December 2020

DRAFT TECHNICAL REPORT

DAVIS DRIVE VEHICULAR AND PEDESTRIAN SAFETY STUDY

Between West Church Road and South Sterling Boulevard

Davis Drive (VA Route 868) in the Sterling and Broad Run Election Districts

Submitted to:

Loudoun County

Department of Transportation

& Capital Infrastructure

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EXECUTIVE SUMMARY

JMT conducted a Traffic Study in 2018 to address safety concerns at the intersection of Davis Drive (Route 868) and Tippett Hill Drive intersection raised by the Old Sterling Gable community. The identified safety issues were speeding, sight distance and parking issues. The previous study area includes:

- Davis Drive between Tippett Hill and Belfort Park Drive
- Tippett Hill Drive between Davis Drive and Glenn Drive
- Glenn Drive between Tippett Hill Drive and Saynamkhan Court

To address additional concerns raised during the September 2019 Loudoun County Board of Supervisors Business Meeting, the Board directed the County staff to expand the original study to incorporate concerns from business owners and residents regarding the Davis Drive corridor and surrounding roadways that were not incorporated in the original study, including:

1. Southbound vehicle queues on Davis Drive extending across and blocking the ingress/egress of the business center located at the northwest quadrant of the Davis Drive/South Sterling Boulevard (Route 846) intersection.
2. Left turning vehicular movements in and out of the business center located at the northwest quadrant of the Davis Drive/South Sterling Boulevard intersection, causing safety issues.
3. Safety concerns at Belfort Park Drive and Glenn Drive intersection. The intersection currently operates with Belfort Park Drive stop-controlled and Glenn Drive in free flow.
4. Pedestrian safety concerns along Davis Drive.
5. Lack of pedestrian connectivity from the Shaw Road/Belfort Park Drive intersection to Lindsay Cars Court

Accordingly, JMT conducted a Traffic Safety Study on Davis Drive corridor. The segment is 1.04-mile long between West Church Road and South Sterling Boulevard. The study area also included other roadways; Glenn Drive (Route 775/864), Belfort Park Drive (Route 634), Shaw Road (Route 636), Tippett Hill Drive, First Potomac Way, and Shepard Drive (Route 867). The study area includes a total of 10 intersections. The 10 study intersections consist of two signalized intersections (#1 and #2) and eight unsignalized (stop-controlled) intersections (#3-#10) from the following list:

1. Davis Drive and West Church Road.
2. Davis Drive and South Sterling Boulevard.
3. Davis Drive and Tippett Hill Drive/Bluemont Junction Square.
4. Davis Drive and Belfort Park Drive.
5. Davis Drive and US Customs and Border Protection (CBP) Entrance.
6. Davis Drive and First Potomac Way.
7. Davis Drive and Shepard Drive.
8. Tippett Hill Drive at Glenn Drive.
9. Belfort Park Drive and Glenn Drive.
10. Shaw Road and Belfort Park Drive.

Traffic data was collected from 5:00 AM to 8:00 PM at the 10 study intersections on Wednesday, January 22, 2020. Traffic operations were normal, and schools were in session at the time of the data collection activities. The AM and PM peak hours for the network used for the analysis were 7:45 AM to 8:45 AM, and 4:45 PM to 5:45 PM, respectively. Speed data was also collected on Davis Drive for a 24-hour period. Based on the collected data, the average 85th percentile speeds along Davis Drive was 42 MPH and 44 MPH (2-4 MPH above speed limit) in the southbound and northbound direction, respectively.

Crash data along Davis Drive was summarized and analyzed for the study area from January 2016 to August 2019 from VDOT's Tableau Crash Analysis Tool. A total of 96 crashes occurred in the study area, 82 crashes were reported along the 1.04-mile segment of Davis Drive between West Church Road and South Sterling Boulevard. Overall, the predominant crash type was angle representing 59% of all Davis Drive corridor crashes. The second predominant crash type was rear-end representing 26% of the total Davis Drive corridor crashes. A major crash hotspot, Sunoco gas station and Auto Service Centers entrance, was identified relative to other locations along Davis Drive. The entrance is located on the west side of Davis Drive between Shepard Drive and South Sterling Boulevard. The number of crashes at this location represents approximately 33% (27 crashes) of all 82 crashes along Davis Drive corridor. Overall, majority of the crashes occurred between Shepard Drive and South Sterling Boulevard segment, representing 70% (57 crashes) of the total Davis Drive corridor crashes.

Synchro models were developed for the existing traffic operations for the AM and PM peak hours along the Davis Drive corridor study area. Based on the analysis, it was found that during the PM peak hour, both signalized intersections northbound and southbound approaches operate at LOS E or F. For the unsignalized intersections, only Tippett Hill Drive/Bluemont Junction Square operate at LOS E during the PM peak hour.

Future conditions were evaluated for the study area for the years 2030 and 2040 to provide a better understanding of the future needs along the corridor based on the projected traffic volume. No-Build scenarios for 2030 and 2040, were used for comparison with other build alternatives to determine the long-term effectiveness of specific improvements along the study corridor. The following intersections experienced safety and/or operational deficiencies based on the preliminary analysis:

1. Davis Drive and West Church Road.
2. Davis Drive and South Sterling Boulevard.
3. Davis Drive and Tippett Hill Drive/Bluemont Junction Square.
4. Davis Drive and Belfort Park Drive.
5. Davis Drive and First Potomac Way.
6. Davis Drive and Shepard Drive.

Multiple alternatives mitigating the operational and safety deficiencies along Davis Drive were considered and analyzed. To improve safety in the Davis Drive corridor study area, corridor-wide and intersection specific improvements were evaluated and identified for implementation. Davis Drive is recommended to be reduced to a two-lane roadway with a two-way left turn lane (TWLTL) "Road Diet" from Tippett Hill Drive/Bluemont Junction Square to Shepard Drive. An arterial analysis indicated that the Davis Drive corridor will operate at an acceptable LOS D or better in both directions in both 2030 and 2040. In addition, dedicated turn lanes at unsignalized intersections are proposed as indicated in the Turn Lane Warrant analyses. Intersection specific improvements were recommended at six intersections based on their operational and/or safety deficiencies. The proposed improvements at the six intersections along Davis Drive include:

- S Sterling Blvd: Dual-left turn lanes and shared thru/right lanes for the northbound and southbound approaches.
- Shepard Dr: Dedicated left turn lane for the northbound approach and dedicated right turn lane for the southbound approach. In addition, right-in, right-out at the business center and 201 Davis Drive industrial building entrances.
- First Potomac Way: Right-in, right-out, left in for the eastbound approach.
- Belfort Park Dr: Conventional Signal.
- Tippett Hill Dr: Right-in, right-out, left-in for the eastbound approach.
- W. Church Rd: Dual-left turn lanes, a thru lane and a shared thru/right lane for the northbound approach. It is recommended that the Davis Drive and West Church Road intersection to be reevaluated as part of a future corridor study along West Church Road.

Additionally, to be in accordance with the CTP, a 10-foot shared use path on the west side of Davis Drive, and 6-foot sidewalk on the east side is recommended. Also, 5-foot bike lanes are proposed in both directions of Davis Drive.

Other improvements within the study area include:

- Converting the Business Center entrance on Davis Drive, that houses a Sunoco Gas Station, to right-in, right-out.
  - Additional signs are recommended to direct left turning vehicles to use the Shepard Drive access.
- Converting 201 Davis Drive entrance to right-in, right-out.
  - An additional access is proposed on South Sterling Boulevard
- Trimming of vegetation and the removal of trees to mitigate sight distance concerns at the following intersections:
  - Davis Drive and Shepard Drive
  - Davis Drive and First Potomac Way
  - Davis Drive and Overmountain Square
  - Davis Drive and Tippett Hill Drive
- Removal of fences impeding sight distance at the intersection of Davis Drive and Shepard Drive.
- Installation of advance warning signs at intersections/entrances with sight distance issues caused by roadway curvature. The locations include:
  - Davis Drive and Overmountain Square
  - Davis Drive and First Potomac Way

As part of this project, a separate study to evaluate an All Way Stop alternative and a Change Stop Sign Configuration alternative was conducted at the intersection of Belfort Park Drive and Glenn Drive. The All Way Stop alternative was conducted using the criteria outlined in the 2009 Manual on Uniform Traffic Control Devices (MUTCD) with Revisions 1 and 2 incorporated, dated May 2012. Based on the result of the analysis, the All Way Stop alternative is not recommended due to the relatively low existing and projected volumes at the intersection. Switching the stop signs from controlling the Belfort Park Drive approaches to controlling the Glenn Drive approaches of the intersection is recommended to meet driver expectations and to mitigate

the safety concerns for the intersection. Another recommendation along Belfort Park Drive is a road diet; reducing the four-lane roadway to a two-lane roadway. This recommendation is in accordance with the CTP.

A preliminary cost estimate was prepared for the overall improvements in the study area, including the Davis Drive corridor, the Belfort Park Drive and Glenn Drive intersection, Tippett Hill Drive, Shepard Drive, and Shaw Road pedestrian improvements. The estimate includes removal of pavement markings, milling and overlay of the existing pavement, installation of shared-used paths and sidewalks, new pavement markings, new traffic signals, and sign relocations and installations. The estimate also includes construction engineering and inspection (CE&I), engineering design, right-of-way, utilities, maintenance of traffic, and mobilization. The overall estimate is $8,130,000. The estimate was further broken down per location, as indicated below:

- Davis Drive Corridor: $6,982,000
- West Church Road: $31,000
- Tippett Hill Drive: $8,000
- Belfort Park Drive: $320,000
- First Potomac Way: $7,000
- Shepard Drive: $84,000
- Sterling Boulevard: $607,000
- Belfort Park Drive & Glenn Drive: $48,000
- Shaw Road: $52,000

INTRODUCTION

JMT prepared a Traffic Study in May 2018 for the Loudoun County Department of Transportation & Capital Infrastructure (DTCI) that identified and evaluated safety issues and concerns expressed by the Old Sterling Gable community. The studied corridors were; (1) Davis Drive (Route 868) corridor between Tippett Hill Drive (Route 892) and Belfort Park Drive (Route 634), (2) Tippett Hill Drive corridor between Davis Drive and Glenn Drive (Route 775), and (3) Glenn Drive corridor from Tippett Hill Drive to Saynamkhan Court. **Figure 1Error! Reference source not found.** illustrates the studied corridors from the previous study. The entire previous study report is included in **Appendix A**.

As the Davis Drive/Tippett Hill Drive safety study was nearing completion, DTCI was informed by the Sterling District Supervisor's office that there were numerous concerns from business owners and residents regarding the Davis Drive corridor and surrounding roadways that were not incorporated in the original study, including:

1. Southbound vehicle queues on Davis Drive extending across and blocking the ingress/egress of the business center located at the northwest quadrant of the Davis Drive/South Sterling Boulevard (Route 846) intersection.
2. Left turning vehicular movements in and out of the business center located at the northwest quadrant of the Davis Drive/South Sterling Boulevard intersection, causing safety issues.
3. Safety concerns at the Belfort Park Drive/Glenn Drive intersection. The intersection currently operates with Belfort Park Drive stop-controlled and Glenn Drive in free flow, as of September 2020.
4. Pedestrian safety concerns along Davis Drive.
5. Lack of pedestrian connectivity from Shaw Road and Belfort Park Drive intersection to Lindsay Cars Court.

BOARD MEMBER INITIATIVE

During the September 19, 2019 Loudoun County Board of Supervisors Business Meeting, the Board directed the County staff to suspend the December 6, 2016 direction to address the safety concerns at the intersection of Davis Drive/Tippett Hill Drive, and the February 21, 2019 direction to incorporate the Davis Drive/Tippett Hill Drive study with traffic safety analysis at the signalized intersection of Sterling Boulevard/Davis Drive study. The Board of Supervisors then directed The Loudoun County Department of Transportation and Capital Infrastructure (DTCI) to pursue a comprehensive study to address vehicular and pedestrian safety concerns along Davis Drive between West Church Road (Route 625) and South Sterling Boulevard, incorporating the previous Davis Drive/Tippett Hill Drive study, the Belfort Park Drive/Glenn Drive intersection, and the immediate vicinity of the missing sidewalk segment along Lindsay Cars Court (Route 775). As part of this comprehensive study, DTCI requested that JMT evaluate alternatives, including multi-way stop control, at the intersection of Glenn Drive and Belfort Park Drive in order to potentially mitigate crashes and safety concerns at this intersection.

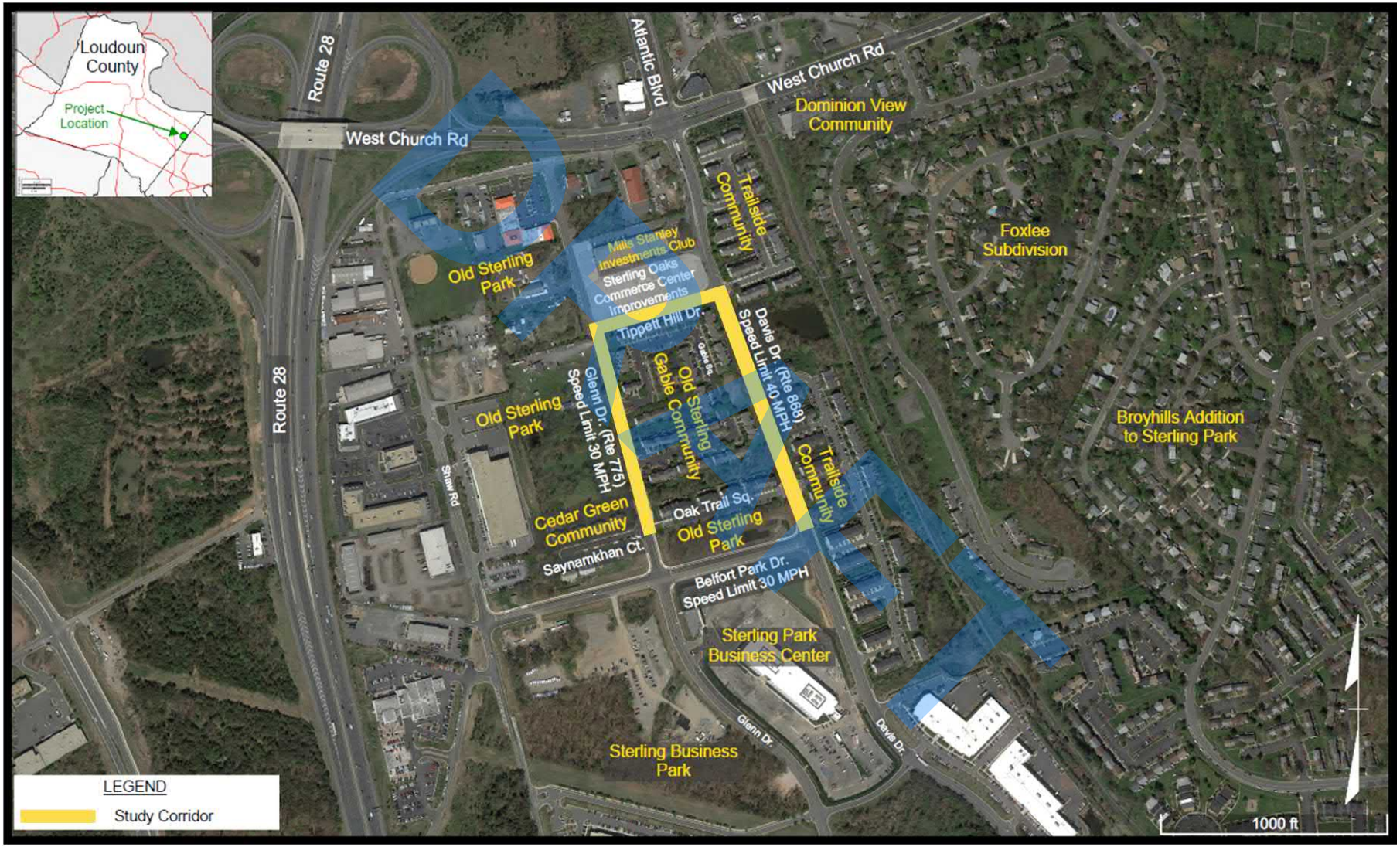


Figure 1: Corridors from Previous Study

EXISTING CONDITIONS

STUDY AREA

Most of the study area is in the Sterling Election District. The study area borders the Broad Run Election District of Loudoun County, Virginia along the southern limit at the intersection of Davis Drive and South Sterling Boulevard. Some of the evaluation components of the study (south leg of Davis Drive at the South Sterling Boulevard intersection) cross the Sterling Election District to the Broad Run Election District. The main study corridor is Davis Drive (Route 868). Other roadways in the study area include Glenn Drive (Route 775/864), Belfort Park Drive (Route 634), Shaw Road (Route 636), Tippett Hill Drive, First Potomac Way, and Shepard Drive (Route 867), as shown in **Figure 2.**

The study area is a mixed-use suburban area with residential, commercial, and industrial facilities. The area north of Belfort Park Drive on Davis Drive and Glenn Drive is residential, with some business centers north of Tippett Hill Drive. The land use south of Belfort Park Drive on Davis Drive and Glenn Drive is predominantly commercial and industrial, which includes the U.S Customs and Border Protection Building, the Sterling Park Business Center, and a Sunoco Gas Station. The Washington and Old Dominion Trail is located along the east side of Davis Drive. The existing zoning map for the study area from County's GIS website is shown in **Figure 3**.

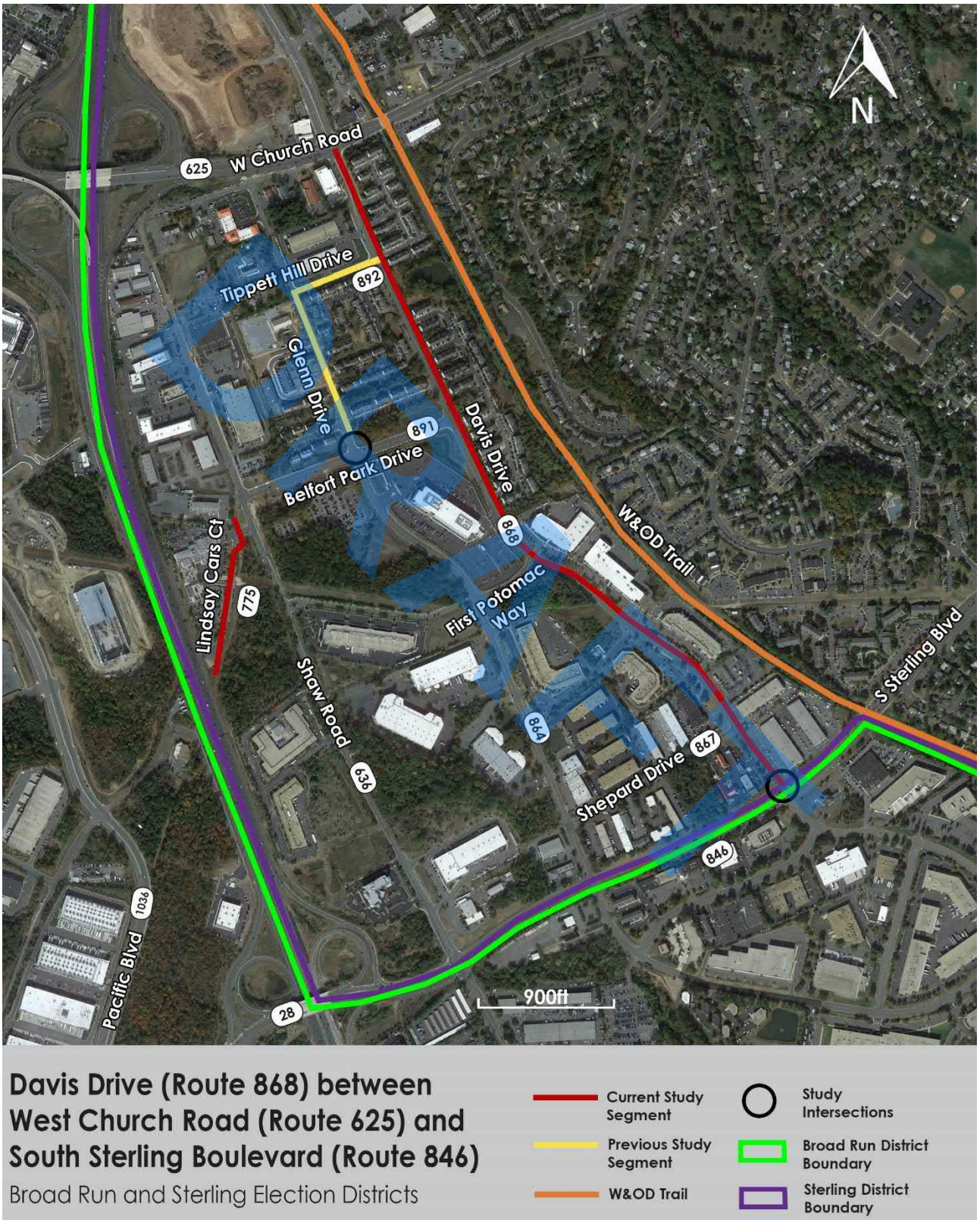
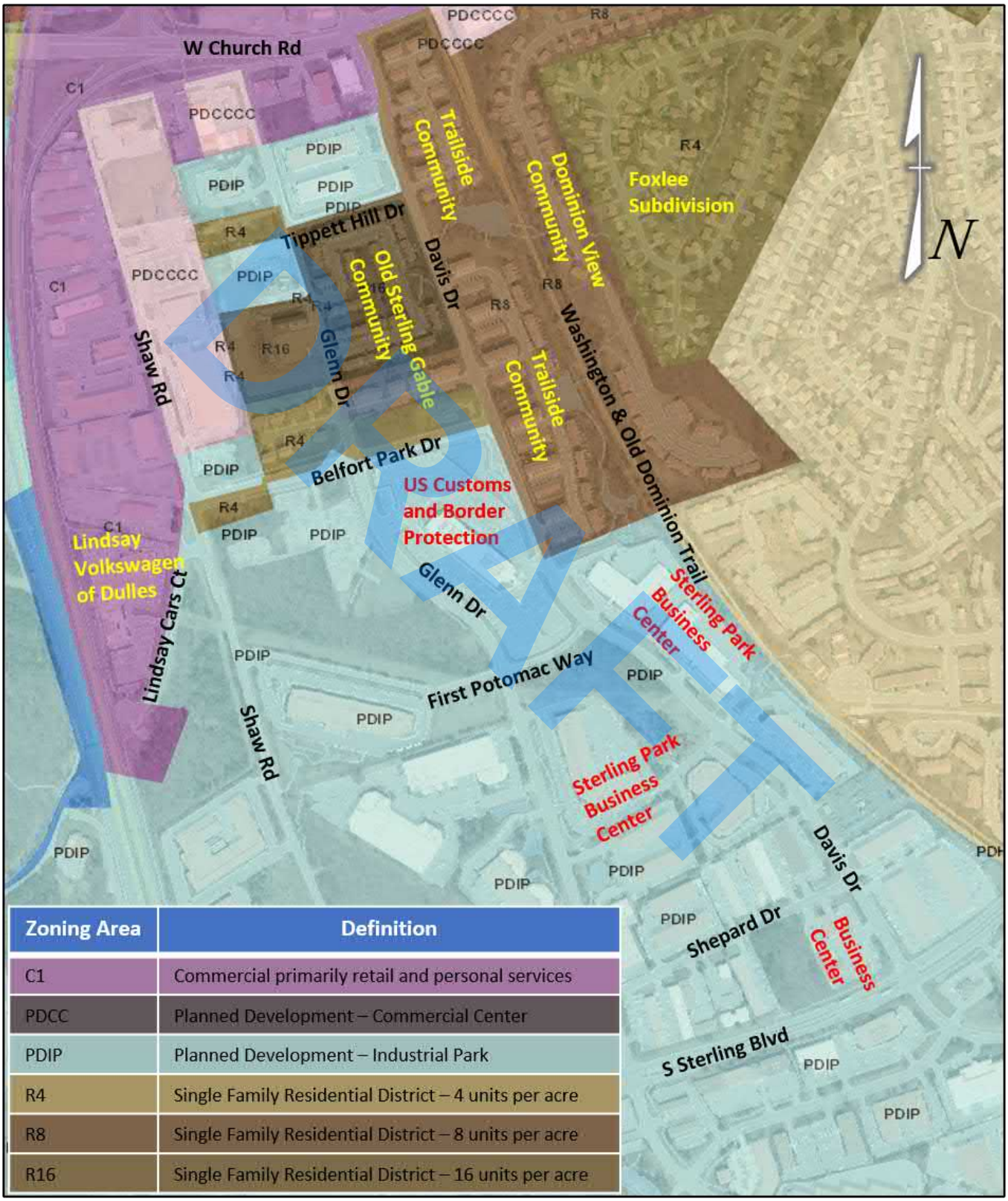


Figure 2: Study Area



Zoning Area	Definition
C1	Commercial primarily retail and personal services
PDCC	Planned Development – Commercial Center
PDIP	Planned Development – Industrial Park
R4	Single Family Residential District – 4 units per acre
R8	Single Family Residential District – 8 units per acre
R16	Single Family Residential District – 16 units per acre

Figure 3: Study Area Existing Zoning Map

ROADWAY CHARACTERISTICS

Davis Drive (Route 868)

Davis Drive within the study area is located in the Sterling District of Loudoun County, and borders the Broad Run District at South Sterling Boulevard. It serves a mixture of residential, industrial, and commercial land uses. Davis Drive is running north-south, 4-lane undivided roadway with curb and gutter on both sides and a posted speed limit of 40 miles per hour (MPH) throughout the study area. The pavement surface is in fair condition with alligator cracking and other age-related deterioration and the pavement markings are in fair to good condition. The roadway is classified as a major collector in the Loudoun County 2019 Countywide Transportation Plan (CTP). The existing lane configuration is in accordance with the ultimate condition in the County's CTP.

According to the 2018 published data from the Virginia Department of Transportation (VDOT), the average annual daily traffic (AADT) is 8,700 vehicles per day (VPD) between Shepard Drive and South Sterling Boulevard in 2014. Recent traffic volume data collected on Wednesday, January 22, 2020 (as part of this study), shows the current AADT is 10,900 VPD between West Church Drive and South Sterling Boulevard.

Tippett Hill Drive

Tippett Hill Drive was known as Shaw Road prior to the Loudoun County Board of Supervisors renaming of the road in July 2012. The roadway is used as an access road from Davis Drive to the Old Sterling Park business area to the west. The Sterling Oaks Commerce Center, located at 22135 and 22149 Davis Drive, shown in **Figure 4**, is relatively a new facility and is not yet at full capacity as of August 2020. This development is accessed along Davis Drive just north of Tippett Hill Drive, and along Tippett Hill Drive, just west of Davis Drive. The project replaced an existing shoulder on the north side of Tippett Hill Drive with curb, gutter, and sidewalk; thereby removing the parallel parking area.

Figure 4: Sterling Oaks Commerce Center

Tippett Hill Drive is an east-west roadway connecting Davis Drive and Glenn Drive. It is a 2-lane undivided roadway with curb and gutter on both sides. The speed limit is not posted; therefore, it is governed by a statutory speed limit of 25 MPH. The westbound lane pavement has been resurfaced by the Sterling Oaks Commerce Center development; therefore, it is in good condition. The eastbound lane pavement is in fair condition. The pavement marking conditions follow the roadway conditions of each direction. There is no

identified roadway classification for Tippett Hill Drive in the CTP. However, Tippett Hill Drive can be categorized as a local road per the definition of a local road in the CTP.

Glenn Drive (Route 775/864)

Glenn Drive runs in the north-south direction parallel to and west of the Davis Drive corridor. The entire Glenn Drive corridor was not analyzed for this study. However, two intersections were analyzed due to resident concerns: specifically, the Tippett Hill Drive and Belfort Park Drive intersections. Glenn Drive is categorized into two separate sections within the study area, and the characteristics of each section is described in the following subsections:

North of Belfort Park Drive

Glenn Drive (Route 775) in this segment is a 2-lane undivided roadway with posted speed limit of 30 MPH that serves the Old Sterling Gable community, the Cedar Green community, and the Old Sterling Park business area. The pavement is in poor condition with pothole patches and longitudinal pavement cracks. The pavement markings have been refreshed with routine maintenance and are in fair condition. A new housing development, Stanley Homes at Dominion Trail, was completed on the west side of Glenn Drive in this segment at the time of preparation of this report. There is no identified roadway classification in the CTP for this section of Glenn Drive, so it is classified as a local road for the purposes of this study.

South of Belfort Park Drive

Glenn Drive (Route 864) in this segment expands to a 4-lane undivided roadway with posted speed limit of 30 MPH and serves the commercial and industrial facilities along the roadway. The pavement and pavement markings are in good condition. The roadway is classified as a neighborhood collector in the CTP. The ultimate lane configuration along this section per the CTP is a 2-lane undivided roadway with on-street bike lanes.

Belfort Park Drive (Route 634)

Belfort Park Drive was constructed in June 2015, runs in the east-west direction parallel to Tippett Hill Drive, and connects Davis Drive to Shaw Road. Belfort Park Drive is a 4-lane undivided roadway with curb and gutter on both sides and has a posted speed limit of 30 MPH. The pavement surface and pavement markings are in good condition. Belfort Park Drive is classified as a minor collector in the CTP. The ultimate lane configuration along Belfort Park Drive per the CTP is a 2-lane undivided roadway, with on-street bike lanes.

First Potomac Way

First Potomac Way is a privately-owned 2-lane undivided, unmarked roadway that runs in the east-west direction connecting Davis Drive to Shaw Road on the south side of the US Customs and Border Protection facility. A speed limit is not posted since it is a private road.

Shepard Drive (Route 867)

Shepard Drive is a 2-lane undivided roadway with curb and gutter on both sides for a majority of its length and the roadway runs in the east-west direction connecting Davis Drive and Glenn Drive. Shepard Drive serves the industrial and commercial facilities in the area. Parking is allowed on both sides of the roadway, except from 11:00 PM to 5:30 AM. A speed limit is not posted so it is governed by a statutory speed limit of 25 MPH. The pavement and pavement markings are in fair condition. There is no identified roadway classification for Shepard Drive in the CTP. Accordingly, it can be categorized as a local road per the definition of a local road in the CTP.

Shaw Road (Route 636)

Shaw Road, from Belfort Park Drive to South Sterling Boulevard, runs in the north-south direction parallel to, and west of, the Glenn Drive corridor. The posted speed limit is 35 MPH, and the roadway serves the industrial and commercial area. Shaw Road varies between a 2-lane undivided and a 3-lane undivided roadway with turn lanes at some intersections. Where the roadway has been improved due to developments, there are curb and gutter sections, otherwise, the roadway has open graded shoulders. The pavement condition varies from good in the improved sections to fair or poor in the unimproved sections. The pavement markings are in good condition.

Shaw Road, from Belfort Park Drive to South Sterling Boulevard, is classified as a minor collector roadway. The existing travel lanes are not in accordance with the ultimate travel lanes in the CTP, which calls for a 4-lane undivided roadway.

Lindsay Cars Court

Lindsay Cars Court is a 2-lane undivided roadway with curb and gutter on the southbound direction, and a posted speed limit of 30 MPH. It mainly serves the Lindsay Volkswagen of Dulles car dealership, and it ends in a cul-de-sac. The southbound direction has a lane assigned for parking. Nevertheless, cars are also parked in the northbound direction. The parked cars on this roadway are assumed to primarily belong to the car dealership and not the general public, because the majority of the cars do not have tags or license plates. The pavement and pavement markings are in good conditions. There is no identified roadway classification for this roadway in the CTP. Accordingly, this roadway can be categorized as a local road per the definition of a local road in the CTP.

SIDEWALK ASSESSMENT

In addition to the sidewalk assessment conducted in the previous Davis Drive/Tippett Hill Drive study along Glenn Drive and Tippett Hill Drive, a sidewalk assessment was conducted along the Davis Drive corridor, Belfort Park Drive, Shaw Road, and Lindsay Cars Court. The existing sidewalks, pedestrian ramp, and crosswalk locations are presented in **Figure 5,** and roadway specific sidewalk details are discussed in the following sections:

Davis Drive Corridor

Although the CTP calls for a shared use path along one side of Davis Drive and a sidewalk along the other, the provision of bicycle and pedestrian facilities along the Davis Drive corridor is piecemeal and has historically been constructed at the discretion of the property developer. A sidewalk assessment was conducted along Davis Drive corridor between South Sterling Boulevard and West Church Road. There are no existing sidewalks along Davis Drive between South Sterling Boulevard and the northern entrance of the East Sterling Park Business center. There is a concrete sidewalk located on the east side of Davis Drive from the northern entrance of the East Sterling Park Business Center to 60 feet north of the entrance. The sidewalk starts from the parking lot of the northern entrance of the East Sterling Park Business Center and continues onto Davis Drive. There is no sidewalk connectivity between the northern entrance of the East Sterling Park Business Center and the upstream intersection at Overmountain Square.

There is an existing concrete sidewalk on the east side of Davis Drive between Overmountain Square and Bluemont Junction Square, and on both sides of Davis Drive between Tippett Hill Drive and West Church Road. The sidewalk widths are presented in the roadway geometry section; however, the sidewalk width is deficient when compared to the 6-foot width sidewalk required in the CTP, except on the west side of Davis Drive, north of Tippett Hill Drive.

There are 37 pedestrian ramps at the intersections and access points along Davis Drive, as shown in **Figure 5**. The ramps are connected to sidewalks at Overmountain Square, Lost Trail Terrace, Great Trail Terrace, and Tippett Hill Drive/Bluemont Junction Square. Other locations are not connected to pedestrian facilities. Below are the locations along Davis Drive with missing ramps (excluding business entrances).

- Northwest and northeast corners of Sterling Boulevard.
- Southeast corner of Shepard Drive.
- All corners of First Potomac Way/Sterling Park Business Center Entrance.
- Northwest corner of Belfort Park Drive.

The pedestrian ramps were not verified to be in compliance with the Americans with Disabilities Act (ADA) of 1990 guidelines. However, it was noted from experience and observations that most are not in compliance. There are marked crosswalks parallel to Davis Drive at the entrances to the residential communities. These crosswalks are located at:

- Clarks Crossing Square.
- Bluemont Junction Square.
- Great Trail Square.
- Lost Trail Terrace.
- Overmountain Square.

There are several areas where ramps are present, but crosswalk markings are not.

Glenn Drive

As part of the previous study, a sidewalk assessment was conducted along Glenn Drive between Tippett Hill Drive and Belfort Park Drive. A concrete sidewalk is present on the east side of Glenn Drive and within the adjacent communities of Old Sterling Gable community. The sidewalks in the area are 5-foot-wide, except for a 4-foot-wide section along Glenn Drive south of Tippett Hill Drive.

There are pedestrian ramps at the intersections and community entrances along this segment of Belfort Park Drive, as shown in **Figure 5**. The ramps were not verified for compliance with ADA guidelines. However, most of the ramps appear not to be in compliance based on experience and observations. There are no sidewalks on Glenn Drive between Belfort Park Drive and South Sterling Boulevard. The CTP calls for a 6-foot sidewalk on both sides of the roadway.

Belfort Park Drive

Sidewalks are located on both sides of the roadway along Belfort Park Drive between Davis Drive and Glenn Drive, and only along the north side of the section between Glenn Drive and Shaw Road. The sidewalk widths are presented in the roadway geometry section. The north side sidewalk along Belfort Park Drive is 5-foot-wide, which is not in compliance with the 6-foot-wide sidewalk called for in the CTP. The CTP also calls for sidewalks on both sides of Belfort Park Drive, however, sidewalk is missing on the southside of Belfort Park Drive between Glenn Drive and Shaw Road.

Shaw Road

There is no sidewalk along Shaw Road between Belfort Park Drive and South Sterling Boulevard. The CTP calls for a shared use path along one side and a sidewalk along the other side of the roadway.

Lindsay Cars Court

There are no existing sidewalks along the roadway. Shaw Road, which intersects with Lindsay Cars Court, also has no sidewalks or crosswalks to provide connectivity from Belfort Park Drive to Lindsay Cars Court. No “goat trail” pedestrian paths were observed during the assessment. There are pedestrian ramps located along the west side of the Lindsay Cars Court lot entrances, as shown in **Figure 5**, however the pedestrian ramps are neither connected to sidewalks nor do they lead to crosswalks. The ramps are oriented to facilitate crossing Lindsay Cars Court.

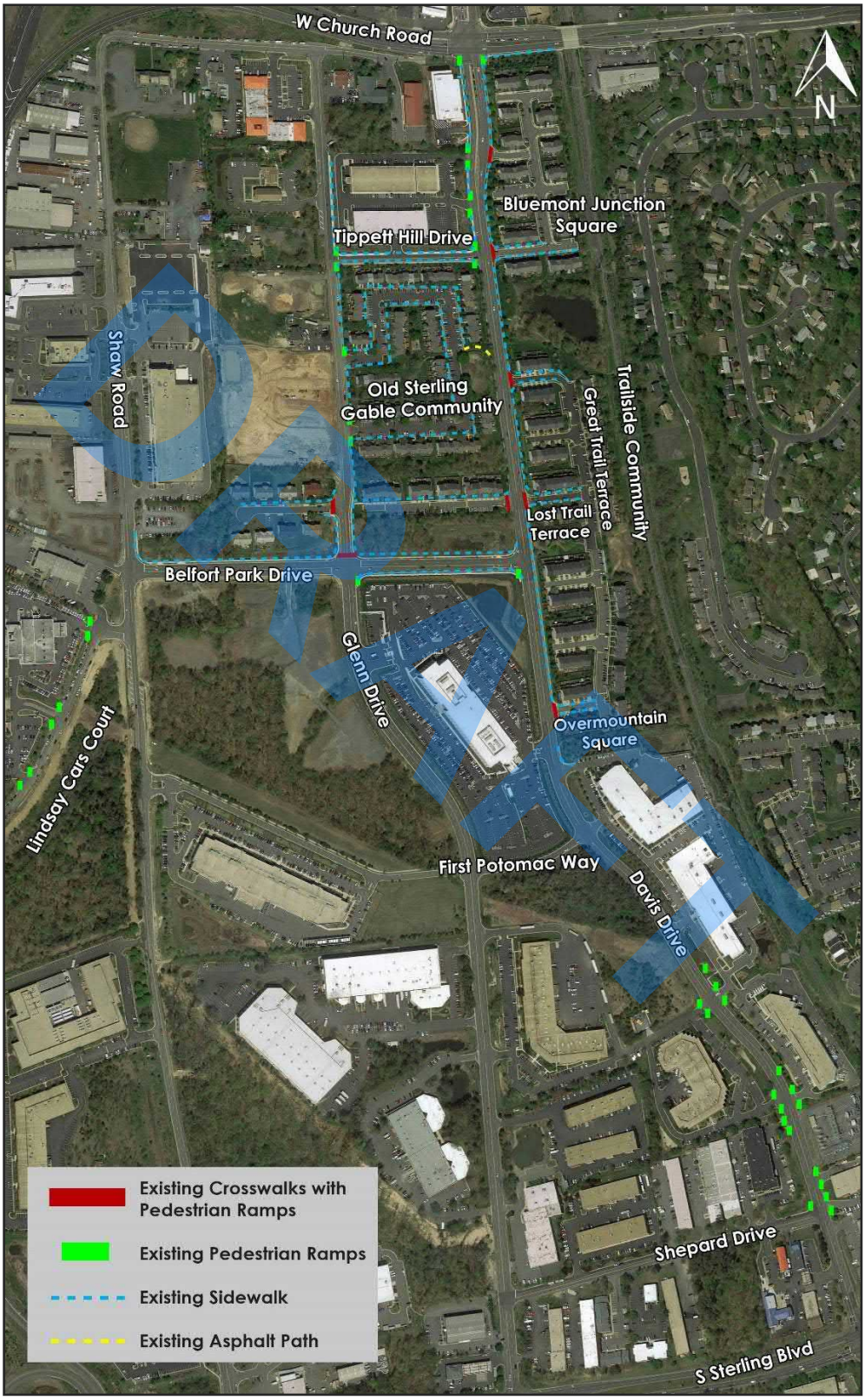


Figure 5: Existing Pedestrian Facilities in the Study Area

ROADWAY GEOMETRY

In addition to the roadway geometry data that was collected on Davis Drive, Tippett Hill Drive, and Glenn Drive on Wednesday, July 26, 2017 for the previous study, roadway data was also collected for the rest of the study area to include the Belfort Park Drive, First Potomac Way, Shepard Drive, Shaw Road, and Lindsay Cars Court corridors. This data was collected on Wednesday, January 22, 2020. The roadway widths were measured from face-of-curb to face-of-curb. Gutter pan, travel lanes, utility strip, sidewalks, and parking lanes if applicable were also measured. **Figure 6** shows the location of the 12 recorded measurements of the roadways, and the cross sections of the roadways are presented in **Figure 7, Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, Figure 13,** and **Figure 14**. None of the figures are drawn to scale.

