

Technical Memorandum

To: Ed Carter
From: David Morris, P.E.
Date: September 16, 2019
Re: Route 7, Clarke County, Roadway Safety Assessment

Introduction

At the request of Clarke County Board of Supervisors, a Roadway Safety Assessment for Route 7, also known as Harry Byrd Highway, from the Frederick County line to the Loudoun County line was conducted. The review consisted of an assessment of existing conditions and correctable crash patterns along the corridor as well as all of the intersections with other state routes. Within the project limits, 289 crashes occurred between January 1, 2016 and December 31, 2018. Of these crashes, there was 1 fatal crash, 98 injury crashes and 190 property damage only crashes. This report will attempt identify those intersections and segments that would benefit from roadway safety improvements and associated recommendations.

Route 7 Operational Characteristics

The study corridor is approximately 13.5 miles long in Clarke County beginning at the Frederick County line ending at the Loudoun County line and passes around the Town of Berryville. Route 7 is designated to run east-west in this report. Route 7 is a four-lane divided with a grassed median and is functional classified as a Principal Arterial.

The alignment of Route 7 could be considered, for the most part, as flat terrain with no severe curvature to the west the Shenandoah River. From east of the Shenandoah River to the Loudoun county line, there is a continuous grade with increased horizontal alignment changes.

Lane widths are approximately 11 feet. Total shoulder widths vary from 6 to 10 feet on the right with 0 to 4 feet of that paved. The left shoulder widths vary from 4 to 6 feet with 0 to 2 feet paved.

There are approximately 110 access points to the eastbound lanes and 115 access points to westbound lanes. Access points include state route intersections, crossovers, driveways, commercial entrances, and field entrances.

There are three signalized intersections on the corridor. There is a grade-separated interchange with Route 340.

Route 7 serves as a major commuter route to NOVA for residents of Frederick and Clarke counties as well as areas in West Virginia. **Table 1** presents the 2018 estimated traffic volumes. Volumes vary from 23,000 to 28,000 Average Annual Daily Traffic (AADT). The Average Annual Weekday Traffic (AAWDT) varies from 25,000 to 30,000. The peak traffic times are generally between 4:30 and 7:30 AM eastbound and 3:00 to 6:00 PM westbound. The percentage of Tractor Trailers is 4% west of Route 340 and 2% east of Route 340.

Table 1, 2018 Estimated Traffic Volumes

Route 7 (Harry Byrd Highway)		
Location (From/To)	AADT (2018)	AAWDT (2018)
Frederick CL/Rt 7 Bus W	28,000	30,000
Rt 7 Bus W/Rt 340	26,000	28,000
Rt 340/Rt 7 Bus E	23,000	25,000
Rt 7 Bus E/ Rt 606	23,000	26,000
Rt 606/Loudoun CL	25,000	28,000

Speed data was reviewed at 3 locations both eastbound and westbound. The approximate average speeds are summarized in **Table 2**. The approximate 85th percentile speeds are summarized in **Table 3**.

Table 2, Approximate Average Speed Results

Route 7 (Harry Byrd Highway)		
Location	Approximate Average Eastbound, MPH	Approximate Average Westbound, MPH
0.3 mile E Route 635	63*	61*
Near Route 621	62	60
Near Route 679 W Int.	60	62

* Estimated from continuous count station

The 85th percentile speed is the speed at or below which 85 percent of all vehicles are observed to travel under free-flowing conditions.

Table 3, Approximate 85th Percentile Speeds

Route 7 (Harry Byrd Highway)		
Location	Approximate 85 th Percentile Eastbound, MPH	Approximate 85 th Percentile Westbound, MPH
0.3 mile E Route 635	66*	64*
Near Route 621	67	65
Near Route 679 W Int.	66	69

* Estimated from continuous count station

The data suggests that majority of drivers are exceeding the posted speed limit and many are greatly exceeding that limit on a daily basis.

Crash Discussion

Overall Crash Data

Within the review limits, 289 crashes occurred during the time period of January 1, 2016 and December 31, 2018. Of these crashes, there was 1 fatal crash, 98 injury crashes and 190 property damage only crashes. The following chart shows the breakdown by type of crashes. The four most common types are Rear Ends (39%), Fixed Object Off-Road (25%), Angle (15%), and Deer (13%).

Chart 1, Route 7 Crash Types

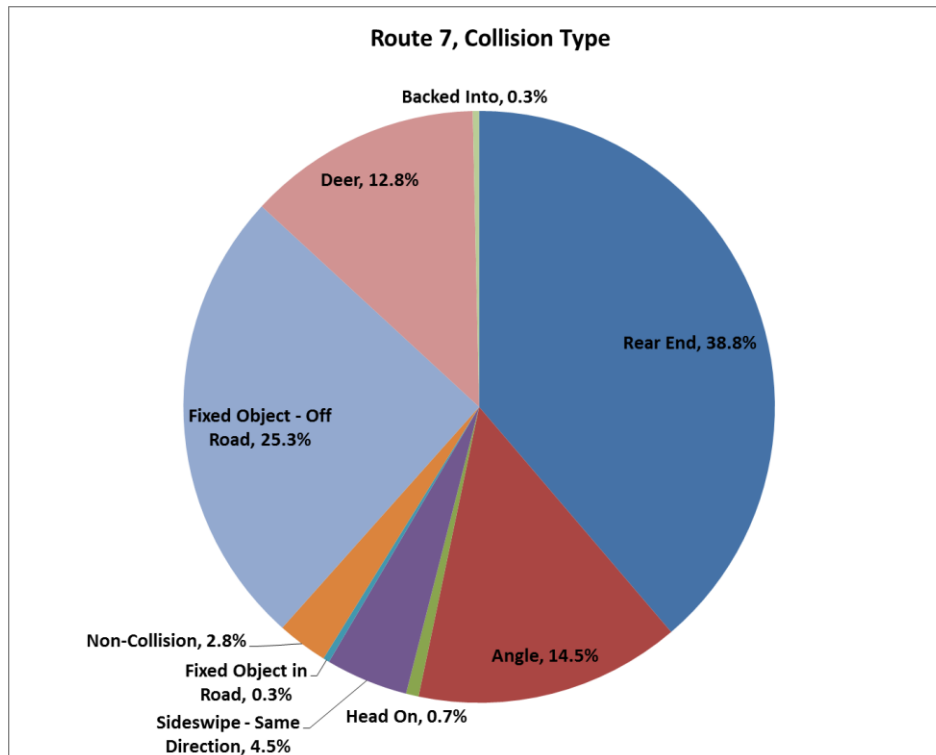


Table 3 shows how the crash rates for Route 7 in Clarke County compares to all the other Routes in the State that are classified as Principal Arterials. The data suggests that, from an overall comparison, the crashes on Route 7 are about the same for similar routes in the State. With the overall Crash rate slightly higher, the Fatality rate much lower, and the Injury rate about the same.

Table 3, Route 7 Crash Rate Comparison

Crash Rates	Route 7, Clarke, 2016-2018	State, Principal Arterials 2017
All Crashes	80	76
Injury	38	39
Fatal	0.28	1.06

Intersection Crashes

Crashes were reviewed at all intersections of Route 7 with other VDOT maintained routes for the period of January 1, 2016 thru December 31, 2018. The purpose was to identify correctable patterns of crashes within a 250 foot radius from the center of the intersection.

There are 19 intersections within the study area. Three of 19 intersections are signalized; they are at Route 632, Route 7 Business western terminus (W Main St), and Route 7 Business eastern terminus (E Main St). The other intersections are controlled by STOP signs.

Based on data provide by VDOT’s Traffic Engineering Division for the time period of 2013-2017, one intersection was identified as having a Potential for Safety Improvement (PSI). The PSI calculation identifies intersections experiencing a greater number of crashes than would be expected based in the intersection traffic control, entering traffic volumes, and the number of lanes. That intersection is Route 601 and Route 7. It is ranked number 47 out of all VDOT maintained intersections within the Staunton District.

Table 4 summarizes the total crashes, total injuries, and total fatalities for each intersection. If a crash pattern was found, those intersections were identified and further review was conducted for each and is discussed subsequently in this report. For those intersections with no identifiable crash pattern, no further review was conducted.

