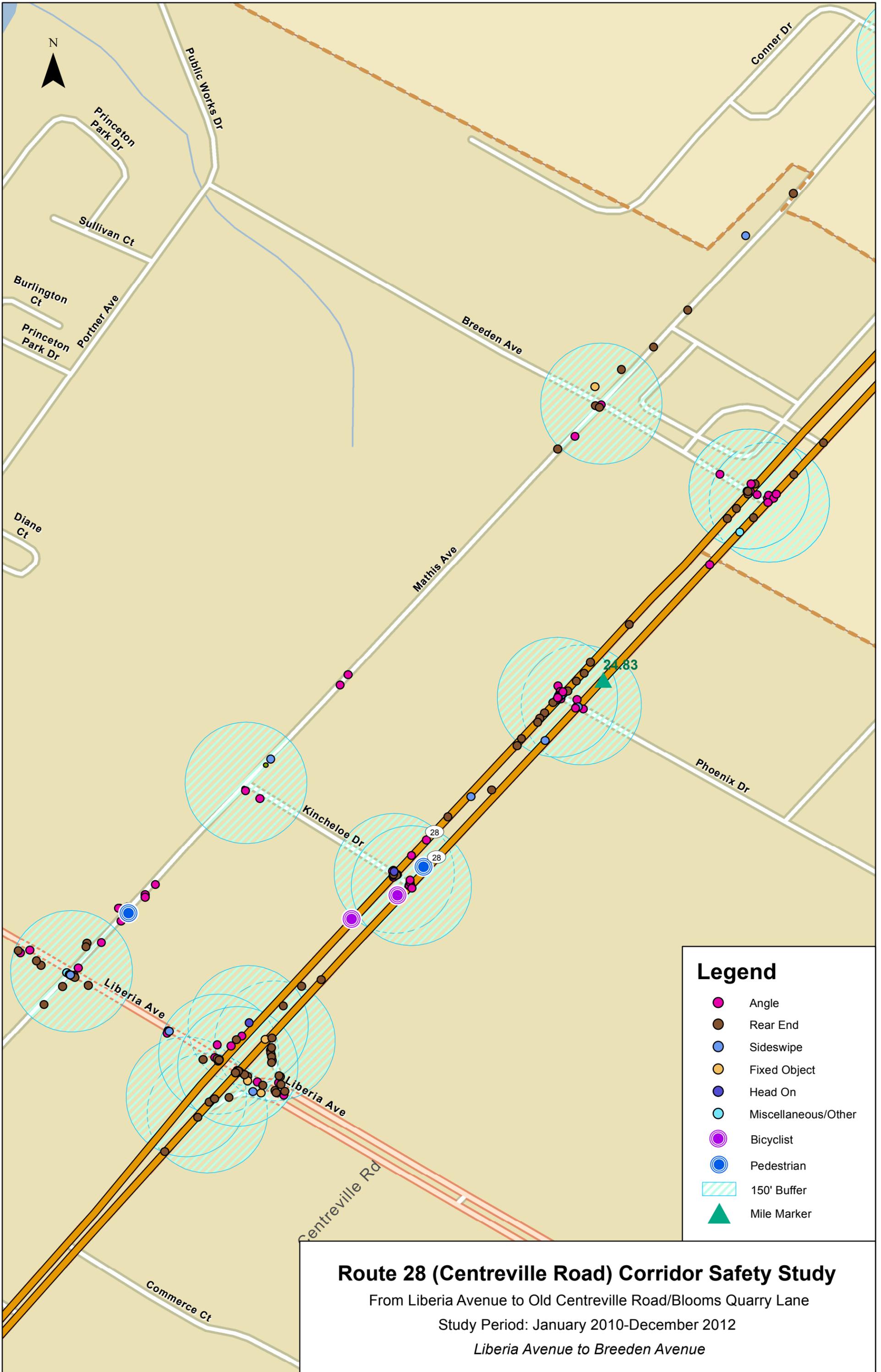
Union Pl

25.08

Swann Ct

Madera Ct

25.33



N

Princeton Park Dr

Public Works Dr

Comer Dr

Sullivan Ct

Burlington Ct

Portner Ave

Breeden Ave

Princeton Park Dr

Diane Ct

Mathis Ave

24.83

Phoenix Dr

Kincheloe Dr

Liberia Ave

Centreville Rd

Liberia Ave

Commerce Ct

Crash Statistics - Route28 from Old Centreville Rd/Bloos Quarry Ln to Route 29 Ramps (January 01, 2010 to December 31, 2012)