Figure 6: Roadway Measurement Locations

Figure 7: Tippett Hill Dr. Cross Sections

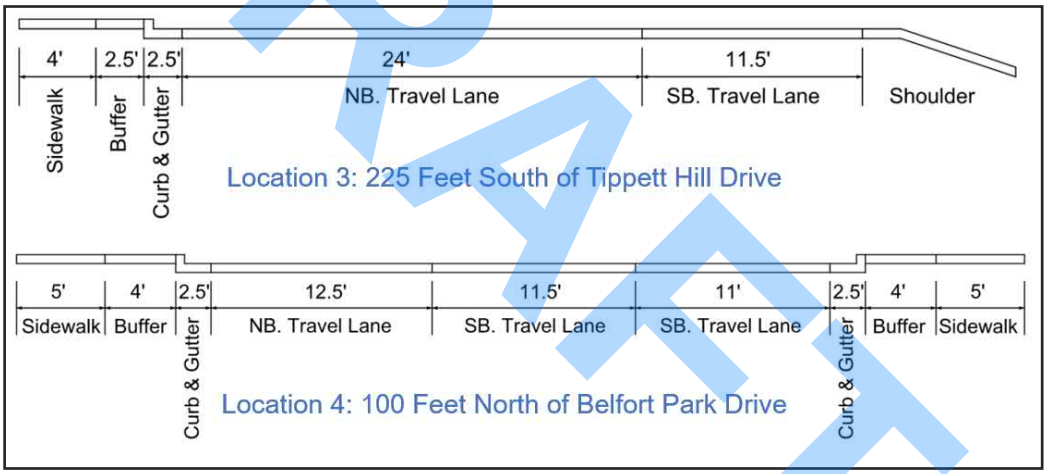


Figure 8: Glenn Dr. Cross Sections

Figure 9: Belfort Park Dr. Cross Sections

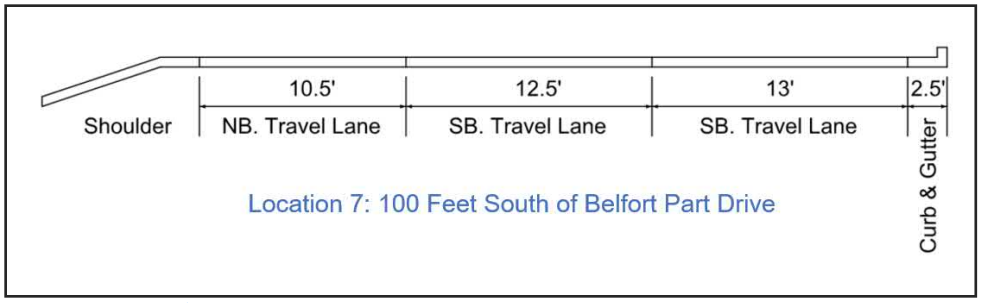


Figure 10: Shaw Rd. Cross Section

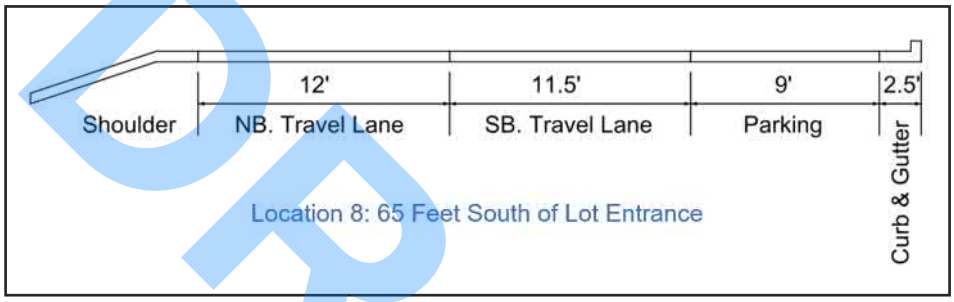


Figure 11: Lindsay Cars Ct. Cross Section

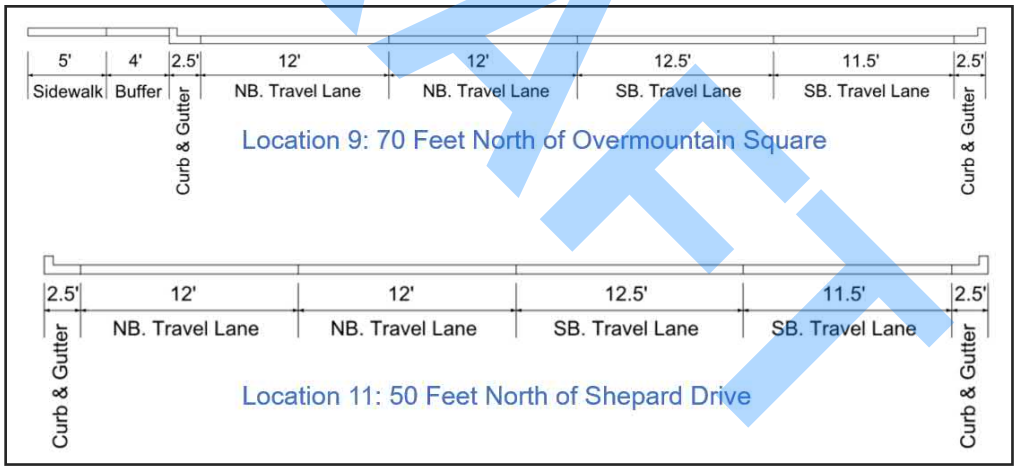


Figure 12: Davis Dr. Cross Sections

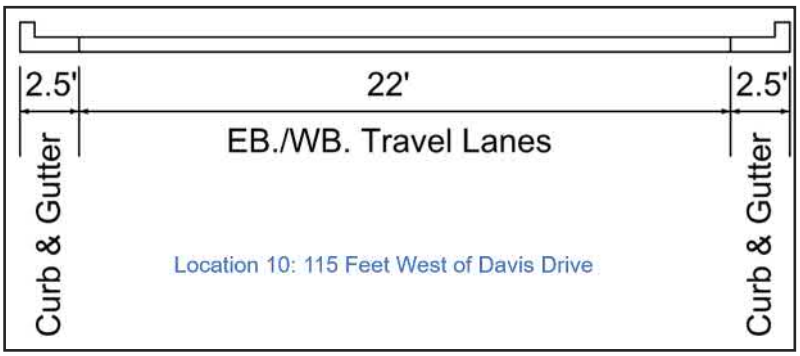


Figure 13: First Potomac Way Cross Section

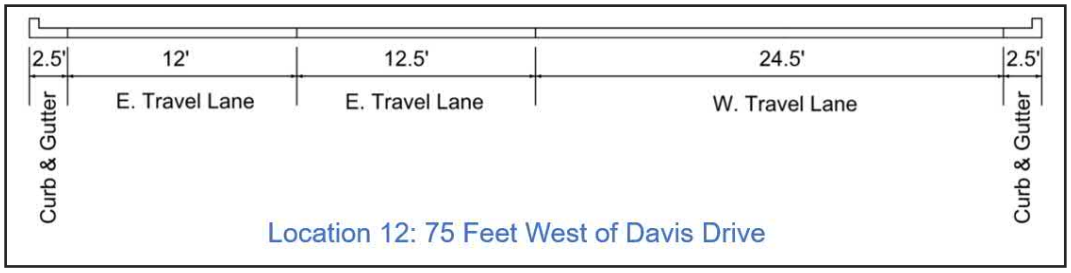


Figure 14: Shepard Dr. Measurement

INTERSECTION SIGHT DISTANCE

According to the VDOT Road Design Manual (RDM), Intersection Sight Distance (ISD) is the sight distance required at entrances and intersections to allow the driver of a stopped vehicle a sufficient view of the intersecting highway to decide when to enter, or cross, the intersecting highway. This distance was determined for each intersection from the following list by measuring the available sight distance, both to the left and the right of the driver, from a stopped vehicle at the stop bar on the minor roadway. The measurements were initially collected from publicly available aerial images and confirmed and verified during the field visit. ISDs were measured at the following intersections:

- Davis Drive and Belfort Park Drive.
- Davis Drive and Overmountain Square Junction.
- Davis Drive and First Potomac Way.
- Davis Drive and Shepard Drive.
- Belfort Park Drive and Glenn Drive.

Table 2-5 in Appendix F of the VDOT RDM was used to determine the required ISD based on the roadway design speed. This table provides the recommended intersection sight distance right (SDR) and recommended intersection sight distance left (SDL). The SDR is the sight distance on the right side of a vehicle stopped at the stop bar to see the vehicle approaching the intersection from the right side to proceed with a left turn maneuver. The SDL is the sight distance on the left side of a vehicle stopped at the stop bar to see the vehicle approaching the intersection from the left side for the stopped vehicle to complete a left or right turn. The SDL and SDR are illustrated in **Figure 15**. The design speed is assumed to be 5 mph over the posted speed limit, per the VDOT RDM.

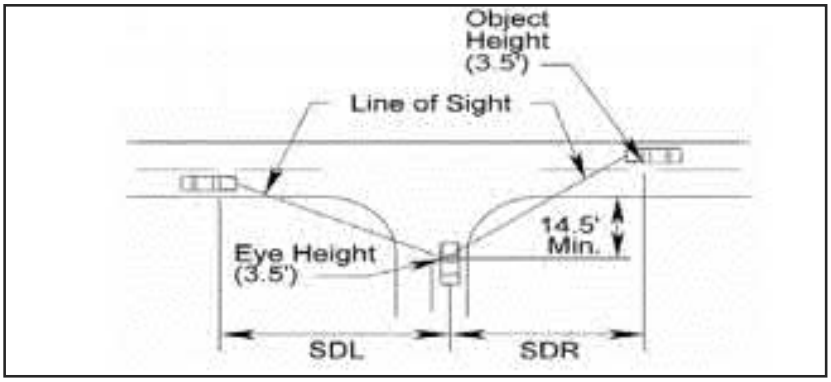


Figure 15: Intersection Sight Distance (Source: VDOT RDM)

Davis Drive and Tippett Hill Drive

The intersection of Davis Drive and Tippett Hill Drive currently operates as a two-way stop-controlled intersection, with stop signs on the Tippett Hill Drive/Bluemont Junction Square approaches. From the previous study, the required SDR is 565 feet and the required SDL is 530 feet. The measured sight distances are shown in **Table 1** with the red number indicates inadequate sight distance. The required sight distance to make a right turn onto Davis Drive from Tippett Hill Drive is met; however, the distance required to make a left turn is not met. The required sight distance for left turning motorists from eastbound Tippett Hill is 565 feet, but motorists only have 460 feet of sight distance. A sight distance issue is present due to the existing trees along the west side of Davis Drive, as seen in **Figure 16**. The required and measured sight distance at Tippett Hill Drive is shown in **Figure 17**.

Table 1: ISD for Tippett Hill Dr.

Approach	Design Speed on Major Road (MPH)	Sight Distance Left - SDL (ft)		Sight Distance Right - SDR (ft)	
		Required	Measured	Required	Measured
Tippett Hill Drive (EB)	45	530	530	565	460

Figure 16: Tippett Hill Dr. Right Side Line of Sight Obstruction

Figure 17: Sight Distance from Tippett Hill Dr. onto Davis Dr.

Davis Drive and Belfort Park Drive

Loudoun County DTCI requested JMT to verify a reported sight distance issue at the intersection of Davis Drive and Belfort Park Drive. The intersection of Davis Drive and Belfort Park drive operates as a two-way stop-controlled intersection, with stop signs on both approaches of Belfort Park Drive. The SDR and SDL from Belfort Park Drive onto Davis Drive is presented in **Table 2**.

Table 2: ISD for Davis Dr. and Belfort Park Dr.

Approach	Design Speed on Major Road (MPH)	Sight Distance Left - SDL (ft)		Sight Distance Right - SDR (ft)	
		Required	Measured	Required	Measured
Belfort Park Drive (EB)	45	530	350	565	>700

The SDR is adequate with over 700 feet of sight distance compared to the VDOT required 565 feet. However, the SDL is inadequate. The sight distance is impeded by an existing chain link fence and vegetation, located north of Belfort Park Drive, as shown in **Figure 18.** The field measured SDL from the approach stop bar is 350 feet, compared to the required 530 feet, as shown in **Figure 19**. However, per the speed data result, the 85th percentile speeds approaching Davis Drive northbound and southbound at Belfort Park Drive are 48 MPH and 47 MPH, respectively. These speeds are more than the established design speed for the ISD. Therefore, a 50 MPH design speed was checked for the ISD at the intersection. In this case, the measured SDR for the left turn is still adequate with over 700 feet of sight distance compared to the required 625 feet, and the measured SDL is still inadequate when compared to the required 590 feet.

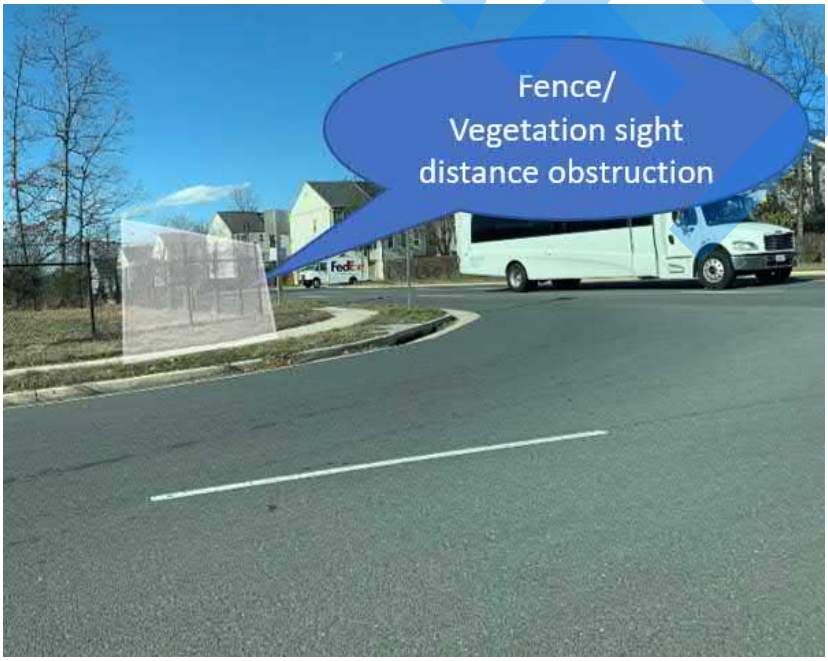


Figure 18: Belfort Park Dr. Left Side Obstruction

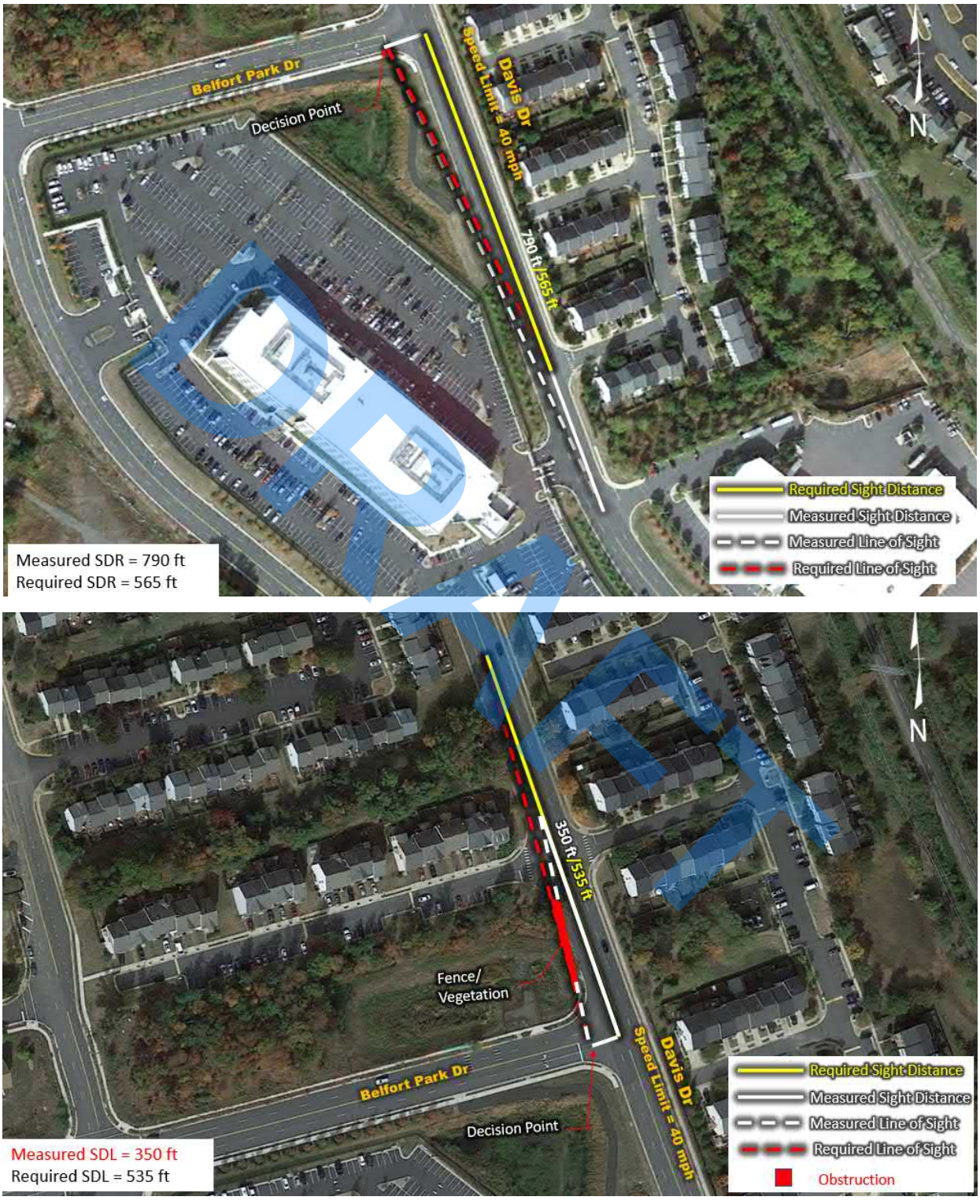


Figure 19: Sight Distance from Belfort Park Dr. onto Davis Dr.

Davis Drive and Overmountain Square Junction

The T-intersection of Davis Drive and Overmountain Square operates with stop control on Overmountain Square approach. The required and measured SDR is 565 feet and the SDL is 530 feet as shown in **Table 3**. The measured SDL is 290 feet and is inadequate, but the measured SDR is 600 feet is adequate.

Table 3: ISD for Davis Dr. and Overmountain Square

Approach	Design Speed on Major Road (MPH)	Sight Distance Left - SDL (ft)		Sight Distance Right - SDR (ft)	
		Required	Measured	Required	Measured
Overmountain Square (WB)	45	530	290	565	600

The ISD from the Overmountain Square is not adequate for right turning and left turning vehicles because the measured SDL from the stop bar is less than the required SDL. This is due to vegetation, and the curvature along Davis Drive northbound approaching the Overmountain Square intersection, as shown in **Figure 20**. The measured and required sight distances for Overmountain Square are shown in **Figure 21**.

Figure 20: Overmountain Sq. Left Side Obstruction

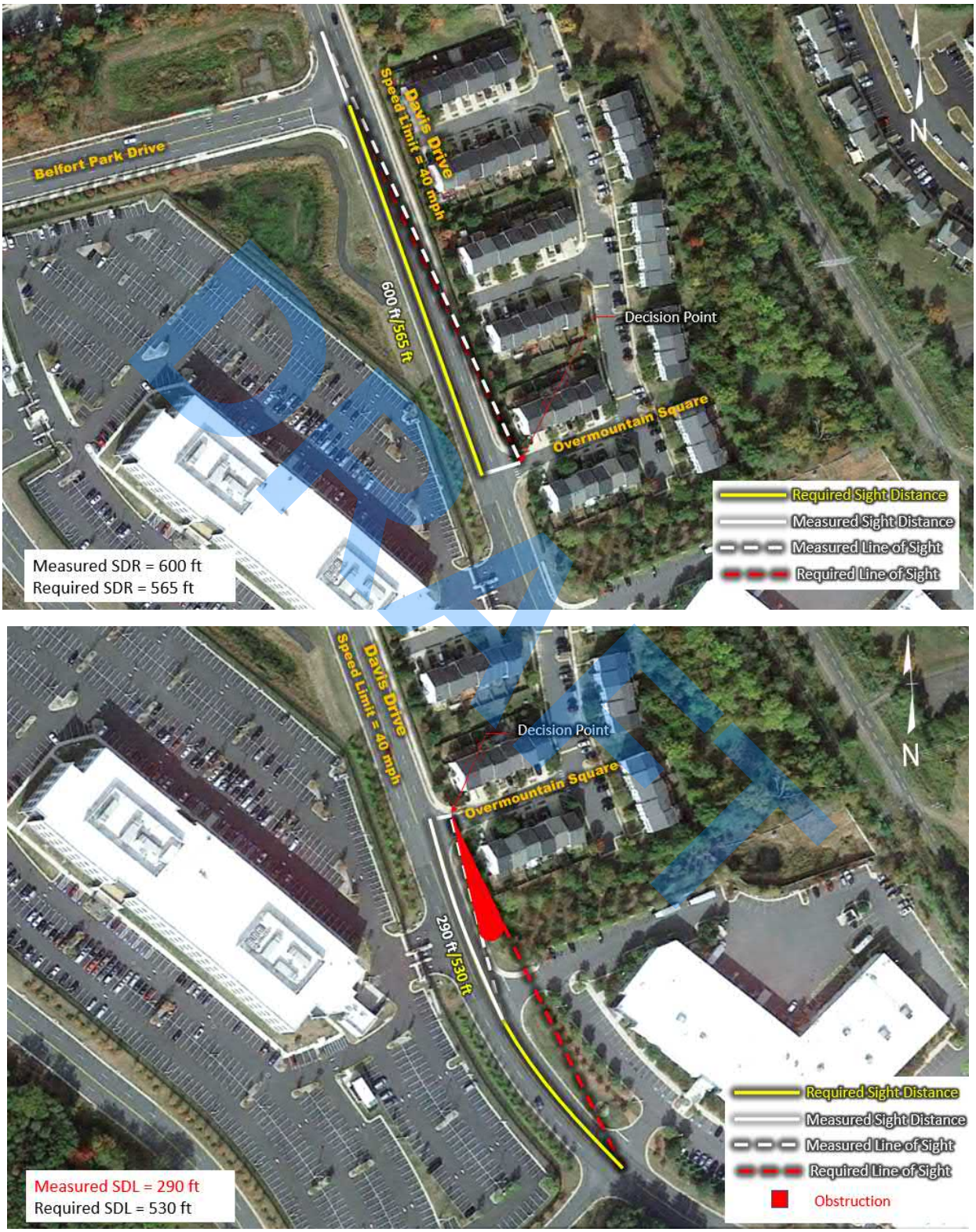


Figure 21: Sight Distance from Overmountain Square onto Davis Dr.

Davis Drive and First Potomac Way/Sterling Park Business Center

The intersection of Davis Drive and First Potomac Way/Sterling Park Business Center operates as a two-way stop-controlled intersection, with stop signs on the First Potomac Way/Sterling Park Business Center approaches. The measured and required ISD are presented in **Table 4.**

Table 4: ISD for Davis Drive and First Potomac Way/Sterling Park Business Center

Approach	Design Speed on Major Road (MPH)	Sight Distance Left - SDL (ft)		Sight Distance Right - SDR (ft)	
		Required	Measured	Required	Measured
First Potomac Way (EB)	45	530	>700	565	250
Sterling Park Business Center (WB)	45	530	250	565	500

The ISD from the eastbound approach is adequate for right turning vehicles. The measured SDL is over 700 feet compared to the required 530 feet. For the left turning vehicles from First Potomac Way, the ISD is not adequate since the measured SDR from the stop bar is less than the required SDR. This is due to the existing vegetation obstructing the driver's line of sight to see vehicles approaching on northbound Davis Drive, as shown in **Figure 22.**

The required ISD to make a left and right turn from Sterling Park Business Center (westbound approach) is inadequate, since both the measured SDR and SDL from this approach are lower than the VDOT required distances. The field investigation showed that the ISD issue is mainly caused by the curvature and slope of Davis Drive approaching the intersection, as shown in **Figure 23**. Line of sight obstructions on the left side are also caused by existing vegetation. Measured sight distances for the eastbound and westbound approaches are shown in **Figure 24** and **Figure 25**, respectively.

Figure 22: First Potomac Way Right Side Obstruction

Figure 23: Sterling Park Business Center Left and Right Side Obstructions

Figure 24: Sight Distance from First Potomac Way EB onto Davis Dr.

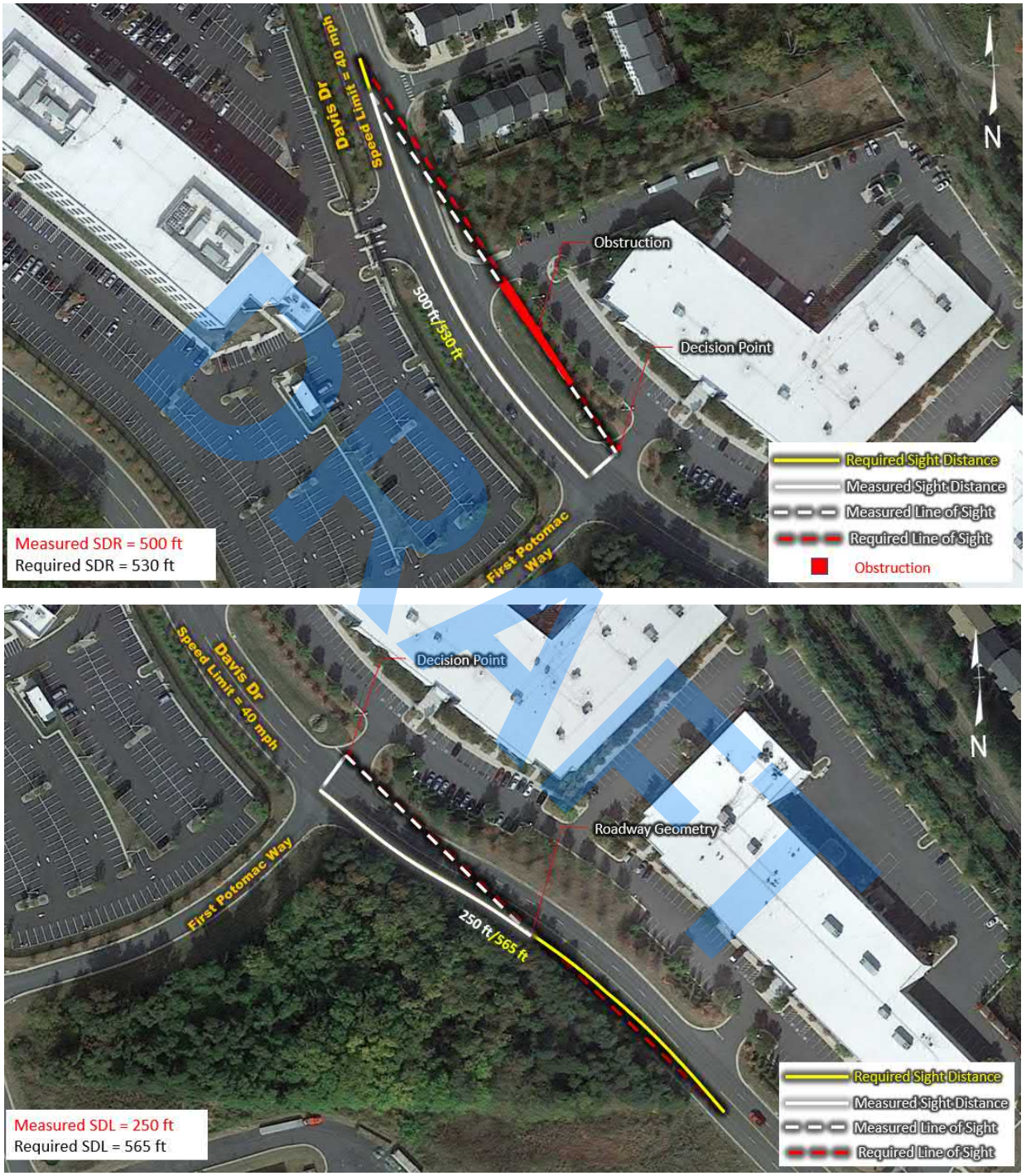


Figure 25: Sight Distance from Sterling Park Business Center WB onto Davis Dr.

Davis Drive and Shepard Drive

The intersection of Davis Drive and Shepard Drive operates as a two-way stop-controlled intersection, with a stop sign on the Shepard Drive approach. The measured ISD presented in **Table 5**, shows the ISD for the right turning vehicles is adequate.

Table 5: ISD for Davis Dr. and Shepard Dr.

Approach	Design Speed on Major Road (MPH)	Sight Distance Left - SDL (ft)		Sight Distance Right - SDR (ft)	
		Required	Measured	Required	Measured
Shepard Drive (EB)	45	530	530	565	185

The measured SDL is the same as the required SDL. The existing SDR is insufficient due to the trees blocking the line of sight of drivers looking right as shown in **Figure 26.** Measured sight distances are shown in **Figure 27.**

Figure 26: Shepard Dr. Right Side Obstruction

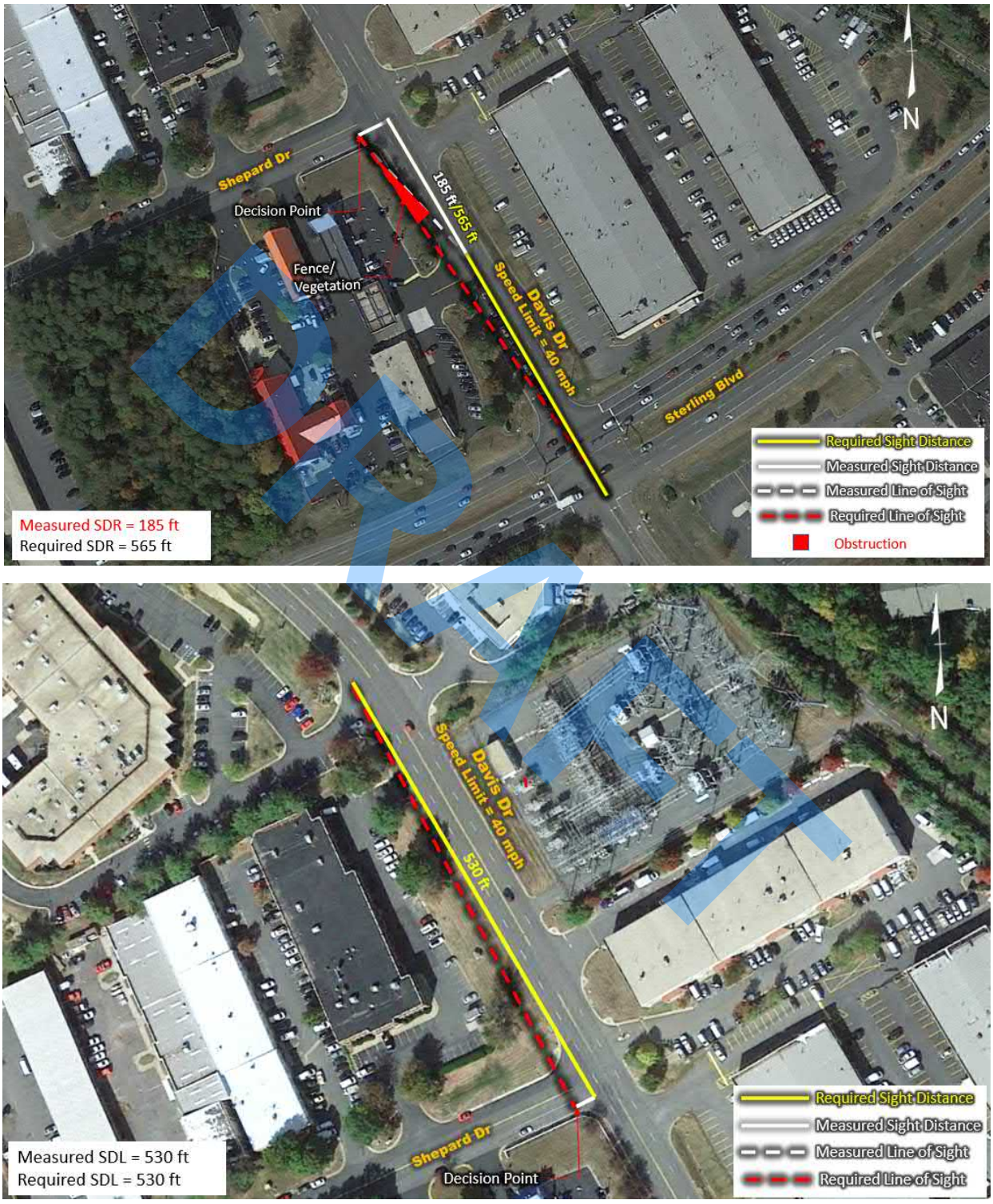


Figure 27: Sight Distance from Shepard Dr. onto Davis Dr.

Belfort Park Drive and Glenn Drive

The intersection of Belfort Park Drive and Glenn Drive currently operates as a two-way stop-controlled intersection, with stop signs on both approaches of the Belfort Park Drive. As shown in **Table 6**, the ISD is adequate in the eastbound direction for the left and right turn movements. ISD was measured to be adequate during field observation; however, there were no tree leaves on the tree branches at the time of the investigation. Aerial maps show that the intersection sight distance may be impeded by the trees for the eastbound approach movements during full foliage times of the year.

The required ISD to make either a left or right turn is inadequate for the westbound approach. The SDL is inadequate with the required 415 feet, but available distance is measured to be approximately 250 feet as shown in **Table 6**. This is mainly due to the presence of trees and the roadway slope approaching the intersection in the northbound direction, as shown in **Figure 28**. The SDR is sufficient based on the field measurements, however, the filed visit was conducted when no leaves on the trees, accordingly, the SDR may be impacted during spring and summer seasons. Measured sight distances are for the eastbound and westbound approaches shown in **Figure 29** and **Figure 30,** respectively.

Table 6: ISD for Glenn Dr. and Belfort Park Dr.

Approach	Design Speed on Major Road (MPH)	Sight Distance Left - SDL (ft)		Sight Distance Right - SDR (ft)	
		Required	Measured	Required	Measured
Belfort Park Drive (EB)	35	415	470	440	480
Belfort Park Drive (WB)	35	415	250	440	600

Figure 28: Belfort Part Dr. Left Side Obstruction

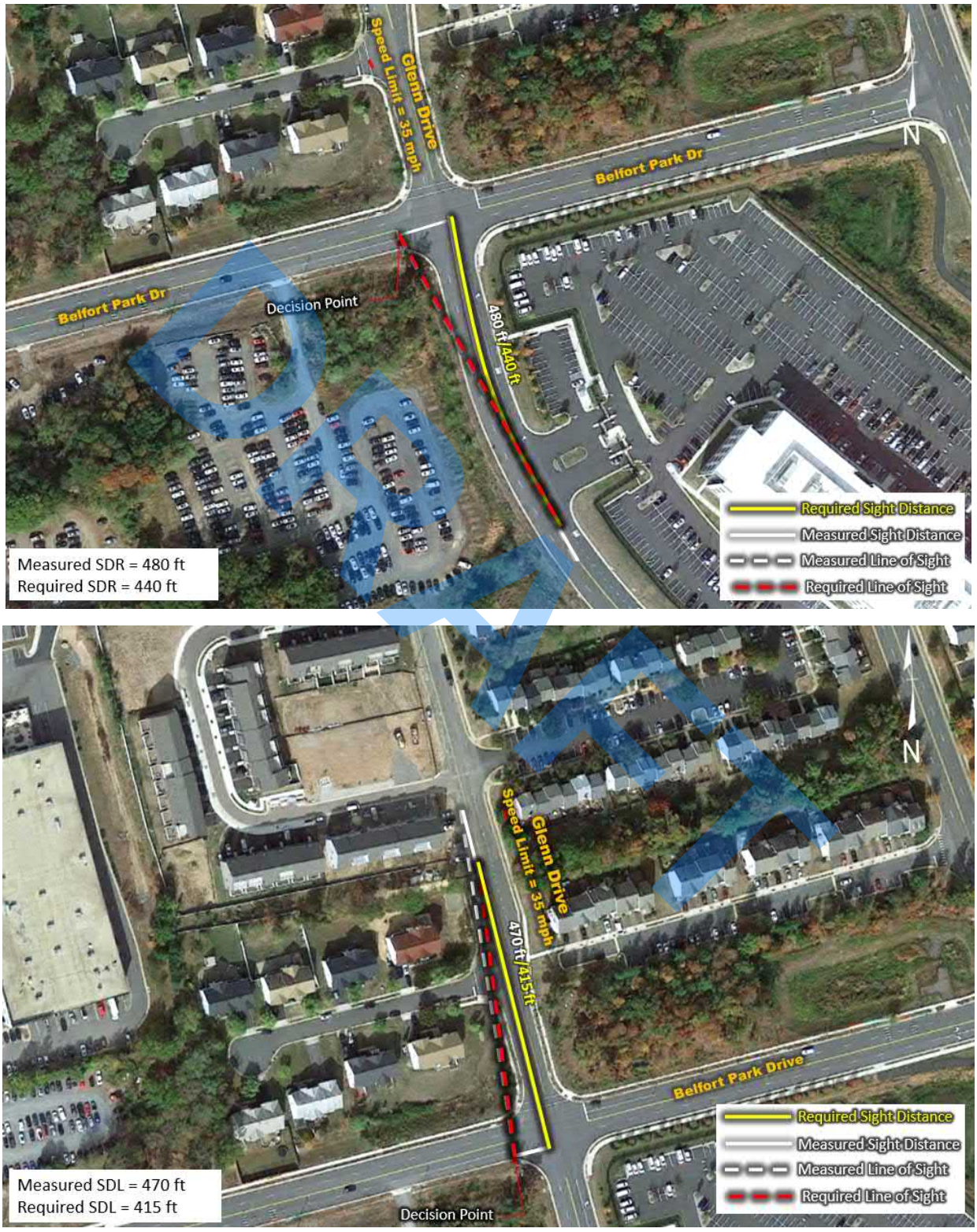


Figure 29: Intersection Sight Distance for Belfort Park Dr. EB onto Glenn Dr.

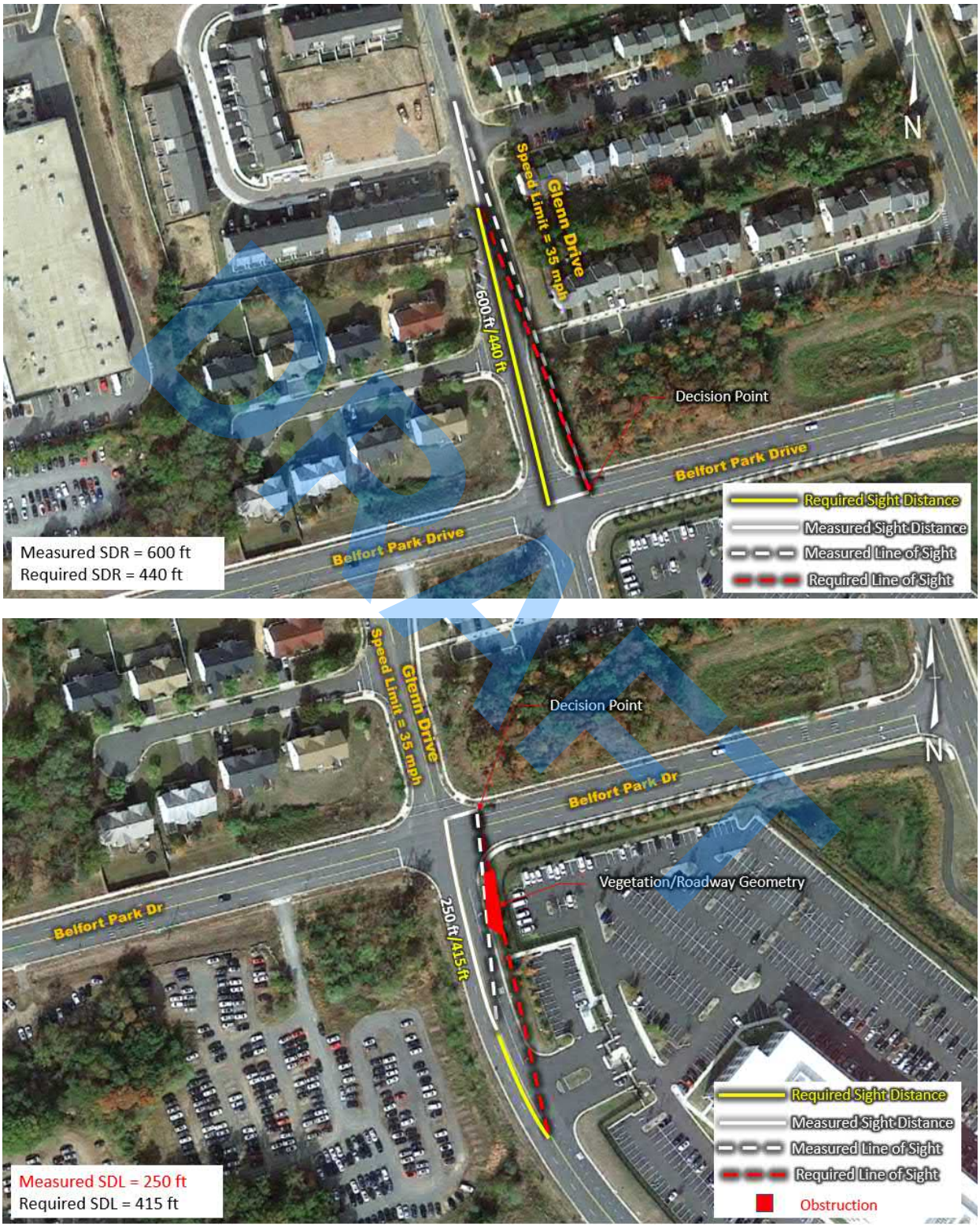


Figure 30: Intersection Sight Distance for Belfort Park Dr. WB onto Glenn Dr.

STUDY INTERSECTIONS

The study area includes a total of 10 intersections and the study network encompasses multiple roadway classifications as defined by the 2019 CTP. These classifications include minor arterial, major collector, minor collector, local roads, and driveways. The intersections lane configurations and existing traffic controls of all the study intersections are shown in **Figure 31**. The 10 study intersections consist of two signalized intersections (#1 and #2) and eight unsignalized (stop-controlled) intersections (#3-#10) from the following list:

7. Davis Drive and West Church Road.
8. Davis Drive and South Sterling Boulevard.
9. Davis Drive and Tippett Hill Drive/Bluemont Junction Square.
10. Davis Drive and Belfort Park Drive.
11. Davis Drive and US Customs and Border Protection (CBP) Entrance.
12. Davis Drive and First Potomac Way.
13. Davis Drive and Shepard Drive.
14. Tippett Hill Drive at Glenn Drive.
15. Belfort Park Drive and Glenn Drive.
16. Shaw Road and Belfort Park Drive.

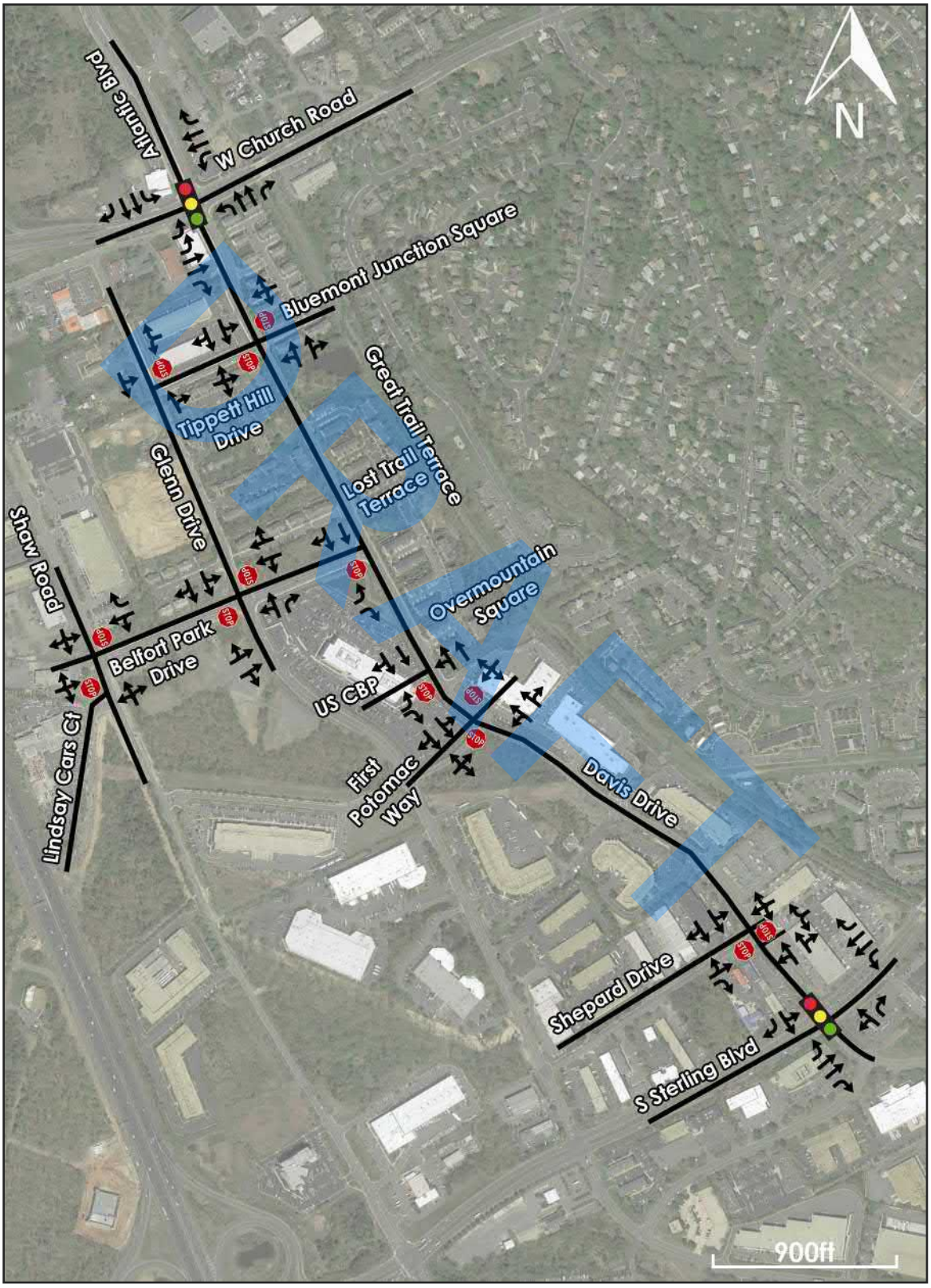


Figure 31: Intersection Lane Configurations and Existing Traffic Controls

EXISTING TRAFFIC & PEDESTRIAN VOLUMES

Data collection including 15-hour turning movement counts were conducted from 5:00 AM to 8:00 PM at the 10 study intersections on Wednesday, January 22, 2020, by National Data & Surveying Services, under clear and dry weather conditions. Traffic operations were normal, and schools were in session at the time of the data collection activities.

The turning movement counts included 15-minute intervals for cars, trucks, bicycles, and pedestrians traversing the study area. The peak hour volumes varied for individual intersections. The AM and PM peak hours for individual intersections were within the 7:15 AM to 10:00 AM, and 4:15 PM to 6:00 PM time periods, respectively. For consistency and to be in accordance with the VDOT Traffic Operation and Safety Analysis Manual (TOSAM) Version 2.0 guidelines, a network level peak hour was developed for the AM and PM peak hours based on the most common peak hour along Davis Drive. As such, the peak hours used for the analysis during the AM and PM peak periods were 7:45 AM to 8:45 AM, and 4:45 PM to 5:45 PM, respectively. **Figure 32** shows the AM and PM peak hour volumes for each intersection in the study area. The turning movement counts, and pedestrian data are provided in **Appendix B.**

The 24-hour volumes were collected on January 22, 2020 on Davis Drive, Glenn Drive and Belfort Park Drive. The ADT along Davis Drive is 10,900 VPD, while the ADTs on Glenn Drive and Belfort Park Drive are 1,400 VPD and 2,000 VPD, respectively. Glenn Drive intersects Belfort Park Drive within the study area, with Belfort Park Drive as the stop-controlled roadway. However, Belfort Park Drive ADT is 31% higher than the Glenn Drive ADT.