Table 4, Intersection Crash Summary

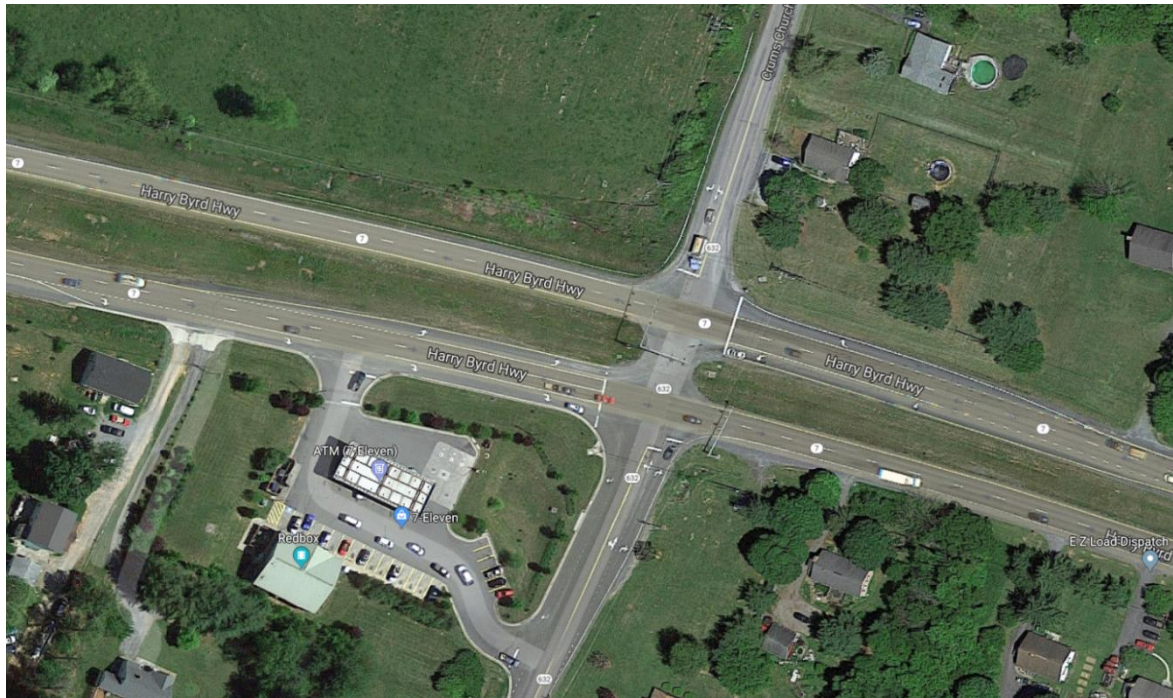
Reported Crashes Route 7 and State Route Intersections 2016-2018				
Intersection	Total Crashes	Injuries	Fatals	Crash Pattern
7 - 645, Wrights Mill Rd	3	2	0	1 Angle in the EB lanes, 1 road rage incident, 1 Fixed Object Off Road. No Pattern. No further review.
7 - 635, Moose Rd/Pierce Rd	0	0	0	No crashes, No further review.
7 - 660, Russell Rd	8	5	0	4 angle crashes where SB vehicles FTYRW to WB vehicles. One of those was due to a floor mat getting caught on the brake pedal. No pattern. No further review
7 - 632, Triple J Rd/Crums Church Rd	11	9	1	Crash Pattern(s): 4 Rear End crashes EB. See detailed intersection review.
7 - 653, Kimble Rd	8	2	0	8 crashes in 3 years. 2 in WB lanes. Of the 6 in the EB lanes, 1 was a secondary crash, 1 was a distracted driver, 1 was due to a queue of stopped traffic from the next signal to the east, 1 was fail to yield the right of way. No pattern. No further review.
7 - 7 BUS W	12	8	0	Crashes Pattern(s): 6 Rear End crashes EB, 2 angle crashes EB (Both Red light running). See detailed intersection review.
7 - 7 BUS E	11	2	0	Crashes Pattern(s): 6 Rear End crashes WB, 2 Rear End crashes EB. 3 Angle crashes EB (2 Red Light Running) See detailed intersection review.
7 - 608S, Parshall Rd	1	0	0	1 crash in 3 years. No Pattern. No further review.
7 - 608N, Wickliffe rd	1	0	0	1 crash in 3 years. No Pattern. No further review.
7 - 621, Chilly Hollow Rd	2	0	0	2 NB FTY to EB. No crashes between 6/16/17 and 12/31/18. No further review.
7 - 612 N, Shepards Mill Rd	12	5	0	Crash Pattern(s): 7 Angle crashes SB fail to yield to WB. See detailed intersection review.
7 - 612 S, Quarry Rd	0	0	0	No crashes, No further review.
7 - 603, Castleman Rd	2	1	0	1 avoiding deer, 1 Fixed Object Off Road. No Pattern. No further review.
7 - 606/FR709, River Rd/Parker Ln	4	4	0	4 crashes in 3 years. 1 Deer, 1 Rear End EB, 1 Angle (NB FTY to EB), 1 Fixed Object Off Road. No Pattern. No further review.
7 - 643, Retreat Rd	3	3	0	1 Deer, 1 Rear End EB (Sun glare), 1 Angle in EB lane, No Pattern. No further review.
7 - 679 W, Pine Grove Rd	1	1	0	1 crash in 3 years. No Pattern. No further review.
7 - 604, Ebenezer Rd/Good Shepherd Rd	0	0	0	No crashes, No further review.
7 - 679 E, Pine Grove Rd	2	1	0	1 crash a result of a DUI driver. No Pattern. No further review.
7 - 601, Blue Ridge Mt Rd/Raven Rocks Rd	9	4	0	Crash Pattern(s): 4 angle crashes in the EB lanes. See detailed intersection review.

Route 7 and Route 632 (Triple J Rd/Crums Church Rd)

Route 7 and Route 632 is a four-leg intersection with all approaches operating under SIGNAL control. See the following figure for aerial view of existing conditions.

Crash Review

The review found 11 crashes resulting in 9 injuries and 1 fatality. The most frequent crash type (6 of 11) was rear end crashes where there were 4 in the eastbound direction and 2 in the westbound direction. There was 1 red-light running crash in the westbound direction and 1 in the southbound direction. Also, there was one crash in the crossover and one at the 7-Eleven entrance on Route 632.



Field Review

Rear ends crashes are most often attributed to drivers following too closely but signal visibility and signal clearance intervals can contribute to drivers making quick decisions to stop on a change of indication from green to yellow to red.

Visibility of the signal heads in both directions is sufficient but could be increased with high visibility back plates. Clearance intervals were reviewed and new timings implemented in October, 2015 and were set based on the intersection geometry and vehicle speed of 62 mph in accordance with VDOT's Traffic Engineering Memorandum 306.1, Yellow Change Intervals and Red Clearance Intervals.

There is a slight crest vertical curve in the eastbound lanes west of the intersection that cars can disappear behind.



