WV 34 FROM I-64 TO GREAT TEAYS BOULEVARD
ROAD SAFETY AUDIT
Regional Intergovernmental Council

Prepared by:

BURGESS & NIPLE

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Table of Contents

1.0 Executive Summary....1
2.0 Purpose and Location....2
3.0 Existing Conditions....3
4.0 Data Collection....6
5.0 Existing Capacity Analysis....9
6.0 Existing Safety Analysis....12
7.0 Countermeasures for Consideration....15
8.0 Countermeasure Evaluation....19
9.0 Conclusions and Recommendations....21

List of Figures

Figure 1: Study Area....2
Figure 2: TA Travel Center Driveway Lane Configuration....4
Figure 3: WV 34 & I-64 Eastbound Ramps Lane Configuration....4
Figure 4: WV 34, Scott Way, & Great Teays Boulevard Lane Configuration....5
Figure 5: 2020 Peak Hour Volumes....7
Figure 6: 2040 Forecasted Peak Hour Volumes....8
Figure 7: Frequency of Crashes by Year and Severity....12
Figure 8: Crash Frequency by Crash Type....13
Figure 9: Crash Frequency by Hour of the Day....13
Figure 10: Access Management Improvements along WV 34....17
Figure 11: Roundabout Corridor along WV 34....18

List of Photos

Photo 1: Traffic Along WV 34 Corridor....3
Photo 2: Semi-Trucks Waiting to Turn Left in Truck Stop....3
Photo 3: Semi-Trucks Leaving Truck Stop....3

List of Tables

Table 1: Operational Analysis Results for Existing (2020) Conditions....10
Table 2: Operational Analysis Results for No-Build (2040) Conditions (With Optimized Signal Timings)....11
Table 3: Existing Conditions HSM Results....14
Table 4: 2040 Roundabout Operational Analysis Results....19
Table 5: Safety Analysis for Access Management Improvements....20
Table 6: Safety Analysis for Roundabout Corridor....20
Table 7: Benefit/Cost Summary....21

Appendices

Appendix A – Raw Traffic Counts
Appendix B – Future Volume Calculations
Appendix C – Existing Capacity Analysis
Appendix D – No Build Capacity Analysis
Appendix E – Crash Diagram
Appendix F – Existing IHSDM Output
Appendix G – Build Capacity Analysis
Appendix H – Build IHSDM Output
Appendix I – Detailed Cost Estimates
Appendix J – Safety Benefit Calculation

1.0 Executive Summary

The purpose of this study is to analyze the existing safety and capacity conditions and to determine potential countermeasures to mitigate crashes and improve traffic operations along WV 34 from Great Teays Boulevard to the I-64 Eastbound Ramps in Teays Valley, West Virginia in Putnam County. This section of WV 34 provides access to restaurants, banks and other commercial properties on both sides of the roadway. WV 34 is a four-lane north-south minor arterial with a two-way left-turn lane and a speed limit of 40 mph.

Crash data from January 1, 2016 to December 31, 2018 was downloaded from the ReportBeam website. Each crash report was reviewed to determine potential factors contributing to crashes. In the three-year study period, there were 124 crashes with 23 (18 percent) resulting in injury. The most prevalent crash types were left-turn and angle collisions related to conflicts at unsignalized intersections and driveways along the corridor.

The Highway Safety Manual (HSM) through the Interactive Highway Safety Design Model (IHSDM) was used to determine how the study area is performing compared to similar locations and to assess the safety benefit of countermeasures. Both the intersection of WV 34 and Great Teays Boulevard and the WV 34 segment between I-64 and Great Teays Boulevard were performing worse relative to safety than other locations with similar volumes and geometric characteristics. The intersection at WV 34 and I-64 Eastbound Ramps is performing slightly better than other similar locations.

Two alternatives were evaluated in detail as part of this study. In Alternative 1, several driveways were proposed to be closed along the corridor in order to have fewer conflict points and fewer challenges for drivers to navigate with entering and exiting traffic at driveways. In Alternative 2, all driveways were converted to right-in/right-out (RIRO) configurations through the construction of a median down the center of WV 34. To facilitate left-turns, roundabouts would be constructed at the I-64 Eastbound Ramps and Great Teays Boulevard. Traffic and safety analysis were performed for both alternatives using 2040 forecasted traffic volumes. Based on the crash patterns, safety analysis and traffic operations in the study corridor, the following countermeasures are recommended:

<u>Short-Term</u>

- Check vehicular clearance intervals.
- Implement coordinated signal timing along WV 34.
- Work with the TA Travel Center to reverse the circulation and reduce confusion and conflicts at the entrance and exit on WV 34.