During the 15-hour turning movement counts, the total pedestrian volume ranged from 0 to 19 pedestrians per intersections along Davis Drive. The intersection with the highest pedestrian activity along Davis Drive during the AM and PM periods was Davis Drive and Tippett Hill Drive/Bluemont Junction Square. This is due to the existence of sidewalks on both sides of Davis Drive and the proximity of residential units surrounding the intersection. The pedestrian volumes for the study intersections are presented in **Figure 33, Figure 34** and **Figure 35**. These pedestrian counts may not typically represent the pedestrian activity on the spring, summer or fall period, since it was collected during winter season (January).

The highest pedestrian activity within the study area occurred at Shaw Road and Belfort Park Drive intersection, with a total 253 pedestrians. The peak hour for pedestrian volume occurred from 7:00 AM to 8:00 AM with a total of 42 pedestrians. Most pedestrians cross the north and west legs of the intersection of Shaw Road and Belfort Park Drive. In the AM peak period, pedestrians on the north leg travel to the west, and pedestrians on the west leg travel to the south, while in the PM peak period, pedestrians on the north leg travel mainly to the east, and pedestrian on the west leg travel to the north, as shown in **Figure 34**.

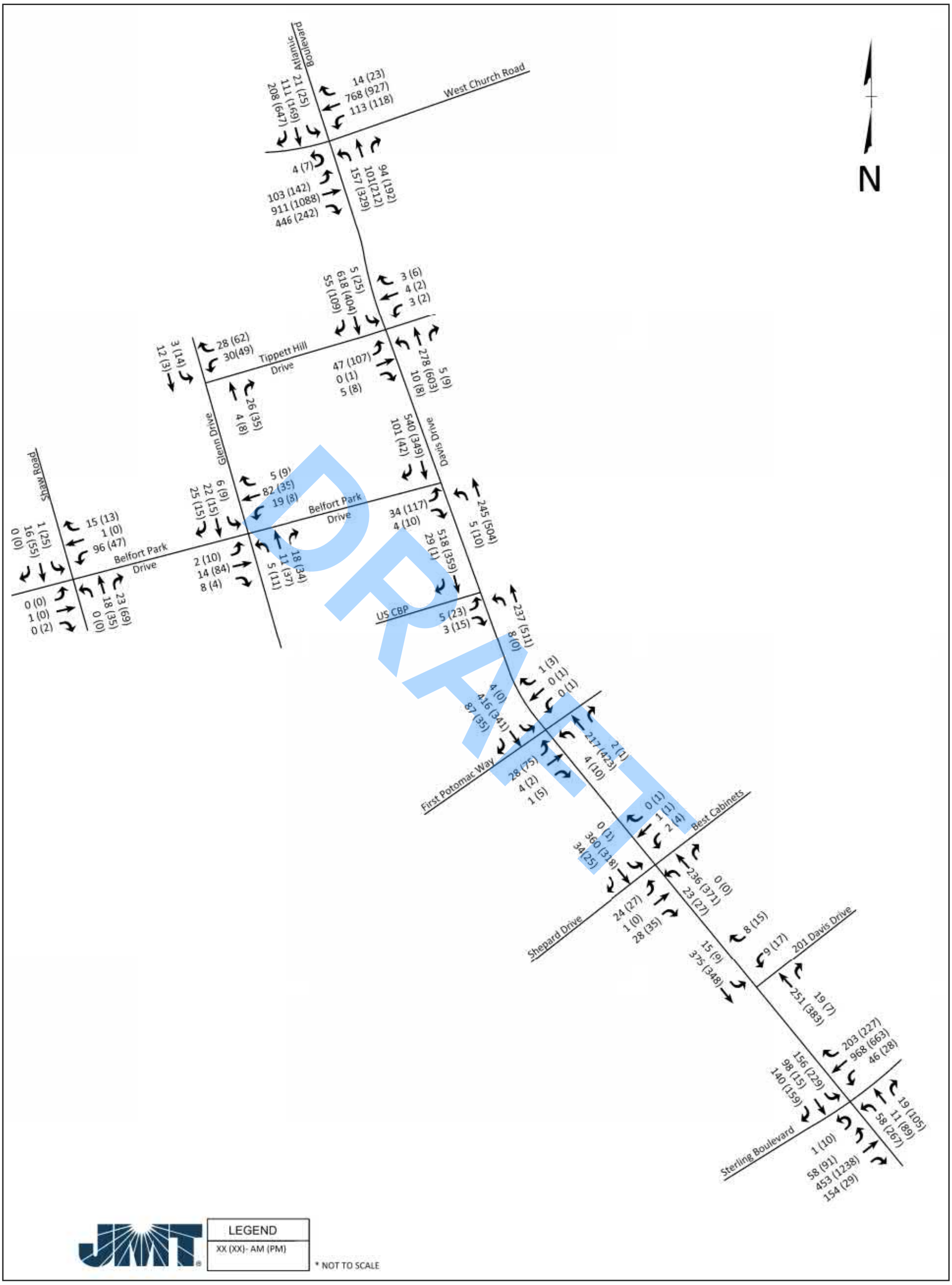


Figure 32: Network Level AM and PM Peak Hour Volumes

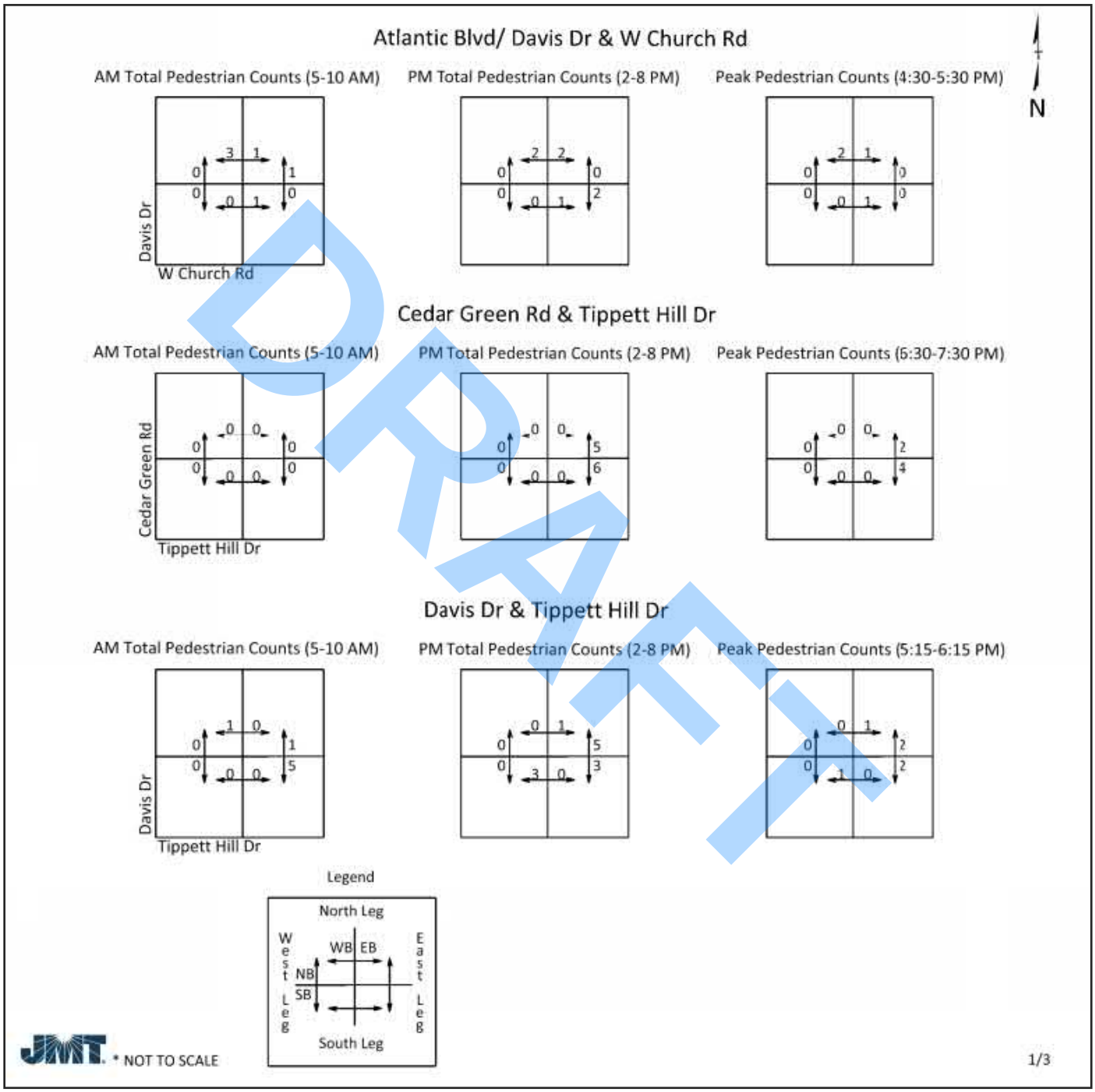


Figure 33: Pedestrian Volumes – 1

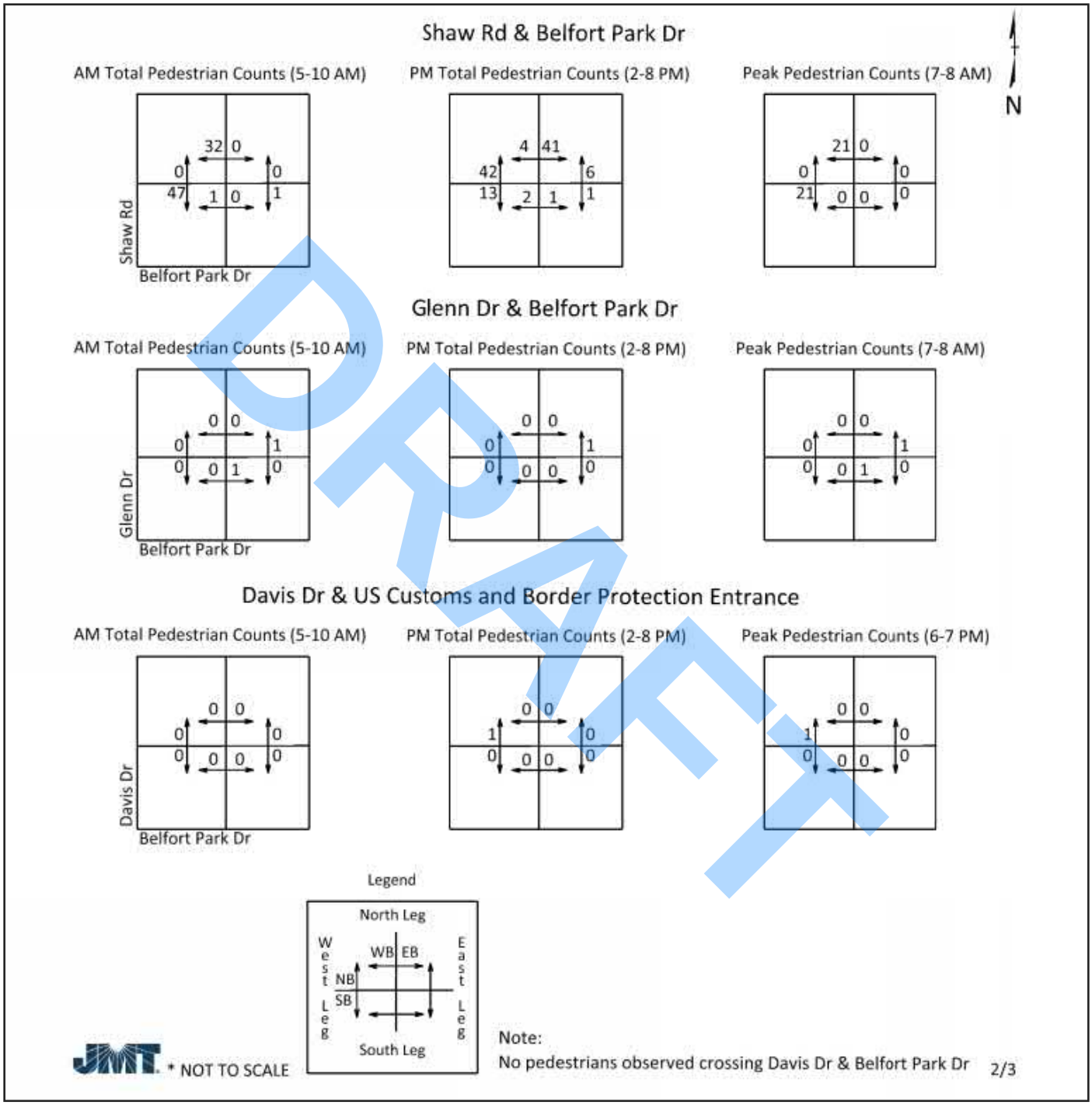


Figure 34: Pedestrian Volumes – 2

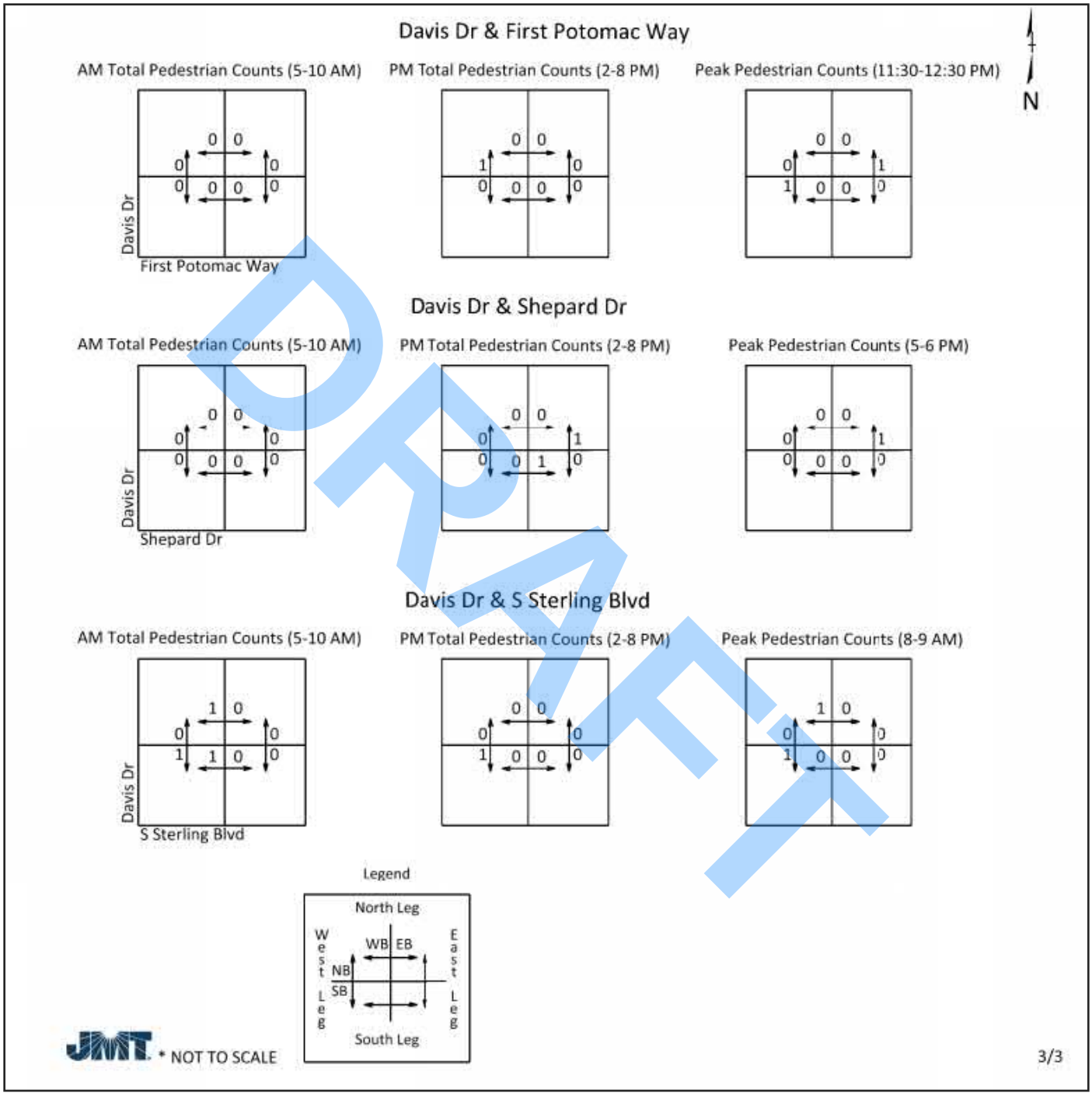


Figure 35: Pedestrian Volumes – 3

EXISTING SPEED DATA

Speed data was also collected on Davis Drive for a 24-hour period, from 12:00 AM to 12:00 AM, on Wednesday, January 22, 2020 with normal traffic operations and schools were in session. The speed data was collected at the following four sites (indicated on **Figure 36)**, and the raw speed data is included in **Appendix C**:

Site 1: Between West Church and Tippett Hill Drive/Bluemont Junction Square.
Site 2: Between Tippett Hill Drive/Bluemont Junction Square and Belfort Park Drive.
Site 3: Between Belfort Park Drive and First Potomac Way.
Site 4: Between First Potomac Way and South Sterling Boulevard.

Figure 36: Davis Dr. Data Collection Sites

The collected data was used to determine the 85th percentile speed in each direction along Davis Drive. **Table 7** provides a summary of the posted speed limits, the calculated 85th percentile speeds, the average speeds, and the current ADTs.

Table 7: Summarized Speed Data

Site	Davis Drive	Posted Speed (MPH)	Northbound			Southbound		
			85th Percentile (MPH)	Average Speed (MPH)	ADT (VPD)	85th Percentile (MPH)	Average Speed (MPH)	ADT (VPD)
1	Between W Church Road and Tippett Hill Drive/ Bluemont Junction Square	40	41	35	6,503	32	28	7,507
2	Between Tippett Hill Drive/ Bluemont Junction Square and Belfort Park Drive	40	45	39	5,478	44	38	6,221
3	Between Belfort Park Drive and First Potomac Way	40	48	41	4,520	47	41	5,180
4	Between First Potomac Way and Shepard Drive	40	43	38	3,745	44	38	4,439
	Average		**44**	**38**	**5,062**	**42**	**36**	**5,837**

Per the summary of the speed data analysis presented in **Table 7**, the 85th percentile speeds along Davis Drive ranged from 32 MPH to 48 MPH with an average of 42 MPH and 44 MPH in the southbound and northbound direction, respectively. The average 85th percentile speed along Davis Drive in both directions, does not exceed 10 MPH over the posted speed, which the threshold to determine the posted speed compliance on the study roadways.

Additional analysis was conducted on the speed data based on different timeframes, to determine if there are speeding issues during a specific period of the day. The speed data was broken into four periods; AM peak (6:00 AM – 9:00 AM), Mid-day (9:00 AM – 4:00 PM), PM peak (4:00 PM – 7:00 PM) and Off peak (7:00 PM – 6:00 AM).The results of analysis, presented in **Table 8,** showed that the majority of the drivers drove within the 5 MPH of the speed limit along the corridor. The average 85th percentile speed of the entire study corridor did not exceed 45 MPH during any study timeframes and in both directions.

Within Site 3, which is located between Belfort Park Drive and First Potomac Way, the 85th percentile speed was the highest in the corridor, with 48 MPH and 47 MPH in the northbound and southbound direction, respectively. However, the 85th percentile speed still did not exceed the 10 MPH of the posted speed limit during any study timeframes in both directions. Based on the data, it can be concluded that speeding is not an issue along Davis Drive corridor.

Table 8: Speed Data Breakdown on Davis Dr.

Timeframe	Posted Speed (MPH)	Northbound			Southbound		
		85th Percentile (MPH)	Average Speed (MPH	ADT (VPD)	85th Percentile (MPH)	Average Speed (MPH	ADT (VPD)
AM Peak Average	40	45	39	672	42	37	1,282
Mid-day Average	40	45	39	2,193	42	37	2,460
PM Peak Average	40	44	38	1,426	41	41	1,119
Off Peak Average	40	43	38	771	41	41	951

CRASH DATA SUMMARY

JMT analyzed and summarized historical crash data along Davis Drive between West Church Road and South Sterling Boulevard, from January 2016 to August 2019 (the latest time period available at the time of the study) from VDOT's Tableau Crash Analysis Tool. VDOT provided the detailed description for each crash to be used in the study crash analysis since Tableau no longer provides crash descriptions.

The following discussion presents common crash trends observed on the Davis Drive Corridor, between West Church Road and South Sterling Boulevard, followed by intersection related crashes at the following locations:

1. Davis Drive and West Church Road – South Leg.
2. Davis Drive and Tippett Hill Drive/Bluemont Junction Square.
3. Davis Drive and Belfort Park Drive.
4. Davis Drive and US Custom and Border Protection Building Truck Entrance.
5. Davis Drive and First Potomac Way.
6. Davis Drive and Shepard Drive.
7. Davis Drive and South Sterling Boulevard.
8. Tippett Hill Drive and Glenn Drive.
9. Belfort Park Drive and Glenn Drive.
10. Belfort Park Drive/Lindsay Cars Court and Shaw Road.

A total of 96 crashes were reported within the study area during the study time period, with the crash locations, extracted from Tableau, are shown in **Figure 37**. The corridor crash trends indicated that insufficient sight distances, as opposed to speeding, improper pavement surfaces, or adverse weather conditions, is the contributing factor to most of the reported crashes.

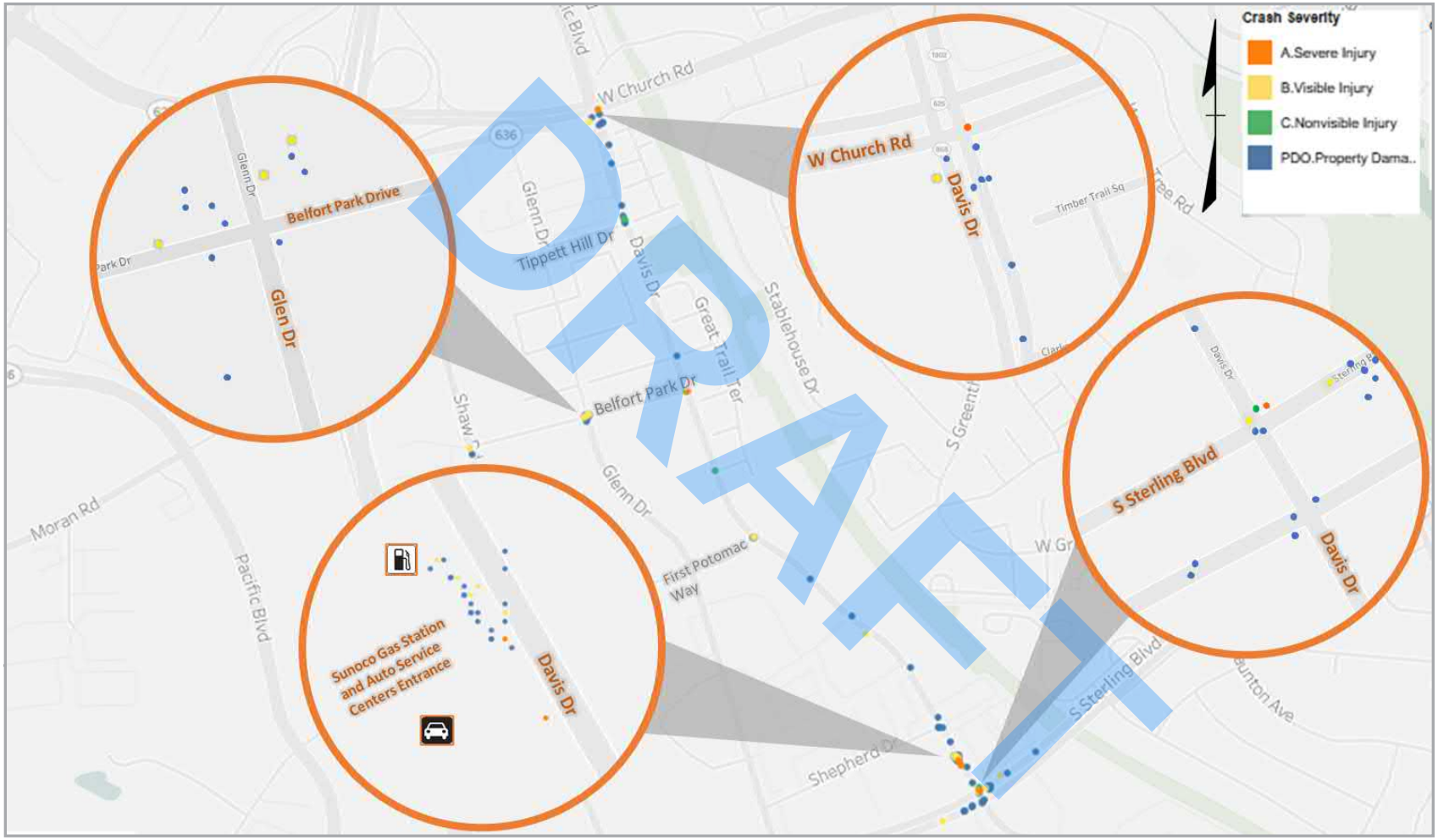


Figure 37: Crash Locations within the Study Area from Tableau (Jan. 2016 – Aug. 2019)

DAVIS DRIVE CORRIDOR CRASH ANALYSIS

During the almost four-year period, of the 96 crashes that occurred in the study area, 82 crashes were reported along the 1.04-mile segment of Davis Drive between West Church Road and South Sterling Boulevard and summarized in **Table 9**. Overall, the predominant crash type was angle representing 59% of all Davis Drive corridor crashes. The second predominant crash type was rear-end representing 26% of the total Davis Drive corridor crashes. Of the total crashes, 73% of the crashes caused property damage only (PDO) and 27% of the crashes caused injury (various severity levels A, B, and C). There were no fatal crashes reported within the study period. Within a full calendar year, the highest crash frequency was recorded in the Year 2016, with a total of 27 crashes, and the lowest occurred in 2017 with 17 crashes. Of the total crashes, 72 crashes (88%) occurred during dry pavement surface conditions, and 62 crashes (76%) occurred during daylight. The detailed crash types and crash severity by year are shown in **Figure 38** and **Figure 39** (note that only eight months of data is included in year 2019).

With respect to the time of the crash occurrence, 17% of the total crashes occurred during AM peak hours (6:00 am to 9:00 am), 43% occurred during Mid-day hours (9:00 am to 4:00 pm), 27% occurred during the PM peak hours (4:00 pm to 7:00 pm), and 13% occurred during Off peak hours (7:00 pm to 6:00 AM).

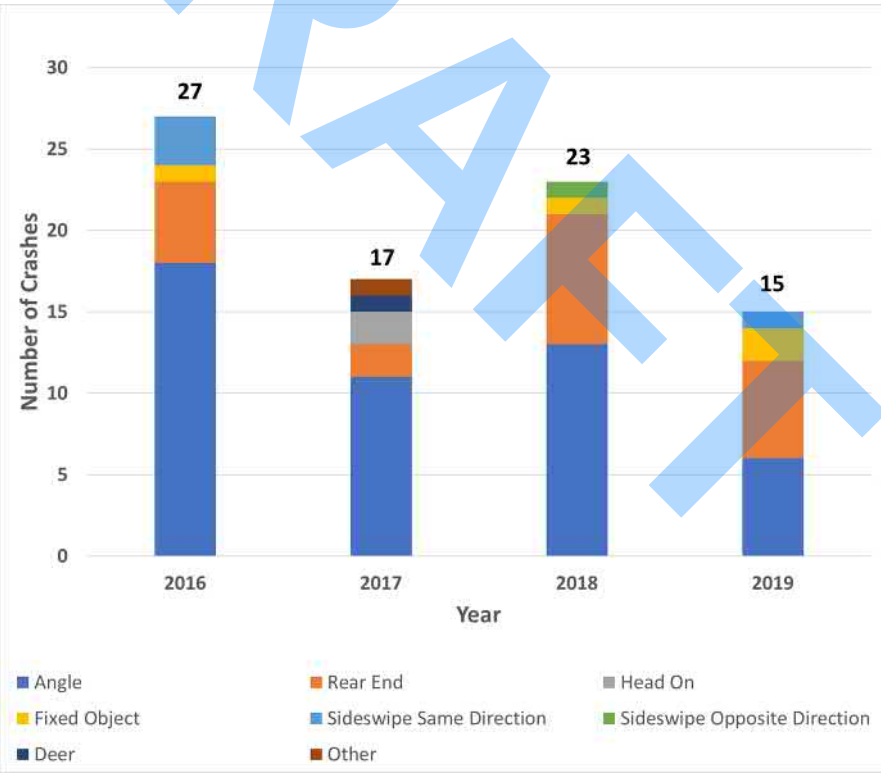


Figure 38: Crash Types by year (Jan. 2016- Aug. 2019)

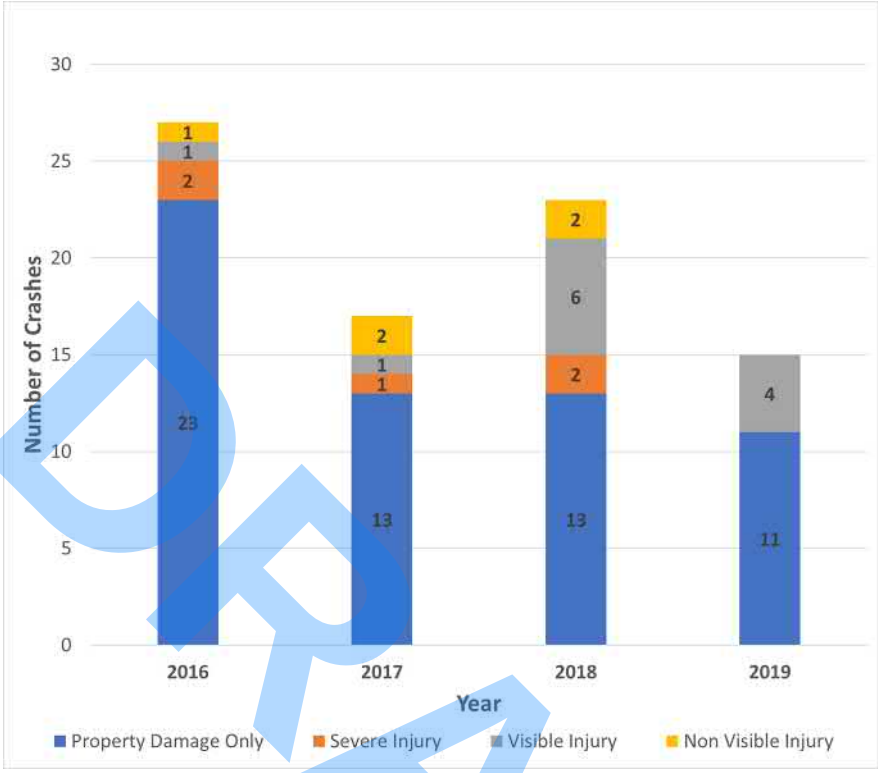


Figure 39: Crash severity by year (Jan. 2016- Aug. 2019)

Table 9: Crash Summary on Davis Dr. Corridor (Jan. 2016 to Aug. 2019)

Year	Type of Collision								Surface			Severity				Time of Day				Light Condition			Total
	Angle	Rear End	Head On	Sideswipe - Same Direction	Sideswipe - Opposite Direction	Fixed Object - Off Road	Deer	Other	Dry	Wet	Snow/Icy	PDO.Property Damage Only	A.Severe Injury	B.Visible Injury	C.Nonvisible Injury	AM Peak (6 - 9 AM)	MID Day (9 AM - 4 PM)	PM Peak (4 -7 PM)	Off Peak (7 PM - 6 AM)	Dawn/Dusk	Daylight	Dark	
1/1/2016 - 12/31/2016	18	5	0	3	0	1	0	0	26	1	0	23	2	1	1	4	10	9	4	2	19	6	**27**
1/1/2017 - 12/31/2017	11	2	2	0	0	0	1	1	15	2	0	13	1	1	2	3	7	5	2	2	12	3	**17**
1/1/2018 - 12/31/2018	13	8	0	0	1	1	0	0	19	3	1	13	2	6	2	3	12	6	2	1	19	3	**23**
1/1/2019 - 8/31/2019	6	6	0	1	0	2	0	0	12	2	1	11	0	4	0	4	6	2	3	1	12	2	**15**
Total	**48**	**21**	**2**	**4**	**1**	**4**	**1**	**1**	**72**	**8**	**2**	**60**	**5**	**12**	**5**	**14**	**35**	**22**	**11**	**6**	**62**	**14**	**82**
%	**59%**	**26%**	**2%**	**5%**	**1%**	**5%**	**1%**	**1%**	**88%**	**10%**	**3%**	**73%**	**6%**	**15%**	**6%**	**17%**	**43%**	**27%**	**13%**	**7%**	**76%**	**17%**	**100%**

The lack of illumination, inclement weather, inadequate pavement friction were not likely contributing factors for these crashes based on the crash data. Also, based on both the crash data and speed data, speeding is likely not a contributing factor to crashes along Davis Drive. The sight distance review determined that sight distance was inadequate at several of the intersections along Davis Drive corridor; thus, sight distance is likely a contributing factor to the angle crashes on Davis Drive at intersections, as shown in **Table 10**. Of the 21 total rear-end crashes, 6 (29%) of the rear-end crashes are attributed to the lack of the turn lanes along Davis Drive at the unsignalized intersections. The remaining rear-end crashes occurred at the northbound approach at Davis Drive and West Church Road intersection (3 crashes), and at eastbound and westbound approaches at South Sterling Boulevard intersection (12 crashes).

Table 10: Crashes attributed to Intersection Sight Distance

Intersection	Number of Crashes	Number of Angle Crash	Adequate Sight Distance	Angle Crashes Cause by Sight Distance
Davis Drive and Belfort Park Drive	2	2	No	2
Davis Drive and First Potomac Way	3	2	No	1
Davis Drive and Shepard Drive	8	6	No	0

Figure 40 summarizes the crashes by type along Davis Drive at each intersection and segments in between. A major crash hotspot, the Sunoco gas station and Auto Service Centers access, was identified relative to other locations along Davis Drive. The entrance is located on Davis Drive between Shepard Drive and South Sterling Boulevard. The number of crashes at this location represents 33% (27 crashes) of the 82 crashes along Davis Drive corridor. This location is described in more detail in the intersection-level crash analysis section of this report. Overall, the majority of the crashes occurred between Shepard Drive and South Sterling Boulevard segment, representing 70% (57 crashes) of the total Davis Drive corridor crashes.

	Segment between W Church & Tippett	Davis & Tippett	Segment between Tippett & Belfort	Davis & Belfort	Davis & CBP Entrance	Davis & First Potomac	Segment between Potomac & Shepard	Davis & Shepard	Segment between Shepard & Sterling (Sunoco Gas Station)	Davis & S Sterling*
Other	0	0	0	0	0	0	0	0	1	0
Deer	0	0	1	0	0	0	0	0	0	0
Sideswipe Opposite Direction	0	0	0	0	0	0	0	0	0	1
Sideswipe Same Direction	2	1	0	0	0	0	0	1	0	0
Fixed Object	2	0	0	0	0	0	1	0	0	1
Head On	1	0	0	0	0	0	0	0	1	0
Rear End	3	2	0	0	1	1	1	1	0	12
Angle	1	2	0	2	0	2	2	6	25	8

* All Rear-End (12) crashes on Davis Dr. & S Sterling Blvd. intersection are occurring on S Sterling Blvd.

Figure 40: Crash Types by Intersection and Segments Along Davis Dr.

INTERSECTION LEVEL CRASH ANALYSIS

The crash data for the ten study intersections were analyzed separately, seven of which were along the Davis Drive corridor, two intersections on Glenn Drive, and one intersection on Shaw Road. The following sections is the discussion regarding these intersections' crash analysis:

Davis Drive and West Church Road – South Leg

Due to the limits of this study, the Davis Drive and West Church Road intersection was analyzed for the south leg only. Within the limits of this intersection with respect to the south leg, a total of nine crashes from January 2016 to August 2019 were reported. **Figure 41** represents the crash types by year for this intersection. The predominant crashes were rear-end crashes, which accounted for approximately 33% (3) of the total crashes at the signalized intersection. All three rear-end crashes occurred at the northbound approach, when vehicles approaching the intersection failed to stop and rear ended the vehicles that were already stopped at the signal. The other crash types reported at this intersection were two sideswipe crashes, two fixed object – Off Road crashes, one angle crash due to driver inattention of the right of way, and one head on crash.

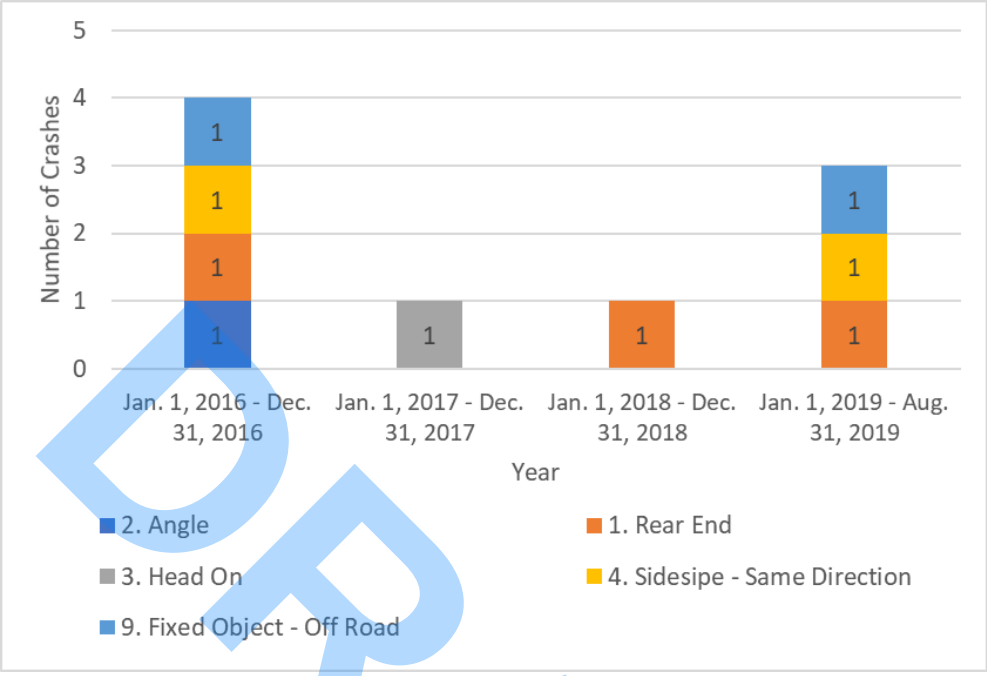


Figure 41: Davis Dr. and Church Rd. (South Leg) - Crash Type by Year

Davis Drive and Tippett Hill Road/Bluemont Junction Square

The Davis Drive and Tippett Hill Drive intersection/Bluemont Junction Square had a total of 5 crashes from January 2016 to August 2019. There were two angle crashes within the limits of this intersection, which were caused due to drivers changing lanes while approaching the intersection. The other crashes involved two rear-end crashes in the southbound direction and one sideswipe crash. Four crashes of the five occurred in 2016, one occurred in 2017, and none occurred in either 2018 or 2019**. Figure 42** shows the crash type by year for this intersection.

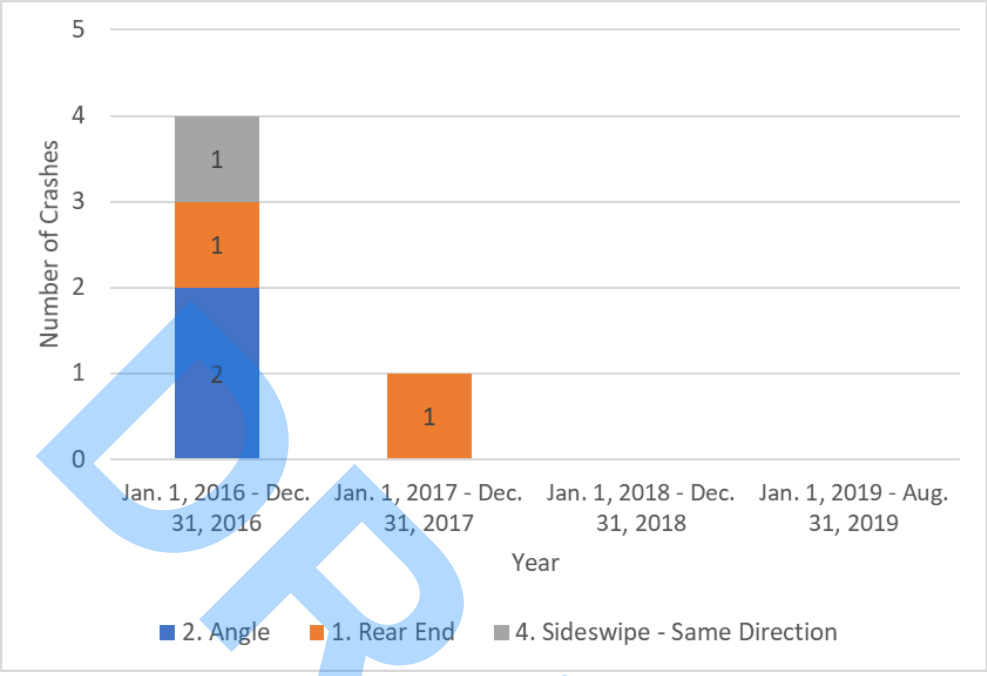


Figure 42: Davis Dr. and Tippett Hill Rd. /Bluemont Junction Sq. - Crash Type by Year

Davis Drive and Belfort Park Drive

The Davis Drive and Belfort Park Drive is a three-leg intersection that has a dedicated right turn lane and left turn lane from Belfort Park Drive. Two angle crashes were recorded at this intersection from January 2016 to August 2019. No crashes were recorded for either 2016 or 2019, one crash occurred in each of 2017 and 2018.

For one of the two crashes, the driver who was making a left turn onto Davis Drive from Belfort Park Drive, reported that overgrown vegetation on the corner limited his view of traffic approaching the intersection on Davis Drive. Additionally, per the crash report, the driver on Davis Drive was reported to be speeding. **Figure 43** shows crash type by year for this intersection.

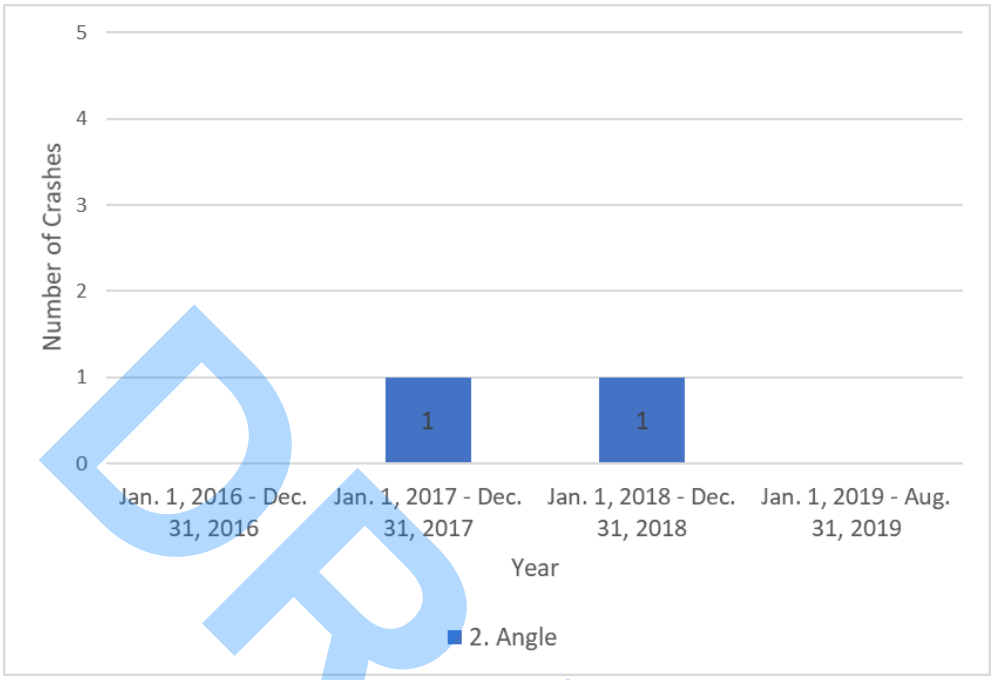


Figure 43: Davis Dr. and Belfort Park Dr. - Crash Type by Year

Davis Drive and US CBP Entrance

No crashes occurred at Davis Drive and the US CBP Entrance. However, from January 2016 to August 2019, one rear-end crash was recorded in 2018 at Overmountain Square, which is approximately 125 feet north of US CBP Entrance. This occurred in the southbound direction when a left turning vehicle was rear ended.