Location	Crash Type										Crash Severity						Time of the Day						Lighting Conditions						Surface Conditions					
	Angle	Rear End	Sideswipe	Fixed Object	Head On	Pedestrian	Bicyclist	Miscellaneous/Other	Crash Totals	Property Damage Only	Injury	Injury Count	Fatality	Fatalities	Injuries and Fatalities	AM Peak	PM Peak	Off Peak	Not Stated	Darkness - Hwy Lighted	Darkness - Hwy not Lighted	Dawn	Daylight	Dusk	Not Stated	Dry	Snowy	Wet	Other					
Intersection of Old Centreville Road and Route 28	12	9	1	1	2	0	0	0	25	11	14	18	0	0	18	9	4	12	0	8	1	0	16	0	0	23	0	0	2	0				
Seg Between Old Centreville Rd and Shoppers Sq	0	6	1	0	0	0	0	0	7	6	3	3	0	0	3	2	2	3	0	1	0	2	4	0	0	5	0	0	2	0				
Intersection of Shoppers Square and Route 28	2	6	0	0	0	0	0	0	8	5	3	4	0	0	4	1	6	1	0	0	0	7	1	0	0	7	0	0	1	0				
Seg between Shoppers Square and Browns Lane	2	1	1	0	0	0	0	0	4	3	1	2	0	0	2	0	1	3	0	3	0	0	1	0	0	2	0	0	2	0				
Intersection of Browns Lane and Route 28	3	17	0	0	0	0	1	2	23	16	7	9	0	0	9	3	8	12	0	6	0	0	17	0	0	18	0	0	5	0				
Segment between Browns Lane and Maplewood Drive	0	6	1	0	0	1	0	0	8	5	3	2	0	0	2	3	4	1	0	0	0	1	6	1	0	7	0	0	1	0				
Intersection of Maplewood Drive and Route 28	3	14	1	0	1	0	0	3	22	12	10	12	0	0	12	3	9	9	0	3	0	0	19	0	0	22	0	0	0	0				
Segment between Maplewood Dr and Birch St	0	2	1	0	0	0	0	0	3	2	1	1	0	0	1	1	0	2	0	0	0	3	0	0	0	3	0	0	0	0				
Intersection of Birch Street and Route 28	1	5	0	0	0	0	0	0	6	3	3	6	0	0	6	2	2	2	0	1	0	1	4	0	0	5	0	0	1	0				
Segment between Birch St and Spruce St	2	3	0	0	2	0	0	7	3	3	3	2	1	1	3	1	3	3	0	2	0	0	3	2	0	5	0	0	2	0				
Intersection of Spruce Street and Route 28	1	9	1	0	0	0	0	11	6	5	7	0	0	0	7	6	0	5	0	3	0	1	7	0	0	6	0	0	5	0				
Segment between Spruce Street and Oak Street	1	1	0	1	0	0	0	3	2	1	1	1	0	0	1	0	0	3	0	1	2	0	0	0	0	2	0	0	1	0				
Intersection of Oak Street and Route 28	2	2	0	0	1	0	0	5	2	2	3	4	0	0	4	1	1	3	0	1	1	0	3	0	0	5	0	0	0	0				
Segment between Oak Street and Leland Rd	0	5	0	1	0	0	0	6	3	3	3	4	0	0	4	1	3	2	0	1	1	0	4	0	0	4	0	0	2	0				
Intersection of Leland Road and Route 28	6	11	1	1	0	0	0	19	10	9	15	0	0	0	15	2	3	14	0	3	2	1	12	1	0	17	0	0	2	0				
Segment between Leland Road and Brooks Lane	1	4	0	0	0	0	1	6	4	2	2	0	0	0	2	0	4	2	0	0	0	0	6	0	0	5	0	0	1	0				
Intersection of Brooks Ln and Route 28	2	5	1	0	1	0	0	9	4	5	7	0	0	0	7	1	1	7	0	2	0	0	7	0	0	6	0	0	3	0				
Segment between Brooks Lane and Rugby Rd	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0				
Intersection of Rugby Road and Route 28	7	7	0	0	1	0	0	15	7	8	11	0	0	0	11	2	7	6	0	3	0	1	10	1	0	11	0	0	4	0				
Segment between Rugby Road and Yorkshire Lane	4	10	2	1	0	0	1	18	8	10	13	0	0	0	13	3	6	9	1	0	1	15	0	1	0	15	0	0	2	1				
Int of Yorkshire Lane/Sharlee Lane and Route 28	8	30	1	0	0	1	0	40	19	21	27	0	0	0	27	7	13	20	0	6	5	0	28	1	0	36	0	0	4	0				
Segment between Sharlee Ln and Patton Ln/Eagle Ln	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0				