Slight Crest Vertical Curve Eastbound

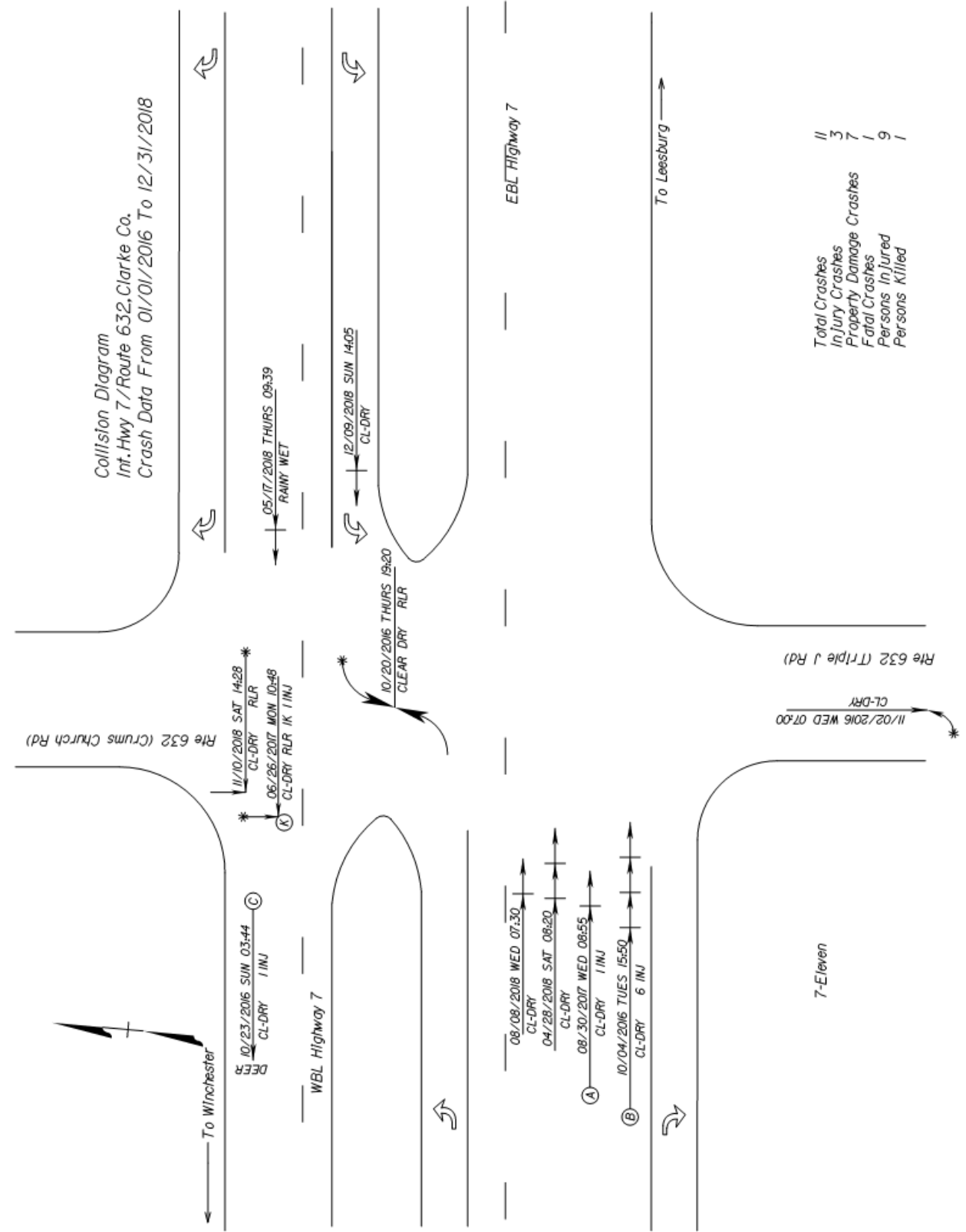
Possible Counter Measures

Based on the crash data review, possible counter measure should focus on reducing rear end crashes.

1. Install high-visibility back plates to the signal heads on all approaches.
2. Install WATCH FOR STOPPED VEHICLES signs, both on the right and left sides of eastbound Route 7 at approximately 1,000 feet west of the intersection.
3. Review existing video detection zones to determine if there is an opportunity to increase the advanced detection.

There is an existing programed safety project to provide advanced vehicle detection on both the Route 7 eastbound and westbound approaches to provide extension of green time in an effort to reduce the number of red light running and rear end crashes. Funding for the preliminary engineering will be available in October 2022 with construction funding available in April 2023.

Crash Diagram Route 7 and Route 632



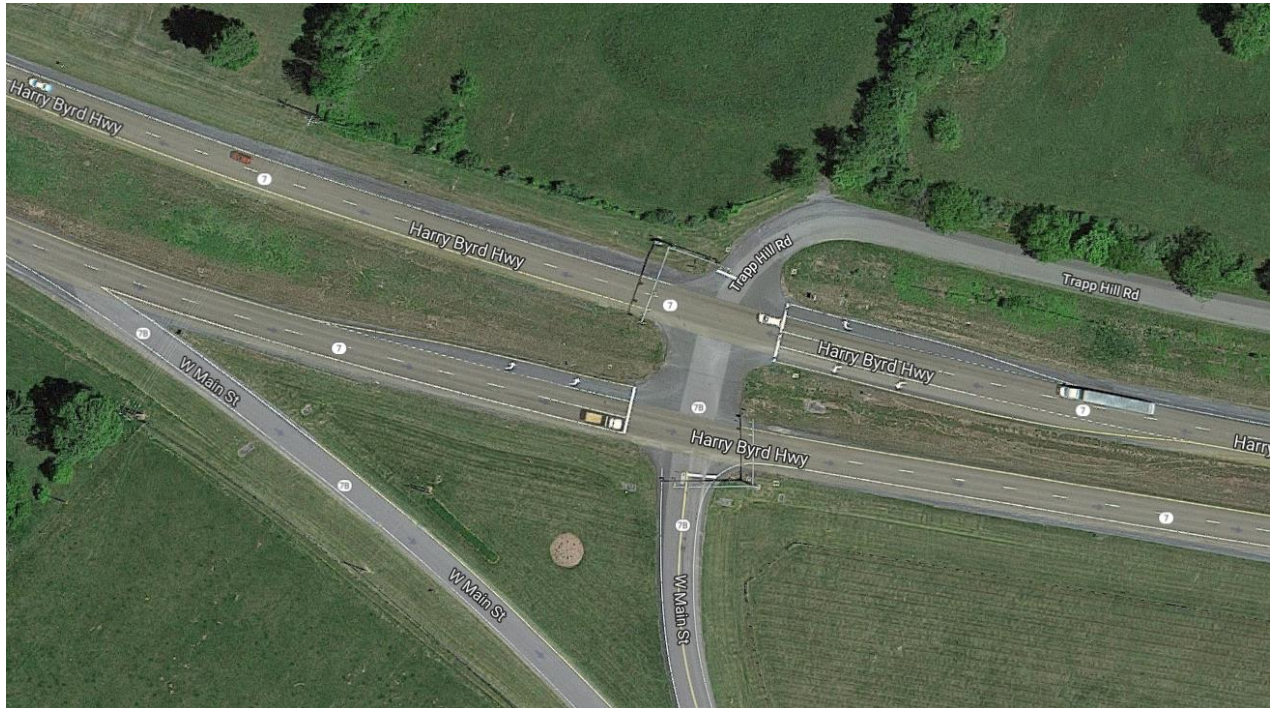
--Not to Scale--

Route 7 and Route 7 BUS (West Main St.)

Route 7 and Route 7 BUS (W. Main St.) is a four-leg intersection with all approaches operating under SIGNAL control. See the following figure for aerial view of existing conditions.

Crash Review

The review found 12 crashes resulting in 8 injuries, 0 fatalities. The most frequent crash type (5 of 12) was rear ends in the eastbound direction. There were 2 additional crashes in the eastbound direction that were a result of a driver running a red light.



Field Review

Rear ends crashes are most often attributed to drivers following too closely but signal visibility and signal clearance intervals can contribute to drivers making quick decisions to stop on a change of indication from green to yellow to red.

There are existing Signal Ahead warning signs with flashers on both the eastbound and westbound approaches.

Clearance intervals were reviewed and new timings implemented in November, 2015 and were set based on the intersection geometry and vehicle speed of 62 mph in accordance with VDOT's Traffic Engineering Memorandum 306.1, Yellow Change Intervals and Red Clearance Intervals.