Davis Drive and First Potomac Way

Three crashes occurred at the Davis Drive and First Potomac Way intersection for the analysis period from January 2016 to August 2019. Two of the three crashes were angle crashes. Both angle crashes occurred between the left turning vehicle from First Potomac Way coming from the eastbound approach and the southbound through vehicle on Davis Drive approaching the intersection. One of the angle crashes was caused due to the vehicle approaching First Potomac Way driving without headlights at night. The third crash, a rear-end crash in the southbound approach along Davis Drive, was attributed to icy conditions. **Figure 44** shows crash type by year for this intersection.

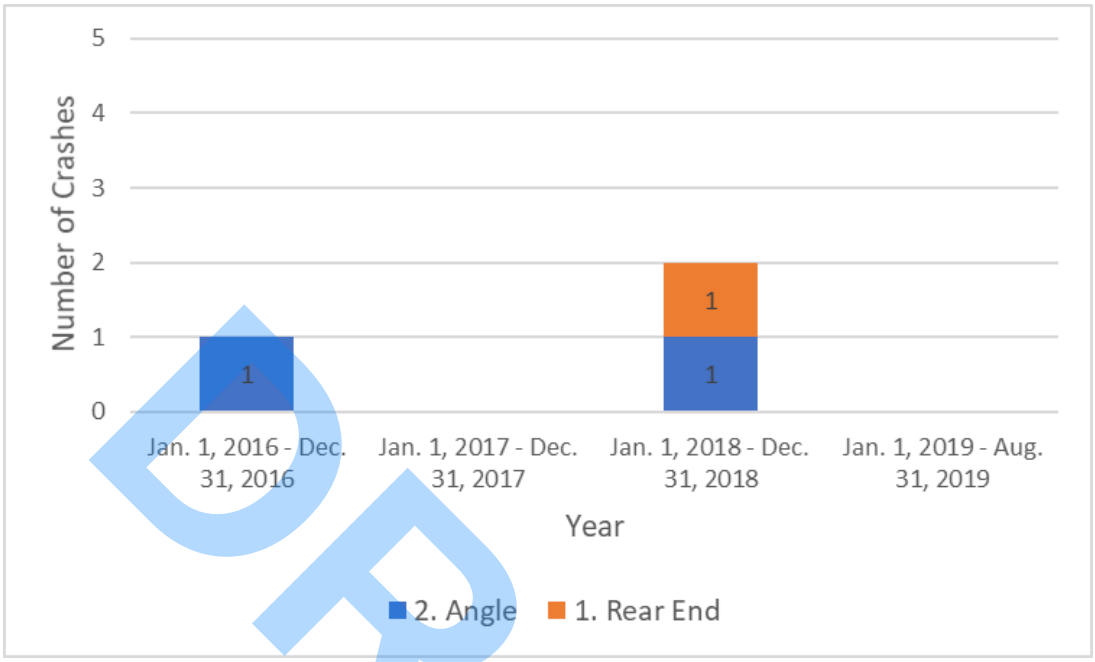


Figure 44: Davis Dr. and First Potomac Way - Crash Type by Year

Davis Drive and Shepard Drive

The Davis Drive and Shepard Drive intersection had a total of eight crashes from January 2016 to August 2019. **Figure 45** shows the crash types by year for this intersection. Overall, the highest number of crashes occurred in 2016, whereas no crashes occurred in 2017. Six of the eight crashes at the intersection were angle crashes. Most angle crashes occurred between northbound left turning vehicles entering the right of way of the southbound through vehicles on Davis Drive. These angle crashes can be associated with sight distance blockage; the shared left/ through movement queue on the southbound approach at South Sterling Boulevard and Davis Drive intersection spills back to the Shepard Drive intersection along Davis Drive, blocking the northbound left turn vehicles from seeing the southbound vehicles driving down the shared right/through lane on Davis Drive. The remaining crashes were one rear-end in the southbound direction and one sideswipe crash. The sideswipe crash was attributed to an improper lane change.

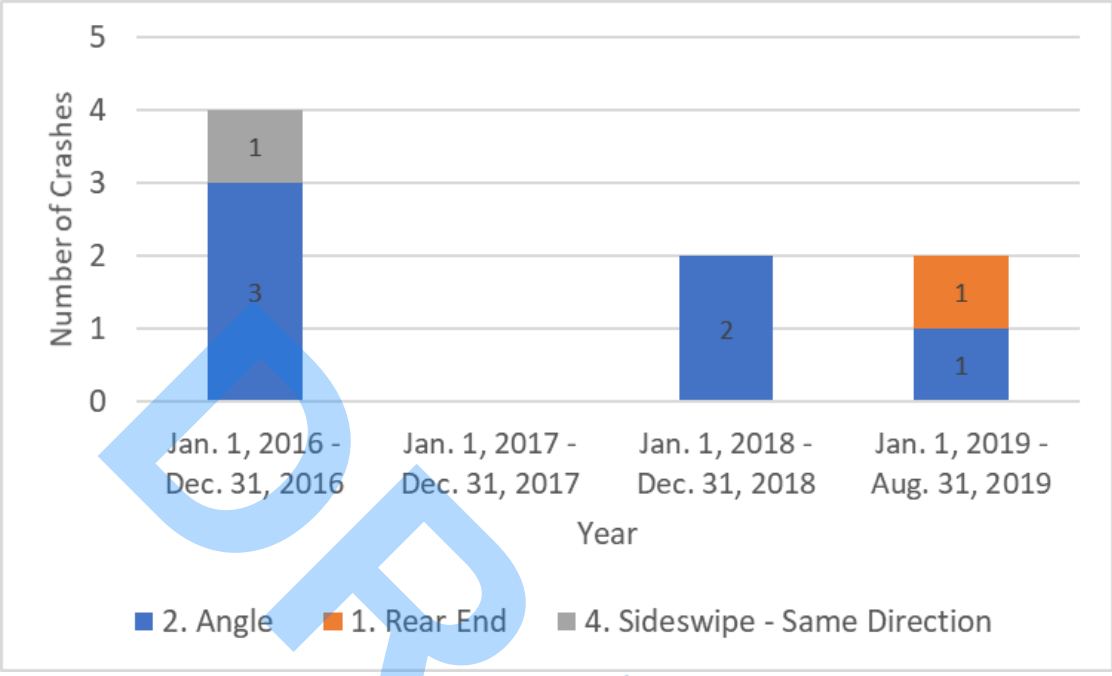


Figure 45: Davis Dr. and Shepard Dr. - Crash Type by Year

Davis Drive and the Sunoco Gas Station Access

Due to a high crash frequency at the access of the Sunoco Gas Station on Davis Drive, the entrance was analyzed as an intersection. The Sunoco Gas Station entrance is 500 feet south of the Davis Drive and Shepard Drive intersection and 500 north of the Davis Drive intersection with South Sterling Boulevard. The Davis Drive and the Sunoco gas station access intersection had a total of 27 crashes from January 2016 to August 2019. **Figure 46** presents the crash types by year for this intersection. The highest number of crashes occurred in year 2017 was ten crashes. Majority of the crashes recorded were angle crashes, which present 93% of the total crashes at this entrance. Based on the crash description, many of the angle crashes were caused by northbound left turn vehicles into the Sunoco gas station with the southbound traffic. These angle crashes can most likely be associated with sight blockage; the shared left/through movement queue on the southbound approach at South Sterling Boulevard and Davis Drive intersection spills back to Shepard Drive intersection with Davis Drive, blocking the northbound left turn vehicles from seeing the southbound vehicles driving down the right lane on Davis Drive. The other crashes involved one sideswipe crash, one head on, and one other undefined crash.

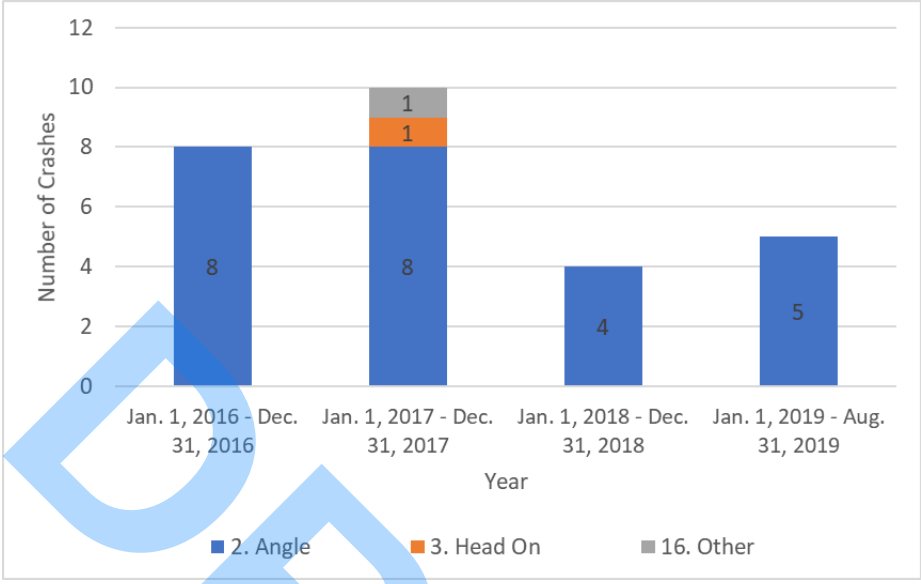


Figure 46: Davis Dr. and Sunoco Gas Station - Crash Type by Year

Davis Drive and South Sterling Boulevard

The Davis Drive and South Sterling Boulevard intersection had a total of 22 crashes from January 2016 to August 2019. **Figure 47** shows the crash types by year for this intersection. Overall, the highest number of crashes occurred in 2018 with nine crashes. Rear-end crashes are predominant throughout all the years presenting 55% of the total crashes, followed by angle crashes presenting a 41% of the total crashes. All the rear-end crashes occurred on South Sterling Boulevard, at the westbound (7 crashes) and the eastbound (5 crashes) approaches of signalized intersection, while the front vehicle is stopped during yellow and/or red indications.

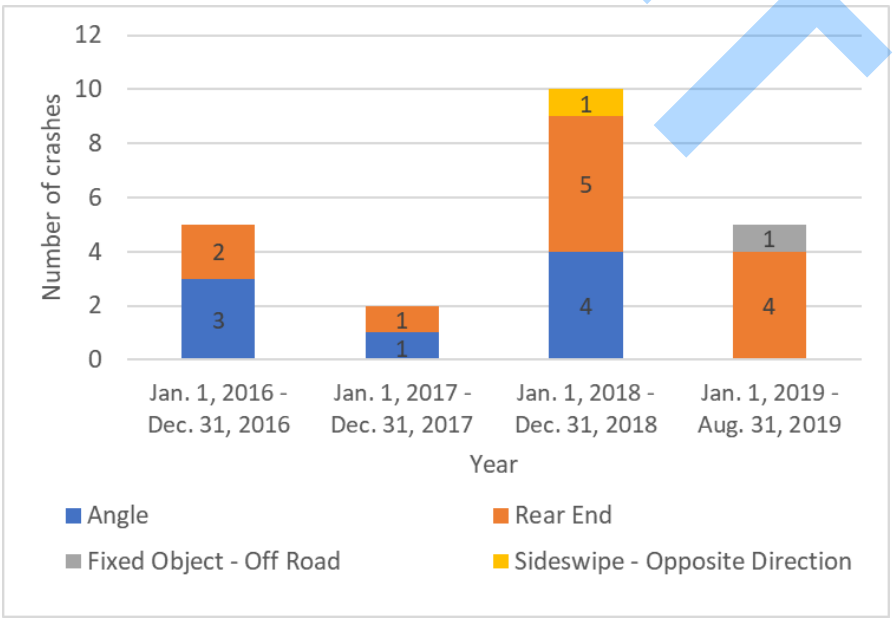


Figure 47: Davis Dr. and South Sterling Blvd. - Crash Type by Year

Tippett Hill Drive and Glenn Drive

No crashes occurred at the Tippett Hill Drive and Glenn Drive intersection between January 2016 and August 2019.

Belfort Park Drive and Glenn Drive

The Belfort Park Drive and Glenn Drive intersection had a total of 12 crashes from January 2016 to August 2019. **Figure 48** shows the crash types by year for this intersection. Overall, the highest number of crashes occurred in 2019 representing 50% of the total crashes. All reported crashes were angle crashes at this intersection. Most of the crashes occurred due to driver's failure on Belfort Park Drive to yield the right of way to the free-flow traffic on Glenn Drive. Some of the drivers approaching from Belfort Park Drive claimed that they thought the intersection is a four-way stop-controlled intersection. Except for one crash, all crashes occurred during daytime.

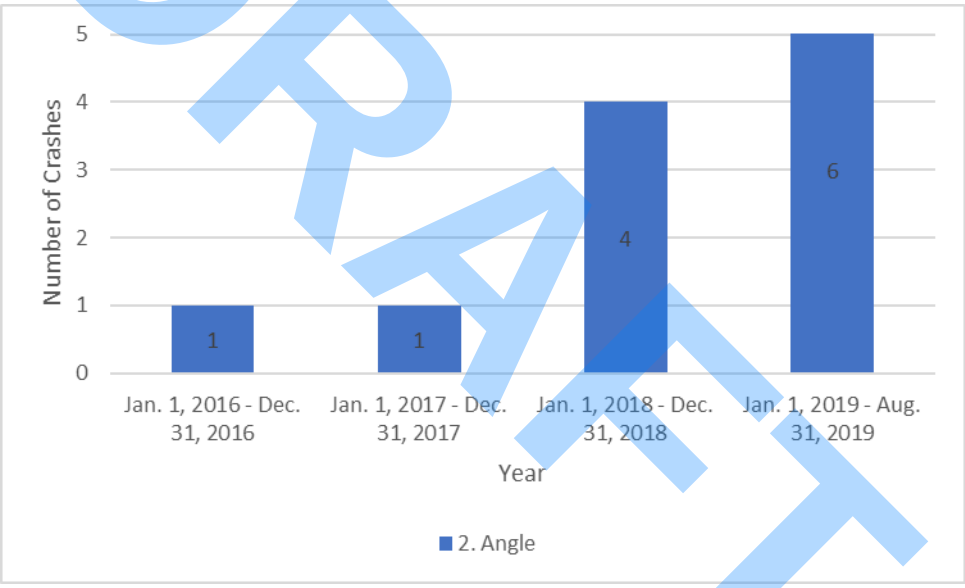


Figure 48: Belfort Park Dr. and Glenn Dr. - Crash Type by Year

Belfort Park Drive/Lindsay Cars Court and Shaw Road

The Belfort Park Drive and Shaw Road intersection recorded a total of two crashes for the analysis period. Both crashes occurred in 2017, with one angle and one fixed object crash, and both were caused by driver distraction.

TRANSIT

The Davis Drive corridor also serves as a transit corridor for Loudoun County Transit Route 84 – Atlantic Connector, which travels along Davis Drive in both directions. There are three bus stops along Davis Drive in each direction. Two of the bus stops are located just north of Shepard Drive to serve the industrial and commercial facilities in Shepard Drive area. The distance between the two bus stops is approximately 0.13 miles. The third bus stop is located north of Great Trail Square to serve the residential community in that area. The third bus stop is approximately 0.55 miles north of the nearest bus stop at Davis Drive and Export

Drive bus stop. The location of the bus stops are shown in **Figure 49** from the Loudoun County Transit website and field verified by JMT. The bus stops have no shelters. All but one of the bus stops have grass landings and are not connected to sidewalks. The exception is the Shaw and Tippett bus stop which has a grass landing on a buffer next to a sidewalk. During the field observation, pedestrians were observed directly crossing Davis Drive outside of any crosswalk to access the bus stops. The total ridership for Loudoun County Transit Route 84 for 2019 was about 21,000 riders, with an average daily ridership of 123 riders. Per the Loudoun County Transit website, the buses are scheduled to run every hour.

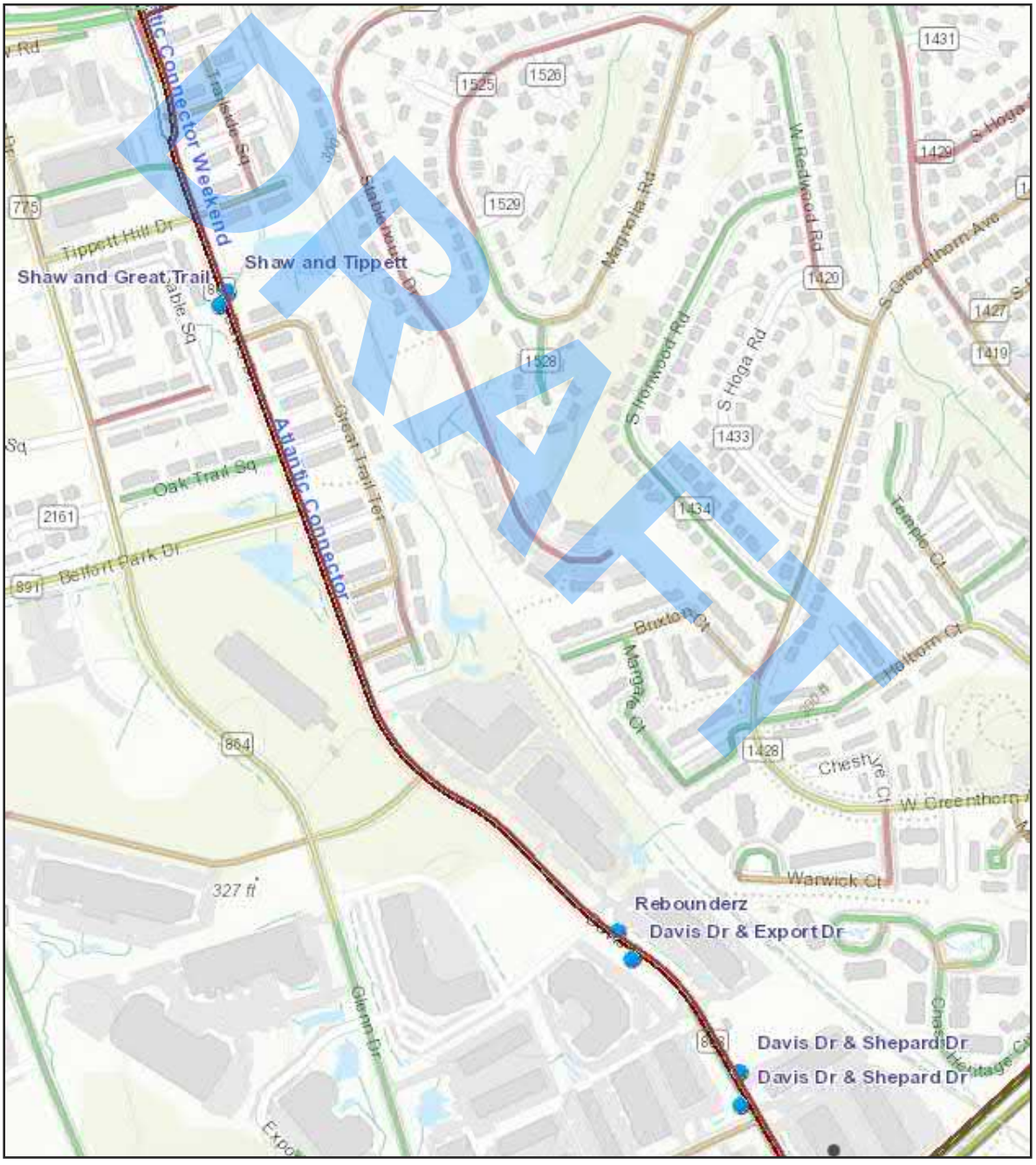


Figure 49: Bus Stop Locations along Davis Dr.

ACCESS MANAGEMENT

Access management controls the location, spacing, design and operation of entrances, intersections, and median openings to promote the safety and efficiency of the transportation system. Spacing between access points needs to maintain the minimum spacing requirements in the RDM in Appendix F as shown in **Table 11**. The minimum spacing is determined based on three factors: functional classification, design speed and existing and proposed access types.

Table 11: Minimum Spacing Standards for Commercial Entrances, Intersections and Median Crossovers

VDOT Road Design Manual Appendix F Table 2-2					
Functional Classification	Design Speed (See Note 2)	Minimum Spacing (Distance) in Feet			
		Type 1 (Signalized)	Type 2 (Unsignalized/ Full Crossover)	Type 3 (Full Access /Directional Crossover)	Type 4 (Partial Access)
Principal Arterial	≤ 30 mph 35 to 45 mph ≥ 50 mph	1,050 1,320 2,640	880 1,050 1,320	440 565 750	250 305 495
Minor Arterial	≤ 30 mph 35 to 45 mph ≥ 50 mph	880 1,050 1,320	660 660 1,050	355 470 555	200 250 425
Collector	≤ 30 mph 35 to 45 mph ≥ 50 mph	660 660 1,050	440 440 660	225 335 445	200 250 360
Local Street	See Note 1				

The spacing between the access points along Davis Drive between West Church Road and South Sterling Boulevard are presented in **Figure 50**, **Table 12**, and **Table 13**. The access points along Davis Drive include commercial entrances, and unsignalized intersections. All the entrances/intersecting roadways have full access movement. The spacing on the east side of the roadway is presented in **Table 12,** and the spacing on the west side of the roadway is presented in **Table 13**.

Figure 50: Accesses along Davis Drive

Table 12: Access Spacing along Davis Drive - East Side

Entrance #	Intersection	Entrance Type FM = Full Movement	Intersection Type Unsignalized/Signalized	Meets VDOT Acc. Mgmt. Spacing STD (Y/N)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
	West Church Road	FM	Signalized			
				Y	420	335
E1	Clark Crossing Square	FM	Unsignalized			
				Y	375	335
E2	Tippet Hill Drive/ Bluemont Junction Square	FM	Unsignalized			
				Y	485	335
E3	Great Trail Terrace	FM	Unsignalized			
				Y	470	335
E4	Lost Trail Terrace	FM	Unsignalized			
				Y	810	335
E5	Overmountain Square	FM	Unsignalized			
				N	215	335
E6	East Sterling Park Business Center Northern Entrance	FM	Unsignalized			
				N	280	335
E7	East Sterling Park Business Center Mid Entrance	FM	Unsignalized			
				Y	515	335
E8	East Sterling Park Business Center Southern Entrance Entrance	FM	Unsignalized			
				N	325	335
E9	West Sterling Park Business Center Northern Entrance	FM	Unsignalized			
				Y	510	440
E10	West Sterling Park Business Center Southern Entrance	FM	Unsignalized			
				N	95	440
E11	Power Station Northern Entrance	FM	Unsignalized			
				N	200	440
E12	Power Station Southern Entrance	FM	Unsignalized			
				N	65	335
E13	22500 Davis Drive Northern Entrance	FM	Unsignalized			
				N	105	335
E14	22500 Davis Drive Southern Entrance	FM	Unsignalized			
				N	105	335
E15	201 Davis Drive Entrance	FM	Unsignalized			
				Y	445	335
	South Sterling Boulevard	FM	Signalized			

Table 13: Access Spacing along Davis Drive – West Side

Entrance #	Intersection	Entrance Type FM = Full Movement	Intersection Type Unsignalized/Signalized	Meets VDOT Acc. Mgmt. Spacing STD (Y/N)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
	West Church Road	FM	Signalized			
				Y	420	335
W1	Sterling Oaks Commerce Center Northern Entrance	FM	Unsignalized			
				N	170	335
W2	Sterling Oaks Commerce Center Southern Entrance	FM	Unsignalized			
				N	200	335
W3	Tippet Hill Drive/ Bluemont Junction Square	FM	Unsignalized			
				Y	935	335
W4	Lost Trail Terrace	FM	Unsignalized			
				N	250	335
W5	Belfort Park Drive	FM	Unsignalized			
				Y	690	335
W6	US CBP Entrance	FM	Unsignalized			
				Y	360	335
W7	First Potomac Way	FM	Unsignalized			
				Y	810	335
W8	West Sterling Park Business Center Northern Entrance	FM	Unsignalized			
				Y	490	440
W9	West Sterling Park Business Center Southern Entrance	FM	Unsignalized			
				N	95	440
W10	Persian Market Entrance	FM	Unsignalized			
				Y	380	335
W11	Shepard Drive	FM	Unsignalized			
				N	250	335
W12	Sunoco Gas station Entrance	FM	Unsignalized			
				N	250	335
	South Sterling Boulevard	FM	Signalized			

In addition to reviewing the spacing along the entire corridor, JMT evaluated two access points along Davis Drive due to reported safety concerns. These access points are the US CBP Entrance on Davis Drive and the ingress/egress of the business center located at the northwest quadrant of the Davis Drive and South Sterling Boulevard intersection. These two access points are discussed in the following sections:

US CBP ENTRANCE ON DAVIS DRIVE

The main entrance of the building is located on Glenn Drive between Belfort Park Drive and First Potomac Way. However, trucks were observed using the entrance located on Davis Drive. This is a safety concern for Davis Drive since there is no dedicated right turn lane for the entrance. The intersection sight distance from the entrance to Davis Drive was not collected due to the security protocols of the federal building. However, the approaching sight distance on Davis Drive toward the entrance appeared to be adequate. Based on the percentage of heavy vehicles using the entrance and recent crash data, there are no safety concerns at this location. Of the 525 total vehicles that were observed to use the entrance during the 15-hour volume, only five heavy vehicles, 1% of the total traffic, were observed entering or leaving the US CBP Entrance. The crash analysis showed there were no crashes at the intersection from January 2016 to August 2019. The US CBP entrance meets the full access entrance standard spacing per VDOT RDM Appendix F, Table 2-2, and as shown in **Table 12**.

BUSINESS CENTER ENTRANCE ON DAVIS DRIVE

The ingress/egress of the business center, located at the northwest quadrant of the Davis Drive and South Sterling Boulevard Intersection, was evaluated. The business center houses multiple businesses including the Sunoco Gas Station, Mr. Tire Auto Service Center, Autobell Car Wash, Honest Tom's Express Lube and Brake Center, and Bubble & Shine DIY Car Wash. The center has three entrances, one on Davis Drive and two on Shepard Drive. The entrance located west of Davis Drive between South Sterling Boulevard and Shepard Drive was evaluated for reported safety concerns.

Based on field observation, vehicles, including trucks, mostly use the entrance on Davis Drive to access the business center. Most of the vehicles accessing the business center come from South Sterling Boulevard, traveling north on Davis Drive, and make a left into the business center using the entrance on Davis Drive. This is likely due to the visibility of the business center and entrance from South Sterling Boulevard along with it is the first entrance drivers will see travelling from South Sterling Boulevard. During the AM peak period, 12 vehicles were observed to turn left into the business center from Davis Drive, and 4 vehicles were observed to turn left onto Davis Drive from the business center. In the PM peak period, 21 vehicles were observed to turn left into the business center from Davis Drive, and 5 vehicles were observed to turn left onto Davis Drive from the business center.

Left turning movements into the business center at the Davis Drive entrance cause safety concerns. The crash data from January 2016 to August 2019 shows that this location has the highest number of crashes along the corridor. The entrance has a total of 27 crashes, with angle crashes (93% of total crashes at this entrance) being the predominant crashes. The crash pattern shows majority of the crashes occurred between northbound left turning vehicles into the center with the southbound through traffic on Davis Drive. The Business Center entrance does not meet the minimum full access entrance standard spacing per VDOT RDM Appendix F, Table 2-2, and as shown in **Table 12**.

OPERATIONAL ANALYSIS

JMT developed Synchro models to analyze the existing traffic operations for the AM and PM peak hours along the Davis Drive corridor study area. This section describes the simulation tools and the calibration techniques that were used in developing the existing AM and PM models, measures of effectiveness, and the results of the analysis. The peak hour intersection turning movement counts were not balanced to account for the commercial driveways/access points in-between the study intersections. Note that the volume differences along Davis Drive between the study intersections are minimal and balancing them throughout the network would have minimum to no impacts on the results of the operational analysis.

SYNCHRO

The evaluation of existing conditions was accomplished using the Synchro/SimTraffic software tools (version 10.3). JMT developed models for the existing AM and PM peak hour conditions to determine the average control delay and the corresponding Level of Service (LOS). Synchro 10.3 software has limitations in analyzing the signalized intersections using the Highway Capacity Manual (HCM) 2010 module that is embedded in the software. The HCM 2010 module expects signals to run on standard NEMA phasing with standard NEMA quad ring-barrier structure. The module does not support multiple barriers. Accordingly, HCM 2000 methodology in Synchro was used to analyze the signalized intersections, whereas HCM 2010 methodology was used to analyze the unsignalized intersections. SimTraffic was used to estimate the travel time, throughput, and speeds along the Davis Drive Corridor.

MODEL CALIBRATION

Calibration of a simulation model is a critical step to ensure that model results reflect existing field conditions to the extent possible and can be relied upon when testing alternative concepts with the future traffic volumes. Existing signal timing and phasing data (including cycle lengths, splits and offsets, yellow, and all-red clearance intervals) were provided by VDOT and used in this evaluation.

The existing models were calibrated using the traffic counts and travel time thresholds as listed in VDOT's TOSAM Version 2.0. During the field observation, ten travel time runs were collected in the AM and PM peak periods along 1.04 mile of Davis Drive, between West Church Road and South Sterling Boulevard, for the northbound and southbound directions. The average of the ten travel time runs is presented in **Table 14**.

Table 14: Field Observed Travel Time along Davis Dr. Corridor

Peak Period	NB	SB
AM Peak	2.3 mins	2.9 mins
PM Peak	2.3 mins	3.0 mins

Calibration Parameters

The existing AM and PM models were calibrated based on two calibration parameters: traffic throughput and travel times. VDOT's TOSAM Version 2.0 lists the following calibration criteria for simulated volumes and simulated travel times on arterials, which applies to Davis Drive Corridor:

- Simulated throughput in vehicles per hour (vph) should be within the following thresholds:
  - ± 20% for < 100 vph
  - ± 15% for ≥100 vph to < 1,000 vph
- Simulated travel time (seconds) should range within ± 30% for average observed travel times

Calibration Output Summary/ Model Validation

The existing conditions Synchro models were calibrated to generate the most reliable output. Existing signal phasing provided by VDOT was verified in the field and signal timing splits were adapted for the model calibration purposes. Field travel times were conducted for the study corridor and compared with travel times obtained from the SimTraffic models. The queue lengths produced by the existing models were found to be similar to the queues observed in the field.

The simulated traffic volumes are summarized and compared to the counted traffic volumes for the AM and PM peak hours as shown in **Table 15** and **Table 16**, respectively. The percentage differences between the simulated traffic volumes and the counted traffic volumes were calculated. A negative percentage difference means the simulated traffic volume is less than the collected field volume. All the simulated traffic volumes at the study intersections along Davis Drive corridor are meeting the volume calibration thresholds.

The travel time runs were measured along the Davis Drive corridor between West Church Road and South Sterling Boulevard. The travel time runs were calculated after traversing the signalized intersection to include the encountered delay at the signalized intersections. The simulated travel times are summarized and compared to the field travel times for the AM and PM peak hours as shown in **Table 17**. The percentage difference between the simulated travel time and the field travel time was calculated with respect to the field travel time. A negative percentage difference means a simulated travel time less than the measured field travel time. Simulated travel times for the northbound and the southbound directions during the AM and PM peak hours are meeting the travel time thresholds. The existing conditions SimTraffic result is included in **Appendix D.**

Table 15: AM Counted and Simulated Traffic Volume Comparison

	Intersection	Approach	AM Existing				
			Field Volumes (vph)	Simulated Volume (vph)	Throughput Difference %	Calibration Threshold	
						Within ±	Meeting Threshold?
Davis Dr	South Sterling Blvd	NB	11	10	**-9%**	20%	Yes
		SB	98	102	**4%**	20%	Yes
	Shepard Dr	NB	236	234	**-1%**	15%	Yes
		SB	360	375	**4%**	15%	Yes
	First Potomac Way	NB	217	231	**6%**	15%	Yes
		SB	416	430	**3%**	15%	Yes
	Belfort Park Dr	NB	245	244	**0%**	15%	Yes
		SB	540	549	**2%**	15%	Yes
	Tippett Hill Dr	NB	278	280	**1%**	15%	Yes
		SB	618	637	**3%**	15%	Yes
	West Church Rd	NB	101	104	**3%**	15%	Yes
		SB	111	107	**-4%**	15%	Yes

Table 16: PM Counted and Simulated Traffic Volume Comparison

	Intersection	Approach	PM Existing				
			Field Volumes (vph)	Simulated Volume (vph)	Throughput Difference %	Calibration Threshold	
						Within ±	Meeting Threshold?
Davis Dr	South Sterling Blvd	NB	89	92	**3%**	20%	Yes
		SB	15	15	**0%**	20%	Yes
	Shepard Dr	NB	371	370	**0%**	15%	Yes
		SB	318	320	**1%**	15%	Yes
	First Potomac Way	NB	423	428	**1%**	15%	Yes
		SB	341	339	**-1%**	15%	Yes
	Belfort Park Dr	NB	504	518	**3%**	15%	Yes
		SB	349	377	**8%**	15%	Yes
	Tippett Hill Dr	NB	603	611	**1%**	15%	Yes
		SB	404	406	**0%**	15%	Yes
	West Church Rd	NB	212	212	**0%**	15%	Yes
		SB	169	168	**-1%**	15%	Yes

Table 17: Field and Simulated Travel Time Comparison (AM & PM)

Travel Time between West Church Rd. and South Sterling Blvd.										
Peak Period	NB					SB				
	Field Travel Time (min.)	Simulated Travel Time (min.)	Travel Time Difference %	Calibration Threshold		Field Travel Time (min.)	Simulated Travel Time (min.)	Travel Time Difference %	Calibration Threshold	
				Within ±	Meeting Threshold ?				Within ±	Meeting Threshold?
AM Peak	2.3	2.3	**-2%**	30%	Yes	2.9	3.2	**10%**	30%	Yes
PM Peak	2.3	2.7	**14%**	30%	Yes	3.0	3.6	**21%**	30%	Yes

NUMBER OF MODEL SIMULATION RUNS

Per the TOSAM 2.0 guidelines, the VDOT Sample Size Determination Tool (Version 2.0) was used to determine the number of simulation runs required. The Measure of Effectiveness used for this tool was the average simulated travel speed. Northbound and southbound speeds in the AM and PM peak periods on Davis Drive between Shepard Drive and Tippett Hill Drive/Bluemont Junction Square were captured for ten individual runs and used as input for the tool. As shown in **Figure 51** and **Figure 52**, ten simulation runs were determined to be adequate for both AM and PM peak hour models.

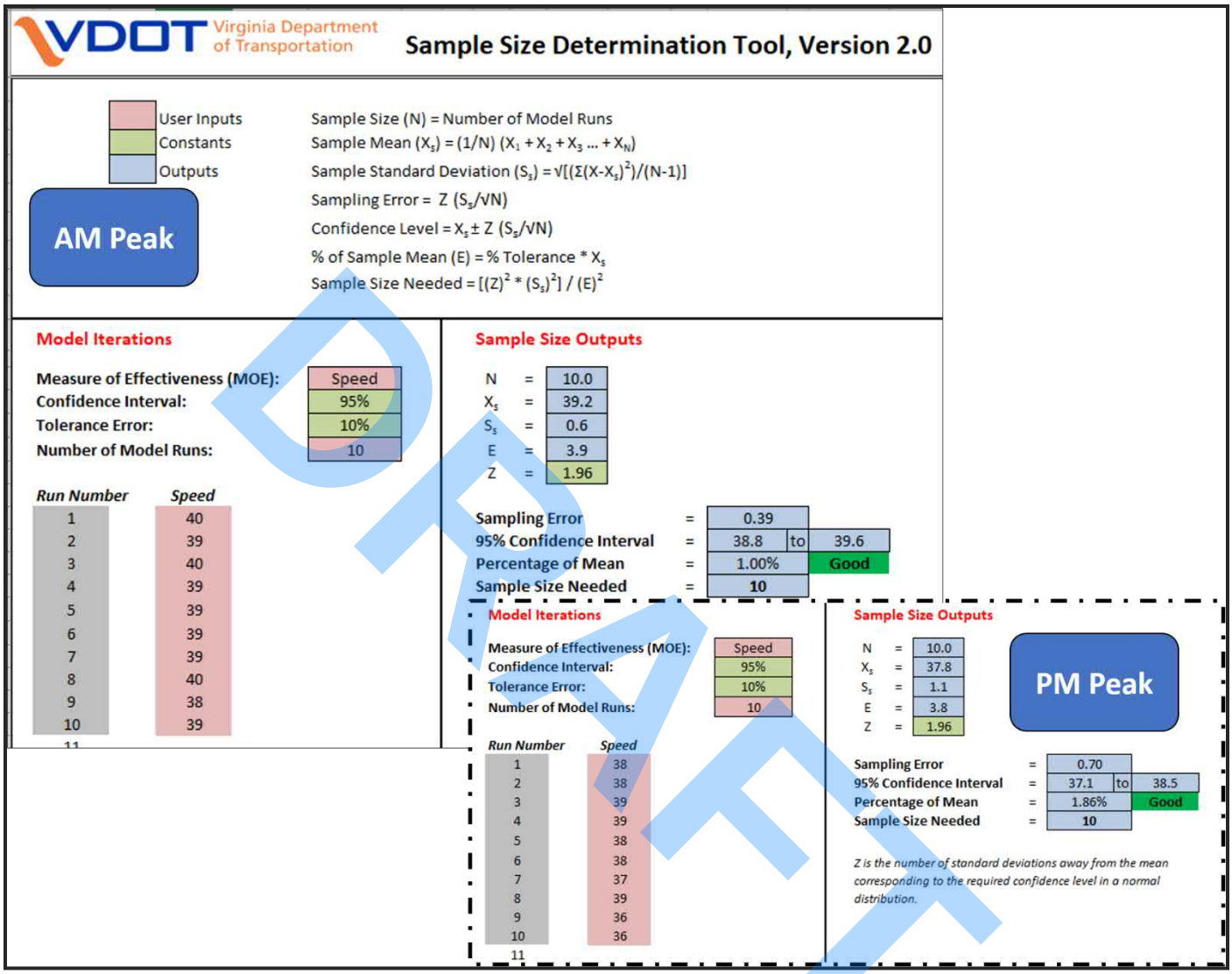


Figure 51: Davis Dr. NB Sample Size Determination (AM & PM Peak Hour)

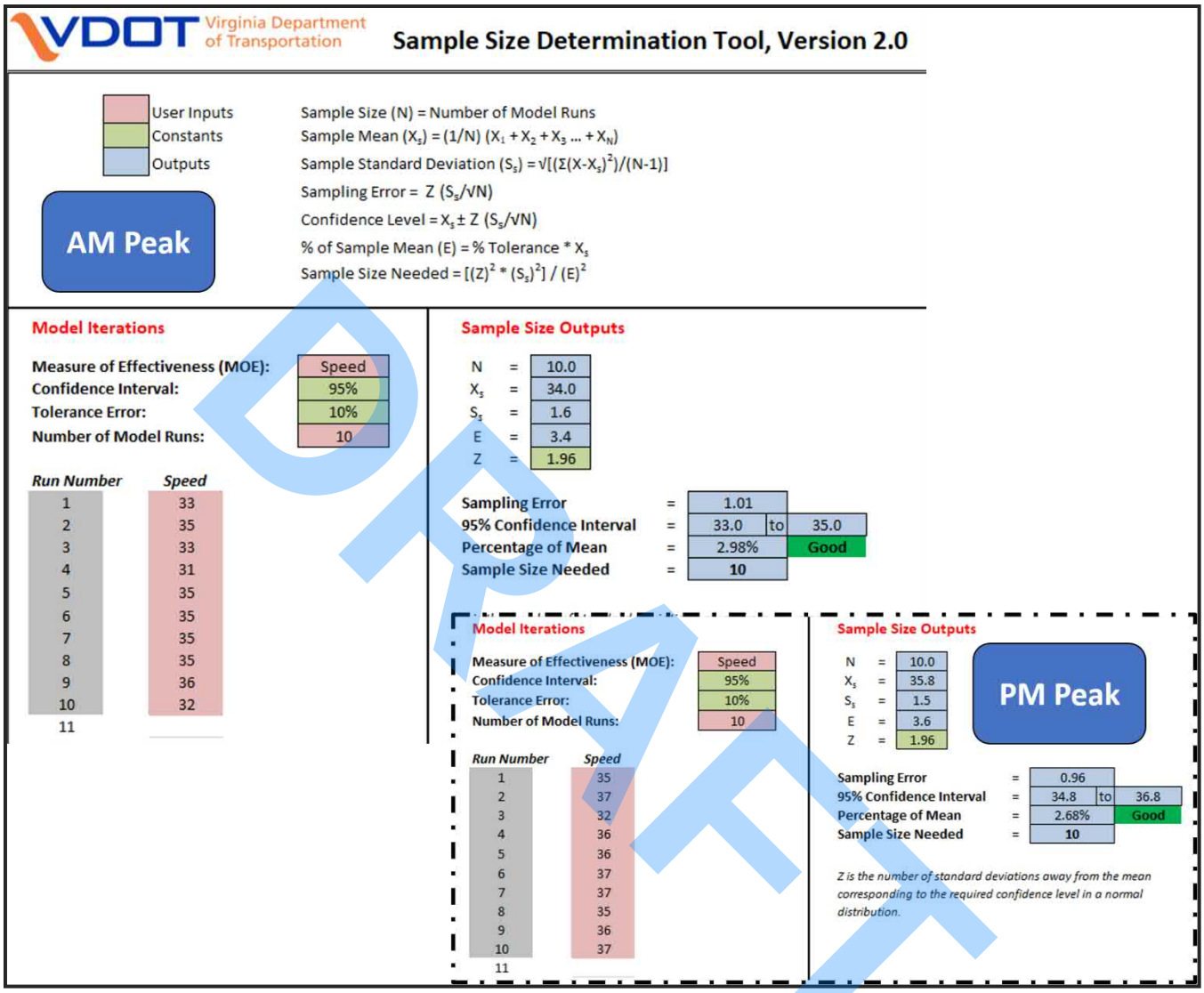


Figure 52: Davis Dr. SB Sample Size Determination (AM & PM Peak Hour)

MEASURES OF EFFECTIVENESS (MOE)

VDOT's TOSAM Version 2.0 lists 95th Percentile Queue Length, Average Control Delay and Average Travel Speed as appropriate MOEs to evaluate the operations for an arterial network. Average control delay and LOS were captured from Synchro output data for the signalized and unsignalized intersections for existing models during AM and PM peak hours. Ten simulation runs from SimTraffic were conducted and averaged to gather additional MOEs pertaining to arterial performance such as 95th percentile queue lengths and average travel speeds for the existing models.

LEVEL OF SERVICE (LOS)

LOS were defined by HCM to provide a quantitative measure to characterize operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience. Letters designate each level, from A to F, with LOS A

representing the best operating conditions and LOS F the worst. Each level of service represents a range of operating conditions and the driver's perception of those conditions. For signalized intersections, LOS is directly related to the average control delay per vehicle in seconds. The criteria for signalized intersections from HCM are presented in **Table 18**.

Table 18: LOS Criteria for Signalized Intersections (HCM 2000)

Level of Service	Average Control Delay *(sec/veh.)*
A	≤ 10
B	> 10 – 20
C	> 20 – 35
D	> 35 – 55
E	> 55 – 80
F	> 80

Two signalized intersections within the study area were analyzed. LOS was determined for signalized intersections for AM and PM peak hours based on the HCM - 2000 edition that is embedded in the Synchro 10.3 software. According to the VDOT standards, and LOS threshold set in the 2019 CTP, a LOS threshold of D or better, overall intersection and each approach, will be the acceptable thresholds for analyzing needed improvements.

LOS criteria for unsignalized/two-way stop-controlled intersection defined in terms of the average control delay for each minor-street movement (or shared movement) as well as major-street left turns. This approach is because major street through vehicles are assumed to experience zero delays due to free flow operations. **Table 19** shows LOS criteria for unsignalized intersections.

Table 19: LOS Criteria for Unsignalized Intersections (HCM 2010)

Level of Service	Average Control Delay *(sec/veh.)*
A	≤ 10
B	> 10 – 15
C	> 15 – 25
D	> 25 – 35
E	> 35 – 50
F	> 50

DELAY AND LOS ANALYSIS

Unsignalized Intersections

The unsignalized intersections analyzed are all two-way stop-controlled with the stop control on the minor roadways and free flow operations on the major roadways. The following is the list of the study unsignalized intersections:

- Davis Drive and Tippett Hill Drive/Bluemont Junction Square, with stop control on the Tippett Hill Drive and Bluemont Junction Square.
- Davis Drive and Belfort Park Drive, with stop control on the Belfort Park Drive.
- Davis Drive and US CBP Entrance, with stop control on the US CBP Entrance.
- Davis Drive and First Potomac Way, with stop control on the First Potomac Way.
- Davis Drive and Shepard Drive, with stop control on the Shepard Drive.
- Tippett Hill Drive at Glenn Drive, with stop control on the Tippett Hill Drive.
- Belfort Park Drive and Glenn Drive, with stop control on the Belfort Park Drive.
- Belfort Park Drive and Shaw Road, with stop control on the Belfort Park Drive.