Int of Patton Lane/Eagle Lane and Route 28	2	13	1	0	0	0	0	16	10	6	9	0	0	0	9	4	4	8	0	3	1	0	12	0	0	15	0	0	1	0				
Seg between Patton Ln and Median MP 27.05-27.08	0	2	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	2	0	0	0	0				
Seg between Patton Ln and Median MP 27.08-27.33	1	8	1	1	0	1	0	12	6	5	6	1	1	1	7	2	5	5	0	0	3	0	9	0	0	10	0	0	2	0				
Seg between Patton Ln and Median MP 27.33-27.58	2	6	0	3	0	0	0	13	8	5	7	0	0	0	7	0	5	8	0	2	3	0	7	1	0	10	1	0	2	0				
Seg between Patton Ln and Median MP 27.58-27.83	3	3	0	3	0	0	0	9	5	4	4	0	0	0	4	2	1	6	0	2	2	0	5	0	0	7	1	0	1	0				
Intersection at Median and Rte 28	2	1	1	1	0	0	0	5	3	2	3	0	0	0	3	1	1	3	0	1	1	0	3	0	0	4	0	0	1	0				
Segment between Median and Compton Road	0	11	0	1	0	0	1	13	9	4	5	0	0	0	5	7	1	5	0	1	3	1	8	0	0	9	0	1	3	0				
Intersection of Compton Road and Route 28	16	15	1	0	2	0	0	34	14	19	35	1	1	1	36	10	10	14	0	8	5	0	21	0	0	30	0	0	4	0				
Segment between Compton Road and Bradenton Drive	1	8	0	2	0	0	0	13	5	8	10	0	0	0	10	3	5	5	0	5	2	2	4	0	0	12	0	0	1	0				
Intersection of Bradenton Drive and Route 28	2	7	0	1	0	0	1	11	7	4	4	0	0	0	4	3	2	6	0	0	2	0	9	0	0	8	0	0	3	0				
Seg between Bradenton Drive and Tallavast Drive	0	4	0	0	0	0	0	5	4	1	1	1	0	0	1	1	2	2	0	2	2	0	1	0	0	4	0	0	1	0				
Intersection of Tallavast Drive and Route 28	0	2	0	0	0	0	0	2	1	1	1	0	0	0	1	0	1	1	0	0	0	2	0	0	0	2	0	0	0	0				
Segment between Tallavast Drive and Old Mill Rd	0	4	0	0	0	0	0	4	2	2	2	0	0	0	2	0	2	2	0	0	0	4	0	0	0	4	0	0	0	0				
Intersection of Old Mill Road and Route 28	11	20	2	0	1	0	0	37	23	14	22	0	0	0	22	3	13	20	0	9	2	0	26	0	0	29	0	0	7	1				
Seg Old Mill Rd - New Braddock Rd MP 28.78-28.83	0	4	0	0	0	0	0	4	1	3	4	0	0	0	4	2	1	1	0	1	0	1	2	0	0	2	0	0	2	0				
Seg Old Mill Rd - New Braddock Rd MP 28.83-29.08	0	11	0	0	0	0	1	12	8	4	7	0	0	0	7	2	3	7	0	2	0	10	0	0	0	11	0	0	1	0				
Seg Old Mill Rd - New Braddock Rd MP 29.08-29.33	0	12	1	0	0	0	0	15	8	7	8	0	0	0	8	4	4	7	0	2	1	0	12	0	0	14	0	0	1	0				
Seg Old Mill Rd - New Braddock Rd MP 29.33-29.37	0	3	1	0	0	0	0	4	3	1	2	0	0	0	2	2	1	1	0	0	0	4	0	0	0	3	0	0	1	0				
Intersection of New Braddock Road and Route 28	10	40	2	0	0	0	0	52	32	20	25	0	0	0	25	8	14	30	0	9	6	0	34	3	0	45	0	0	7	0				
Segment between New Braddock Road and Machlen Rd	1	15	1	0	0	0	0	17	11	6	10	0	0	0	10	0	6	11	0	3	0	0	13	1	0	16	0	0	1	0				
Intersection of Machen Rd and Route 28	8	33	2	1	0	0	1	45	28	17	25	0	0	0	25	5	14	26	1	14	1	27	1	1	1	36	0	0	9	0				
Segment between Machen Road and Upperridge Drive	3	17	0	1	0	0	0	21	12	9	11	0	0	0	11	2	7	11	0	3	3	0	15	0	0	20	0	0	1	0				
Intersection of Upperridge Drive and Route 28	9	12	1	0	0	0	1	23	17	6	7	0	0	0	7	2	5	16	0	4	1	0	18	0	0	17	0	0	6	0				
Segment between Upperridge Dr and Route 29	1	4	0	0	1	0	0	6	3	3	5	0	0	0	5	0	0	6	0	2	0	0	4	0	0	4	0	0	2	0				
Intersection of Route 29 and Route 28	0	3	2	0	0	0	0	5	3	2	3	0	0	0	3	2	0	2	0	2	0	2	0	0	0	4	0	0	1	0				
TOTAL:	129	413	28	19	10	5	21	627	358	266	366	3	3	369	115	184	325	3	119	51	13	428	13	3	523	2	1	99	2					