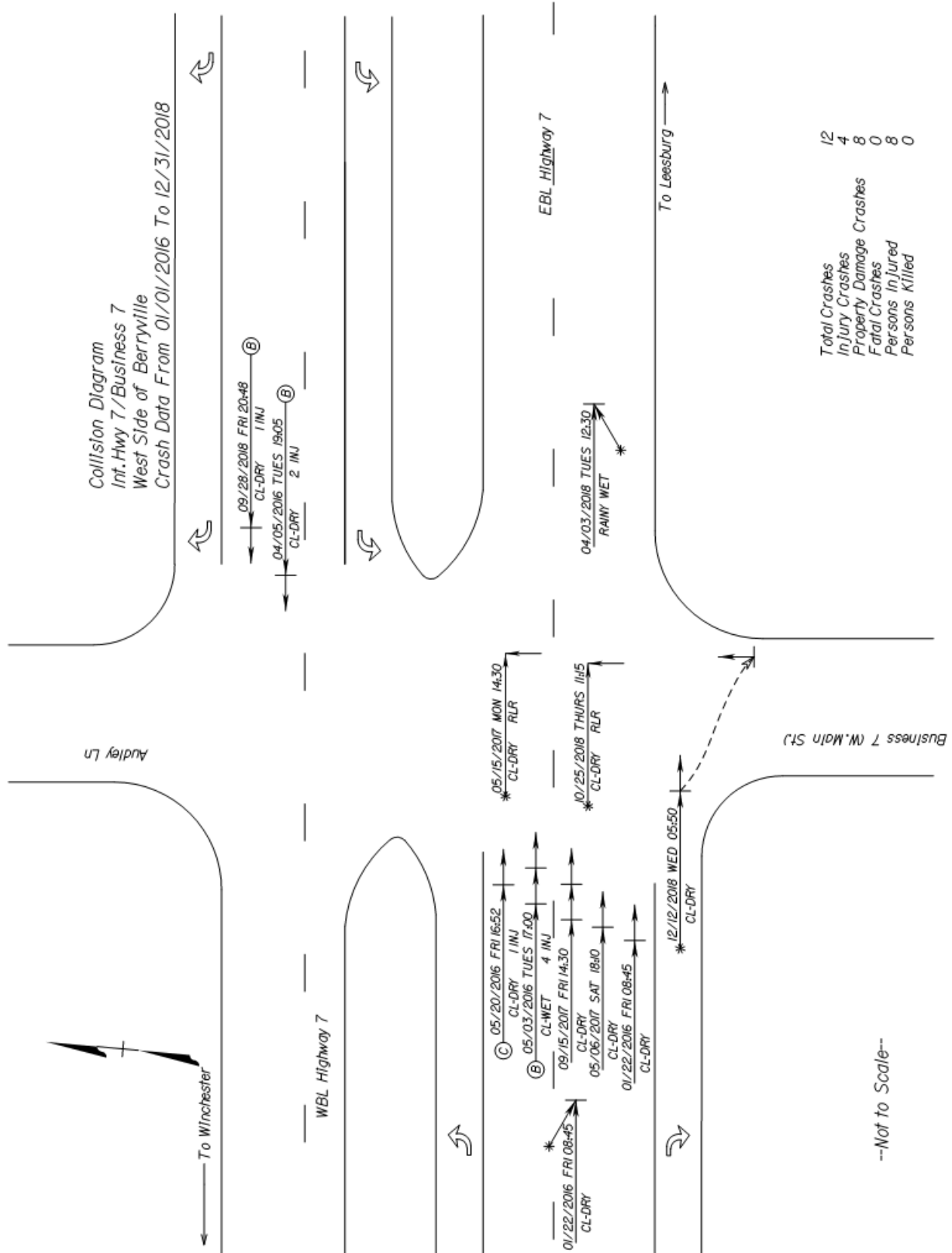
Route 7 eastbound Signal Head Visibility

Possible Counter Measures

Based on the crash data review, possible counter measure should focus on reducing rear end crashes.

1. Install high-visibility back plates to the signal heads on all approaches.
2. Install WATCH FOR STOPPED VEHICLES signs, both on the right and left sides of eastbound Route 7 at approximately 1,000 feet west of the intersection
3. Review existing video detection zones to determine if there is an opportunity to increase the advanced detection.

Crash Diagram Route 7 and Route 7 Bus (W. Main St.)

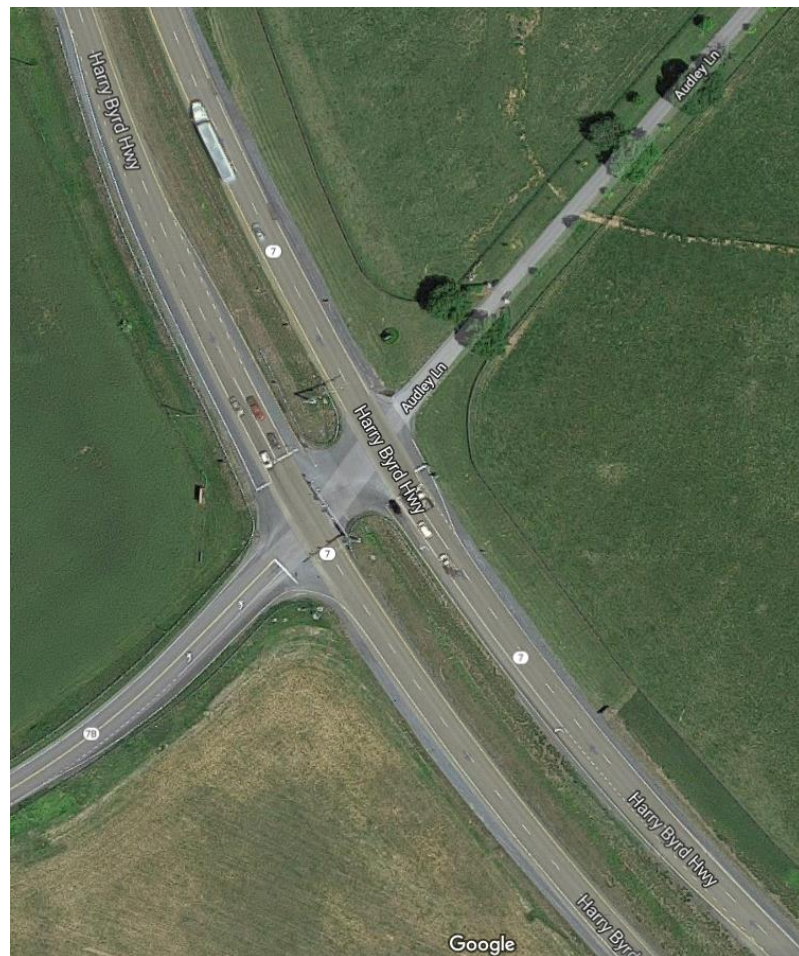


Route 7 and Route 7 BUS. (East Main St.)

Route 7 and Route & 7 BUS (E. Main St) is a four-leg intersection (one private driveway) with all approaches operating under SIGNAL control. See the following for an aerial view of existing conditions.

Crash Review

The review found 11 crashes resulting in 2 injuries, and 0 fatalities. The most frequent crash type (8 of 11) was rear end crashes of which 6 occurred in the westbound direction with two of those in the left turn lane. One was on a snowy road, two were driver distraction.



Field Review

Rear ends crashes are most often attributed to drivers following too closely but signal visibility and signal clearance intervals can contribute to drivers making quick decisions to stop on a change of indication from green to yellow to red.

There are existing Signal Ahead warning signs with flashers on both the eastbound and westbound approaches.

Clearance intervals were reviewed and new timings implemented in October, 2015 and were set based on the intersection geometry and vehicle speed of 62 mph in accordance with VDOT's Traffic Engineering Memorandum 306.1, Yellow Change Intervals and Red Clearance Intervals.