Signalized Intersections

As mentioned earlier, the study area includes two signalized intersections; Davis Drive and West Church Road intersection and Davis Drive and South Sterling Boulevard intersection, which were evaluated. in this study. The existing signal at the intersection of Davis Drive and West Church Road includes a protected left turn phase for all the approaches. The intersection also has an overlapping right turn phase for the northbound and southbound approaches on Davis Drive.

The existing signal at the intersection of Davis Drive and South Sterling Boulevard operates with a split phase for the Davis Drive northbound and southbound approaches. South Sterling Boulevard have protected left turn phases for the eastbound and westbound approaches. The intersection also includes overlapping right turn phases for all the approaches.

RESULTS

Unsignalized Intersections

Control delay, LOS and the 95th percentile queues for the AM and PM peak hours for the unsignalized intersections are presented in **Table 20.** All the approaches with the stop control operate at LOS C or better during the AM and PM peak periods, except at the Tippett Hill Drive eastbound approach at the Davis Drive intersection. The Tippett Hill Drive eastbound approach operates at LOS D and LOS E during the AM and PM peak periods, respectively. The existing conditions Synchro analysis reports are included in **Appendix D**.

Table 20: Synchro/SimTraffic Results for Unsignalized Intersections (AM & PM Peak Hours)

Intersection	Approach	Movement	AM Existing					PM Existing				
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	95th Percentile Queue (ft)	Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	95th Percentile Queue (ft)
Davis Dr & Tippett Hill Dr	WB	L/T/R	17.7	C	17.7	C	29	16.6	C	16.6	C	29
	EB	L/T/R	28.0	D	28.0	D	64	35.3	E	35.3	E	236
Davis Dr & Belfort Park Dr	EB	Left	20.4	C	19.2	C	51	21.5	C	20.6	C	80
		Right	10.9	B			17	9.7	A			27
Davis Dr & CBP Entrance	EB	Left	15.8	C	14.0	C	21	15.0	C	12.8	B	40
		Right	11.1	B			22	9.5	A			34
Davis Dr & First Potomac Way	WB	L/T/R	9.0	A	9.0	A	10	12.9	B	12.9	B	19
	EB	L/T/R	19.2	C	19.2	C	67	19.3	C	19.3	C	58
Davis Dr & Shepard Dr	WB	L/T/R	14.3	B	14.3	B	17	14.8	B	14.8	B	25
	EB	L/T	15.7	C	12.6	B	52	15.5	C	12.1	B	45
		Right	9.8	A			48	9.5	A			43
Glenn Dr & Tippett Hill Dr	WB	L/R	8.9	A	8.9	A	53	9.2	A	9.2	A	52
Glenn Dr & Belfort Park Dr	WB	L/T	10.1	B	10.1	B	40	10.1	B	9.8	A	33
		T/R	10.0	B			29	9.5	A			21
	EB	L/T	10.1	B	9.6	A	35	10.4	B	10.3	B	48
		T/R	9.3	A			37	10.2	B			35
Shaw Rd & Belfort Park Dr	WB	L/T	9.9	A	9.7	A	48	10.2	B	9.9	A	48
		Right	8.6	A			33	8.7	A			33
	EB	L/T/R	9.6	A	9.6	A	11	8.6	A	8.6	A	15

Signalized Intersections

Control delay, LOS and the 95th percentile queues for the AM and PM peak hours for the signalized intersections along the corridor are presented in **Table 21** and **Table 22**, respectively. The results show that both intersections operate at an acceptable overall intersection LOS D or better during the AM peak period. Both intersections operate at LOS E or better during the PM peak period. In addition to the reported 95th percentile queue lengths, the number of turning vehicles prevented to enter the storage lane due to the adjacent through traffic blocking the corresponding storage lane are noted in the tables (see the annotation at the bottom of Table 22). When the through lane blocks a storage lane, SimTraffic reports the number of vehicles that were prevented to access the turn-lane as a "queuing penalty".

The intersection of Davis Drive and West Church Road approaches operate at a LOS D or better during the AM peak hour. However, the northbound approach operates at LOS E and the southbound approach operates at LOS F during the PM peak hour.

At the intersection of Davis Drive and South Sterling Boulevard, the northbound approach operates at LOS E and the southbound approach operates at a LOS F during the AM Peak period. During the PM peak period, the northbound and southbound approaches both operate at a LOS F.

Queue observations were collected at both signalized intersections for both the AM and PM peak periods. This is shown in **Table 23.** The collected data was used to calibrate the queue lengths simulated in SimTraffic with the field observed queues. The simulated queues along the northbound left and southbound through/right lanes at the Davis Drive/West Church Road intersection, extend beyond turn lane storage during the PM peak period.

In addition, the field observed southbound queues at the South Sterling Boulevard/Davis Drive intersection spill back to and beyond the upstream Davis Drive and Shepard Drive intersection. Similar queue lengths were visually represented at those critical locations in the SimTraffic simulation.

Table 21: Synchro/SimTraffic Results for Signalized Intersections - AM Peak Hour

Intersection	Approach	Movement	AM Existing							
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	95th Percentile Queue (ft)	Storage Lane (ft)
Davis Dr & W Church Rd	NB	Left	67.8	E	49.7	D	32.8	C	249	310
		Through	39.9	D					86	-
		Right	29.7	C					65	300
	SB	Left	60.3	E	46.5	D			71	315
		Through/Right	50.2	D					195	-
		Right	36.0	D					139	295
	WB	Left	57.7	E	28.2	C			191	415
		Through	24.0	C					296	-
		Right	17.7	B					47	215
	EB	Left	53.7	D	28.3	C			134	390
		Through	28.0	C					308	-
		Right	22.8	C					136	-
Davis Dr & S Sterling Blvd	NB	Left/Through	68.4	E	64.2	E	38.4	D	169	-
		Right	49.1	D					28	-
	SB	Left/Through	102.7	F	81.3	F			385	-
		Right	42.3	D					117	-
	WB	Left	67.8	E	29.6	C			172	260
		Through	31.6	C					391	-
		Right	10.6	B					189	250
	EB	Left	70.3	E	25.7	C			110	310
		Through	23.8	C					186	-
		Right	13.9	B					55	260

Table 22: Synchro/SimTraffic Results for Signalized Intersections - PM Peak Hour

Intersection	Approach	Movement	PM Existing							
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	95th Percentile Queue (ft)	Storage Lane (ft)
Davis Dr & W Church Rd	NB	Left	90.0	F	59.2	E	56.6	E	400 (53)*	310
		Through	38.9	D					875	-
		Right	29.0	C					124	300
	SB	Left	69.7	E	102.2	F			89	315
		Through/Right	133.3	F					542	-
		Right	57.3	E					395 (33)*	295
	WB	Left	73.5	E	38.9	D			233	415
		Through	34.8	C					392	-
		Right	24.0	C					88	215
	EB	Left	65.2	E	42.0	D			259	390
		Through	41.9	D					440	-
		Right	28.1	C					71	-
Davis Dr & S Sterling Blvd	NB	Left/Through	95.1	F	83.0	F	53.7	D	400	-
		Right	42.1	D					163	-
	SB	Left/Through	119.5	F	90.7	F			403	-
		Right	46.7	D					80	-
	WB	Left	77.5	E	34.9	C			160	260
		Through	37.2	D					330	-
		Right	19.2	B					123	250
	EB	Left	72.2	E	45.7	D			359	310
		Through	44.4	D					498	-
		Right	10.5	B					183	260

*(xx) –SimTraffic-reported turn-lane queuing penalty, represent by number of turning vehicles (veh) blocked from accessing the storage lane

Table 23: Maximum Observed Queues at the Signalized Intersections - AM & PM Peak Hours

Intersection	Approach	Storage Length (ft)	AM Existing		PM Existing	
			Max Observed Queue (ft)	Exceed Storage Length	Max Observed Queue (ft)	Exceed Storage Length
Davis Drive and West Church Rd	NBL	310	200	No	425	Yes
	NBT	-	175	-	450	-
	SBL	315	75	No	75	No
	SBT/SBR	-	125	-	650	-
	WBL	415	175	No	150	No
	WBT	-	350	-	475	-
	EBL	390	175	No	210	No
	EBT	-	350	-	450	-
Davis Drive and South Sterling Blvd	NBL/NBT	-	175	-	300	-
	SBL/SBT	-	450	-	450	-
	WBL	260	160	No	150	No
	WBT	-	450	-	200	-
	EBL	310	125	No	300	No
	EBT	-	300	-	620	-

Davis Drive Corridor Travel Speed

The simulated travel speed for the northbound and southbound directions for the AM and PM peak hours are shown in **Table 24** and **Table 25**, respectively. The speed presented is measured for two segments. First segment covers the total study corridor along Davis Drive between West Church Road and South Sterling Boulevard to include the encountered delays at the signalized intersections. The second segment covers the average speed data between Shepard Drive and Tippett Hill Drive to measure the speed at the uninterrupted corridor segments excluding the delay at the signalized intersections.

Table 24: AM Average Simulated Travel Speed

	Existing AM	
Davis Drive Corridor	NB Simulated Speed (MPH)	SB Simulated Speed (MPH)
Between West Church Rd and South Sterling Blvd	27	20
Between Shepard Dr and Tippett Hill Dr	39	34

Table 25: PM Average Simulated Travel Speed

	Existing PM	
Davis Drive Corridor	NB Simulated Speed (MPH)	SB Simulated Speed (MPH)
Between West Church Rd and South Sterling Blvd	23	17
Between Shepard Dr and Tippett Hill Dr	38	35

DEFICIENCIES IN THE EXISTING CONDITIONS

Based on the analysis and/or observations of the existing conditions in the study area, several deficiencies were identified. The deficiencies relate to roadway elements, safety, and operational issues. The following details the identified deficiencies within the study area:

Roadway Elements

- The pavement along Davis Drive and intersecting roadways is either in fair or poor condition and some pavement markings, particularly the stop bars, are faded:
  - Pavement condition along Davis Drive was observed to be in fair condition as asphalt cracking was observed throughout the corridor.
  - Pavement condition along Shepard Drive was observed to be in fair condition as asphalt cracking was observed between Davis Drive and Glenn Drive.
  - The stop bar on the Shepard Drive approach to Davis Drive is missing.
  - The stop bar on the First Potomac Way approach to Davis Drive is faded.
  - The stop bar on the Tippett Hill Drive approach to Davis Drive is faded.
  - The stop bars on the northbound and southbound approaches on Davis Drive at South Sterling Boulevard are faded.
  - The stop bar and turn-lane arrow markings on the northbound Davis Drive approach to West Church Road are faded.
  - Missing on-street bicycle facility on Belfort Park Drive and Glenn Drive per the CTP. It is recognized that this has yet to be implemented in the corridor.
- Belfort Park Drive 4-lane roadway configuration is inconsistent with the CTP, which calls for a 2-lane roadway with on-street bike lane.
- Glenn Drive, south of Belfort Park Drive, 4-lane roadway configuration is inconsistent with the CTP, which calls for a 2-lane roadway with on-street bike lane.

Pedestrian Facilities

- Sidewalks are not continuously provided along Davis Drive. A 5-foot-wide sidewalk exists from Overmountain Square to West Church Road on the east side of Davis Drive, which connects the residential community on the northern part of Davis Drive, and a 6-foot sidewalk on the west side of Davis Drive, north of Tippett Hill Drive.
- According to the Loudoun County 2019 CTP, a 6-foot-wide sidewalk on one side and 10-foot-wide Shared Use Path on the other side is planned along Davis Drive.
  - Approximately 0.9 miles of standard 6-foot-wide sidewalk is missing along Davis Drive.
  - There is no shared use path along Davis Drive.
- There is no sidewalk connectivity between the intersection of Shaw Road and Belfort Park Drive, as well as Lindsay Cars Court.
- Pedestrian ramps are available at most of the intersections along Davis Drive except at:
  - Northwest quadrant at Belfort Park Drive.
  - First Potomac Way.
  - Southwest quadrant at Shepard Drive.
  - South Sterling Boulevard.

- Most pedestrian ramps appear not to be in compliance with ADA guidelines.
    - The ramps located on the west side of Davis Drive and north of Tippett Hill Drive appear to be new and in compliance with ADA guidelines.
- There is no pedestrian connectivity, such as crosswalks or sidewalks, to the bus stops along Davis Drive. Pedestrians were observed to do mid-block crossings across Davis Drive to access bus stops.

Safety

- Intersection sight distances does not meet the required ISD at Shepard Drive, First Potomac Way and Belfort Park Drive along the Davis Drive corridor, which is likely a contributing factor to the angle crashes.
- High crash location is identified at the entrance of business center, located on the west side of Davis Drive between South Sterling Boulevard and Shepard Drive. Majority of the crashes were angle crashes (93% of total crashes at the entrance). This is likely caused by inadequate sight distance for this approach. Vehicles stopped at the traffic signal of Davis Drive and South Sterling Boulevard intersection in the southbound approach shared left-through lane create a long queue that spills back to Shepard Drive blocking the northbound left turn vehicles from seeing the southbound vehicles driving down the right lane on Davis Drive.
- Prevalent rear-end crashes observed along the Davis Drive corridor are due to the lack of turn lanes for the turning vehicles at:
    - Tippett Hill Drive/Bluemont Junction Square,
    - Overmountain Square, and
    - Shepard Drive.

Operations

- The unsignalized Tippett Hill Drive/Bluemont Junction Square at Davis Drive intersection is operating at an unacceptable LOS (LOS E) during the PM peak period.
- The signalized Davis Drive and West Church Road intersection is operating at LOS E during the PM peak period.
- The northbound Davis Drive approach at the Davis Drive and West Church Road intersection is operating at capacity, with the left turn movement failing at a delay of 90 sec/veh. during the PM peak hour. Also, the queue extends 90 feet beyond the left turn storage lane.
- At the Davis Drive and South Sterling Boulevard intersection during PM peak period:
    - The shared left/through lane operation in the northbound direction is failing at LOS F and delay of 95 sec/veh. The 95th percentile queue spills back to the upstream intersection.
    - The shared left/through lane operation in the southbound direction is failing at a LOS F and delay of 120 sec/veh. The 95th percentile queue spills back to the upstream intersection of Davis Drive and Shepard Drive.

FUTURE CONDITIONS

Future conditions were evaluated for the study area based on observations from existing conditions and the traffic data collected on January 22, 2020. The future years developed and analyzed in this study are 2030 and 2040 to provide a better understanding of the future needs along the corridor based on the projected traffic volume.

In addition to evaluating existing conditions, this study considered the impact of proposed developments within the study area. There is a rezoning application for the Belfort Park Drive Townhomes which was approved at the September 9, 2020 BOS Public Hearing. The rezoning application also included the provision of a shared use path along the frontage of Davis Drive. The townhomes, which are proposed to be completed and occupied in 2021, will be located on the vacant lot north of Belfort Park Drive and east of Glenn Drive and will have entrance from Belfort Park Drive between Davis Drive and Glenn Drive. The townhomes are expected to generate 7 additional vehicles to the Belfort Park Drive approaches at Glenn Drive during the AM peak hour and 4 additional vehicles during the PM peak hour.

Also, On December 2, 2015, the BOS approved the design and construction of improvements and widening of Shaw Road between Lindsay Cars Court and South Sterling Boulevard. The project, Shaw Road Widening and Drainage Improvements (County Road Project CRCP-2017-0004), as of the January 17, 2019 BOS meeting, is in the process of right-of-way acquisition.

TRAFFIC GROWTH RATE

Compound Annual Growth Rates (CARG) were calculated to determine the historic traffic growth rate along multiple locations in the study area. The Loudoun County Travel Demand Model (TDM) volumes from years 2016, 2030 and 2040, provided by Loudoun County DTCI, were used to determine the annual growth rates in the study area. The volumes from the TDM were compared to the collected ADT. The annual growth rates determined and used for this study are presented in **Table 26**. Based on the projected TDM volumes, Belfort Park Drive was forecasted to have a growth rate of 4%. Nevertheless, this growth was based on the assumption that Belfort Park Drive would be extended over Route 28 (Sully Road) to connect to Pacific Boulevard. However, this extension is no longer being considered according to DTCI. Therefore, the traffic volumes indicated in the plan between 2016 and 2030 are no longer applicable along Belfort Park Drive. A growth rate of 1% is used based on the development potential along Belfort Park Drive corridor.

Table 26: Determined and Recommended CAGR

Location	2016-2040	2016-2030	2030-2040	Average 2016-2040	Rates Used in Study
Davis Drive	3%	4%	1%	3%	**3%**
West Church Road	2%	2%	1%	2%	**2%**
South Sterling Boulevard	0.5%	0.4%	0.6%	0.5%	**1%**
Shaw Road	2%	4%	1%	2%	**2%**
Belfort Park Drive	4%	7%	1%	4%	**1%**
Tippett Hill Drive	1%	0.3%	1%	1%	**1%**

The growth rates were applied to the existing condition peak hour turning movement volumes to determine projected 2030 and 2040 peak hour traffic volumes. The volumes were balanced where applicable in the study area, but mainly kept unbalanced to account for normal fluctuations in traffic volumes from commercial driveways/access points between the study intersections. Year 2030 and Year 2040 peak hour volumes are presented in **Figure 53** and **Figure 54**, respectively.

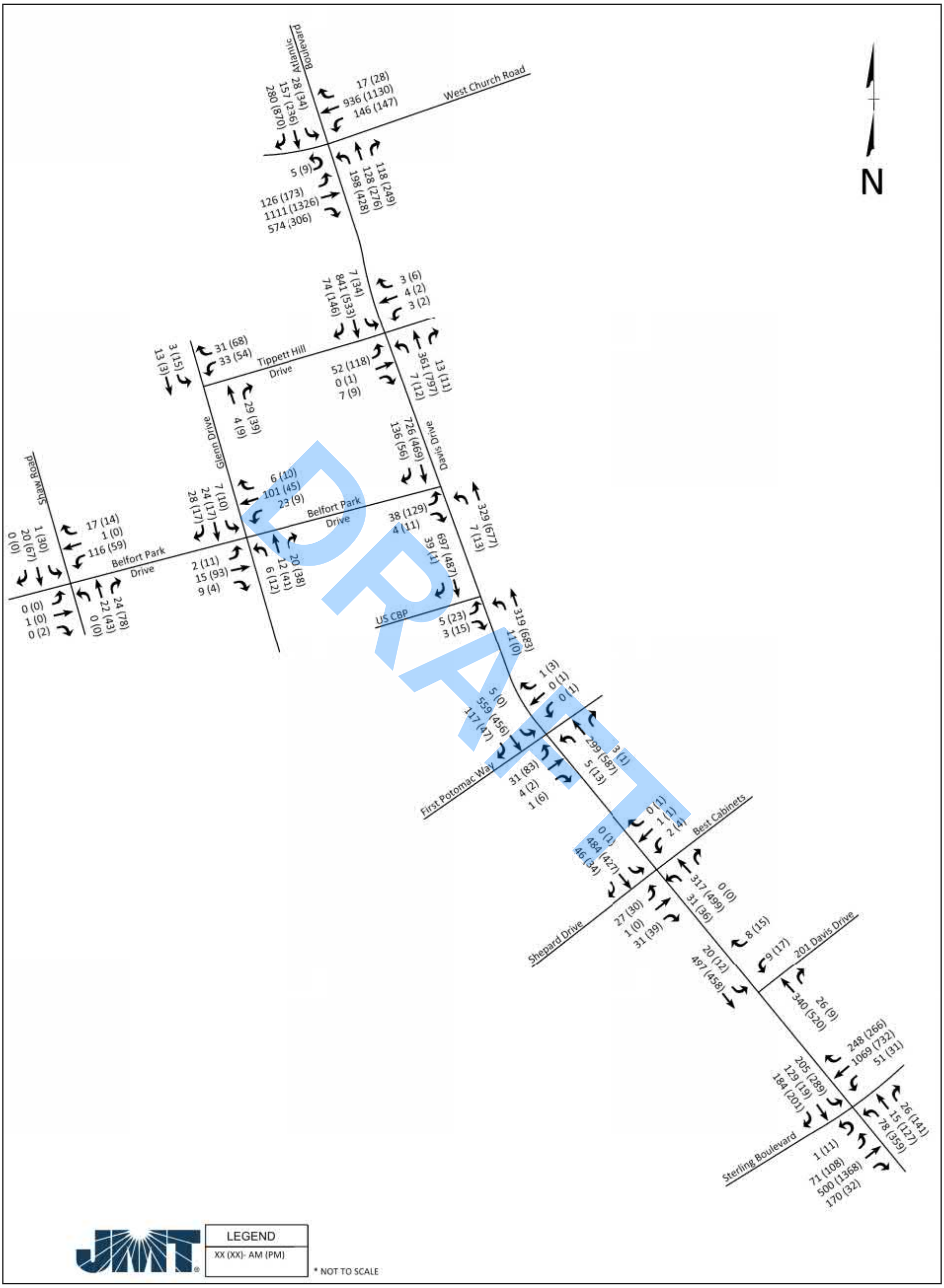


Figure 53: Year 2030 AM and PM Peak Hour Volumes

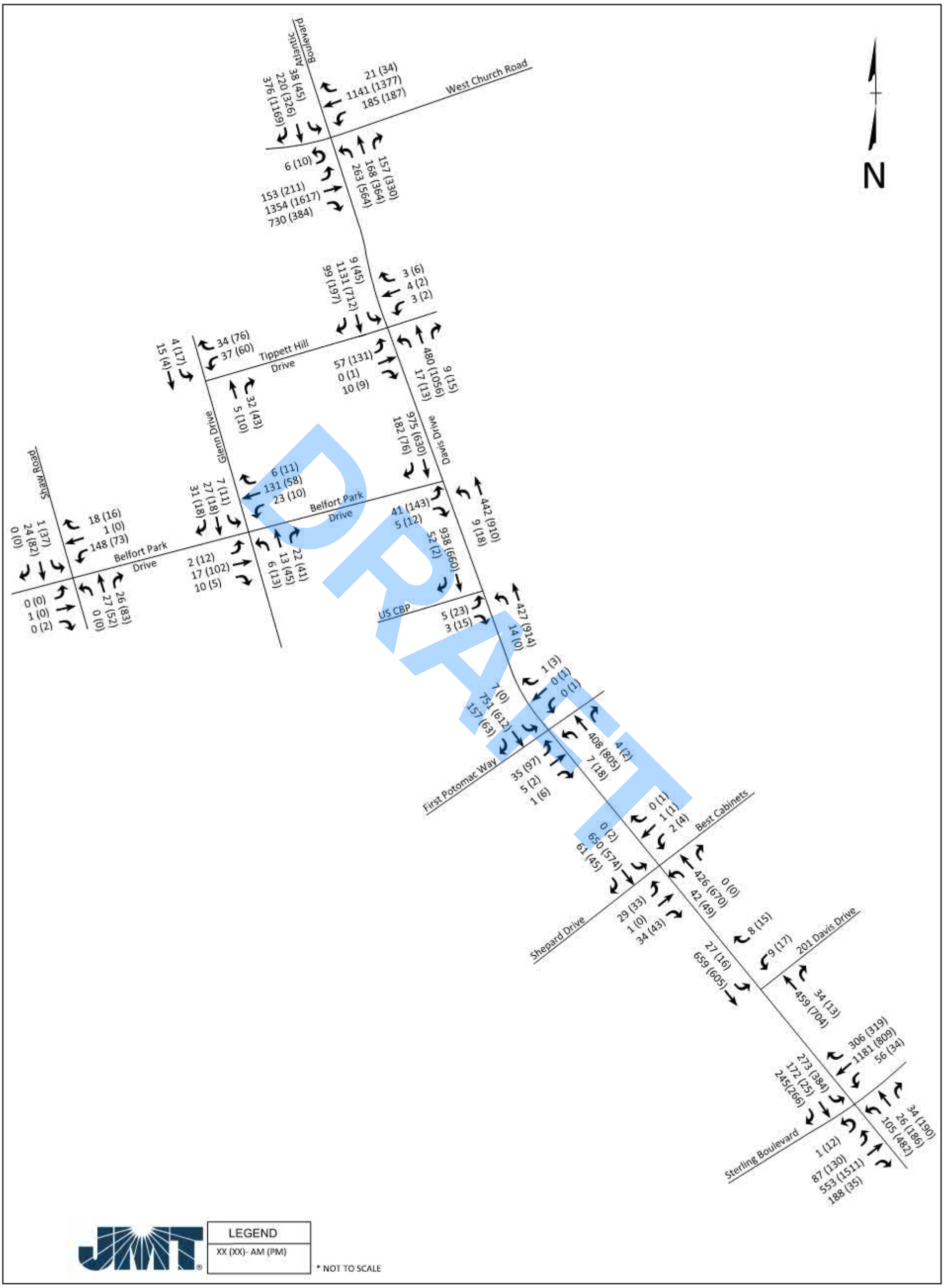


Figure 54: Year 2040 AM and PM Peak Hour Volumes

NO-BUILD CONDITIONS

The No-Build conditions represent future traffic conditions that would result from background traffic growth with the existing roadway geometrics. No-Build scenarios for 2030 and 2040, while being valid alternatives on their own, are used for comparison with other build alternatives to determine the long-term effectiveness of specific improvements along the study corridor. Per the VDOT TOSAM Version 2.0 guidelines, the higher of 0.92 or existing peak hour factor (PHF) was used for the future analysis. 2040 No-Build (worst-case condition) was analyzed using the same cycle lengths and signal splits as the existing conditions.

UNSIGNALIZED INTERSECTIONS

Unsignalized control delays, LOS, and the 95th percentile queues for the No-Build conditions during the AM and PM peak hours, are presented in **Table 27**. Three of the eight unsignalized intersections approaches are expected to operate at LOS E or F. Future 2040 No-Build conditions Synchro output is included in **Appendix F**.

Table 27: 2040 No-Build Delay, LOS and 95th Percentile Queues for Unsignalized Intersections

Intersection	Approach	Movement	AM 2040 No-Build					PM 2040 No-Build				
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	95th Percentile Queue (ft)	Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	95th Percentile Queue (ft)
Davis Dr & Tippett Hill Dr	WB	L/T/R	41.7	E	41.7	E	33	49.2	E	49.2	E	127
	EB	L/T/R	222.6	F	222.6	F	409	741.3	F	741.3	F	649
Davis Dr & Belfort Park Dr	EB	Left	51.1	F	46.9	E	83	131.2	F	121.9	F	652
		Right	13.5	B			21	10.9	B			580
Davis Dr & CBP Entrance	EB	Left	30.3	D	24.1	C	20	28.7	D	21.6	C	61
		Right	13.8	B			32	10.8	B			34
Davis Dr & First Potomac Way	WB	L/T/R	9.6	A	9.6	A	9	22.6	C	22.6	C	24
	EB	L/T/R	43.1	E	43.1	E	114	84.5	F	84.5	F	130
Davis Dr & Shepard Dr	WB	L/T/R	25.4	D	25.4	D	60	29.4	D	29.4	D	69
	EB	L/T	33.8	D	21.8	C	704	34.9	D	21.2	C	719
		Right	11.3	B			92	10.7	B			101
Glenn Dr & Tippett Hill Dr	WB	L/R	8.9	A	8.9	A	59	9.3	A	9.3	A	51
Glenn Dr & Belfort Park Dr	WB	L/T	10.1	B	10.1	B	41	10.3	B	10.0	B	39
		T/R	10.0	A			28	9.8	A			26
	EB	L/T	10.0	B	9.5	A	36	10.7	B	10.6	B	368
		T/R	9.2	A			37	10.4	B			348
Shaw Rd & Belfort Park Dr	WB	L/T	9.7	A	9.6	A	49	11.2	B	10.8	B	52
		Right	8.6	A			39	8.8	A			34
	EB	L/T/R	9.5	A	9.5	A	10	8.7	A	8.7	A	17

SIGNALIZED INTERSECTIONS

The 2040 No-Build control delay, LOS, and the 95th percentile queues for the study signalized intersections are presented in **Table 28** and **Table 29** for the AM and PM peak periods, respectively. The results show that both intersections will operate at an overall intersection LOS E during the AM peak period, while during the PM peak period, both intersections are anticipated to operate at LOS F.

The northbound and eastbound approaches for the Davis Drive/West Church Road intersection are anticipated to operate at LOS F and E, respectively during the AM peak period. However, during the PM peak period all the approaches are anticipated to operate at LOS F except the westbound approach, which will operate at LOS E.

The northbound and southbound approaches for the Davis Drive/South Sterling Boulevard intersection, are anticipated to operate at LOS F during the AM and PM peak periods.

The 95th percentile queues at the signalized intersections shown in red in **Table 28** and **Table 29** are anticipated to spill back beyond the available turn lane storage for the AM and PM peak periods, respectively. Projected queues along the northbound approach at the Davis Drive/West Church Road intersection are anticipated to extend to the Davis Drive/Tippett Hill Drive/Bluemont Junction Square intersection. Note that the through lane adjacent to the northbound left turn lane impacted 156 vehicles from entering the storage lane during the PM peak hour. An additional 561 vehicles are impacted by the lane blockage for the southbound right turn lane

Queues along the northbound, southbound, and eastbound approaches to the Davis Drive/South Sterling Boulevard intersection are anticipated to extend to the upstream intersections. Overall, both signalized intersections are anticipated to operate at an unacceptable LOS and improvements will be required to operate at acceptable LOS.

Table 28: AM 2040 No-Build Delay, LOS and 95th Percentile Queues for Signalized Intersections

Intersection	Approach	Movement	AM 2040 No-Build							
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	95th Percentile Queue (ft)	Storage Lane (ft)
Davis Dr & W Church Rd	NB	Left	179.3	F	98.7	F	67.0	E	390 (62)*	310
		Through	39.3	D					946	-
		Right	27.3	C					133	300
	SB	Left	59.3	E	52.1	D			122	315
		Through/Right	59.2	E					358	-
		Right	35.3	D					309	295
	WB	Left	69.7	E	42.3	D			404 (19)*	415
		Through	38.2	D					509	-
		Right	21.1	C					126	215
	EB	Left	53.5	D	77.8	E			412	390
		Through	90.6	F					721	-
		Right	59.5	E					494	-
Davis Dr & S Sterling Blvd	NB	Left/Through	99.6	F	88.7	F	81.5	F	263	-
		Right	47.0	D					37	-
	SB	Left/Through	349.2	F	241.3	F			398	-
		Right	45.0	D					280	-
	WB	Left	69.0	E	38.2	D			235	260
		Through	42.9	D					553	-
		Right	13.7	B					324 (1)*	250
	EB	Left	67.1	E	28.1	C			162	310
		Through	26.5	C					221	-
		Right	14.4	B					92	260

*(xx) –SimTraffic-reported turn-lane queuing penalty, represent by number of turning vehicles (veh) blocked from accessing the storage lane

Table 29: PM 2040 No-Build Delay, LOS and 95th Percentile Queues for Signalized Intersections

Intersection	Approach	Movement	PM 2040 No-Build							
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	95th Percentile Queue (ft)	Storage Lane (ft)
Davis Dr & W Church Rd	NB	Left	341.7	F	174.8	F	242.4	F	340 (156)*	310
		Through	44.1	D					733	-
		Right	33.5	C					276 (2)*	300
	SB	Left	67.4	E	648.9	F			171	315
		Through/Right	883.3	F					626	-
		Right	328.5	F					373 (515)*	295
	WB	Left	105.0	F	61.4	E			506 (47)*	415
		Through	56.5	E					673	-
		Right	24.2	C					179	215
	EB	Left	75.4	E	129.0	F			541 (561)*	390
		Through	158.8	F					1,174	-
		Right	34.2	C					1,371	-
Davis Dr & S Sterling Blvd	NB	Left/Through	427.7	F	342.8	F	142.8	F	355	-
		Right	44.3	D					306	-
	SB	Left/Through	381.3	F	250.6	F			409	-
		Right	49.9	D					213 (3)	-
	WB	Left	88.4	F	39.5	D			231	260
		Through	42.9	D					415	-
		Right	21.6	C					254	250
	EB	Left	74.5	E	70.6	E			427 (1)*	310
		Through	71.6	E					1,578	-
		Right	10.6	B					205	260

*(xx) –SimTraffic-reported turn-lane queuing penalty, represent by number of turning vehicles (veh) blocked from accessing the storage lane

Simulated travel times along Davis Drive corridor for the 2040 No-Build conditions compared to the Existing conditions are presented in **Table 30**. The travel time is measured between West Church Road and South Sterling Boulevard along Davis Drive corridor in the northbound and southbound directions. During the AM peak period, the travel time is anticipated to be 4.7 minutes for the northbound direction and 16.2 minutes for the southbound direction for the 2040 No-Build conditions compared to the Existing conditions. During the PM peak period, the travel time is anticipated to increase for the 2040 No-Build compared to the Existing conditions from 2.7 minutes to 9.3 minutes and from 3.6 minutes to 12.6 minutes for the northbound and southbound direction, respectively. To improve travel time for the No-Build conditions, the signal timings were optimized as presented in the following sections.

Table 30: Existing and 2040 No-Build Simulated Travel Time

Peak Period	Simulated Travel Time (min) Between West Church Rd and South Sterling Blvd			
	NB		SB	
	Existing	2040 No Build	Existing	2040 No Build
AM Peak	2.3	4.7	3.2	16.2
PM Peak	2.7	9.3	3.6	12.6

NO-BUILD (OPTIMIZED SIGNAL SPLITS) CONDITIONS

To improve the traffic operations for the future conditions, the No-Build scenarios were further investigated by optimizing the signal split timings for all the future scenarios, while keeping the same cycle length as the existing conditions.

YEAR 2030 RESULTS

Unsignalized Intersections

Unsignalized intersection control delays, LOS and the 95th percentile queues for the 2030 No-Build conditions, during the AM and PM peak hours, are presented in **Table 31.** The results show that all the stop-controlled approaches are expected to operate at an acceptable LOS D or better during the AM and PM peak hours, except at the Tippett Hill Drive eastbound approach at Davis Drive. The Tippett Hill Drive eastbound approach is expected to operate at LOS E during the AM peak hour, and LOS F during the PM peak hour. 2030 No-Build conditions Synchro output is included in **Appendix E**.

Table 31: 2030 No-Build (Optimized) Delay, LOS and 95th Percentile Queues for Unsignalized Intersections

Intersection	Approach	Movement	AM 2030 No-Build					PM 2030 No-Build				
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	95th Percentile Queue (ft)	Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	95th Percentile Queue (ft)
Davis Dr & Tippett Hill Dr	WB	L/T/R	23.4	C	23.4	C	31	24.2	C	24.2	C	38
	EB	L/T/R	47.7	E	47.7	E	70	128.4	F	128.4	F	654
Davis Dr & Belfort Park Dr	EB	Left	26.3	D	24.9	C	53	34.2	D	32.3	D	117
		Right	11.6	B			16	10.1	B			27
Davis Dr & CBP Entrance	EB	Left	19.9	C	16.9	C	21	19.0	C	15.4	C	43
		Right	12.0	B			24	10.0	A			35
Davis Dr & First Potomac Way	WB	L/T/R	9.2	A	9.2	A	9	15.6	C	15.6	C	21
	EB	L/T/R	23.4	C	23.4	C	62	28.2	D	28.2	D	69
Davis Dr & Shepard Dr	WB	L/T/R	17.8	C	17.8	C	17	19.1	C	19.1	C	32
	EB	L/T	21.0	C	15.4	C	50	20.8	C	14.7	B	140
		Right	10.4	B			46	10.0	A			67
Glenn Dr & Tippett Hill Dr	WB	L/R	8.9	A	8.9	A	55	9.2	A	9.2	A	45
Glenn Dr & Belfort Park Dr	WB	L/T	9.9	A	9.9	A	38	10.1	B	9.8	A	36
		T/R	9.8	A			29	9.6	A			27
	EB	L/T	9.8	A	9.4	A	34	10.5	B	10.4	B	50
		T/R	9.2	A			32	10.3	B			32
Shaw Rd & Belfort Park Dr	WB	L/T	9.5	A	9.4	A	43	10.6	B	10.3	B	52
		Right	8.5	A			39	8.8	A			34
	EB	L/T/R	9.4	A	9.4	A	11	8.6	A	8.6	A	14

Signalized Intersections

2030 No-Build control delay, LOS and the 95th percentile queues for the study signalized intersections are presented in **Table 32** and **Table 33** for the AM and PM peak periods, respectively. The results show that both intersections will operate at an overall intersection LOS D during the AM peak period, whereas during the PM peak period, both intersections are anticipated to operate at LOS F.

The intersection approaches for Davis Drive and West Church Road are expected to operate at LOS D during the AM peak period. However, during the PM peak period all the approaches are anticipated to operate at LOS E or F.

At the intersection of Davis Drive and South Sterling Boulevard, the northbound and southbound approaches on Davis Drive are anticipated to operate at LOS E, while the eastbound and westbound approaches will operate at LOS D or better during the AM peak period. During the PM peak period, all the approaches will operate at LOS F, except the westbound approach, which is projected to operate at LOS D.

The 95th percentile queues at the signalized intersections are not expected to spill back beyond the available turn lane storage during the AM peak period except for the westbound right turn movement at the Davis Drive and South Sterling Boulevard intersection.

During the PM peak period, the 95th percentile queues are anticipated to extend beyond the available turn lane storage length for both signalized intersections. The projected queues along the northbound approach at the Davis Drive and West Church Road intersection will extend to Davis Drive and Tippett Hill Drive/Bluemont Junction Square intersection.

Additionally, 95th percentile queues along the northbound, southbound, and eastbound approaches at the Davis Drive and South Sterling Boulevard intersection are anticipated to extend to the upstream intersections. Overall, both signalized intersections will not operate at an acceptable LOS and improvements will be required to operate at acceptable LOS. The improvements are discussed in the **BUILD CONDITION** section of this report.

Table 32: AM 2030 No-Build (Optimized) Delay, LOS and 95th Percentile Queues for Signalized Intersections

Intersection	Approach	Movement	AM 2030 No-Build							
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	95th Percentile Queue (ft)	Storage Lane (ft)
Davis Dr & W Church Rd	NB	Left	59.2	E	43.2	D	40.9	D	223	310
		Through	34.0	C					78	-
		Right	26.3	C					86	300
	SB	Left	82.2	F	47.2	D			79	315
		Through/Right	49.3	D					247	-
		Right	35.6	D					202	295
	WB	Left	114.9	F	41.6	D			229	415
		Through	30.6	C					369	-
		Right	20.3	C					67	215
	EB	Left	64.1	E	38.3	D			235	390
		Through	39.3	D					460	-
		Right	30.4	C					200	-
Davis Dr & S Sterling Blvd	NB	Left/Through	83.5	F	76.2	E	41.7	D	225	-
		Right	50.2	D					33	-
	SB	Left/Through	70.8	E	59.2	E			359	-
		Right	38.1	D					125	-
	WB	Left	74.8	E	37.5	D			243	260
		Through	41.8	D					488	-
		Right	10.4	B					291	250
	EB	Left	82.2	F	31.9	C			145	310
		Through	29.4	C					216	-
		Right	17.9	B					68	260

Table 33: PM 2030 No-Build (Optimized) Delay, LOS and 95th Percentile Queues for Signalized Intersections

Intersection	Approach	Movement	PM 2030 No-Build							
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	95th Percentile Queue (ft)	Storage Lane (ft)
Davis Dr & W Church Rd	NB	Left	176.4	F	96.2	F	92.8	F	348 (112)*	310
		Through	33.9	C					849	-
		Right	27.4	C					168	300
	SB	Left	68.4	E	116.3	F			98	315
		Through/Right	150.2	F					704	-
		Right	67.9	E					415 (106)*	295
	WB	Left	148.5	F	65.1	E			462 (14)*	415
		Through	55.2	E					584	-
		Right	29.1	C					164	215
	EB	Left	76.9	E	96.2	F			576 (172)*	390
		Through	113.0	F					1138	-
		Right	35.3	D					1350	-
Davis Dr & S Sterling Blvd	NB	Left/Through	117.8	F	100.2	F	80.2	F	368	-
		Right	39.4	D					279	-
	SB	Left/Through	135.1	F	100.1	F			469	-
		Right	46.6	D					183	-
	WB	Left	158.1	F	47.2	D			311 (58)*	260
		Through	47.9	D					479	-
		Right	22.7	C					214	250
	EB	Left	88.7	F	88.0	F			430 (1)*	310
		Through	89.7	F					1695	-
		Right	11.0	B					263	260

*(xx) –SimTraffic-reported turn-lane queuing penalty, represent by number of turning vehicles (veh) blocked from accessing the storage

Simulated travel times along Davis Drive corridor for the 2030 No-Build conditions are presented in **Table 34**. The travel time is measured from West Church Road to South Sterling Boulevard along Davis Drive corridor in the northbound and southbound directions. During the AM peak period, the northbound travel time is anticipated to be 2 minutes and the southbound travel time is anticipated to be 2.6 minutes. During the PM peak period, travel times are expected to be 3.6 minutes and 4.9 minutes for the northbound and southbound directions, respectively.

Table 34: Existing and 2030 No-Build (Optimized) Simulated Travel Time

Peak Period	Simulated Travel Time (min) Between West Church Rd and South Sterling Blvd			
	NB		SB	
	Existing	2030 No Build	Existing	2030 No Build
AM Peak	2.3	2.0	3.2	2.6
PM Peak	2.7	3.6	3.6	4.9

Table 35 shows the 2030 AM and PM No-Build simulated travel speeds along Davis Drive for the northbound and southbound directions. During the AM peak period, the average speed between West Church Road and South Sterling Boulevard is 31 mph and 24 mph for the northbound and southbound approaches, respectively. During the PM peak hour, the simulated speed is 18 mph and 13 mph for the northbound and southbound approaches, respectively. This is consistent with the increased delay during the PM peak hour.

Table 35: 2030 No-Build (Optimized) Simulated Travel Speed

	AM Peak		PM Peak	
Davis Drive Corridor	NB Simulated Speed (MPH)	SB Simulated Speed (MPH)	NB Simulated Speed (MPH)	SB Simulated Speed (MPH)
Between West Church Rd and South Sterling Blvd	31	24	18	13
Between Shepard Dr and Tippett Hill Dr/Bluemont Junction Sq.	39	35	35	31

YEAR 2040 RESULTS

Unsignalized Intersections

Unsignalized control delays, LOS and the 95th percentile queues for the for the No-Build conditions, during the AM and PM peak hours, are presented in **Table 36.** Three of the eight unsignalized intersections

approaches are expected to operate at LOS E or F. Future 2040 No-Build conditions Synchro output is included in **Appendix F**.

Table 36: 2040 No-Build (Optimized) Delay, LOS and 95th Percentile Queues for Unsignalized Intersections

Intersection	Approach	Movement	AM 2040 No-Build					PM 2040 No-Build				
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	95th Percentile Queue (ft)	Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	95th Percentile Queue (ft)
Davis Dr & Tippett Hill Dr	WB	L/T/R	41.7	E	41.7	E	36	49.2	E	49.2	E	69
	EB	L/T/R	222.6	F	222.6	F	147	741.3	F	741.3	F	654
Davis Dr & Belfort Park Dr	EB	Left	51.1	F	46.9	E	67	131.2	F	121.9	F	751
		Right	13.5	B			14	10.9	B			696
Davis Dr & CBP Entrance	EB	Left	30.3	D	24.1	C	23	28.7	D	21.6	C	42
		Right	13.8	B			26	10.8	B			32
Davis Dr & First Potomac Way	WB	L/T/R	9.6	A	9.6	A	10	22.6	C	22.6	C	22
	EB	L/T/R	43.1	E	43.1	E	71	84.5	F	84.5	F	89
Davis Dr & Shepard Dr	WB	L/T/R	25.4	D	25.4	D	16	29.4	D	29.4	D	33
	EB	L/T	33.8	D	21.8	C	54	34.9	D	21.2	C	362
		Right	11.3	B			55	10.7	B			93
Glenn Dr & Tippett Hill Dr	WB	L/R	8.9	A	8.9	A	54	9.3	A	9.3	A	148
Glenn Dr & Belfort Park Dr	WB	L/T	10.1	B	10.1	B	42	10.3	B	10.0	B	41
		T/R	10.0	A			27	9.8	A			27
	EB	L/T	10.0	B	9.5	A	35	10.7	B	10.6	B	450
		T/R	9.2	A			40	10.4	B			427
Shaw Rd & Belfort Park Dr	WB	L/T	9.7	A	9.6	A	50	11.2	B	10.8	B	53
		Right	8.6	A			35	8.8	A			34
	EB	L/T/R	9.5	A	9.5	A	9	8.7	A	8.7	A	15

Signalized Intersections

The 2040 No-Build control delay, LOS and the 95th percentile queues for the study signalized intersections are presented in **Table 37 and Table 38** for the AM and PM peak periods, respectively. The results show that both intersections will operate at an overall intersection LOS E during the AM peak period, while during the PM peak period, both intersections are anticipated to operate at LOS F.