Crash Statistics - Route 28 from Liberia Ave. to Old Centreville Rd. (January 01, 2010 to December 31, 2012)																																
Location	Crash Type										Crash Severity						Time of Day					Lighting Conditions					Surface Conditions					
	Angle	Rear End	Sideswipe	Fixed Object	Head On	Pedestrian	Bicyclist	Miscellaneous/Other	Crash Totals	Property Damage Only	Injury	Injury Count	Fatality	Fatalities	Injuries and Fatalities	AM Peak	PM Peak	Off Peak	Darkness - Street or Highway Lighted	Darkness - Street or Highway not Lighted	Dawn	Daylight	Dusk	Not Stated	Dry	Wet	Snowy	Icy	Oil/Other	Other		
Intersection of Liberia Ave and Route 28	15	54	3	4	1	0	0	2	79	35	44	67	0	0	67	14	17	48	23	0	2	50	3	1	59	1	1	1	17	1	0	
Segment between Liberia Ave and Kincheloe Drive	0	1	0	0	0	0	1	2	1	1	0	0	0	0	0	0	0	2	0	0	0	2	0	0	1	0	0	1	0	0	0	
Intersection of Kincheloe Dr and Route 28	22	3	0	0	1	1	2	29	14	15	23	0	0	23	6	7	16	6	1	2	19	1	0	25	0	0	3	0	1	0	1	
Segment between Kincheloe Dr and Phoenix Dr	0	3	1	0	0	0	0	4	3	1	2	0	0	2	0	1	3	1	0	0	3	0	0	2	0	0	2	0	0	0	0	
Intersection of Phoenix Dr and Route 28	19	12	3	0	0	0	1	35	13	22	34	0	0	34	4	10	21	6	0	0	29	0	0	30	0	0	5	0	0	0	0	
Segment between Phoenix Dr and Breeden Ave	1	1	0	0	0	0	0	2	1	1	1	0	0	1	1	0	1	1	0	0	1	0	0	1	0	0	1	0	0	0	0	
Intersection of Breeden Ave and Route 28	16	7	0	0	0	0	1	24	15	9	13	0	0	13	7	10	7	4	1	0	18	1	0	18	0	0	6	0	0	0	0	
Segment between Breeden Avenue and Conner Drive	0	2	0	0	0	0	0	2	1	1	1	0	0	1	0	2	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0
Intersection of Conner Drive and Route 28	10	1	1	2	0	0	0	14	10	4	4	0	0	4	5	3	6	1	0	0	13	0	0	13	0	0	1	0	0	0	0	
Segment Between Conner Drive and Manassas Dr	3	3	1	1	0	0	0	8	6	2	5	0	0	5	1	0	7	5	0	0	3	0	0	7	0	0	1	0	0	0	0	
Intersection of Manassas Drive and Route 28	9	9	2	0	0	1	2	23	16	7	11	0	0	11	2	3	18	8	0	1	12	2	0	19	0	0	4	0	0	0	0	
Segment between Manassas Dr and Old Centreville Rd	0	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	
TOTAL:	95	97	11	7	2	2	7	223	116	107	161	0	0	161	41	53	129	55	2	5	153	7	1	178	1	1	1	41	1	1	1	