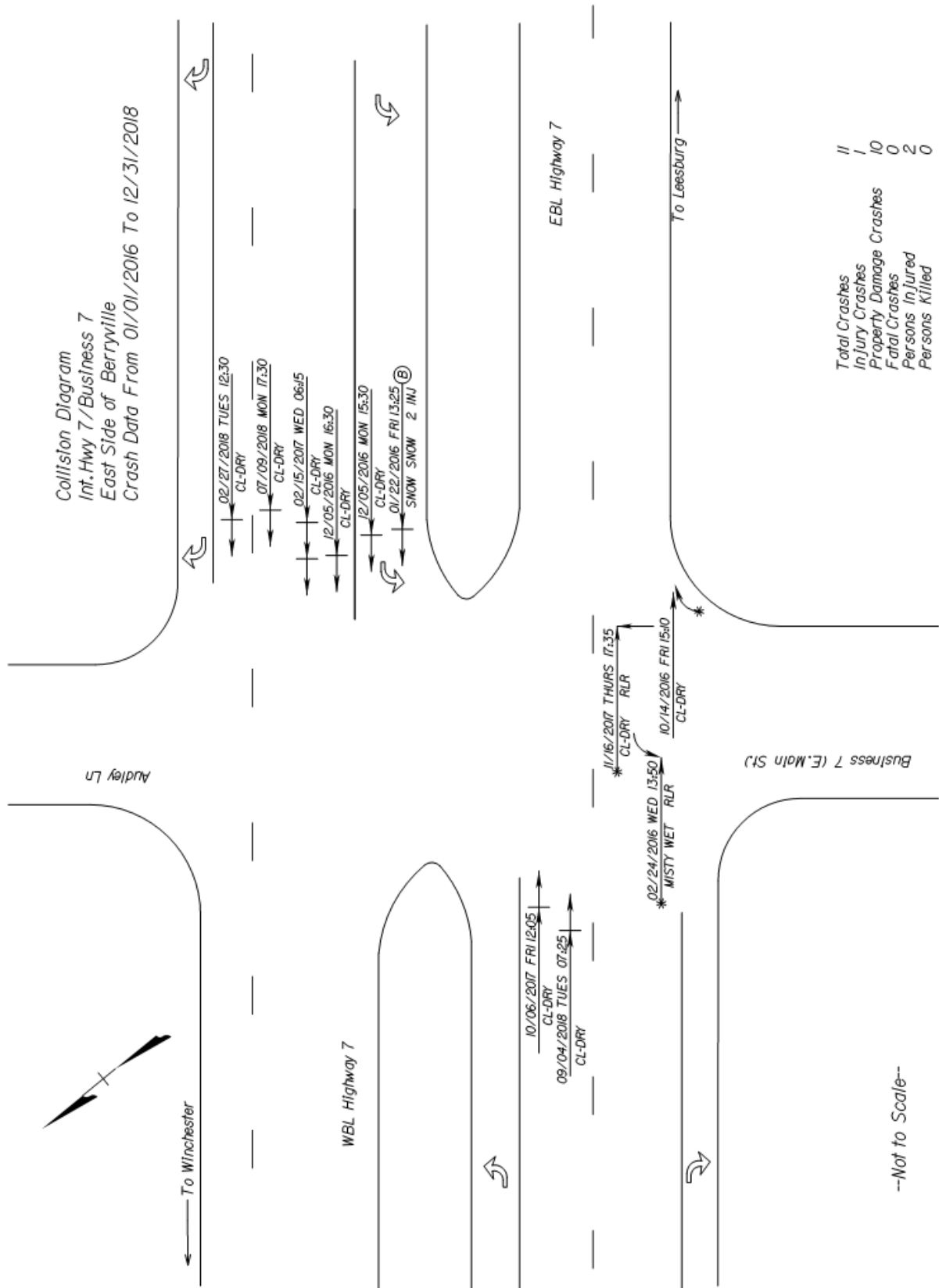
Route 7 westbound, signs blocking signal heads

Possible Counter Measures

Based on the crash data review, possible counter measure should focus on reducing rear end crashes.

1. Install high-visibility back plates to the signal heads on all approaches.
2. Relocate signs on the westbound right shoulder to increase signal head visibility.
3. Install WATCH FOR STOPPED VEHICLES signs, both on the right and left sides of westbound Route 7 approximately 1,000 feet east of the intersection
4. Review existing video detection zones to determine if there is an opportunity to increase the advanced detection.

Crash Diagram Route 7 and Route 7 Bus (E. Main St.)

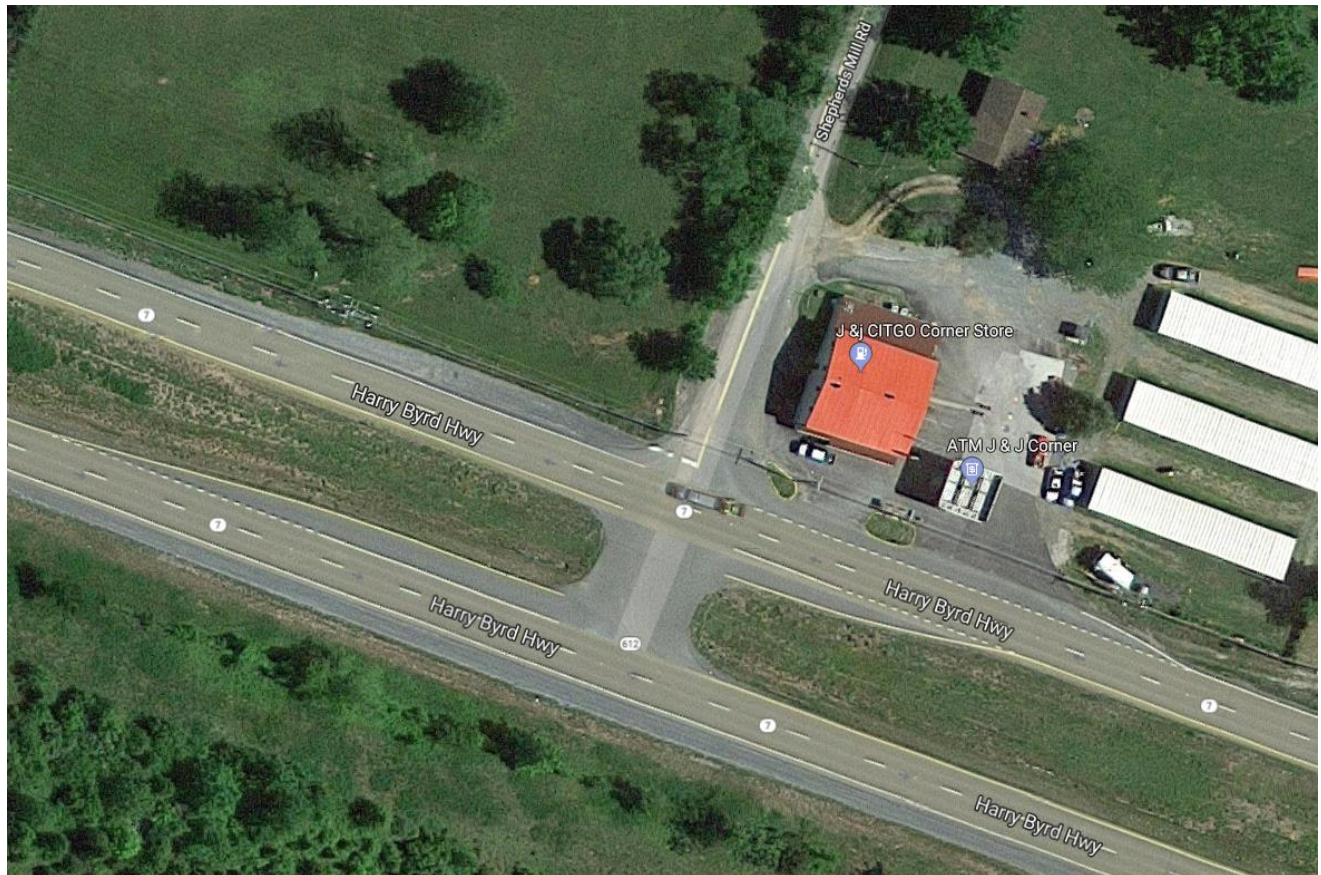


Route 7 and Route 612 (Shepherds Mill Rd)

Route 7 and Route 612 is a three-leg intersection with the Route 612 approach operating under STOP sign control. See the following figure for an aerial view of existing conditions

Crash Review

The review found 12 crashes resulting in 5 injuries and 0 fatalities. The most frequent crash type (8 of 12) was angle crashes, 7 of which were vehicles on Route 612 failing to yield the right of way to westbound vehicles on Route 7.



Field Review

Sight Distance to the east while stopped on Route 612 is being limited by a business entrance, vegetation, an embankment, and a sag vertical curve.

The Route 7 westbound “right turn lane” is too narrow to allow right turning vehicles the ability to completely move out of the westbound thru lane.

There is an existing WATCH FOR TURNING VEHICLES and an Intersection warning sign on the right shoulder of westbound approach to the intersection.

Route 612 acts a connector between Route 7 and Route 340.