The northbound and southbound approaches for Davis Drive and West Church Road intersection are anticipated to operate at an acceptable LOS D during the AM peak period, whereas the westbound and eastbound approaches will operate at LOS E and LOS F, respectively. However, during the PM peak period all the approaches are anticipated to operate at LOS F.

The northbound and southbound approaches for Davis Drive and South Sterling Boulevard intersection, are anticipated to operate at LOS F and LOS E during the AM peak period, respectively. During the PM peak period, all the approaches are expected to operate at LOS E or LOS F.

The 95th percentile queues at the signalized intersections shown in red in **Table 37** and **Table 38** are anticipated to spill back beyond the available turn lane storage for the AM and PM peak periods, respectively. Projected queues along the northbound approach at the Davis Drive and West Church Road intersection are anticipated to extend to Davis Drive and Tippett Hill Drive/Bluemont Junction Square intersection. **Figure 55** and **Figure 56** show the 95th percentile queue length for the Existing and 2040 No-Build conditions at the Davis Drive/West Church Road intersection for the AM and PM peak periods, respectively. The 2040 No-Build conditions have higher blocking problems than the Existing conditions. During the PM peak hour, 155 vehicles were blocked to enter the northbound left turn lane during the 2040 No-Build conditions versus 53 vehicles during the Existing conditions, which is also reflected in the travel time.

Additionally, queues along the northbound, southbound, and eastbound approaches at the Davis Drive/South Sterling Boulevard intersection are anticipated to extend to the upstream intersections. **Figure 57** and **Figure 58** show the 95th percentile queue length for the Existing and 2040 No-Build conditions at the Davis Drive and South Sterling Boulevard intersection for the AM and PM peak periods, respectively.

Overall, both intersections are anticipated to operate at an unacceptable LOS and improvements, discussed in the **BUILD CONDITION** section of this report, will be required to operate at acceptable LOS.

Table 37: AM 2040 No-Build (Optimized) Delay, LOS and 95th Percentile Queues for Signalized Intersections

Intersection	Approach	Movement	AM 2040 No-Build							
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	95th Percentile Queue (ft)	Storage Lane (ft)
Davis Dr & W Church Rd	NB	Left	68.4	E	46.1	D	74.2	E	303 (1)*	310
		Through	31.4	C					144	-
		Right	25.1	C					122	300
	SB	Left	77.8	E	49.6	D			98	315
		Through/Right	53.4	D					306	-
		Right	35.6	D					263	295
	WB	Left	252.1	F	73.9	E			550 (280)*	415
		Through	45.9	D					724	-
		Right	23.2	C					148	215
	EB	Left	95.7	F	88.6	F			629	390
		Through	110.6	F					1131	-
		Right	46.5	D					1316	-
Davis Dr & S Sterling Blvd	NB	Left/Through	131.0	F	114.1	F	58.2	E	345	-
		Right	49.1	D					54	-
	SB	Left/Through	95.5	F	74.8	E			440	-
		Right	37.1	D					197	-
	WB	Left	73.8	E	53.2	D			287	260
		Through	63.1	E					630	-
		Right	10.7	B					370 (1)*	250
	EB	Left	135.5	F	42.7	D			174	310
		Through	35.2	D					246	-
		Right	21.0	C					94	260

*(xx) –SimTraffic-reported turn-lane queuing penalty, represent by number of turning vehicles (veh) blocked from accessing the storage lane

Table 38: PM 2040 No-Build (Optimized) Delay, LOS and 95th Percentile Queues for Signalized Intersections

Intersection	Approach	Movement	PM 2040 No-Build							
			Delay (s/veh)	LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	95th Percentile Queue (ft)	Storage Lane (ft)
Davis Dr & W Church Rd	NB	Left	368.1	F	182.0	F	196.0	F	335 (155)*	310
		Through	34.4	C					753	-
		Right	26.4	C					216	300
	SB	Left	67.5	E	204.8	F			121	315
		Through/Right	260.2	F					627	-
		Right	128.9	F					371 (288)*	295
	WB	Left	144.5	F	156.7	F			578	415
		Through	161.5	F					610	-
		Right	32.2	C					208	215
	EB	Left	71.1	E	226.0	F			580 (49)*	390
		Through	290.5	F					972	-
		Right	43.7	D					964	-
Davis Dr & S Sterling Blvd	NB	Left/Through	229.5	F	187.2	F	143.3	F	355	-
		Right	38.7	D					289	-
	SB	Left/Through	213.9	F	148.5	F			416	-
		Right	48.0	D					206 (3)	-
	WB	Left	199.5	F	57.0	E			348 (143)*	260
		Through	59.0	E					743	-
		Right	24.8	C					342 (1)*	250
	EB	Left	119.1	F	179.6	F			422 (6)*	310
		Through	189.1	F					1438	-
		Right	11.9	B					228	260

*(xx) –SimTraffic-reported turn-lane queuing penalty, represent by number of turning vehicles (veh) blocked from accessing the storage lane

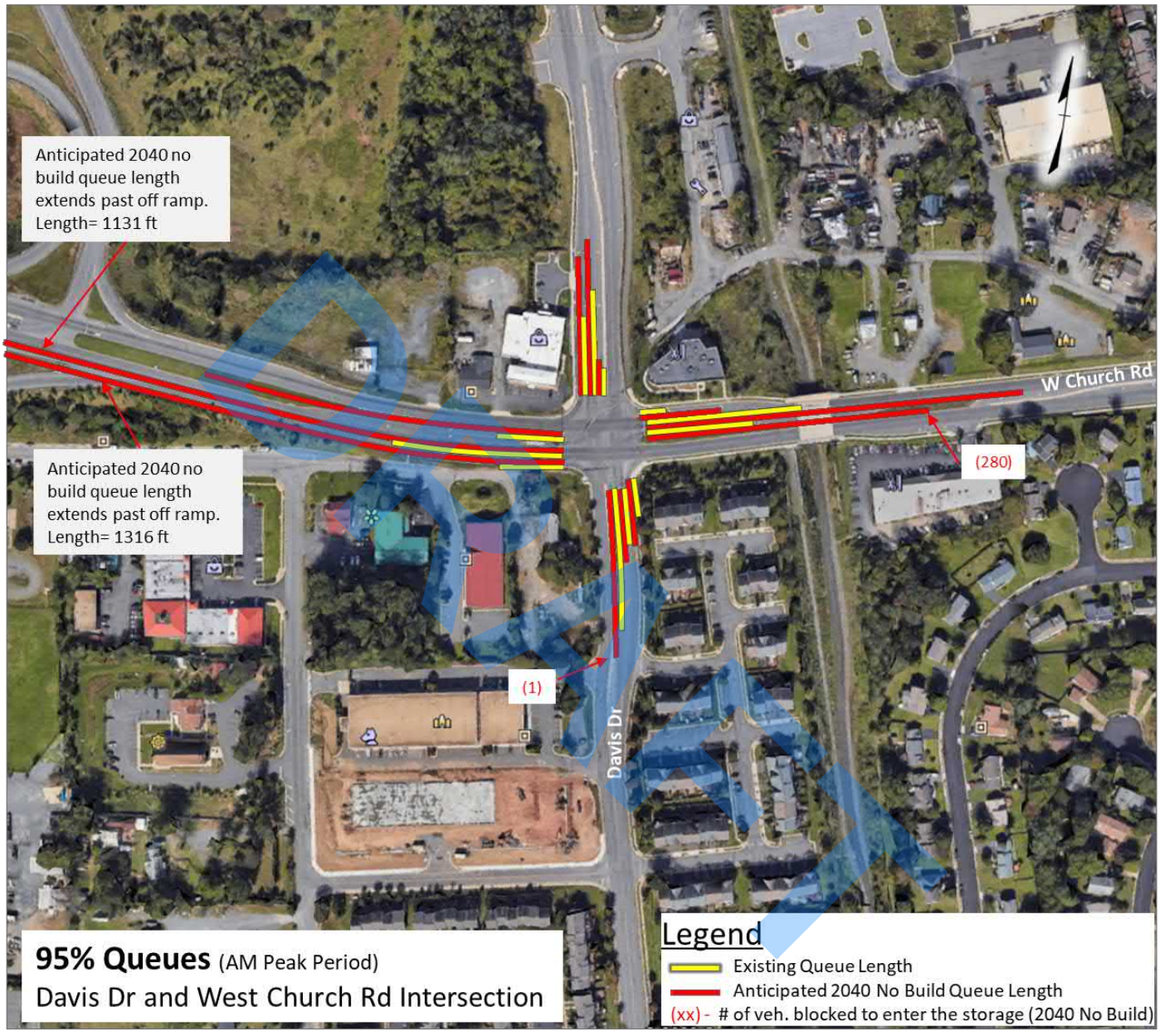


Figure 55: AM Peak 95th percentile Existing and 2040 No-Build (Optimized) Queues at Davis Dr. and W Church Rd. Intersection

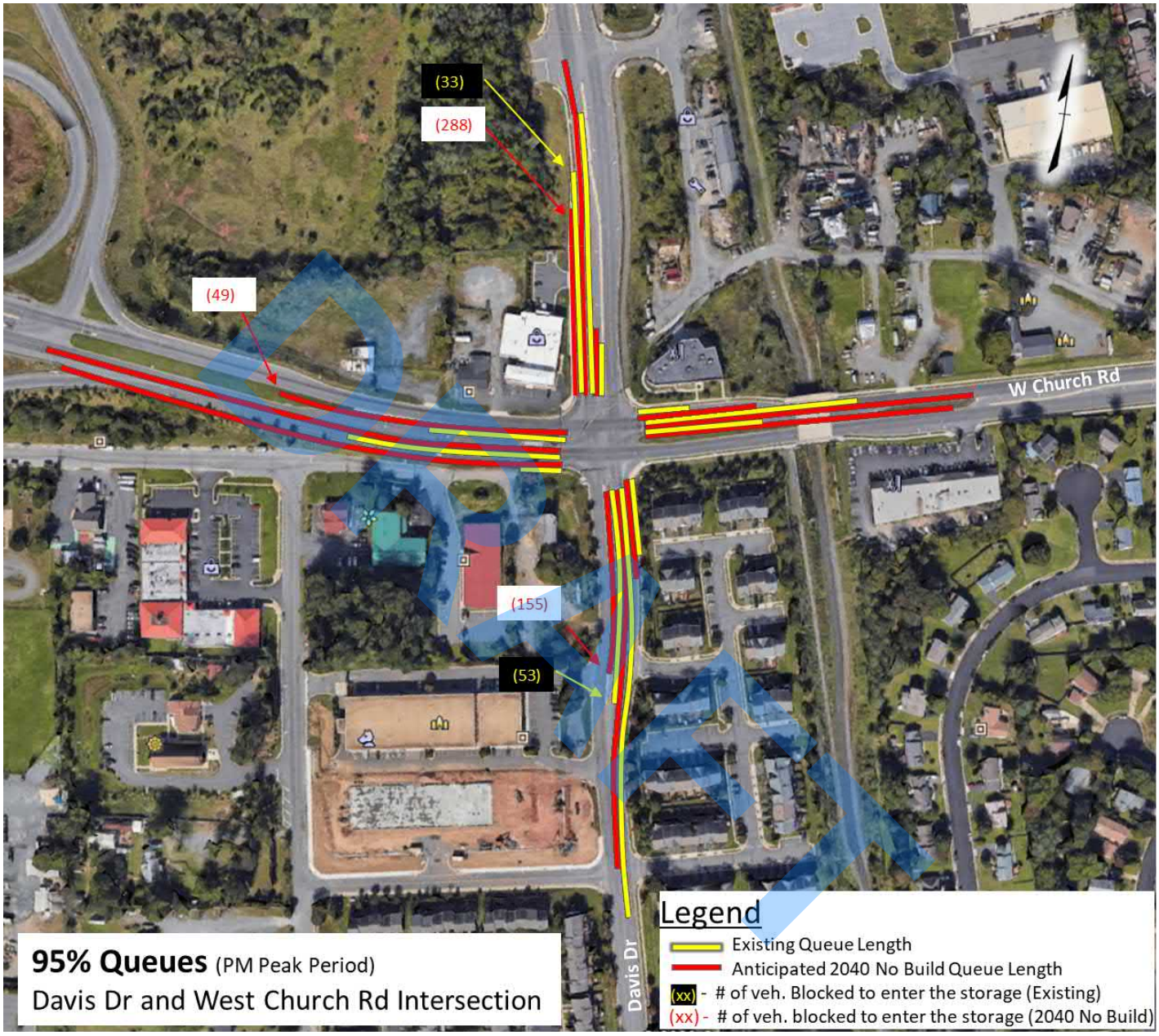


Figure 56: PM Peak 95th percentile Existing and 2040 No-Build (Optimized) Queues at Davis Dr. and W Church Rd. Intersection

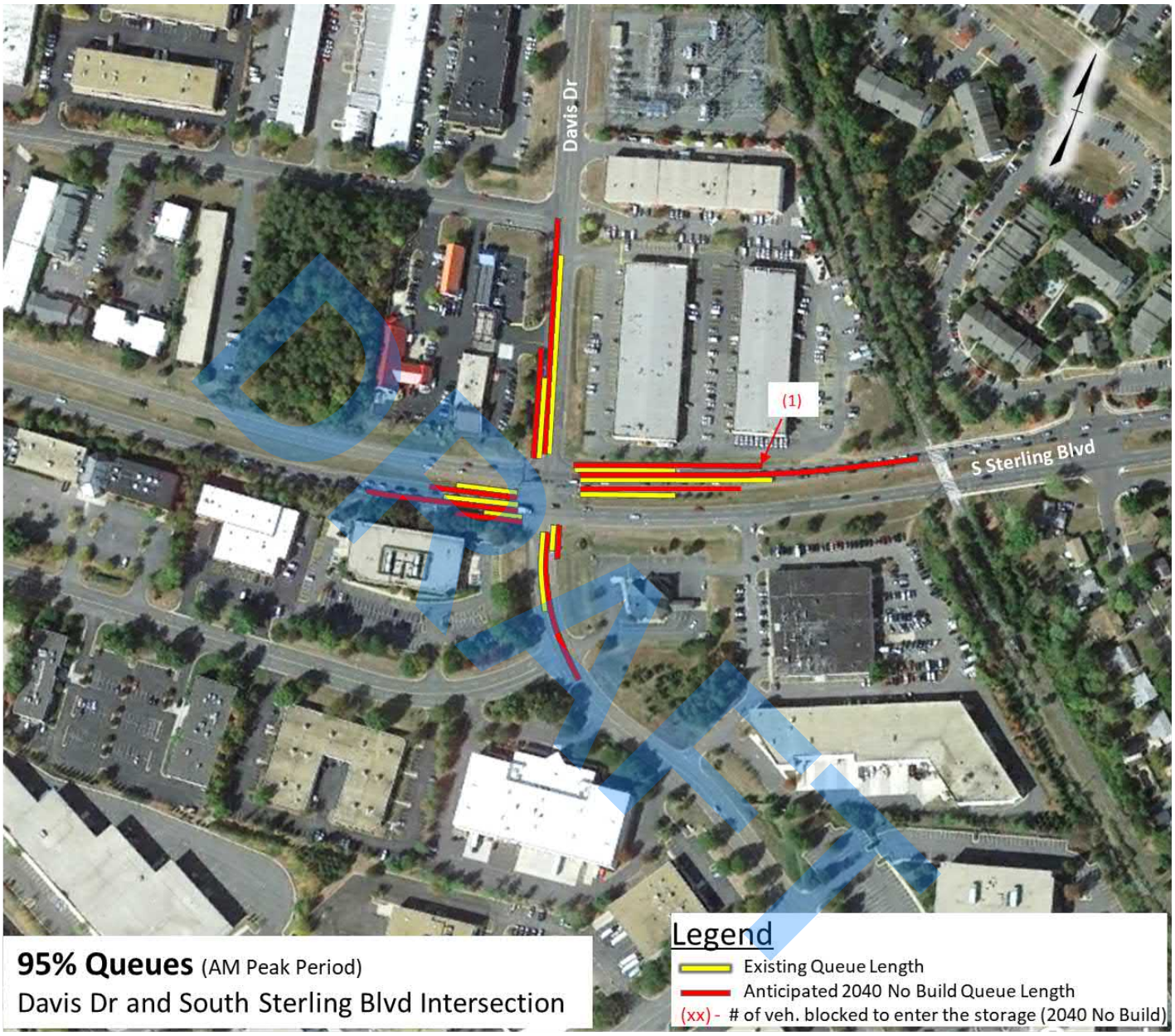


Figure 57: AM Peak 95th percentile Existing and 2040 No-Build Queues (Optimized) at Davis Dr. and S Sterling Blvd. Intersection

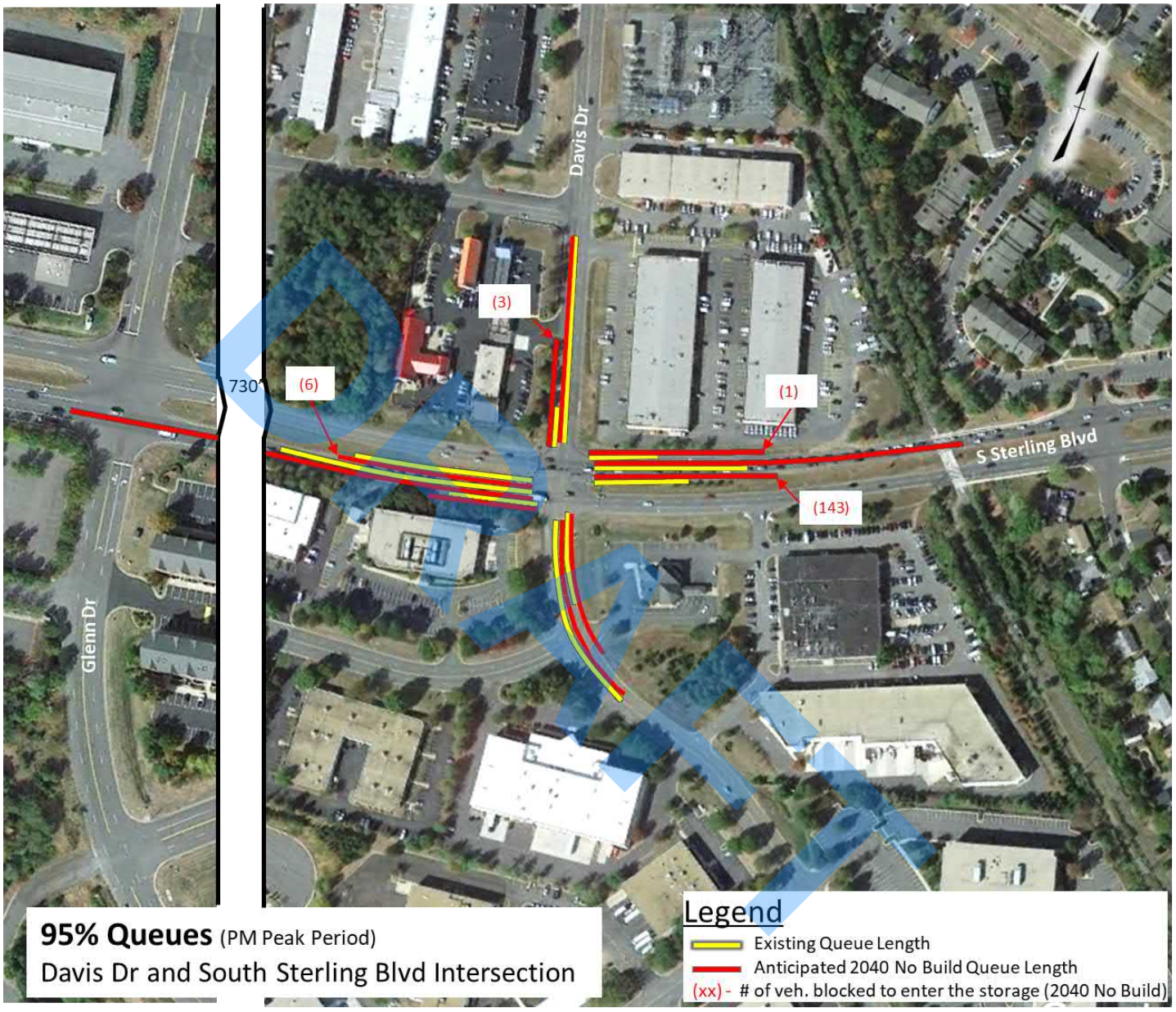


Figure 58: PM Peak 95th percentile Existing and 2040 No-Build (Optimized) Queues at Davis Dr. and S Sterling Blvd. Intersection

Simulated travel times along Davis Drive corridor for the 2040 No-Build conditions compared to the Existing conditions are presented in **Table 39**. The travel time is measured from West Church Road to South Sterling Boulevard along Davis Drive corridor in the northbound and southbound directions. During the AM peak period, the travel time is anticipated to be 2.0 minutes for the northbound direction and 2.9 minutes for the southbound direction for the 2040 No-Build conditions with minimum change compared to the Existing conditions. During the PM peak period, the travel time is anticipated to increase for the 2040 No-Build compared to the Existing conditions from 2.7 minutes to 9 minutes and from 3.6 minutes to 6.7 minutes for the northbound and southbound direction, respectively. It is to be noted that the improvements shown in the travel times compared to the existing are attributed to the signal timings optimization and allowing more green time to the side streets (Davis Drive).

Table 39: Existing and 2040 No-Build (Optimized) Simulated Travel Time

Peak Period	Simulated Travel Time (min) Between West Church Rd and South Sterling Blvd			
	NB		SB	
	Existing	2040 No Build	Existing	2040 No Build
AM Peak	2.3	2.0	3.2	2.9
PM Peak	2.7	9.0	3.6	6.7

Table 40 shows the Existing AM and PM and the 2040 AM and PM No-Build simulated travel speeds along Davis Drive for the northbound and southbound directions. During the AM peak period, the average simulated speed between West Church Road and South Sterling Boulevard is 31 mph and 22 mph for the northbound and southbound approaches, respectively. Higher speeds in the No-Build compared to the Existing are attributed to the improvements in the travel time during the AM peak hour. During the PM peak hour, the simulated speed is 7 mph and 9 mph for the northbound and southbound approaches, respectively. This is consistent with the increased delay during the PM peak hour.

Table 40: Existing and 2040 No-Build (Optimized) Simulated Travel Speed

Davis Drive Corridor	AM Peak				PM Peak			
	NB Simulated Speed (MPH)		SB Simulated Speed (MPH)		NB Simulated Speed (MPH)		SB Simulated Speed (MPH)	
	Existing	2040 No Build	Existing	2040 No Build	Existing	2040 No Build	Existing	2040 No Build
Between West Church Rd and South Sterling Blvd	27	31	20	22	23	7	17	9
Between Shepard Dr and Tippett Hill Dr/Bluemont Junction Sq.	39	38	34	33	38	28	35	29

OPERATIONAL DEFICIENCIES IN THE NO-BUILD CONDITIONS

Unsignalized Intersections

- In the year 2030, Tippett Hill Drive at Davis Drive is expected to operate at an unacceptable LOS E during the AM peak period and LOS F during the PM peak period. However, in year 2040, stop-controlled approaches at the following intersections are expected to operate at LOS E or worse:
    - Tippet Hill Drive/Bluemont Junction Square approaches at Davis Drive.
    - Belfort Park Drive approach at Davis Drive.
    - First Potomac eastbound approach at Davis Drive.

Signalized Intersections

- In 2030, both signalized intersections are expected to operate an acceptable LOS D during the AM peak hour.
- During the PM peak hour in year 2030, both signalized intersections are expected to operate at LOS F during the PM peak period.
    - The northbound and southbound approaches at both signalized intersections along Davis Drive are expected to operate at LOS F.
    - 95th percentile queues along the northbound approach at the intersection of Davis Drive at West Church Road are expected to spill back to Tippett Hill Drive. The failing operations at Davis Drive and Tippett Hill Drive can be attributed to the long northbound queues at the Davis Drive and West Church Road intersection.
    - 95th percentile queues for the northbound shared left/through movement, southbound shared left/through movement, as well as the eastbound through movement at the intersection of Davis Drive and South Sterling Boulevard are all expected to spill back to the upstream intersections.
- In 2040, traffic operations are expected to deteriorate at all signalized intersections. During the AM peak period, the intersections are expected to operate at LOS E or worse.
    - At the Davis Drive and West Church Road intersection, the eastbound and westbound approaches are expected to operate at unacceptable LOS F and LOS E, respectively.
    - The northbound and southbound approaches at the intersection of Davis Drive and South Sterling Boulevard are expected to operate at unacceptable LOS F and LOS E, respectively.
    - The 95th percentile queues for the eastbound and westbound approaches left turn movement at the Davis Drive and West Church Road intersection are expected to extend beyond the available turn lane storage length.
    - The 95th percentile queues of the westbound approach left turn and right-turn movement are anticipated to extend beyond the available turn lane storage length at the Davis Drive and South Sterling Boulevard intersection.

- During the PM peak period, the intersections are expected to operate as the following:
    - At the Davis Drive and West Church Road intersection, all approaches fail with LOS F.
    - At Davis Drive and South Sterling Boulevard intersection, all approaches fail, except the westbound approach.
    - 95th percentile queues along the northbound approach at the intersection of Davis Drive at West Church Road are expected to spill back to Tippett Hill Drive. The failing operations at Davis Drive and Tippett Hill Drive can be attributed to the long northbound queues at the Davis Drive and West Church Road intersection (same as in year 2030).
    - 95th percentile queues for the northbound shared left/through movement, southbound shared left/through movement, as well as the eastbound through movement at the intersection of Davis Drive and South Sterling Boulevard are all expected to spill back to the upstream intersections, similar to year 2030

BUILD CONDITIONS

Following the operational and safety analysis of intersections within the study area, multiple alternatives mitigating the operational and safety deficiencies along Davis Drive were considered and analyzed. The alternatives are described in further detail throughout this section. It is worth mentioning that the analysis for the different alternatives was based on 2040 volumes as a worst-case condition. The recommended alternatives are presented with both the 2030 and the 2040 volumes.

As presented earlier, operational and safety assessments identified deficiencies at the corridor and intersection levels during the Existing Conditions as well as the No-Build Conditions.

The following sections present the turn lane warrant analysis at the different intersections within the study area, followed by the Davis Drive corridor-level and intersection-level improvements for the previously indicated intersections.

TURN LANE WARRANTS

Davis Drive is currently a 4-lane undivided roadway with no dedicated turn lanes to the cross streets or driveways. The existing crash data shows a pattern of rear-end crashes between turning vehicles and through vehicles. As such, left turn lane and right turn lane warrant analyses were conducted to determine whether adding dedicated turn lanes is justified. The warrants were conducted at the following cross streets or driveways along Davis Drive, using both existing and projected future year volumes:

- Tippett Hill Drive/ Bluemont Junction Square.
- Belfort Park Drive.
- US CBP Entrance.
- First Potomac Way/ Sterling Park Business Center Entrance.
- Shepard Drive/ 201 Davis Drive Entrance.

Appendix F of the VDOT RDM was used as the main reference for the turn lane warrant analyses. If turn lanes are to be installed based on the turn lane warrant analyses, it is assumed Davis Drive will be reduced to a two-lane roadway by removing a through lane. For this reason, turn lane warrants along Davis Drive were evaluated for a two-lane roadway instead of a four-lane roadway. The operational feasibility of a two-

lane roadway along Davis Drive corridor, with future volumes, is described in the **DAVIS DRIVE CORRIDOR IMPROVEMENT** section.

Right Turn Lane Warrant

The right turn lane warrant is based on Figure 3-26 in Appendix F of the VDOT RDM for two-lane roadways. The figure plots the right turn peak hour volume (PHV) versus the approach's total PHV. No adjustments were applied to right turn volumes. The warrant was analyzed for existing conditions and projected future conditions (years 2030 and 2040) during the AM and PM peak periods. **Figure 59** and **Figure 60** show the data points for right turn volumes versus the approach total volume for the existing condition during the AM and PM hours, respectively. Under the existing conditions, a full width right turn lane and taper are required along Davis Drive at the following intersections:

- Tippett Hill Drive (Southbound direction on Davis Drive),
- Belfort Park Drive (Southbound direction on Davis Drive), and
- First Potomac Way (Southbound direction on Davis Drive).

A right turn taper is required along Davis Drive at US CBP Entrance. However, Shepard Drive, 201 Davis Drive Entrance (business entrance opposite Shepard Drive), and Bluemont Junction Square peak hour turning movements do not meet the threshold to warrant a right turn lane or taper.

Under future conditions, by Year 2040, all the side streets/driveways analyzed will warrant a right turn lane with a taper, during both AM and PM peak periods, except at Bluemont Junction Square and 201 Davis Drive Entrance, as presented in **Figure 61** and **Figure 62** . Davis Drive at the 201 Davis Drive Entrance will only require a right turn taper, and no right turn lane or taper will be required at Bluemont Junction Square.

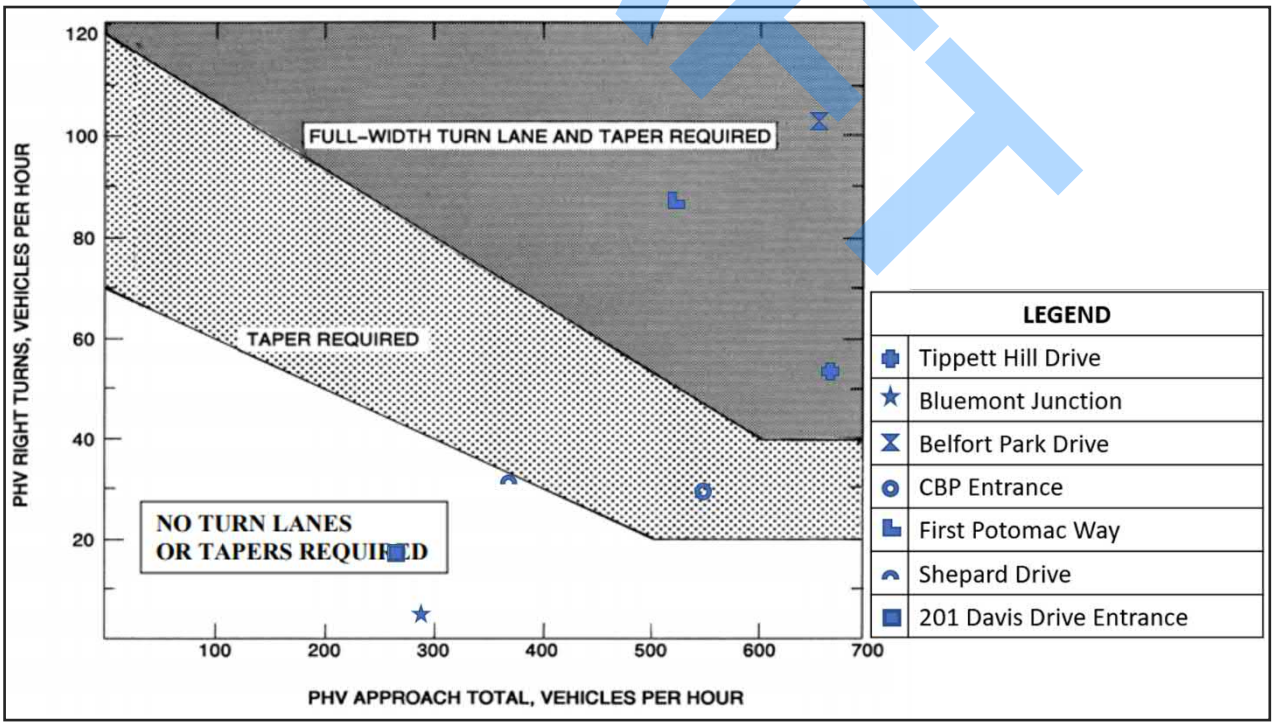


Figure 59: Existing Condition Right Turn Lane Warrant in the AM Peak Hour

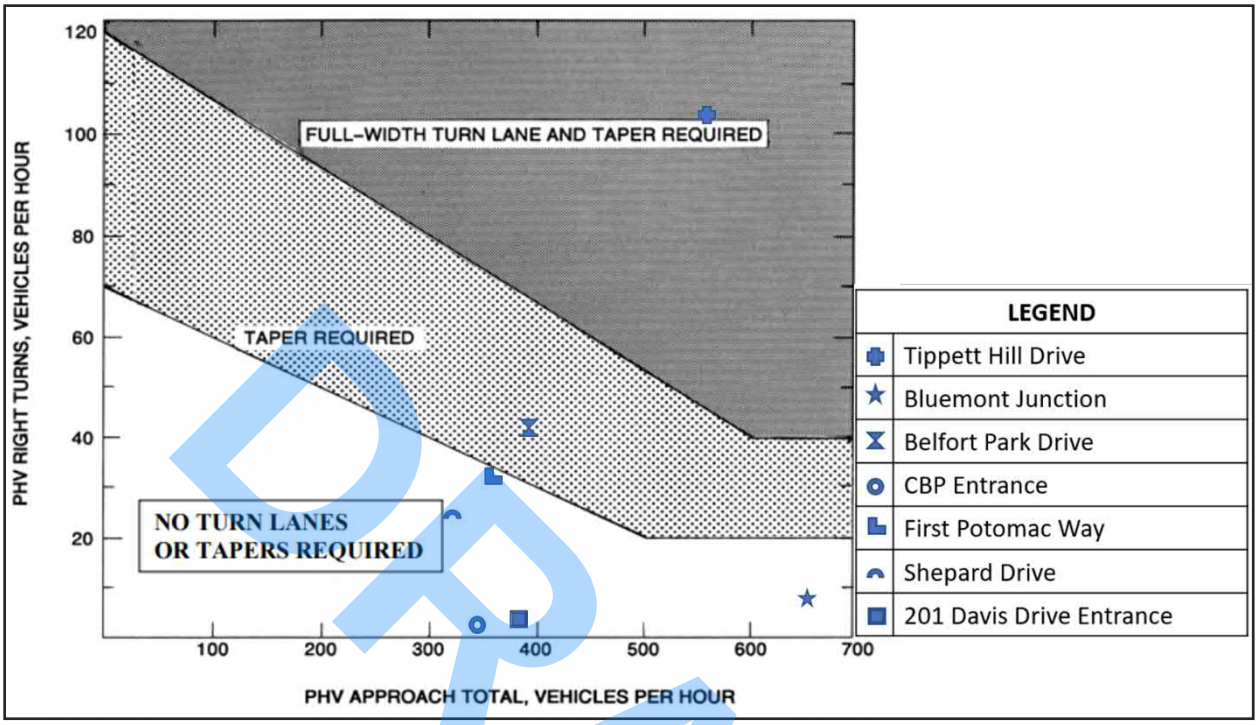


Figure 60: Existing Condition Right Turn Lane Warrant in the PM Peak Hour

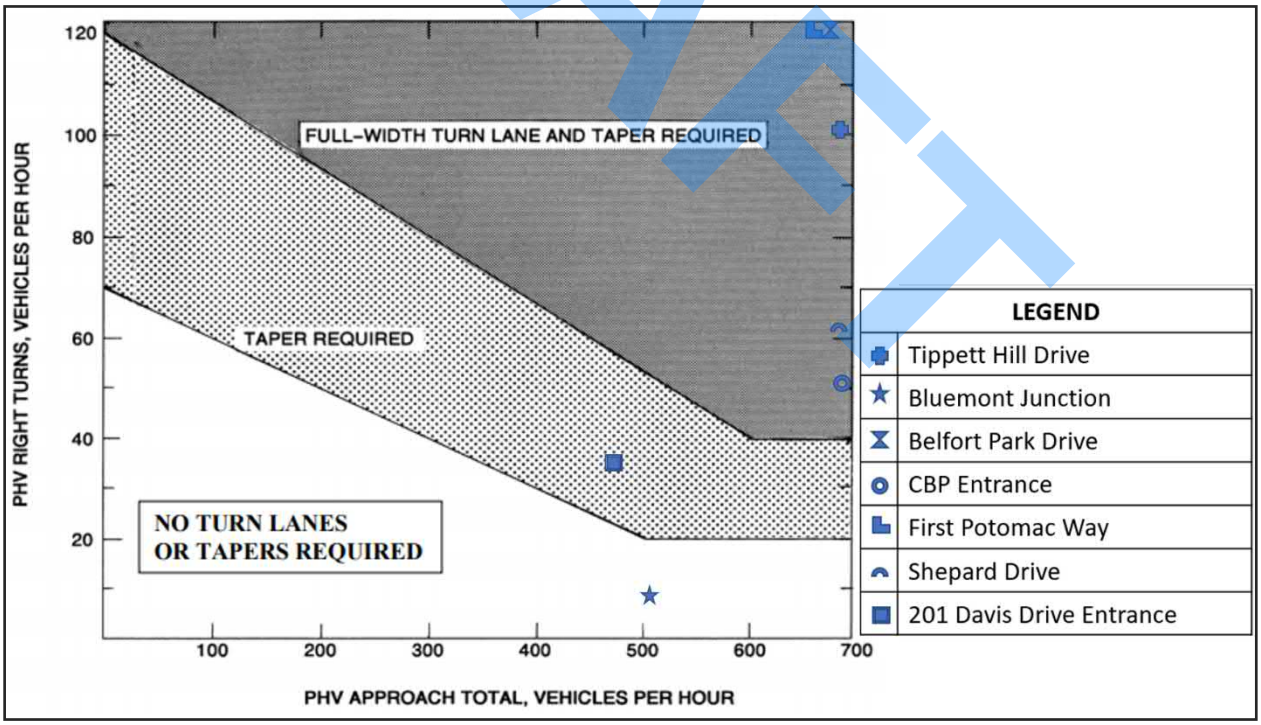


Figure 61: Year 2040 Right Turn Lane Warrant in the AM Peak Hour

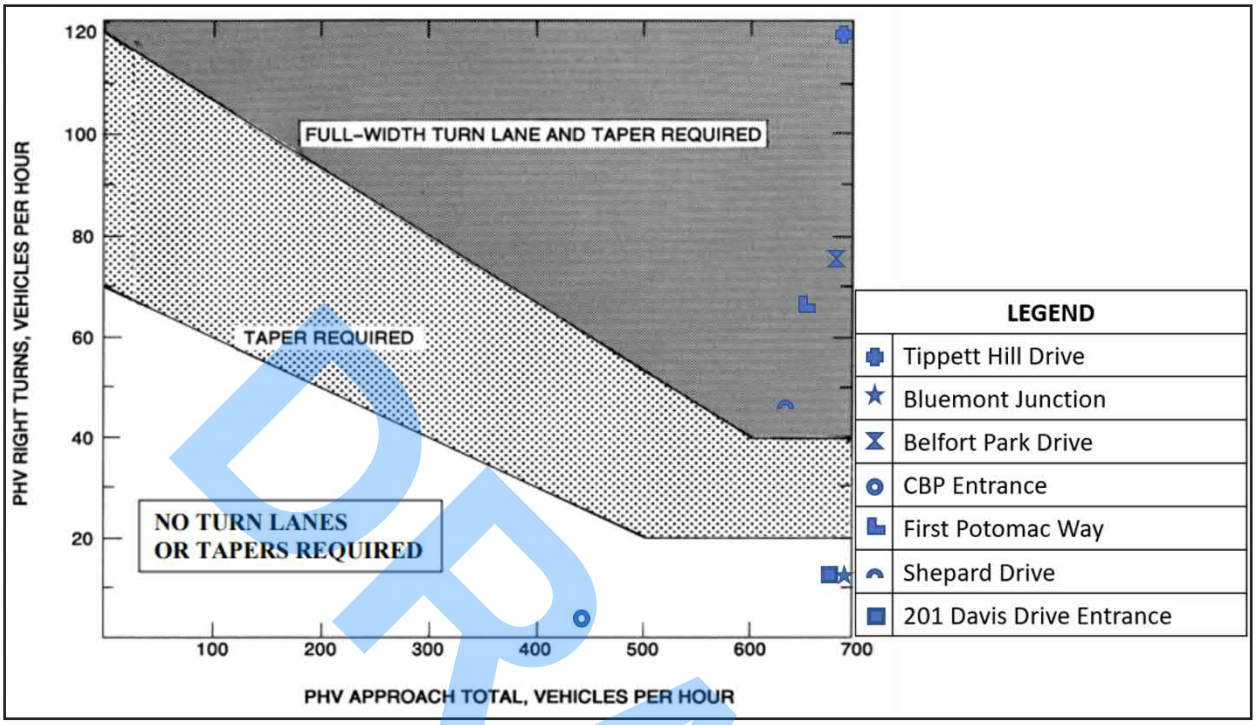


Figure 62: Year 2040 Right Turn Lane Warrant in the PM Peak Hour

Left Turn Lane Warrant

The left turn lane warrant is based on Table 3-1 in Appendix F of the VDOT RDM. Advancing volumes (VPH), opposing volumes (VPH), design speed, and percent left turns are used to determine whether a left turn storage lane is warranted on two-lane roadway. A design speed of 45 MPH was used for the analyses. Table 3-1 in Appendix F provides warrant guidance for 40 MPH, 50 MPH, and 60 MPH design speeds. The volumes in Table 3-1 were interpolated to determine 45 MPH design speed volumes. The interpolated volumes for 45 MPH design speed were further extrapolated to determine all the left turn percentages and opposing volumes not provided in Table 3-1 in Appendix F. **Table 41** shows the extrapolated requirements for a left turn lane on a two-lane roadway with a design speed of 45 MPH.

Table 41: Extrapolated Traffic Volume Threshold for Design Speed of 45 MPH

VPH Opposing Volume	Advancing Volume									
	1% Left Turns	2% Left Turns	3% Left Turns	4% Left Turns	5% Left Turns	6% Left Turns	7% Left Turns	8% Left Turns	9% Left Turns	10% Left Turns
	45-MPH Design Speed									
800	369	353	337	321	305	289	273	257	241	225
750	389	373	357	340	324	308	291	275	258	242
700	410	393	376	359	343	326	309	293	276	259
650	430	413	396	378	361	344	327	310	293	276
600	450	433	414	398	380	363	345	328	310	293
550	479	460	441	422	403	384	365	346	326	307
500	508	487	467	446	425	404	384	363	342	322
450	537	515	492	470	448	426	403	381	358	336
400	566	542	518	494	470	446	422	398	374	350
350	605	579	553	527	501	475	449	423	397	371
300	645	617	589	561	533	505	477	449	421	393
250	684	754	624	594	564	534	504	474	444	414
200	723	691	659	627	595	563	531	499	467	435

The warrant was analyzed for existing conditions and projected future conditions (Years 2030 and 2040) during the AM and PM peak periods. The results of the analyses presented in **Table 42** show under which conditions a left turn lane is warranted. Under existing conditions, a left turn lane is warranted on Davis Drive northbound and southbound at Tippett Hill Drive and Bluemont Junction Square only.

Projected Year 2030 volumes will warrant left turn lanes along Davis Drive at the following locations:

- Belfort Park Drive.
- US CBP Entrance.
- First Potomac Way.
- Sterling Park Entrance.
- Shepard Drive.

Furthermore, projected Year 2040 volumes are anticipated to warrant a left turn lane along Davis Drive at the 201 Davis Drive Entrance.

Table 42: Left Turn Warrant Analysis Warrants

Location	Condition	Peak Period	Opposing volume (VPH)	Advance Volume (VPH)	Left Turn (VPH)	Left Turn Percentage
Tippett Hill Drive	Existing	PM	404	620	8	1%
Bluemont Junction Square	Existing	PM	603	538	25	5%
Belfort Park Drive	2030	PM	349	514	10	2%
US CBP Entrance	2030	AM	330	695	10	1%
First Potomac Way	2030	PM	341	434	10	2%
Sterling Park Entrance	2030	AM	305	680	5	1%
Shepard Drive	2030	PM	310	390	25	6%
201 Davis Drive Entrance	2040	AM	358	344	9	3%

DAVIS DRIVE CORRIDOR IMPROVEMENTS

Davis Drive is currently a four-lane roadway, it is proposed to be reduced to a two-lane roadway with a two-way left turn lane (TWLTL) from Tippett Hill Drive to Shepard Drive. In addition, dedicated turn lanes at the unsignalized intersections will be added as indicated in the Turn Lane Warrant analyses. This lane re-configuration is known as “Road Diet” by the Federal Highway Administration (FHWA). Per FHWA guidance, roadways with ADT of 20,000 vpd or less may be good candidates for roadway diet and should be evaluated for feasibility. The forecasted future ADT along Davis Drive, using the 3% growth rate is 13,300 vpd in 2030, and 16,200 vpd in 2040. These volume fall within the threshold advised by FHWA.