<u>Medium-Term</u>

Construct roundabout corridor. This alternative has the most potential to reduce crashes and improve operations in the corridor. While this improvement is costly, the benefit-to-cost ratio is 5.61. While securing funding for this improvement, the access management modifications that close the Go-Mart, KFC, Taco Bell, and Scott Junction Plaza could be implemented to improve safety in the interim.

2.0 Purpose and Location

The purpose of this study is to analyze the existing safety and capacity conditions and to determine potential countermeasures to mitigate crashes and improve traffic operations along WV 34 from Great Teays Boulevard to the I-64 Eastbound Ramps in Teays Valley, West Virginia in Putnam County. The study area is shown in **Figure 1.**

Figure 1: Study Area

3.0 Existing Conditions

Roadway Conditions

The land use in the study area is primarily commercial. This section of WV 34 provides access to restaurants, banks and other commercial properties on both sides of the roadway. WV 34 is a four-lane north-south minor arterial with a two-way left-turn lane (TWLTL) and a speed limit of 40 mph. This section of WV 34 has a high truck volume due to the large truck stop and I-64 Interchange located on the northern end of the study area. Overhead lighting is provided in the study area and sidewalks are located on both sides of the roadway from Great Teays Boulevard to the northern leg of Grille Lane. **Photo 1** shows the southbound traffic volume in the corridor during the early afternoon. Some vehicles were observed to experience significant delays (well over a minute) while waiting for a gap in traffic along WV 34 to turn left out of driveways. This delay caused many drivers to accept smaller, less desirable gaps when turning from driveways.

Photo 1: Traffic Along WV 34 Corridor

In front of the TA Travel Center, southbound semi-trucks were observed to queue in the TWLTL while waiting to turn into the truck stop as shown in **Photo 2.** Semi-trucks traveling out of the truck stop would occasionally stop traffic as they slowly exited the driveway as shown in **Photo 3.** The TA Travel Center driveway is set up such that the vehicles exit on the left-most driveway and enter on the right-most driveway as illustrated in **Figure 2**. This configuration leads to more potential conflicts as incoming turning traffic must yield to traffic leaving the TA Travel Center which is not typical.

Photo 2: Semi-Trucks Waiting to Turn Left in Truck Stop

Photo 3: Semi-Trucks Leaving Truck Stop

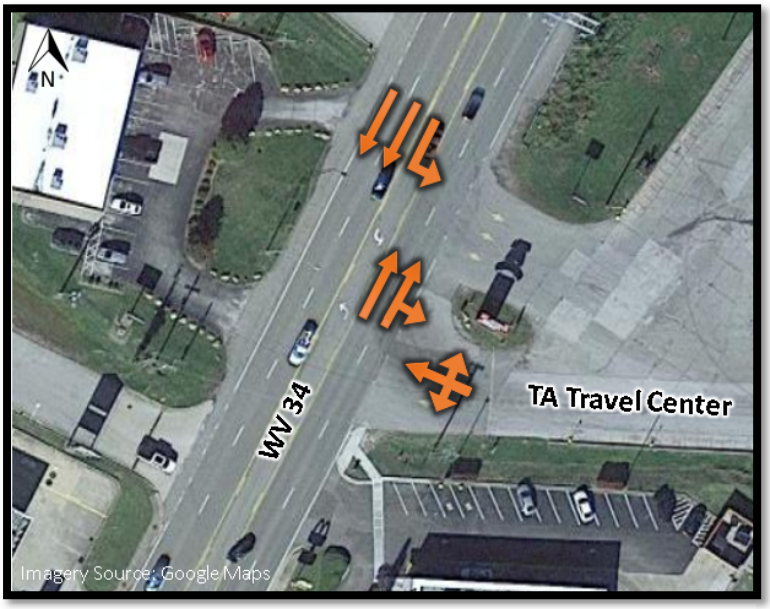


Figure 2: TA Travel Center Driveway Lane Configuration

Intersection Conditions

WV 34 and I-64 Eastbound Ramps

The ramp terminal intersection of WV 34 and the I-64 Eastbound Ramps is a signalized intersection. The lane configuration is shown in **Figure 3.** The box-span signal provides backplates on the signal heads for all approaches. There are no pedestrian facilities or sidewalks provided at this intersection. The rightmost signal head on the southbound approach was out of alignment at the time of the field visit. The northbound right-turn lane is free-flowing onto the I-64 Eastbound On-Ramp.