Sight Distance, Rt 612 Looking to the east in the westbound lane



Route 7 westbound approaching Rt 612

Possible Counter Measures

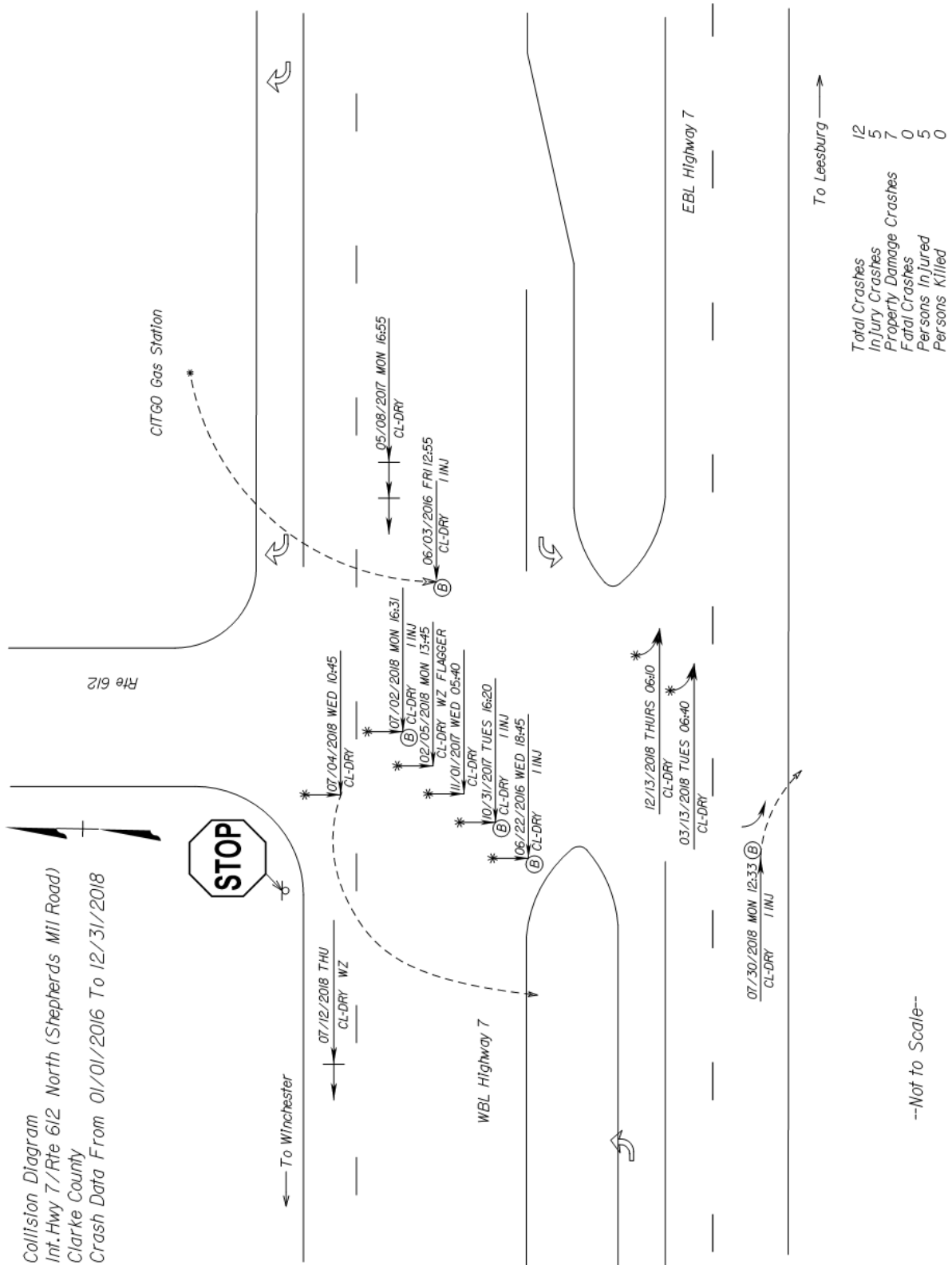
Based on the crash data review, possible countermeasures should be focused on reducing angle crashes crossing of the westbound lanes.

1. Improve sight distance to the east by removing vegetation, cutting back the slope on the north side of Route 7.
2. Install signing to encourage traffic to use Route 7 and Route 340 instead of Route 612 to go to and from West Virginia.
3. Install optical speed bars on Route 7 westbound to possibly reduce the speed of traffic approaching the intersection.
4. Install centerline in the crossover.
5. Refresh the stop bar on Route 612.
6. Widen and extend the westbound right turn lane to Route 612 North.
7. Modify crossover to allow eastbound traffic to turn north onto Route 612 but not allow southbound Route 612 traffic to cross the westbound lanes to turn left onto eastbound Route 7. Close westbound left turn lane to Route 7 eastbound. Extend westbound left turn lane at Hawthorne Ln.
8. Raising the grade of the sag vertical curve in the westbound lanes east of the intersection.



Example of Optical Speed Bar Markings for westbound Route 7

Crash Diagram Route 7 and Route 612 (Shepherds Mill Rd)



Route 7 and Route 601 (Blueridge Mt Rd/Raven Rocks Rd)

Route 7 and Route 601 is a four-leg intersection with the Route 601 approaches operating under STOP sign control. See the following figure for an aerial view of existing conditions

Crash Review

The review found 9 crashes resulting in 4 injuries. The most frequent crash type (8 of 9) was angle crashes of which 4 occurred in the eastbound lanes and 2 occurred in the crossover.



Field Review

There are existing Intersection and Watch for Turning Vehicles warning signs with flashers on both the eastbound and westbound approaches.

The narrow crossover makes it difficult to complete a two-stage crossing. It appears drivers may be looking for a gap in both directions, become impatient, and take undue risks.

The sight distance to the west in the eastbound lane is limited by a crest vertical curve both for northbound vehicles attempting to cross the eastbound lanes and for westbound left turners attempting to cross the eastbound lanes.

The narrow crossover and existing markings promote uncertainty as to who has the right of way.

There is a public parking area in the southwest quadrant of the intersection. It is identified as the Snickers Gap Appalachian Trailhead in Google Maps. The parking lot serves Appalachian Trail day-hikers and, although not identified as a park and ride, probably is for a limited number of commuters.

The access to the trail to the west requires hikers to walk along the shoulder of Route 7 and subsequently cross Route 7 to hike to destinations to the north.

Subsequent to the field review, additional signing was installed to alert drivers to pedestrians accessing the Appalachian Trail.



Sight Distance looking east from Rt 601



Sight Distance looking east from crossover



Route 7 eastbound crest vertical curve hiding intersection

Possible Counter Measures

Based on the crash data review, possible countermeasures should be focused on reducing angle crashes.

1. Convert existing intersection warning signs with flashers to a dynamic flasher that is turned on when there are vehicles on Route 601 and/or in the crossover.