An arterial analysis of the Davis Drive corridor was conducted using Synchro in the future 2030 and 2040 conditions. Also, two-lane segment analysis with the study corridor was conducted using the Two-Lane Module in the Highway Capacity Software for both directions during the AM and PM peak hours. The result of the arterial analysis, presented in **Table 43,** shows the overall arterial will operate at an acceptable LOS D or better except in the northbound direction in year 2040 during the PM peak hour. The corridor is expected to operate at a LOS E. The decline in LOS in the northbound direction in year 2040 during the PM peak hour is attributed to the delay at the intersection of Davis Drive and West Church Road. The Synchro arterial analysis result is presented in **Appendix G**.

Table 43: Davis Drive Arterial Level of Service

Peak Period	2030		2040	
	NB	SB	NB	SB
AM Peak	C	D	C	D
PM Peak	D	C	E	C

In addition to the arterial analysis, two-lane segment analysis was conducted between the intersections along Davis Drive, listed below:

- Between South Sterling Boulevard and Shepard Drive,
- Between Shepard Drive and First Potomac Way,
- Between First Potomac Way and Belfort Park Drive, and
- Belfort Park Drive and Tippett Hill Drive.

As shown in **Figure 63** and **Figure 64**, the corridor is expected to operate at under capacity (V/C is less than 1) in both directions along Davis Drive corridor, during both peak periods in 2030 and 2040. Therefore, a road diet is operationally feasible along Davis Drive Corridor. The Two-lane HCS analysis result is in **Appendix G.**

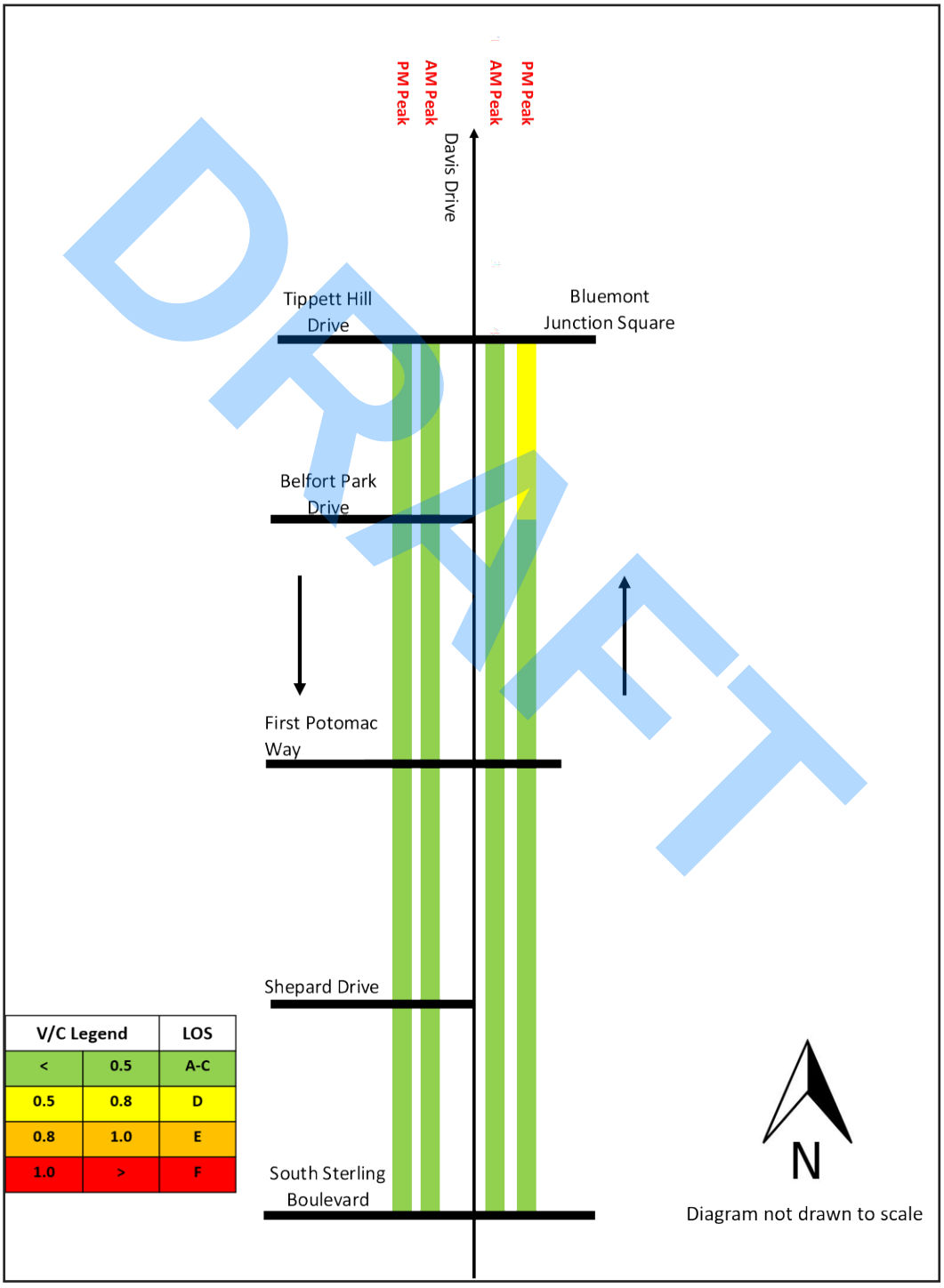


Figure 63: 2030 Davis Drive Segment Analysis

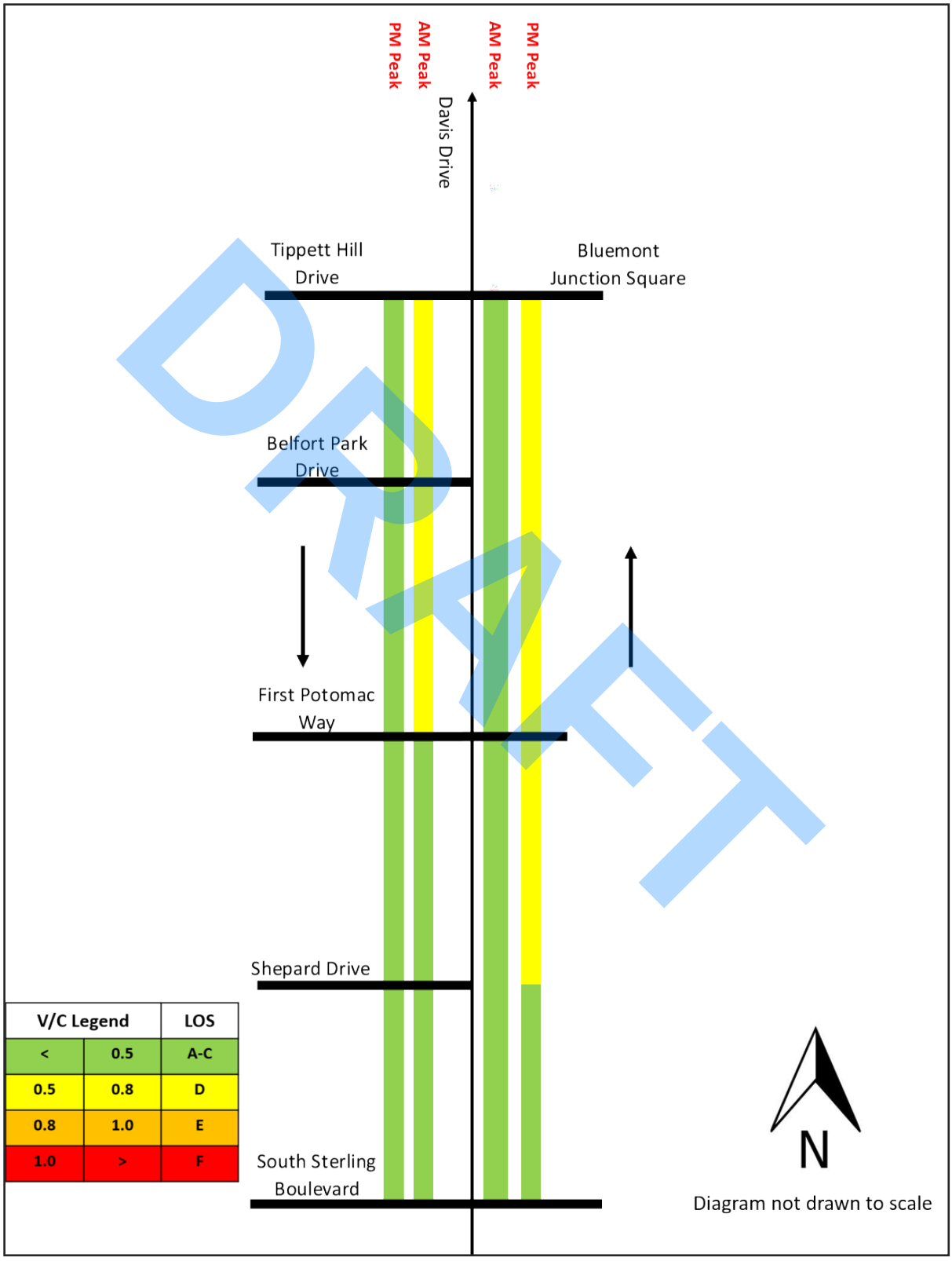


Figure 64: 2040 Davis Drive Segment Analysis

According to FHWA road diet informational guide, benefits of a road diet are:

- Safety improvement along the study corridor,
- Left turning traffic separation to reduce through traffic delay
- Speed reduction along the study corridor, and
- Pedestrian and Bicyclist improvement

With the implementation of the road diet, bike lanes will be added on both sides of the roadway within the existing pavement. A shared use path on the west side of Davis Drive and a sidewalk on the east side will be included as part of this plan. **Figure 65** shows a typical cross section with the corridor improvements on Davis Drive. An overview of the entire corridor is shown in **Appendix H**.

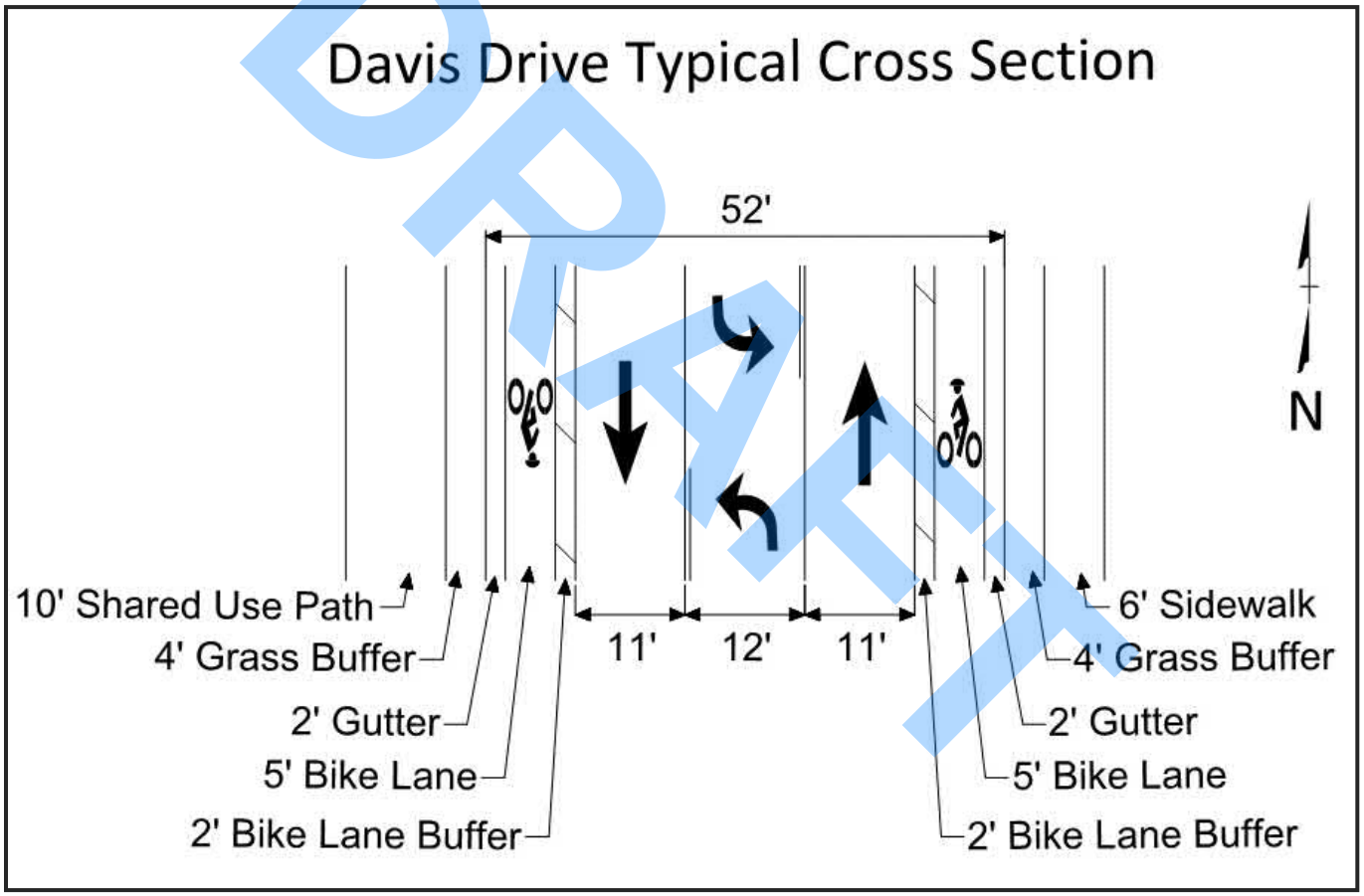


Figure 65: Typical Cross Section of the Davis Dr. Corridor Improvements

INTERSECTION IMPROVEMENTS

Davis Drive and West Church Road

Davis Drive and West Church Road is one of the intersections that exhibit operational deficiencies with all approaches operating at LOS F under the future No-Build scenarios. Accordingly, this intersection was further investigated. **Figure 66** shows the existing lane configuration with the 2040 AM and PM peak hourly volumes.

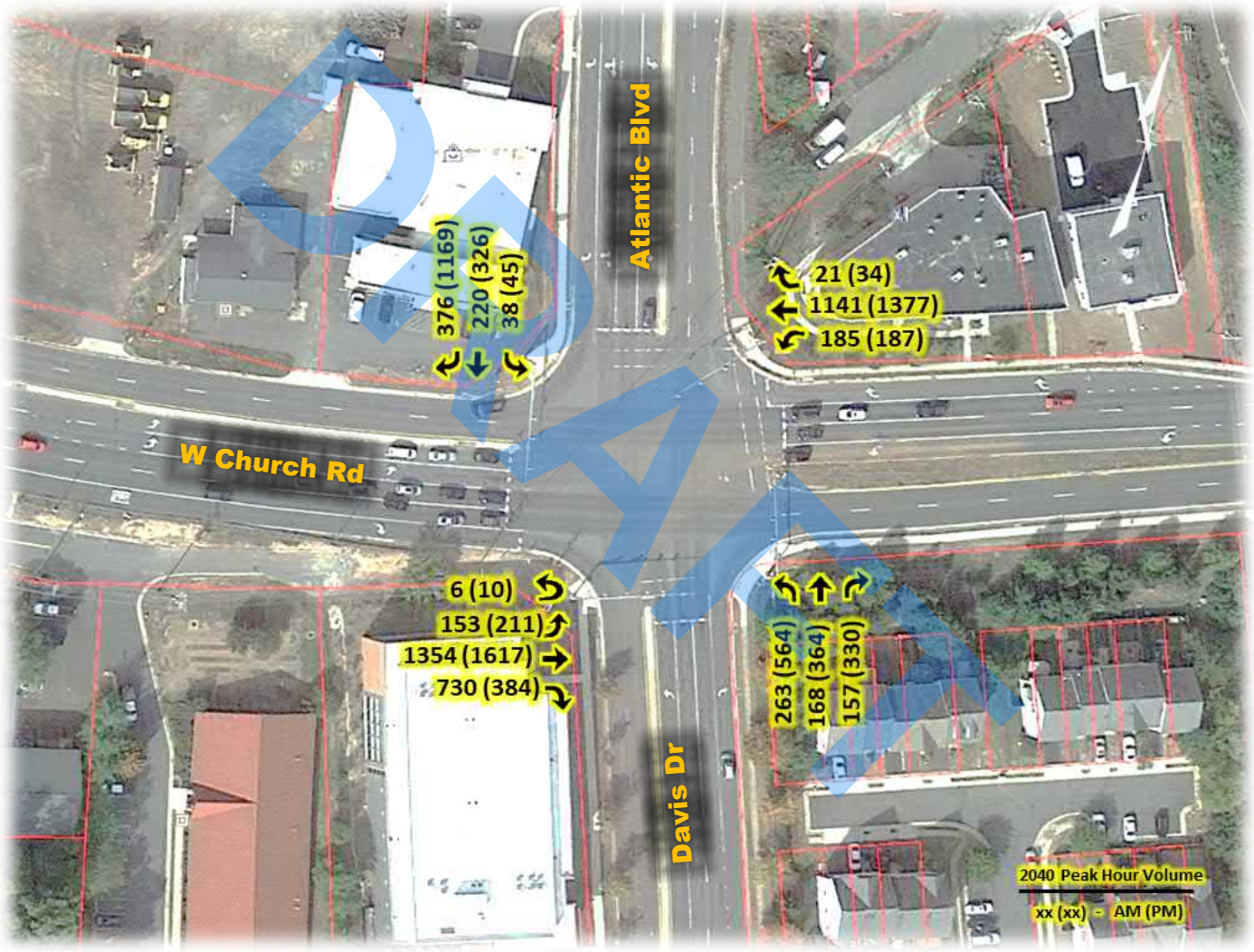


Figure 66: Davis Dr. and W. Church Rd. Existing Lane Configuration and 2040 AM (PM) Peak Hour Volumes

Short-Term Improvements

To address the operational issues at this intersection within the study limits, dual left turn lanes for the northbound approach are proposed. **Figure 67** presents the proposed lane configuration. Dual left turn lanes were analyzed using AutoTURN with a Single-Unit 30 (SU-30) design vehicle in the outside left turn lane, concurrent with a Five-Axle Tractor Semitrailer 67 (WB-67) design vehicle in the inside left turn lane, from the northbound approach. Based on the analysis, it is recommended to shorten the median for the west leg to accommodate the dual lefts from the northbound approach.

Figure 67: Davis Dr. and W. Church Rd. Proposed Alternative

Delay and LOS are compared between the 2040 No-Build and proposed alternative for the AM and PM peak hours as shown in **Table 44** and **Table 45**, respectively. Overall, this intersection is operating over capacity during the PM peak hour. Nevertheless, the overall intersection delay improved by 50 seconds for the PM peak hour. In addition, the delay for the northbound approach intensively improved by more than 1.5 minutes, which will drastically impact the travel time for the northbound direction in the PM peak hour as will be further discussed in the following sections.

Table 44: AM 2040 No-Build and Proposed Alternative Delay/ LOS for Davis Dr. and W. Church Rd.

Intersection	Approach	2040 AM Peak							
		No-Build V/C = 1.02				Proposed Alternative V/C = 0.89			
		Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS
Davis Dr & W Church Rd	NB	46	D	74	E	55	D	53	D
	SB	50	D			59	E		
	WB	74	E			47	D		
	EB	89	F			54	D		

Table 45: PM 2040 No-Build and Proposed Alternative Delay/ LOS for Davis Dr. and W. Church Rd.

Intersection	Approach	2040 PM Peak							
		No-Build V/C = 1.50				Proposed Alternative V/C = 1.29			
		Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS
Davis Dr & W Church Rd	NB	182	F	196	F	72	E	146	F
	SB	205	F			191	F		
	WB	157	F			109	F		
	EB	226	F			185	F		

The proposed improvements will enhance the operations at the intersection, especially the northbound approach. These improvements are accordingly impacting the long queues spilling back to the upstream intersections. Nevertheless, an overall intersection re-evaluation is recommended to improve the capacity constraints.

Davis Drive and Tippett Hill Drive

Davis Drive and Tippett Hill Drive intersection is one of the intersections that shows safety and operational deficiencies. Accordingly, this intersection was further investigated. **Figure 68** shows the existing lane

configuration with the 2040 AM and PM peak hourly volumes. For this intersection, two alternatives were evaluated.

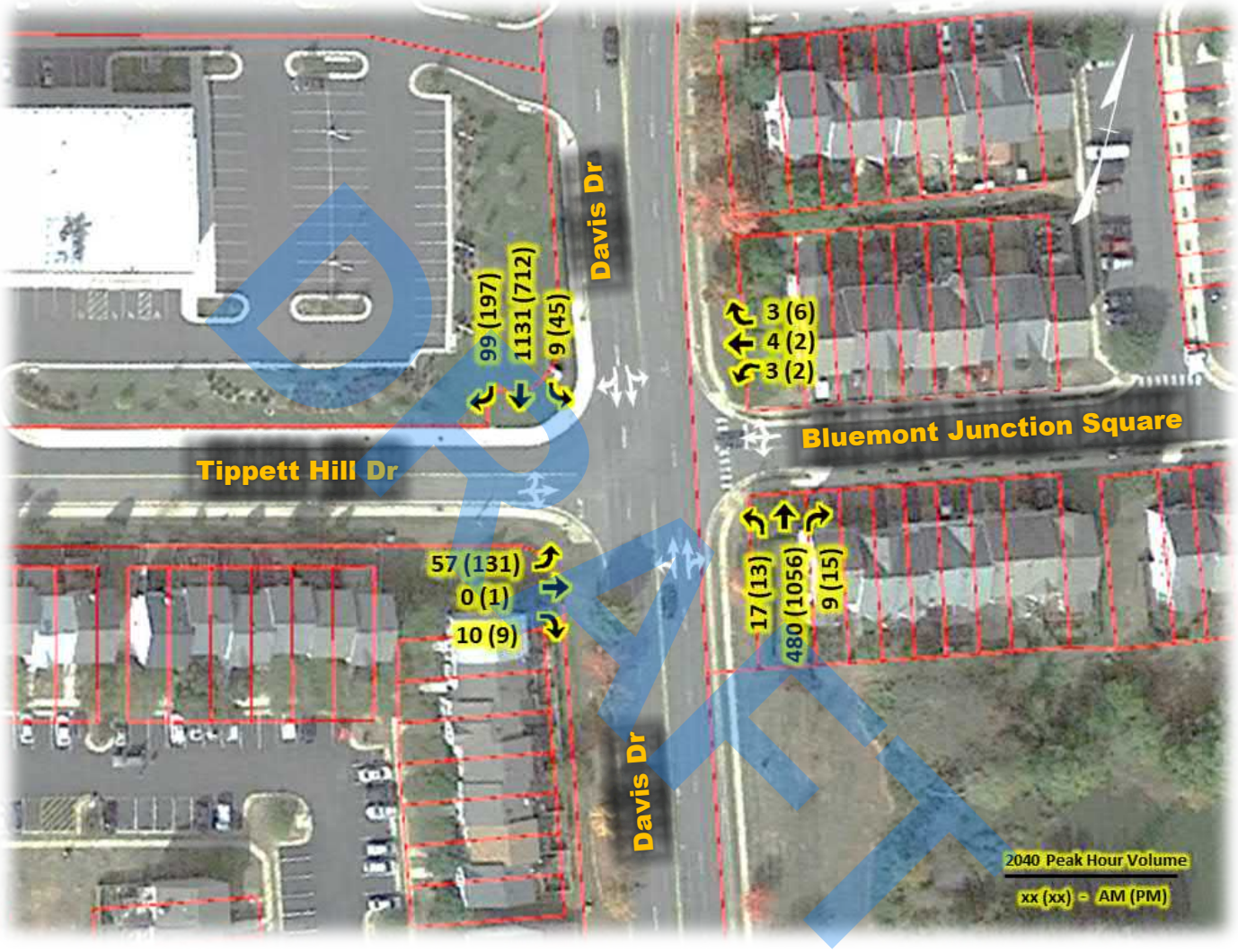


Figure 68: Davis Dr. and Tippett Hill Dr. Existing Lane Configuration and 2040 AM (PM) Peak Hour Volumes

Alternative 1

To address the operational issues at this intersection, a right-in, right-out, left-in operation is proposed at Tippett Hill Drive. **Figure 69** presents Alternative 1 with the proposed lane configuration for the right-in, right-out, left-in in addition to the proposed "road diet" corridor-wide improvement described earlier. The intersection improvements will eliminate the intersection sight distance issues. In addition, the improvements will reduce conflict points at the intersection.

Figure 69: Davis Dr. and Tippett Hill Dr. Proposed Alternative 1

Alternative 2

The second alternative considered at this intersection is converting Tippett Hill Drive from a two-way traffic operation to a one-way traffic operation in the westbound direction. **Figure 70** presents Alternative 2 with the proposed lane configuration for westbound one-way operation in addition to the other corridor improvements. The expected benefits from the westbound one-way operation is the elimination of the sight distance issue for the eastbound turning left onto Davis Drive. Additionally, the improvements will reduce conflict points at the intersection and increase the parking capacity at Tippett Hill Drive.

Figure 70: Davis Dr. and Tippett Hill Dr. Proposed Alternative 2

Table 46: AM 2040 No-Build and Proposed Alternatives Delay/LOS for Davis Dr. and Tippett Hill Dr.

Intersection	Approach	2040 AM Peak					
		No-Build		Tippett Hill Dr - Right in, Right out, Left in		Tippett Hill Dr - Westbound One Way	
		Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS
Davis Dr & Tippett Hill Dr	WB	42	E	64	F	38	E
	EB	223	F	22	C		

Table 47: PM 2040 No-Build and Proposed Alternatives Delay/LOS for Davis Dr. and Tippett Hill Dr.

Intersection	Approach	2040 PM Peak					
		No-Build		Tippett Hill Dr - Right in, Right out, Left in		Tippett Hill Dr - Westbound One Way	
		Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS
Davis Dr & Tippett Hill Dr	WB	49	E	79	F	44	E
	EB	741	F	14	B		

Delay and LOS are compared between the 2040 No-Build and proposed alternatives for the AM and PM peak hours as shown in **Table 46** and **Table 47**, respectively. The eastbound approach has LOS F for both the 2040 AM and PM No-Build conditions, which improves to LOS C and B for the right-in, right-out, left-in offered in Alternative 1 during the AM and PM peak hours, respectively. Note that the westbound approach 2040 volumes do not exceed 10 vehicles per hour.

The right-in, right-out, left-in option (Alternative 1) is recommended for this intersection to allow the eastbound right turn movement, while still achieving acceptable operations. **Figure 71** shows the rerouting necessary for the Tippett Hill Drive through and left turn movement.

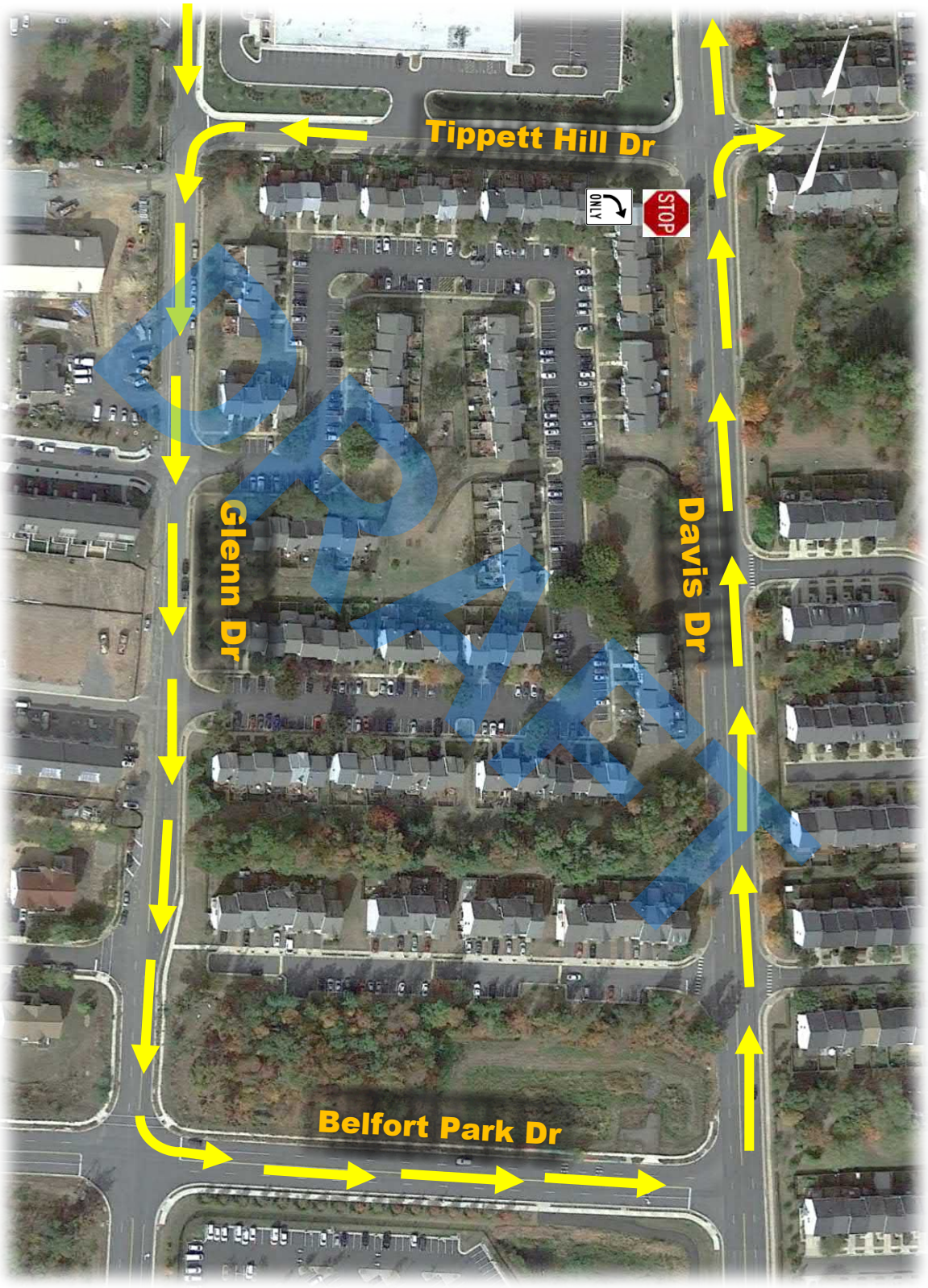


Figure 71: Rerouting of Tippett Hill Dr. Eastbound Approach

Davis Drive and Belfort Park Drive

Davis Drive and Belfort Park Drive is one of the intersections that shows safety and operational deficiencies. Accordingly, this intersection was further investigated. **Figure 72** shows the existing lane configuration with the 2040 AM and PM peak hourly volumes.

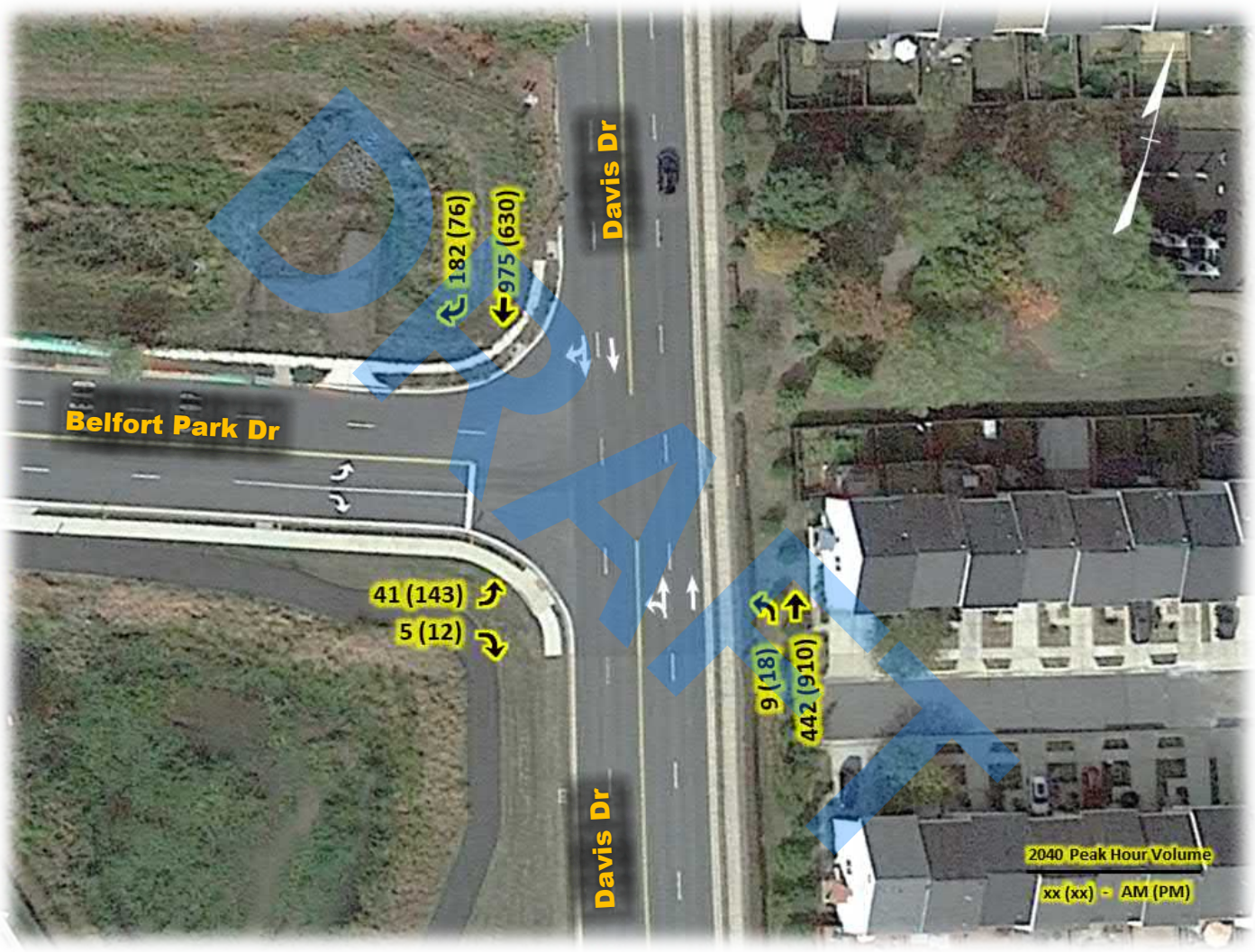


Figure 72: Davis Dr. and Belfort Park Dr. Existing Lane Configuration and 2040 AM (PM) Peak Hour Volumes

Signal Warrant Summary

A traffic signal warrant analysis was conducted at the intersection of Davis Drive and Belfort Park Drive using 13-hour turning movement vehicular counts collected in January 2020.

In certain applications, the side street right-turn volumes used in a signal warrant analysis may be reduced. Right Turn on Red (RTOR) signal operations or side streets that experience adequate gaps between mainline traffic platoons are two situations where the side street right turn volumes may be reduced for warrant

analysis. Belfort Park Drive eastbound approach has a dedicated right lane, therefore right turn volumes may be reduced.

Synchro models for the proposed signal were analyzed using HCM 2000 Signalized Intersection Capacity Analysis to find the Right Turn on Red (RTOR) reduction. For the eastbound approach, the AM peak hour has an average of a 100% reduction and the PM peak hour has an average of a 80% reduction, therefore the eastbound right turn volumes at the Davis Drive and Belfort Park Drive intersection were reduced by 90%; and one travel lane was considered for the signal warrants evaluation.

The results for Warrants 1-3 based on the existing traffic volumes are shown in **Table 48**. Warrant 1-B per the MUTCD requirements is satisfied and accordingly, Warrant 1 is met.

Table 48: Warrant 1-3 at Davis Dr. and Belfort Park Dr. Intersection

Davis Drive and Belfort Park Drive

TRAFFIC SIGNAL VOLUME WARRANT ANALYSIS

INTERSECTION NAME: Davis Drive at Belfort Park Drive — COUNT DATE: 1/22/2020

INTERSECTION CONDITION: Existing Conditions

MAJOR STREET: Davis Drive — # OF APPROACH LANES: 2

MINOR STREET: Belfort Park Drive (10% Right Turn) — # OF APPROACH LANES: 1

ISOLATED COMMUNITY WITH POPULATION LESS THAN 10,000 (Y OR N): N

85TH PERCENTILE SPEED GREATER THAN 40 MPH ON MAJOR STREET (Y OR N): Y

			MAJOR ST	MINOR ST		WARRANT 1, Condition A			WARRANT 1, Condition B			WARRANT 1, Combination Warrant						WARRANT 2	WARRANT 3
												CONDITION A			CONDITION B				
			BOTH APPROACHES	HIGHEST APPROACH		MAJOR STREET	MINOR STREET	BOTH MET	MAJOR STREET	MINOR STREET	BOTH MET	MAJOR STREET	MINOR STREET	BOTH MET	MAJOR STREET	MINOR STREET	BOTH MET	MINOR STREET	MINOR STREET
THRESHOLD VALUES			NB/SB	EB	WB	420	105		630	53		336	84		504	42		Varies	Varies
6:00 AM	TO	7:00 AM	428	23	0	Y						Y							
7:00 AM	TO	8:00 AM	728	20	0	Y			Y			Y			Y				
8:00 AM	TO	9:00 AM	883	35	0	Y			Y			Y			Y				
9:00 AM	TO	10:00 AM	623	37	0	Y						Y			Y				
10:00 AM	TO	11:00 AM	475	33	0	Y						Y							
11:00 AM	TO	12:00 PM	643	64	0	Y			Y	Y	Y	Y			Y	Y	Y		
12:00 PM	TO	1:00 PM	734	65	0	Y			Y	Y	Y	Y			Y	Y	Y		
1:00 PM	TO	2:00 PM	679	68	0	Y			Y	Y	Y	Y			Y	Y	Y		
2:00 PM	TO	3:00 PM	637	84	0	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y		
3:00 PM	TO	4:00 PM	762	82	0	Y			Y	Y	Y	Y			Y	Y	Y		
4:00 PM	TO	5:00 PM	833	107	0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
5:00 PM	TO	6:00 PM	883	115	0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
6:00 PM	TO	7:00 PM	659	71	0	Y			Y	Y	Y	Y			Y	Y	Y		
			8,967	804	0			2			8			3			8	2	0
						8 HOURS NEEDED NOT SATISFIED			8 HOURS NEEDED SATISFIED			8 HOURS OF BOTH COND. A AND COND. B NEEDED NOT SATISFIED						4 HRS NEEDED NOT SATISFIED	1 HR NEEDED NOT SATISFIED

WARRANT 1 -- Eight-Hour Vehicular Volume Warrant
Condition A : Minimum Vehicular Volume
Condition B : Interruption of Continuous Traffic
Combination : Combination of Condition A and Condition B
WARRANT 2 -- Four-Hour Vehicular Volume Warrant
WARRANT 3 -- Peak Hour Warrant

VJuST Innovative Intersection Concepts

VJuST was used to evaluate feasible alternative intersections including the existing intersection geometry with 2040 AM and PM peak hour volumes. The evaluated alternatives were Conventional Signal, Continuous Green-T, Roundabout, Mini Roundabout and Two-Way Stop Control. The VJuST results for the 2040 AM and 2040 PM peaks are presented in **Table 49** and **Table 50**. Conventional Signal and Continuous Green-T have favorable V/C ratios compared to all other alternatives.

Table 49: 2040 AM Peak VJuST Results

Intersection Results					
2040 AM Peak		Congestion	Pedestrian	Safety	Notes
Type	Dir	Maximum V/C	Accommodation Compared to Conventional	Weighted Total Conflict Points	
Conventional	-	0.72		48	
Continuous Green-T	-	0.72	-	12*	
50 Mini Roundabout	-	159.00		8	
75 Mini Roundabout	-	2.04		8	
Roundabout	-	0.87		8	
Two-Way Stop Control	-	0.87		48	

Table 50: 2040 PM Peak VJuST Results

Intersection Results					
2040 PM Peak		Congestion	Pedestrian	Safety	Notes
Type	Dir	Maximum V/C	Accommodation Compared to Conventional	Weighted Total Conflict Points	
Conventional	-	0.75		48	
Continuous Green-T	-	0.64	-	12*	
50 Mini Roundabout	-	1.32		8	
75 Mini Roundabout	-	1.24		8	
Roundabout	-	0.88		8	
Two-Way Stop Control	-	2.68		48	

Conventional Signal, Continuous Green-T and the Roundabout alternatives had the lowest V/C ratios. Accordingly, they were selected as top three alternatives that were further investigated and analyzed in Synchro to compare the traffic operations of the intersection with the three alternatives. Delay and LOS are compared between the 2040 No-Build and proposed alternatives for the AM and PM peak hours as shown

in **Table 51** and **Table 52**, respectively. The eastbound approach has LOS E and LOS F for the 2040 AM and PM, respectively in the No-Build conditions, which improves to LOS C or better for all the proposed alternatives. Nevertheless, the roundabout condition is anticipated to operate at LOS F for the southbound approach during the AM peak hour. The traffic volumes from prohibited movements from Tippett Hill and First Potomac Way are included in the Belfort Park Drive analysis.

Table 51: AM 2040 No-Build and Proposed Alternatives Delay/ LOS for Davis Dr. and Belfort Park Dr.

Intersection	Approach	2040 AM Peak							
		No-Build		Conventional (Signalized)		Continuous Green T (Signalized)		Roundabout	
		Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS
Davis Dr & Belfort Park Dr	NB			4	A				
	SB			14	B	14	B	74	F
	EB	47	E	35	C	35	C	18	C

Table 52: PM 2040 No-Build and Proposed Alternatives Delay/ LOS for Davis Dr. and Belfort Park Dr.

Intersection	Approach	2040 PM Peak							
		No-Build		Conventional (Signalized)		Continuous Green T (Signalized)		Roundabout	
		Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS
Davis Dr & Belfort Park Dr	NB			14	B				
	SB			14	B	23	C	15	B
	EB	122	F	33	C	19	B	10	B

Installing a Conventional Signal is recommended at the Davis Drive and Belfort Park Drive intersection. According to a warrant analysis, the 2020 volumes at this intersection meet the numerical thresholds for warrant of a traffic signal. A traffic signal will eliminate the sight distance issues at this intersection. In addition, the proposed signal will improve the delay and LOS for the side street for both the AM and PM peak hours beside accommodating prohibited movements for other intersections. In addition, incorporation of a signal at this intersection would provide a new marked pedestrian crossing with pedestrian signals. Furthermore, a Conventional Signal will have less construction cost and minimal right of way compared to Continuous Green-T and Roundabout. In addition, the recommended conventional signal meets the RDM access management

standard (greater than 660 feet) between two signals, however, does not meet the minimum spacing between a signalized intersection and unsignalized intersection. **Figure 73** presents the proposed recommendation.

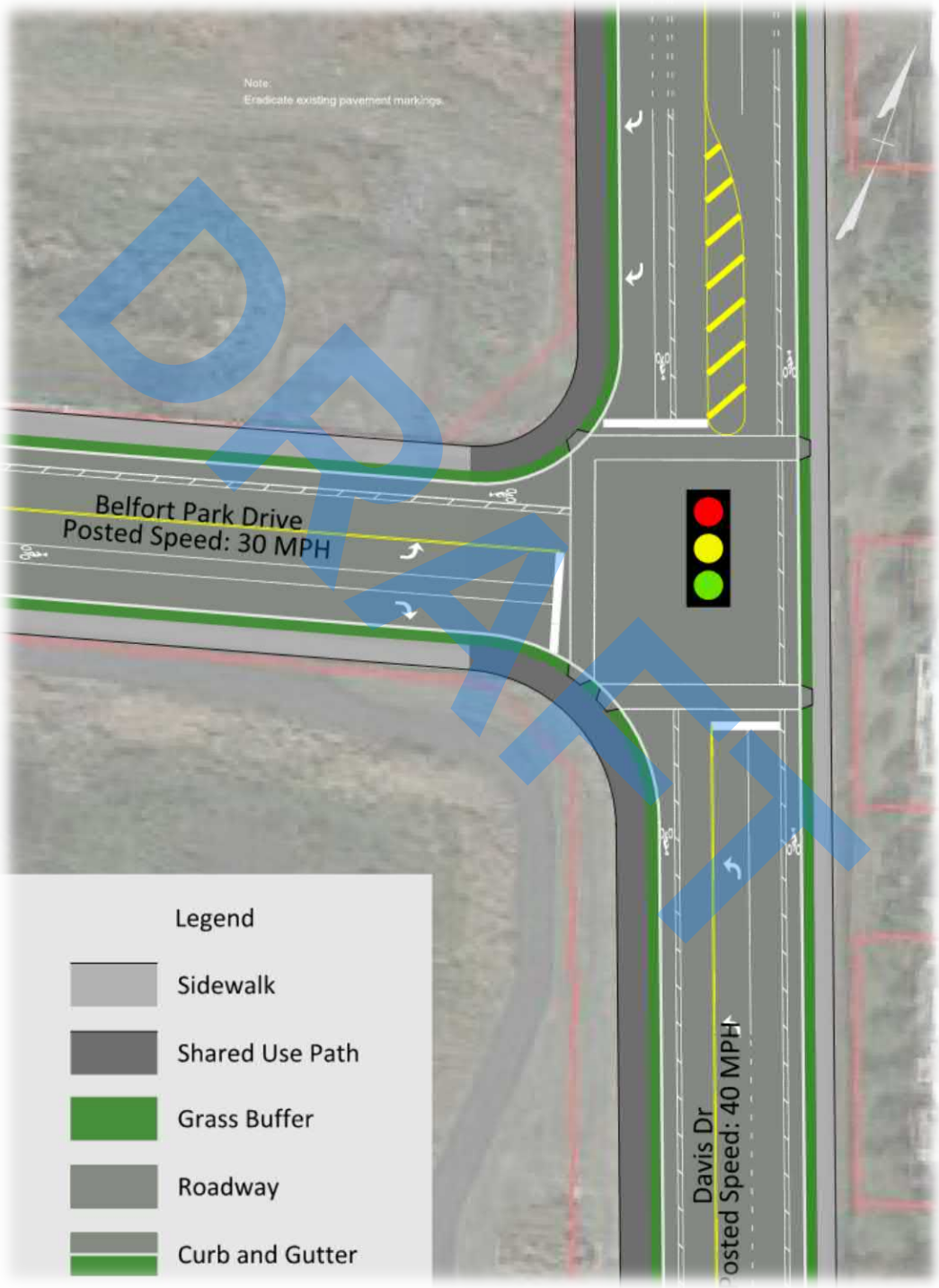


Figure 73: Davis Dr. and Belfort Park Dr. Proposed Alternative

Davis Drive and First Potomac Way

Davis Drive and First Potomac Way intersection is one of the intersections that shows safety and operational deficiencies. Accordingly, this intersection is being further investigated. **Figure 74** shows the existing lane configuration with the 2040 AM and PM peak hourly volumes.