Crash Statistics - Mathis Ave. from Manassas Drive to Liberia Avenue (January 01, 2010 to December 31, 2012)																								
Location	Crash Type										Crash Severity					Time of Day			Lighting		Surface Cond.			
	Angle	Rear End	Sideswipe	Fixed Object	Head On	Pedestrian	Bicyclist	Miscellaneous/ Other	Non-Collision	Crash Totals	Property Damage Only	Injury	Injury Count	Fatality	Fatalities	Injuries and Fatalities	AM Peak	PM Peak	Off Peak	Daylight	Darkness - Street or Highway Lighted	Dusk	Dry	Wet
Intersection of Liberia Ave. and Mathis Ave	13	13	1	0	0	0	1	0	28	6	22	32	0	0	32	9	10	12	24	4	0	0	21	7
Segment between Liberia Ave and Kincheloe Dr	8	0	0	0	1	0	0	0	9	5	4	5	0	0	5	0	5	4	8	1	0	9	0	
Intersection of Kincheloe Dr and Mathis Ave	2	0	1	0	0	0	2	1	6	3	2	5	0	0	5	0	2	3	4	0	1	4	1	
Segment between Kincheloe Dr and Breedon Ave	2	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	2	2	0	0	2	0	
Intersection of Breedon Ave and Mathis Ave	3	4	0	0	0	0	0	0	7	2	6	11	0	0	11	1	3	4	7	1	0	5	3	
Segment between Breedon Ave and Conner Dr	0	3	1	0	0	0	0	0	4	2	2	2	0	0	2	1	0	3	3	1	0	4	0	
Intersection of Conner Dr and Mathis Ave	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Segment between Hardees Dr and Conner Dr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Intersection of Mathis Ave and Hardees Dr	2	0	0	0	0	0	0	0	2	0	2	3	0	0	3	0	0	2	2	0	0	1	1	
Segment between Manassas Dr and Hardees Dr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Intersection of Manassas Dr and Mathis Ave	5	3	1	0	1	0	1	0	11	5	6	5	0	0	5	1	6	4	8	3	0	9	2	
Total	35	23	4	0	1	1	4	1	69	25	44	63	0	0	63	9	26	34	58	10	1	55	14	