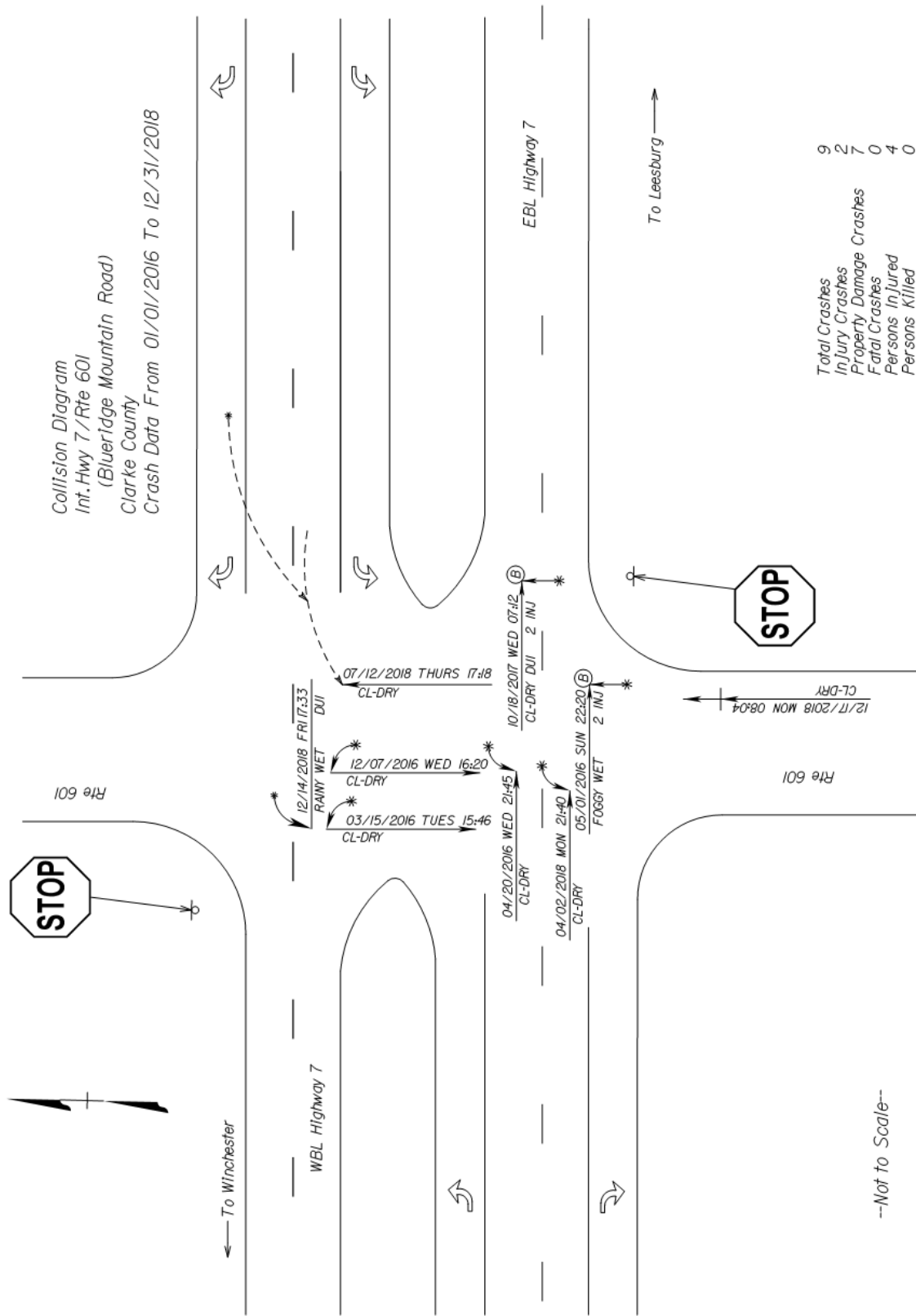
2. The stop bars in the crossover should be removed.
3. Install signs on Rt 601 approaches indicating the requirement to yield to traffic in the crossover.
4. Create a connection from the parking area to the Appalachian Trail that would not require hikers use the shoulder of Route 7.
5. Widen crossover to allow for a two-stage crossing.
6. Lower the crest vertical curve on eastbound Route 7 to increase the sight distance.

There is an existing programmed safety project to provide a dynamic warning flasher on the Route 7 eastbound approach to warning eastbound drivers that vehicles are entering. Funding for the preliminary engineering will be available in September 2023 with construction funding available in March 2024.



Example of Dynamic Warning Flashers

Crash Diagram Route 7 and Route 601 (Blue Ridge Mountain Rd/Raven Rocks Rd)



Segment Crashes

Crashes were reviewed for segments that showed a concentration of crashes. The segment that was identified as having the highest density of crashes is MP 15.75- MP 18.75, 0.28 mi. W North Hill Ln – 0.05 mi. E Route 679 (W Intersection) at 8.8 crashes per mile per year. This segment begins about 0.4 mile W of the Shenandoah River Bridge and runs to the Loudoun County line. This segment has the sharpest curves and the steepest grades of all of Route 7 Clarke County.

The other segments analyzed were as follows:

MP 5.51- MP 7.5, Frederick County Line to 0.1 mile W Route 660; 5.9 crashes/year/mile

MP 9.41-MP 12.31, 0.1 mile E Route 7 Bus (W) to 0.1 mile W Route 7 Bus (E); 3.9 crashes/mile/year

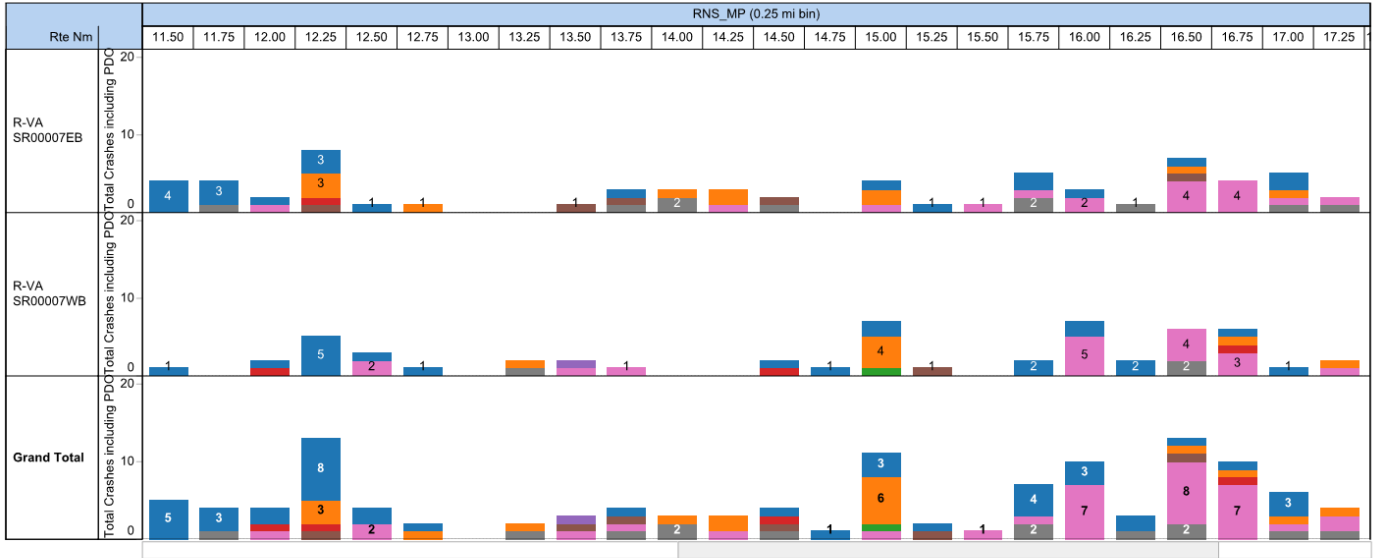
MP 12.41- MP 15.75, 0.1 mile E Rt 7 Bus (E) to 0.28 mile W North Hill Ln; 4.2 crashes/mile/year

The next three charts show the frequency and type of crashes for each 0.25 mile section



- 1. Rear End
- 2. Angle
- 3. Head On
- 4. Sideswipe - Same Dire..
- 6. Fixed Object in Road
- 8. Non-Collision
- 9. Fixed Object - Off Road
- 10. Deer
- 15. Backed Into

Collision Type Route Information (MP 0 may be ramps)