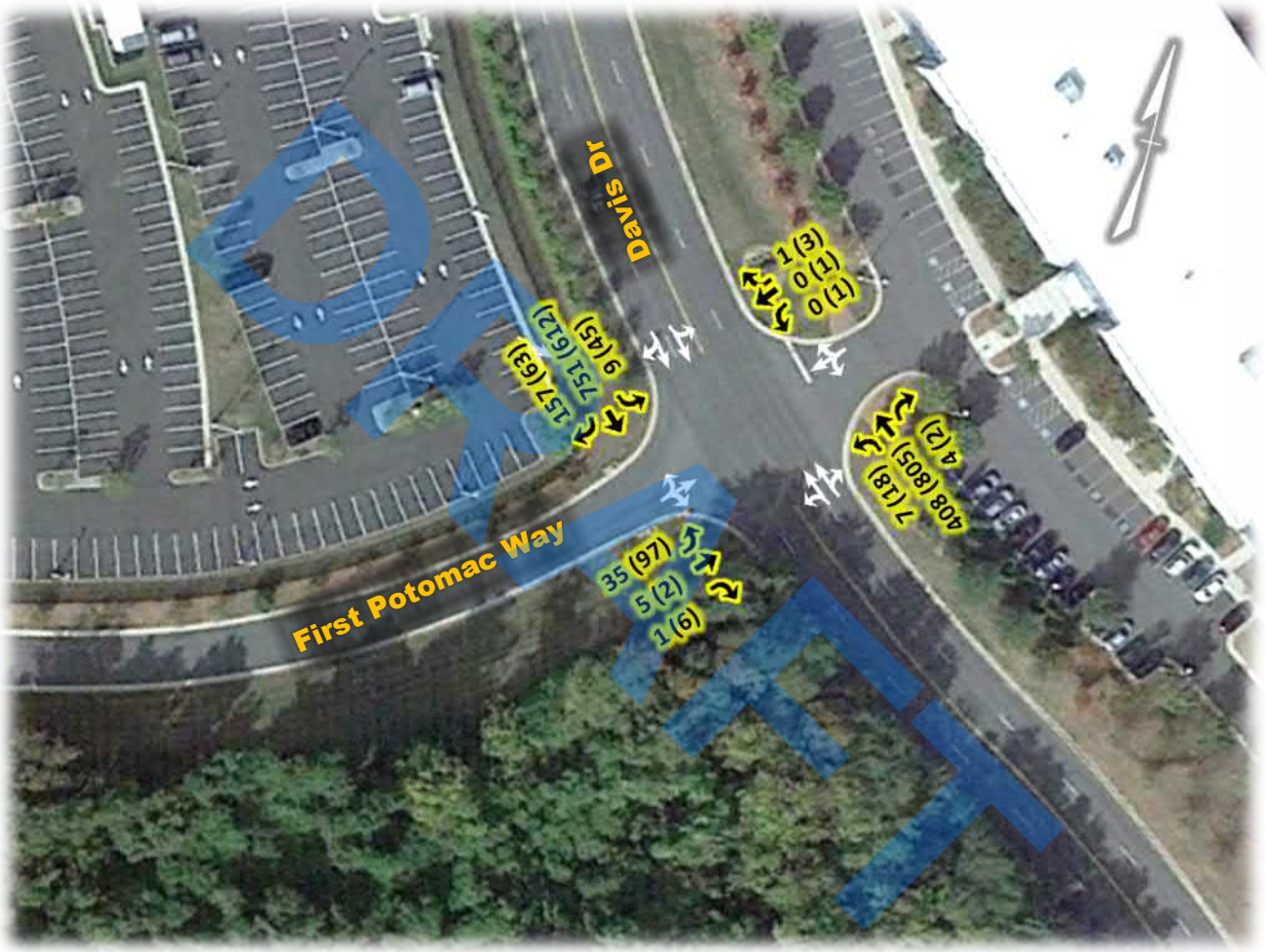


Figure 74: Davis Dr. and First Potomac Way Existing Lane Configuration and 2040 AM (PM) Peak Hour Volumes

To address the operational issues at this intersection, a right-in, right-out, left-in operation is proposed at First Potomac Way. **Figure 75** presents the proposed lane configuration for the right-in, right-out, left-in including the corridor improvements. These improvements will eliminate the intersection sight distance issues. In addition, the improvements will reduce conflict points at the intersection and will improve the safety, delay, and LOS.

Figure 75: Davis Dr. and First Potomac Way Proposed Alternative

Delay and LOS are compared between the 2040 No-Build and proposed alternatives for the AM and PM peak hour as shown in **Table 53** and **Table 54**, respectively. The eastbound approach has LOS E and F for the AM and PM No-Build conditions, which improves to LOS C and B for the right-in, right-out, left-in.

Table 53: AM 2040 No-Build and Proposed Alternatives Delay/ LOS for Davis Dr. and First Potomac Way

Intersection	Approach	2040 AM Peak			
		No-Build		First Potomac Way Right in, Right out, Left in	
		Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS
Davis Dr & First Potomac Way	WB	10	A	11	B
	EB	43	E	19	C

Table 54: PM No-Build and Proposed Alternatives Delay/ LOS for Davis Dr. and First Potomac Way

Intersection	Approach	2040 PM Peak			
		No-Build		First Potomac Way Right in, Right out, Left in	
		Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS
Davis Dr & First Potomac Way	WB	23	C	28	D
	EB	85	F	13	B

Figure 76 shows the rerouting necessary for the First Potomac Way through and left turn movement.

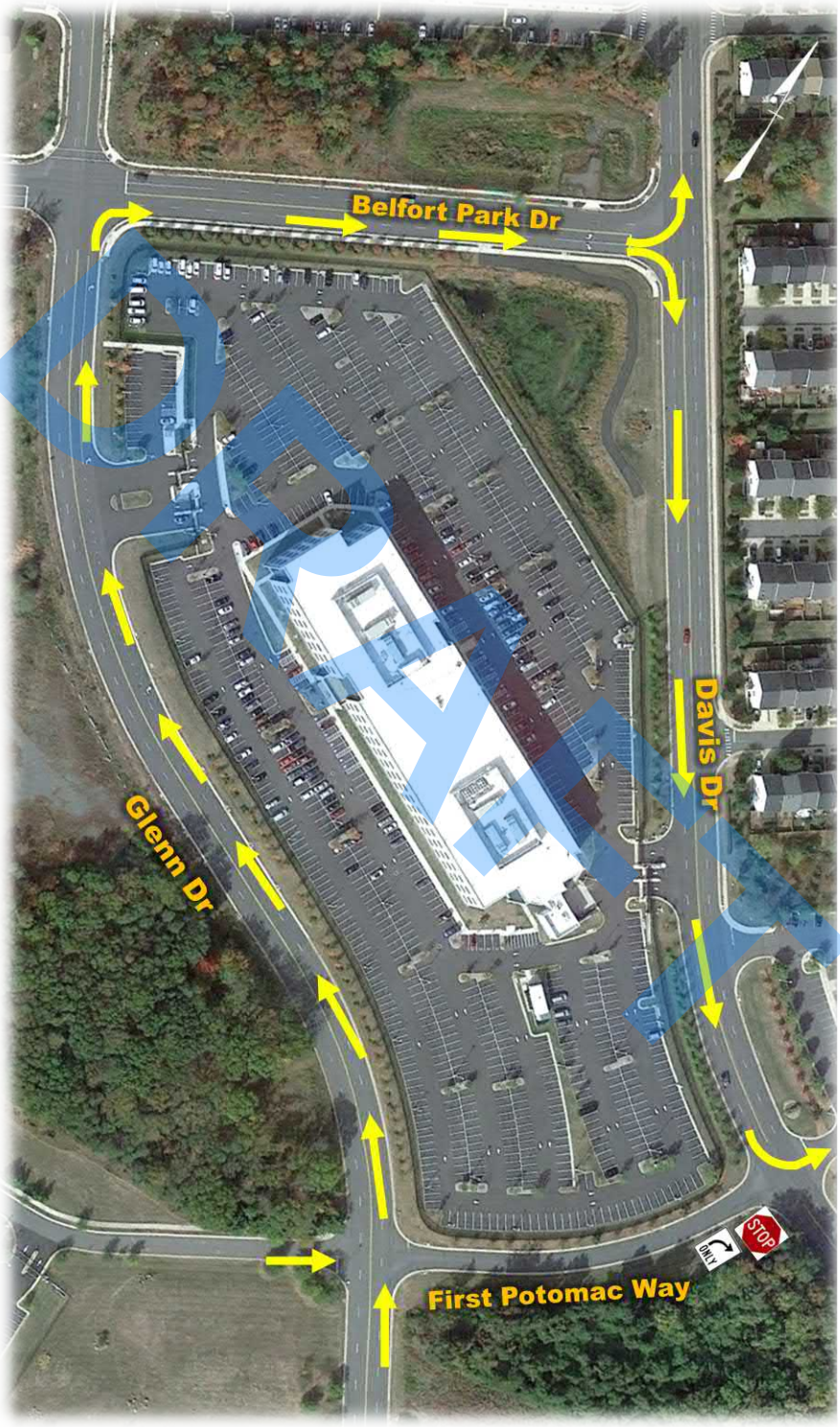


Figure 76: Rerouting of First Potomac Way Eastbound Approach

Davis Drive between Shepard Drive and South Sterling Boulevard

The high crash location noted at the entrance of the business center, located on the west side of Davis Drive between South Sterling Boulevard and Shepard Drive, is a major safety concern as discussed earlier. To address the safety issues at Davis Drive and Shepard Drive intersection, adding a left turn lane for the northbound approach and a right turn lane for the southbound approach are recommended. In addition, the suggested safety improvements for the segment between Shepard Drive and South Sterling Boulevard are shown in **Figure 77** reduces the number of conflict points among vehicular movements at the Shepard Drive intersection and brings the surrounding access points up to current access management spacing standards. The conceptual safety improvements follow the guidelines provided in the VDOT RDM, Appendix F and are described below:

- Two access points directly across Davis Drive at the business complex and industrial park are proposed to be modified into a right-in/right-out configuration
    - Eliminates conflict caused by drivers exiting to make a left onto Davis Drive.
    - Reduces conflict points and increases the maneuver areas and driver reaction time, thereby improving safety for drivers.
    - Vehicles turning left into Davis Drive from the business complex will be able to go on the back side of the building further north of the intersection.
    - Vehicles turning left into Davis Drive from the industrial park to access South Sterling Blvd will be able to make this movement via the new proposed partial access on the southeast corner of the lot.
    - Other alternative includes coordination with the business complex and industrial park to provide a joint access point between the complexes, in lieu of providing a new proposed partial access on South Sterling Blvd.
- The Gas Station entrance on Davis Drive is proposed to be converted to a right-in/right-out
    - Decreases number of conflict points and meets the current minimum spacing standard of 250’.
    - Vehicles traveling north on Davis Drive will be able to enter the gas station via access from Shepard Drive.

Figure 77: Davis Dr. Access Management Concept (Shepard Dr. to S Sterling Blvd.)

Davis Drive and South Sterling Boulevard

Davis Drive and South Sterling Boulevard is one of the intersections that exhibited operational deficiencies. **Figure 78** shows the existing lane configuration with the 2040 AM and PM peak hourly volumes. For this intersection, two alternatives were evaluated and described below.

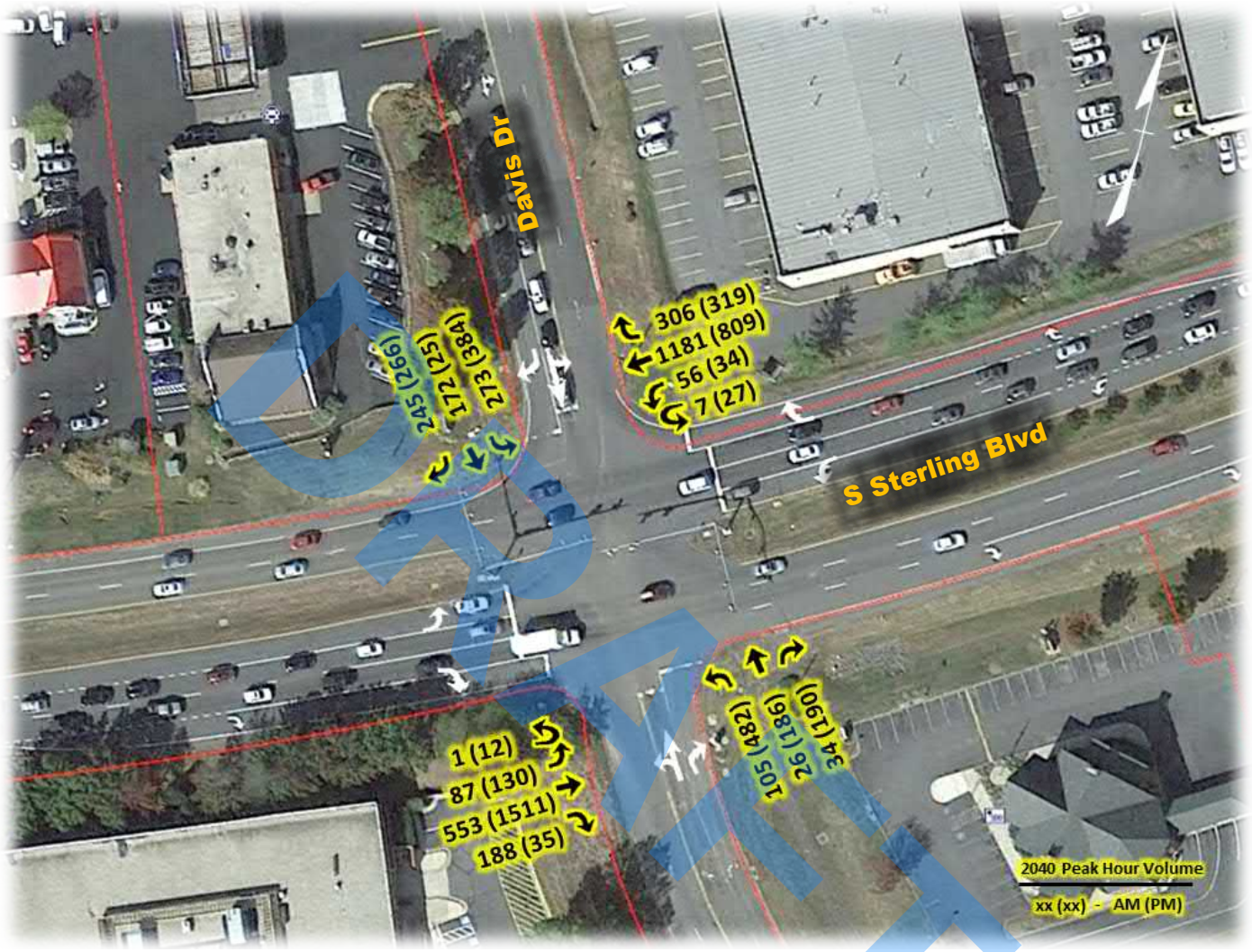


Figure 78: Davis Dr. and South Sterling Blvd. Existing Lane Configuration and 2040 AM (PM) Peak Hour Volumes

Alternative 1

Alternative 1 modifies the lane configurations within the existing pavement width. Based on the continuity of the road diet, the three-lane cross section was used, and dual-left turn lanes were accommodated within the existing pavement width of the northbound and southbound approaches to the intersection. **Figure 79** presents the proposed lane configuration for Alternative 1. Dual-left turn lanes were analyzed using AutoTURN using a SU-30 design vehicle in the outside left turn lane, concurrent with a WB-67 design vehicle in the inside left turn lane, from the northbound and southbound approaches. Based on the analysis, it is recommended to shorten the median as shown in **Figure 80** and **Figure 81** to accommodate the dual-left turn lanes in addition to lead-lag left turn phasing for the northbound and southbound approaches.

Figure 79: Davis Dr. and South Sterling Blvd. Proposed Alternative 1

Figure 80: AutoTURN for Dual-Lefts for the Northbound Approach

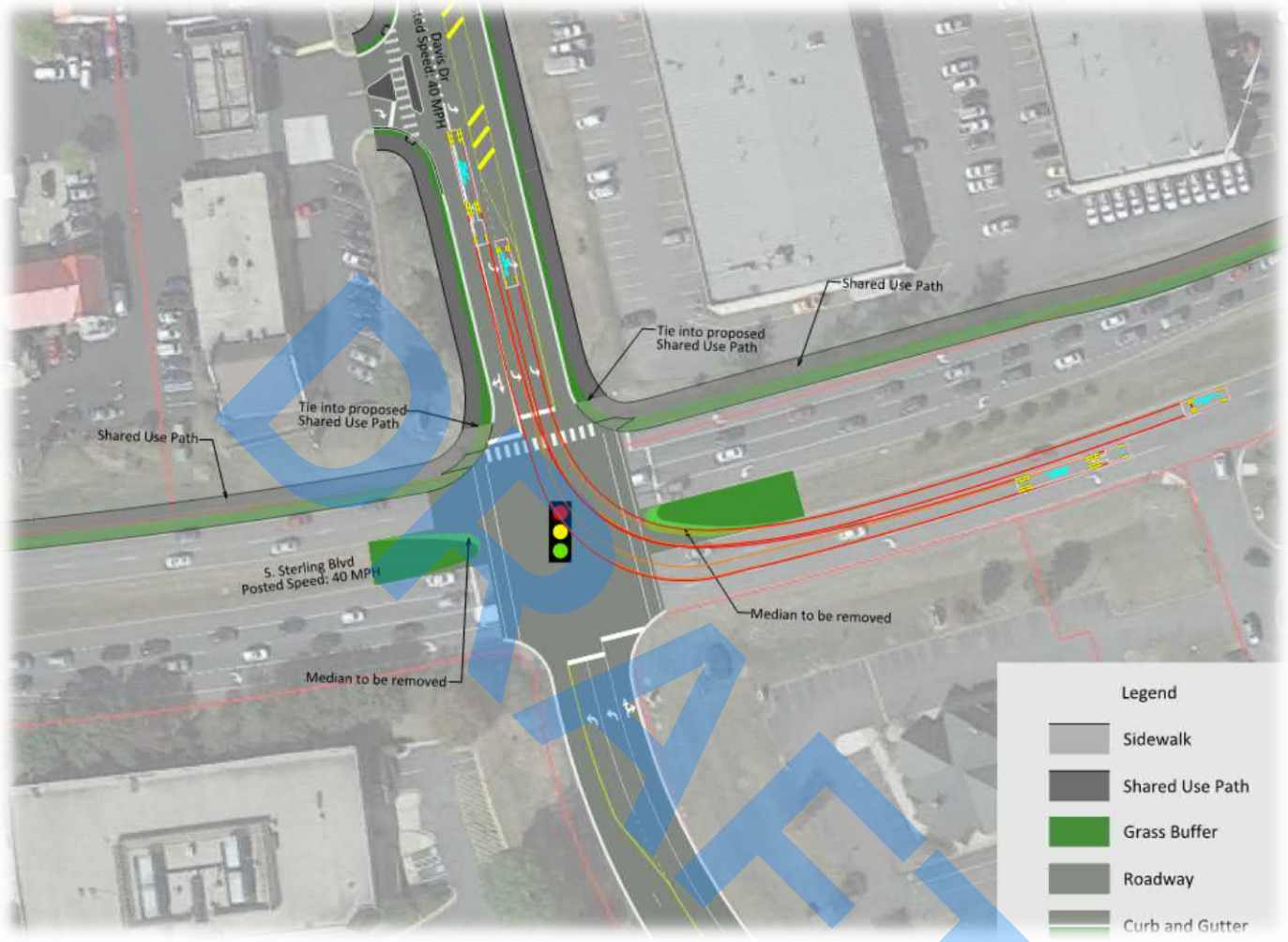


Figure 81: AutoTURN for Dual-Lefts for the Southbound Approach

Delay and LOS are compared between the 2040 No-Build and proposed alternative for the AM and PM peak hours as shown in **Table 55** and **Table 56**, respectively. In the AM peak hour, the northbound and southbound approaches improved from LOS F and LOS E to LOS D with the proposed improvements. In the PM peak hour, northbound and southbound approaches improved from LOS F to LOS E with more than one-minute reduction in the approach delays. The westbound approach improved from LOS E to LOS D, whereas the eastbound approach improved from LOS F to LOS D. The overall intersection delay for the PM peak hour improved by more than one minute.

Table 55: AM 2040 No-Build and Proposed Alternative 1 Delay/LOS for Davis Dr. and S Sterling Blvd.

Intersection	Approach	2040 AM Peak							
		No-Build V/C = 0.99				Proposed Alternative 1 V/C = 0.93			
		Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS
Davis Dr & S Sterling Blvd	NB	114	F	58	E	55	D	53	D
	SB	75	E			54	D		
	WB	53	D			53	D		
	EB	43	D			53	D		

Table 56: PM 2040 No-Build and Proposed Alternative 1 Delay/LOS for Davis Dr. and S Sterling Blvd.

Intersection	Approach	2040 PM Peak							
		No-Build V/C = 1.34				Proposed Alternative 1 V/C = 1.00			
		Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS
Davis Dr & S Sterling Blvd	NB	187	F	143	F	79	E	58	E
	SB	149	F			75	E		
	WB	57	E			38	D		
	EB	180	F			54	D		

Alternative 2

Alternative 2 builds upon Alternative 1 by widening South Sterling Boulevard by narrowing the median to accommodate the additional lane for both the westbound and eastbound approaches. These improvements would require additional corridor level improvements to South Sterling Boulevard to include drainage, environmental documentation, signal coordination, right-of-way considerations, etc. **Figure 82** presents the proposed lane configuration for Alternative 2. Delay and LOS are compared between the 2040 No-Build and proposed Alternative 2 for the AM and PM peak hours as shown in **Table 57** and **Table 58**, respectively. The proposed improvements make all approaches LOS D or better in both the AM and PM peak hours.

Figure 82: Davis Dr. and South Sterling Blvd. Proposed Alternative 2

Table 57: AM 2040 No-Build and Proposed Alternative 2 Delay/LOS for Davis Dr. and S Sterling Blvd.

Intersection	Approach	2040 AM Peak							
		No-Build V/C = 0.99				Proposed Alternative 2 V/C = 0.86			
		Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS
Davis Dr & S Sterling Blvd	NB	114	F	58	E	42	D	39	D
	SB	75	E			41	D		
	WB	53	D			42	D		
	EB	43	D			33	C		

Table 58: PM 2040 No-Build and Proposed Alternative 2 Delay/LOS for Davis Dr. and S Sterling Blvd.

Intersection	Approach	2040 PM Peak							
		No-Build V/C = 1.34				Proposed Alternative 2 V/C = 0.98			
		Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS
Davis Dr & S Sterling Blvd	NB	187	F	143	F	54	D	44	D
	SB	149	F			51	D		
	WB	57	E			32	C		
	EB	180	F			46	D		

Modifying the northbound and southbound lane configurations to dual-lefts and shared through/right lane as outlined in Alternative 1 is recommended for this intersection. Widening South Sterling Boulevard, per Alternative 2, is considered a long-term solution as part of future South Sterling Boulevard corridor improvement.

2030 BUILD CONDITIONS

Based on the final 2040 Build recommendations for the overall corridor-level as well as intersection-level improvements, the 2030 Build conditions were analyzed with the proposed improvements. **Table 59** and **Table 60** are summarizing the delay and LOS for the signalized intersection for the AM and PM peak hours, respectively. Delay and LOS for the unsignalized intersections for the AM PM peak hours are shown in **Table 61** and **Table 62**, respectively. The operations at all the intersections perform better with the proposed improvements, compared to 2040 Build conditions, given the lower 2030 volumes.

Table 59: AM 2030 No-Build and Recommended Alternative Delay/LOS for Signalized Intersections

Intersection	Approach	2030 AM Peak								
		No-Build				Recommended Alternative				
		Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	Improvement
Davis Dr & W Church Rd	NB	43	D	41	D	44	D	39	D	Dual-left turn lanes, a thru lane and a shared thru/right lane for the northbound approach.
	SB	47	D			43	D			
	WB	42	D			46	D			
	EB	38	D			32	C			
Davis Dr & S Sterling Blvd	NB	76	E	42	D	41	D	37	D	Dual-left turn lanes and shared thru/right lanes for the northbound and southbound approaches
	SB	59	E			49	D			
	WB	38	D			33	C			
	EB	32	C			35	D			

Table 60: PM 2030 No-Build and Recommended Alternative Delay/LOS for Signalized Intersections

Intersection	Approach	2030 PM Peak								
		No-Build				Recommended Alternative				
		Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	Appr. Delay (s/veh)	Appr. LOS	Inter. Delay (s/veh)	Inter. LOS	Improvement
Davis Dr & W Church Rd	NB	96	F	93	F	66	E	64	E	Dual-left turn lanes, a thru lane and a shared thru/right lane for the northbound approach.
	SB	116	F			70	E			
	WB	65	E			52	D			
	EB	96	F			69	E			
Davis Dr & S Sterling Blvd	NB	100	F	80	F	54	D	44	D	Dual-left turn lanes and shared thru/right lanes for the northbound and southbound approaches
	SB	100	F			45	D			
	WB	47	D			28	C			
	EB	88	F			50	D			

Table 61: AM 2030 No-Build and Recommended Alternative Delay/LOS for Unsignalized Intersections

Intersection	Approach	2030 AM Peak				
		No-Build		Recommended Alternative		
		Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS	Improvements
Davis Dr & Tippett Hill Dr	WB	23	C	31	D	Right-in, right-out, left-in for the eastbound approach
	EB	48	E	16	C	
Davis Dr & Belfort Park Dr	NB			3	A	Conventional Signal
	SB			9	A	
	EB	25	C	26	C	
Davis Dr & First Potomac Way	WB	9	A	10	A	Right-in, right-out, left in for the eastbound approach
	EB	23	C	15	C	
Glenn Dr & Belfort Park Dr	NB			9.0	A	Switching the stop signs from Belfort Park Drive approaches to Glenn Drive approaches
	SB			10.2	B	
	WB	9.9	A			
	EB	9.4	A			

Table 62: PM 2030 No-Build and Recommended Alternative Delay/LOS for Unsignalized Intersections

Intersection	Approach	2030 PM Peak				
		No-Build		Recommended Alternative		
		Appr. Delay (s/veh)	Appr. LOS	Appr. Delay (s/veh)	Appr. LOS	Improvements
Davis Dr & Tippett Hill Dr	WB	24	C	35	E	Right-in, right-out, left-in for the eastbound approach
	EB	128	F	12	B	
Davis Dr & Belfort Park Dr	NB			9	A	Conventional Signal
	SB			12	B	
	EB	32	D	20	C	
Davis Dr & First Potomac Way	WB	16	C	18	C	Right-in, right-out, left in for the eastbound approach
	EB	28	D	11	B	
Glenn Dr & Belfort Park Dr	NB			9.6	A	Switching the stop signs from Belfort Park Drive approaches to Glenn Drive approaches
	SB			11.8	B	
	WB	9.8	A			
	EB	10.4	B			

DAVIS DRIVE TRAVEL TIME

Simulated travel times for the Davis Drive corridor with the recommended corridor-level and intersection-level improvements, discussed earlier, were compared to the No-Build conditions for the 2030 and 2040 as presented in **Table 63** and **Table 64**, respectively. The travel time is measured from West Church Road to South Sterling Boulevard along Davis Drive corridor in the northbound and southbound directions. During the AM peak period, the northbound travel time is anticipated to increase with the recommended improvements by no more than 0.5 minutes for both northbound and southbound directions for the 2030 and 2040 volumes. During the PM peak period, 2030 and 2040 travel times are expected to improve compared to the No-Build conditions for both the northbound and southbound directions, despite the proposed road diet along Davis Drive. Most of the travel time reduction is attributed to the improvements proposed at the two signalized intersections.

In the northbound direction, modifications to the northbound lane configurations at the Davis Drive and West Church Road intersection along with the signal timing optimization have significant impacts on the simulated travel time. As presented earlier, the Davis Drive and West Church Road intersection is operating more than 50% over capacity in the 2040 PM No-Build conditions, where northbound queues are spilling back to Belfort Park Drive. These extended queues result in long delays along the northbound direction of Davis Drive between West Church Road and Belfort Park Drive. To distinguish between the Road Diet impact and the intersection-level modifications impact, the No-Build scenario was tested, but only with the proposed improvements for Davis Drive and West Church Road intersection. The travel time comparison for the 2040 PM No-Build and the test No-Build scenarios shows travel time reduction from 9 minutes to 2.3 minutes for the northbound direction. Future 2030 Build and 2040 Build conditions Synchro and SimTraffic output are included in **Appendix I** and **Appendix J**, respectively.

Table 63: Simulated Travel Time for the 2030 AM and PM Peak Hours

2030 Simulated Travel Time (min) Between West Church Rd and South Sterling Blvd				
Approach	2030 AM Peak		2030 PM Peak	
	No-Build	Recommended Improvements	No-Build	Recommended Improvements
NB	2.0	2.2	3.6	2.4
SB	2.6	2.8	4.9	2.7

Table 64: Simulated Travel Time for the 2040 AM and PM Peak Hours

2040 Simulated Travel Time (min) Between West Church Rd and South Sterling Blvd				
Approach	2040 AM Peak		2040 PM Peak	
	No-Build	Recommended Improvements	No-Build	Recommended Improvements
NB	2.0	2.4	9.0	3.1
SB	2.9	3.4	6.7	3.1

Belfort Park Drive and Glenn Drive

As part of this project, a separate study to evaluate an All Way Stop alternative and a Change Stop Sign Configuration alternative was conducted at the intersection of Belfort Park Drive and Glenn Drive. The All Way Stop alternative was conducted using the criteria outlined in the 2009 Manual on Uniform Traffic Control Devices (MUTCD) with Revisions 1 and 2 incorporated, dated May 2012.

The intersection is a 4-leg intersection that currently operates as a 2-way stop control with stop signs on Belfort Park Drive. Glenn Drive has two lanes entering the intersection in the northbound and southbound approaches. The northbound approach has a shared left and through lane, and an exclusive right turn lane, and the southbound approach has a shared left and through lane, and a shared through and right lane. Belfort Park Drive has two lanes entering the intersection in the eastbound and westbound approaches, and the lanes in both approaches are a shared left and through lane, and a shared through and right lane. Both roadways have a posted speed limit of 30 miles per hour (MPH).

Per the result of the analysis, the All Way Stop alternative is not recommended due to the relatively low existing and projected volumes at the intersection. Switching the stop signs from controlling the Belfort Park Drive approaches to controlling the Glenn Drive approaches of the intersection is recommended to meet driver expectations and to mitigate the safety concerns for the intersection. Another recommendation along Belfort Park Drive is a road diet, reducing the four-lane roadway to a two-lane roadway. This recommendation is in accordance with the CTP's number of travel lanes along Belfort Park Drive. Achieving the adequate sight distance with the installation of the stop bar on Glenn Drive should be considered in the design phase. The detailed report for the Belfort Park Drive and Glenn Drive study, including the preliminary cost estimate is in **Appendix K**.

PEDESTRIAN IMPROVEMENTS

Davis Drive Corridor

The Davis Drive corridor has been identified as among the top 12 sidewalk/trail projects countywide. There are currently no continuous sidewalks along the Davis Drive corridor. A 10-foot wide shared use path on the west side of Davis Drive, 6-foot wide sidewalk on the east side of Davis Drive, and a 5-foot wide on street bike lane are recommended from Shepard Drive to Tippett Hill Drive/Bluemont Junction Square to maintain continuity with the existing pedestrian facilities outside the study limits. A shared use path on both sides of Davis Drive is recommended between South Sterling Boulevard and Shepard Road, and between Tippett Hill Drive/Bluemont Junction Square and West Church Road. There is a shared use path along the east side of Davis Drive approximately 0.40 miles south of South Sterling Boulevard and just north of West Church Road outside the study limits. Pedestrian facility continuity is recommended with the Davis Drive improvement, which is a road diet with bicycle facility in both directions, a shared-use path on the west side of Davis Drive, and sidewalk on the east side, to be in accordance with the CTP.

Any pedestrian ramp not in compliance with current ADA and VDOT guidelines should be replaced with an acceptable pedestrian ramp along Davis Drive during the design phase of this project. New ADA pedestrian ramps should be installed at all the access points along Davis Drive, particularly at the following locations:

- Northwest and northeast corners of Sterling Boulevard.
- Southeast corner of Shepard Drive.
- All corners of First Potomac Way/Sterling Park Business Center Entrance.
- Northwest corner of Belfort Park Drive.

Pedestrian crosswalks across Davis Drive will be accommodated with the proposed signal at Davis Drive and Belfort Park Drive, and across Davis Drive at the South Sterling Boulevard intersection. Also, installation of bus pads at bus stop locations are recommended to be coordinated during the design phase of this project.

Glenn Drive

Glenn Drive between Tippett Hill Drive and Belfort Park Drive is not identified in the CTP. As such, there are no specific pedestrian/bicycle plans for this roadway. The CTP, however, recommends that local roads such as Glenn Drive have a minimum 5-foot-wide sidewalk. The existing concrete sidewalk on the east side of Glenn Drive should be upgraded to meet the standard 5-foot-wide sidewalk for local roadway where the existing sidewalks are currently 4-foot-wide. According to the approved rezoning application for the Stanley Homes at Dominion Trail, the owners will install new sidewalk along the frontage of the property.

Belfort Park Drive

The CTP identifies 6-foot sidewalks on both sides of Belfort Park Drive. The north side sidewalk along Belfort Park Drive is 5-foot-wide, which is not in compliance with the 6-foot-wide sidewalk called for in the CTP. The CTP also calls for sidewalks on both sides of Belfort Park Drive, however, sidewalk is missing on the southside of Belfort Park Drive between Glenn Drive and Shaw Road. Installation of the missing sidewalk should be considered when development occurs in this segment of Belfort Park Drive. Consideration should also be given to updating the sidewalk on the north side.

Shaw Road

There is no sidewalk along Shaw Road between Belfort Park Drive and South Sterling Boulevard. The CTP calls for a shared use path along one side and a sidewalk along the other side of the roadway. The existing pedestrian volume in the study area indicated that the highest pedestrian activity occurred at Shaw Road and Belfort Park Drive. There are no existing sidewalks along or crosswalks across Shaw Road, which results in no pedestrian connectivity to Lindsay Cars Court. Therefore, a sidewalk and shared use path is recommended to be installed on both sides of Shaw Road to be in accordance with the CTP. As parcels along Shaw Road are developed, the installation of the shared use path and sidewalk along Shaw Road in conformance with the CTP should be considered to improve pedestrian mobility and connectivity along the corridor and to Lindsay Cars Court. The installation of a crosswalk at the north and west legs of the Shaw Road and Belfort Park Drive intersection is recommended as shown in **Figure 83**.

Figure 83: Pedestrian Improvements at Shaw Rd.

Lindsay Cars Court

Lindsay Cars Court is not identified in the CTP. As such, there are no specific pedestrian/bicycle plans for this roadway. The CTP, however, recommends that local roads such as Lindsay Cars Court have a minimum 5-foot-wide sidewalk. However, a sidewalk is not recommended for this roadway because it primarily serves the dealership, and the roadway ends in a cul-de-sac.

South Sterling Boulevard

As part of Loudoun County's ongoing effort for safe pedestrian/bicycle facility in the county, pedestrian/bicycle facility along South Sterling Boulevard has been identified as the top sidewalk/trail project countywide. A conceptual design, obtained from DTCI, showed a 10-foot shared use path is recommended along the northside of South Sterling Boulevard, from Shaw Road, and ties into the W&OD trail.

OTHER IMPROVEMENTS

Other improvements within the study area include:

- Converting the Business Center access on Davis Drive that serves a Sunoco Gas Station to right-in, right-out.
    - Additional signs are recommended to direct left turning vehicles to use the Shepard Drive access.
- Converting 201 Davis Drive access to right-in, right-out.
    - An additional entrance is proposed on South Sterling Boulevard
- Trimming of vegetation or the removal of trees to improve sight distances at the following intersections:
    - Davis Drive and Shepard Drive
    - Davis Drive and First Potomac Way
    - Davis Drive and Overmountain Square
    - Davis Drive and Tippett Hill Drive
- Removal of fences impeding sight distance at the Davis Drive/Shepard Drive intersection.
- Installation of advance warning signs at intersections/entrances with sight distance issues caused by roadway curvature. The locations include:
    - Davis Drive and Overmountain Square
    - Davis Drive and First Potomac Way

SUMMARY OF RECOMMENDATIONS

To improve safety in the Davis Drive corridor study area, corridor-wide and intersection specific improvements were evaluated and identified for implementation. Davis Drive is recommended to be reduced to a two-lane roadway with a two-way left turn lane (TWLTL) "Road Diet" from Tippett Hill Drive to Shepard Drive. The CTP calls for a four-lane undivided roadway along Davis Drive, however, section 3-2.12 of the CTP for Traffic Calming allows for consideration of traffic calming measures on local and collector roadways in the Suburban Policy area to improve multimodal safety and quality of life.

In addition, dedicated turn lanes at the unsignalized intersections are proposed as indicated in the Turn Lane Warrant analyses. Intersection specific improvements were recommended at six intersections based on their

operational and/or safety deficiencies. The proposed improvements at the six intersections along Davis Drive include:

- S Sterling Blvd: Dual-left turn lanes and shared thru/right lanes for the northbound and southbound approaches.
- Shepard Dr: Dedicated left turn lane for the northbound approach and dedicated right turn lane for the southbound approach. In addition, right-in, right-out at the business center and 201 Davis Drive industrial building entrances.
- First Potomac Way: Right-in, right-out, left in for the eastbound approach. This will also solve the sight distance concerns at this location.
- Belfort Park Dr: Conventional Signal. This will also solve the sight distance concerns at this location.
- Tippett Hill Dr: Right-in, right-out, left-in for the eastbound approach. This will also solve the sight distance concerns at this location.
- W. Church Rd: Dual-left turn lanes, a thru lane and a shared thru/right lane for the northbound approach. It is recommended that the Davis Drive and West Church Road intersection to be reevaluated as part of a future corridor study along West Church Road.

The CTP calls for a shared-use path (SUP) on one side of Davis Drive, and sidewalk on the other side. A 10-foot shared use path on the west side of Davis Drive, and 6-foot sidewalk on the east side of Davis Drive, are recommended from Shepard Drive to Tippett Hill Drive/Bluemont Junction Square to maintain continuity with the existing pedestrian facilities outside the study limit. A shared use path on both sides of Davis Drive is recommended between South Sterling Boulevard and Shepard Road, and between Tippett Hill Drive/Bluemont Junction Square and West Church Road. Also, a bike lane in both directions is recommended along Davis Drive between Tippett Hill Drive and Shepard Drive.

The installation of physical barriers should be considered during the design phase for locations with turn restrictions, such as at Tippett Hill Drive and First Potomac Way.

PRELIMINARY COST ESTIMATES

A preliminary cost estimate was prepared for the overall improvements in the study area, including the Davis Drive corridor, the Belfort Park Drive and Glenn Drive intersection, Tippett Hill Drive, Shepard Drive, and Shaw Road pedestrian improvements. The estimate includes removal of pavement markings, milling and overlay of the existing pavement, installation of shared-used paths and sidewalks, new pavement markings, new traffic signals, and sign relocations and installations. The estimate also includes construction engineering and inspection (CE&I), engineering design, right-of-way, utilities, maintenance of traffic, and mobilization. The overall estimate is $8,130,000 and is presented in **Table 65**. The detailed cost estimate is presented in **Appendix L**.

Table 65: Study Area Preliminary Cost of Improvements

DESCRIPTION	COST
MOBILIZATION	$215,800
ROADWAY	$1,554,760
MEDIAN	$21,300
SIDEWALK AND SHARED USE PATH	$173,420
DRAINAGE	$217,545
EARTHWORK	$20,000
EROSION AND SEDIMENT CONTROL	$176,398
MOT	$289,800
TRAFFIC	$720,856
CE&I (17%)	$574,878
CONSTRUCTION TOTAL (Rounded)	**$3,964,758**
ADDITIONAL COST	
UTILITY	$60,000
RIGHT-OF-WAY	$1,210,000
CONTIGENCY (40%)	$2,090,851
ENGINEERING DESIGN	$804,119
TOTAL COST	**$8,130,000**

In addition, the preliminary cost estimate of the improvements was broken down per location, and corridor. A summary of the cost estimate for the Davis Drive corridor and intersection improvements are presented in **Table 66**.

Table 66: Corridor and Intersection Improvement Preliminary Cost Estimate

DESCRIPTION	DAVIS DRIVE CORRIDOR	WEST CHURCH ROAD	TIPPETT HILL DRIVE	BELFORT PARK DRIVE	FIRST POTOMAC WAY	SHEPARD DRIVE	STERLING BOULEVARD	BELFORT PARK & GLENN DRIVE	SHAW ROAD
MOBILIZATION	$165,000	$2,000	$1,000	$11,000	$1,000	$5,000	$28,000	$1,800	$1,000
ROADWAY	$1,541,260	$2,700	$0	$0	$0	$8,100	$2,700	$0	$0
MEDIAN	$0	$1,450	$0	$0	$0	$19,850	$0	$0	$0
SIDEWALK AND SHARED USE PATH	$164,785	$0	$0	$4,210	$0	$0	$0	$0	$4,425
DRAINAGE	$217,545	$0	$0	$0	$0	$0	$0	$0	$0
EARTHWORK	$20,000	$0	$0	$0	$0	$0	$0	$0	$0
EROSION AND SEDIMENT CONTROL	$176,398	$0	$0	$0	$0	$0	$0	$0	$0
MOT	$245,000	$2,000	$300	$9,600	$300	$3,000	$27,000	$2,000	$600
TRAFFIC	$323,228	$8,838	$2,796	$91,116	$2,086	$9,982	$267,180	$15,030	$600
CE&I (17%)	$485,047	$2,888	$696	$19,707	$576	$7,808	$55,230	$1,800	$1,126
CONSTRUCTION TOTAL (Rounded)	**$3,339,000**	**$20,000**	**$5,000**	**$136,000**	**$4,000**	**$54,000**	**$381,000**	**$20,630**	**$8,000**
ADDITIONAL COST									
UTILITY	$40,000	$0	$0	$10,000	$0	$0	$10,000	$0	$0
RIGHT-OF-WAY	$1,125,000	$0	$0	$60,000	$0	$0	$0	$0	$25,000
CONTIGENCY (40%)	$1,801,600	$8,000	$2,000	$82,400	$1,600	$21,600	$156,400	$5,200**	$13,200
ENGINEERING DESIGN	$675,600	$3,000	$750	$30,900	$600	$8,100	$58,650	$22,000	$4,950
TOTAL COST (Rounded)	**$6,982,000**	**$31,000**	**$8,000**	**$320,000**	**$7,000**	**$84,000**	**$607,000**	**$48,000**	**$52,000**

**: A 25% contingency was approved for this location.