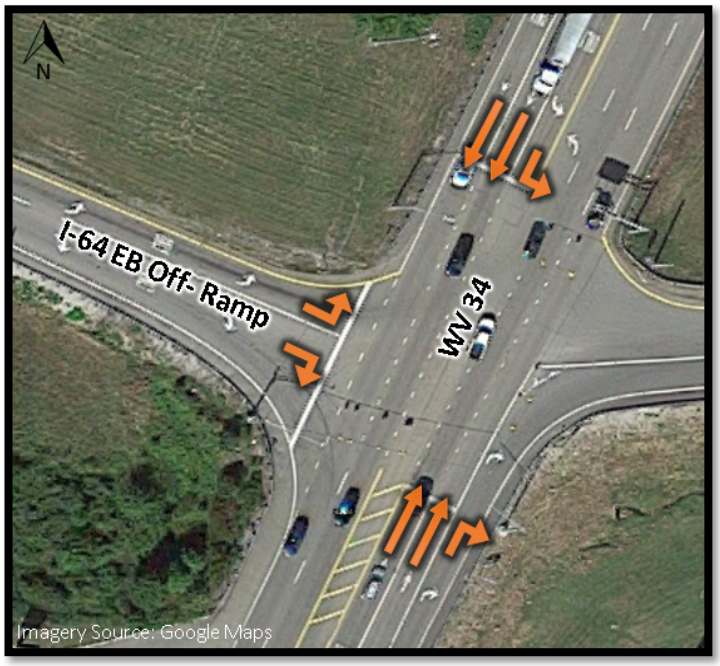


Figure 3: WV 34 & I-64 Eastbound Ramps Lane Configuration

WV 34 and Great Teays Boulevard/Scott Way

The intersection of WV 34 and Great Teays Boulevard is a four-legged signalized intersection with a box span configuration. Backplates are on all the signal heads at the intersection. The lane configuration is shown in **Figure 4**. The eastbound and westbound approaches are split phased due to the skewed geometry of the intersection and resulting path overlap for left-turning vehicles. The southbound left-turn movement has a five-section signal head to support protected-permitted left-turn phases. However, during review of the footage from the cameras used to collect traffic counts, the southbound protected-permitted left-turn phase operated as permitted-only and never provided the left-turn arrow during the AM and PM peak hours. A right-turn overlap is provided for the westbound right-turn movement so that this movement can run concurrently with the southbound left-turn movement when the green arrow (protected phase) is provided. The southbound left-turn movement operates under permissive-only phasing. Crosswalks are provided on all legs of the intersection and all but the east leg of the intersection have pedestrian signal heads. Pedestrian push buttons were present for crossing the north and south legs. During the field review it was observed that the pedestrian signal head for crossing the east leg was not operating correctly as the walk symbol never appeared. It was also observed that the push buttons on the northeast and southeast corner did not trigger the walk sign. During the field visit, the southbound left-turn movement to Great Teays Boulevard was observed to queue beyond its storage length. Additionally, when southbound through vehicles were stopped at the signal, the queues were observed to extend past the Taco Bell and Scott Junction driveways, preventing vehicles from turning left into or out of those driveways.