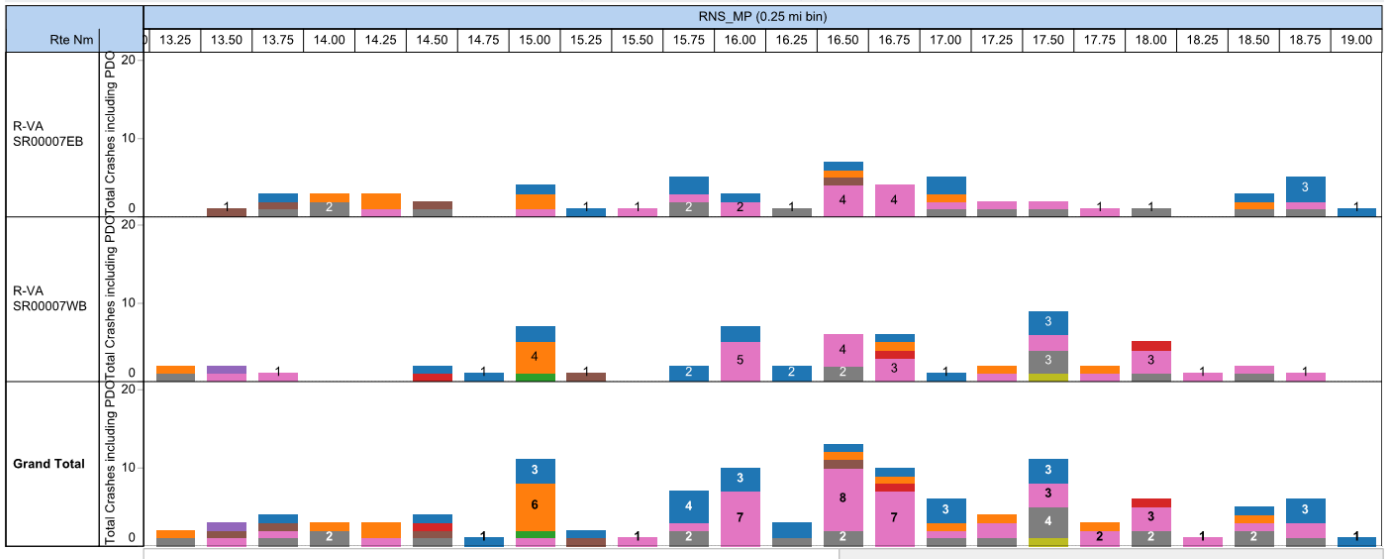


Rt 7 Bus

Rt 612

- 1. Rear End
- 2. Angle
- 3. Head On
- 4. Sideswipe - Same Dire..
- 6. Fixed Object in Road
- 8. Non-Collision
- 9. Fixed Object - Off Road
- 10. Deer
- 15. Backed Into

Collision Type Route Information (MP 0 may be ramps)



Rt 612

Shenandoah River Bridge

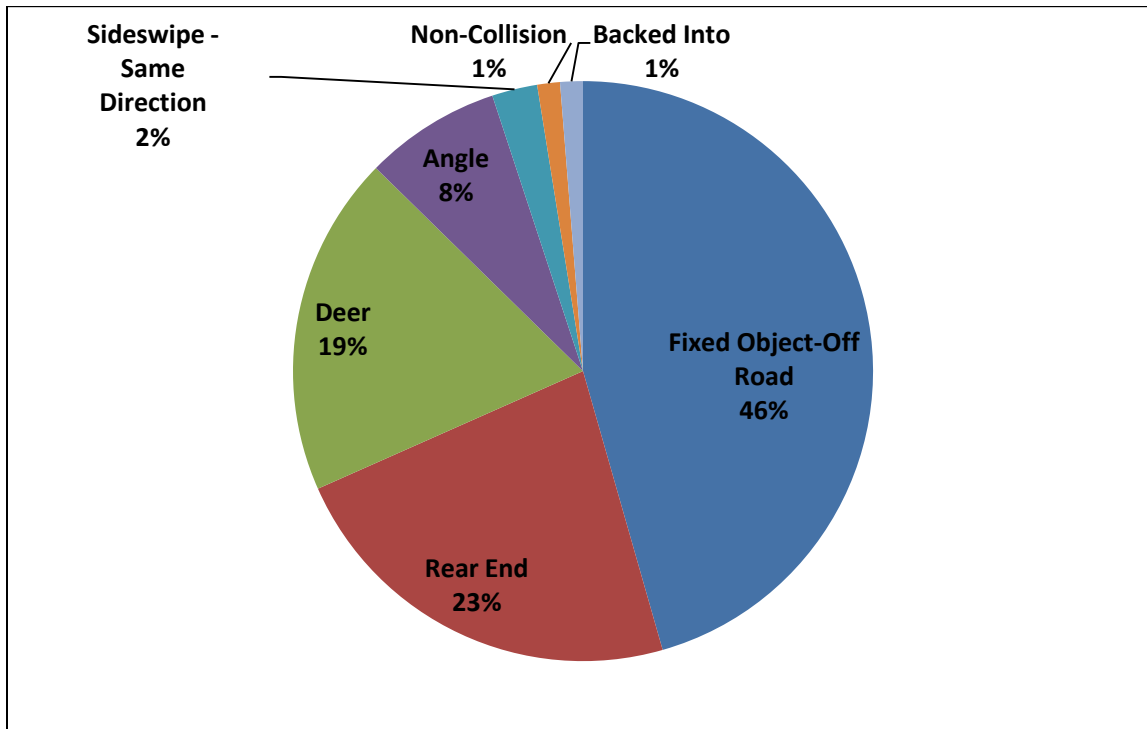
Rt 601



Summary of crashes: MP 15.75- MP 18.75 0.28 mi. W North Hill Ln – 0.05 mi. E Route 679 (W Intersection)

- 79 crashes, 46 injuries, 0 fatalities
- 36 Fixed Object Off-Road, 18 Rear End, 15 Deer, 6 Angle, 2 Sideswipes Same Direction, 1 Non-Collision, 1 Backed Into
- 39 Speed related
- 52 daylight, 27 low light
- 35 Eastbound, 44 Westbound

Route 7 Crashes 2016-2018, MP 15.75 – 18.75



Contributing Factors:

- 36 Fixed Object Off-Road: In 19 of the 36 crashes the driver was exceeding the speed limit or the maximum safe speed. Other factors noted; 5 DUI, 4 Snow/Ice related, 2 Driver Fatigue, 2 Tire Failure, 1 Medical Emergency, 1 Eluding Police, and 1 Avoiding Deer.
- 18 Rear End: In 14 of the 18 crashes the driver was exceeding the speed limit or the maximum safe speed. Other factors noted; 5 were congestion related, 2 cited sun glare going eastbound, 2 were slowing for deer, 1 was in a work zone, 1 involved a farm tractor, 1 was a secondary crash, 1 DUI, 1 driver distraction.
- 6 Angle: 2 were Snow/Ice related.
- 15 Deer: 11 of 15 occurred in the months of October and November

Possible Counter Measures

Based on the crash review, the most frequent crash type is Fixed Object off- Road. Possible countermeasure should focus keeping motorists on the road, providing recovery area, and encouraging motorists to reduce their speed.

1. The paved shoulders should be widened 2 – 4 feet in areas where the existing shoulder can accommodate. Edgeline or shoulder rumble strips should be installed as shoulder widening occurs and with maintenance repaving projects.
2. Based on the high operating speeds, install curve warning and chevrons signs on the westbound lanes on the curve at the Route 604 intersection.
3. Law Enforcement should conduct targeted speed enforcement on a more frequent basis.

There is an existing programmed safety project to widen the paved shoulders, install rumble strips, and upgrade existing guardrail in both direction from the Shenandoah Bridge to the Loudoun CL (UPC 112899). Funding for the preliminary engineering will be available in November 2022 with construction funding available in December 2024.

Possible Corridor Countermeasures

Roadway Departure

1. The paved shoulders should be widened 2 – 4 feet in areas where the existing shoulder can accommodate. Edgeline or shoulder rumble strips should be installed as shoulder widening occurs and with maintenance repaving projects.
2. All existing shoulders should be reviewed and any pavement edge drop-offs addressed.
3. Future paving projects should include the use of Pavement Safety Edge.
4. Widen existing 4 inch edge lines to 6 inches.
5. Missing guardrail delineators should be replaced.
6. The existing centerline raised pavement markers should be inspected with missing and broken lens replaced. New pavement markers should be installed where none exist as resurfacing projects occur.

7. All roadway alignment warning signs should be dual indicated if not already.
8. Law Enforcement should conduct targeted speed enforcement on a more frequent basis.

There is an existing programmed safety project to widen the paved shoulders, install rumble strips and upgrade the guardrail from Rt 7 BUS (E. Main St.) to the Shenandoah Bridge (UPC 110827). Funding for the preliminary engineering will be available in March 2022 with construction funding available in March 2023.

STOP Sign Controlled Intersections/Crossovers

1. Install stop bars where none exist on all VDOT maintained STOP sign controlled secondary route approaches. Refresh existing stop bars on all VDOT maintained STOP sign controlled secondary route approaches.
2. All intersection warning signs should be dual indicated if not already.
3. Due to the speed of the traffic, extend the westbound left turn lanes at Valley Springs Lane and at Rt 679 (Pine Grove Rd/Longwood Lane) to facilitate westbound u-turns.
4. Due to the speed of the traffic and its location in a curve, extend the westbound right turn lane at Route 604 (Good Shepherd Road)
5. Law Enforcement should conduct targeted speed enforcement on a more frequent basis.