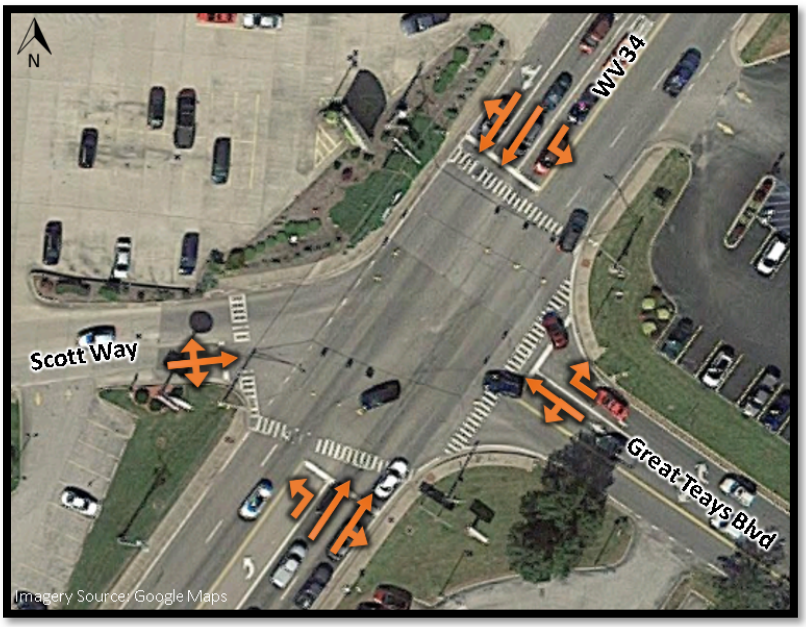


Figure 4: WV 34, Scott Way, & Great Teays Boulevard Lane Configuration

4.0 Data Collection

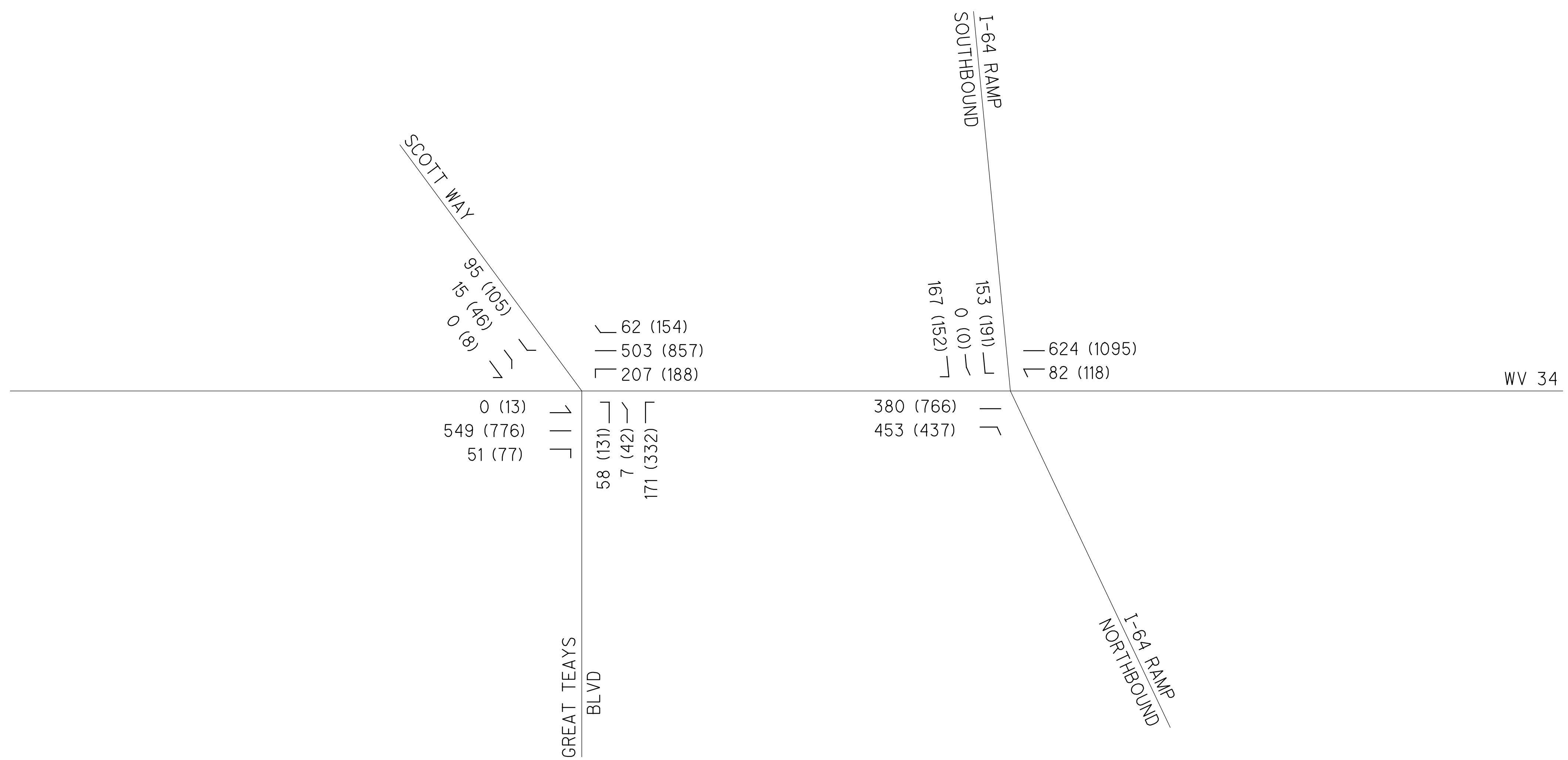
Turning movement counts were collected for 24 hours on Tuesday June 2, 2020 at the following intersections:

- WV 34 and I-64 Eastbound Ramps
- WV 34 and Great Teays Boulevard/Scott Depot

Peak hour 2020 volumes are summarized in **Figure 5**. The AM peak hour was determined to be 7:45 AM to 8:45 AM while the PM peak hour was 4:15 PM to 5:15 PM. The volumes were adjusted to account for the changes in traffic volumes due to the COVID-19 pandemic using existing 24-hour 2019 counts. An adjustment factor of 1.02 and 1.05 was used for the AM and PM peak, respectively. Raw traffic counts are provided in **Appendix A**.

Based on output from the RIC travel demand model, a 0.80 percent annual growth rate was applied to the 2020 volumes to determine the future 2040 volumes at the intersection. Future volumes calculations are provided in **Appendix B**. The 2040 forecasted peak hour volumes are summarized in **Figure 6**.

XX: 2020 AM PEAK HOUR 7:45AM TO 8:45AM
(XX): 2020 PM PEAK HOUR 4:15PM TO 5:15PM

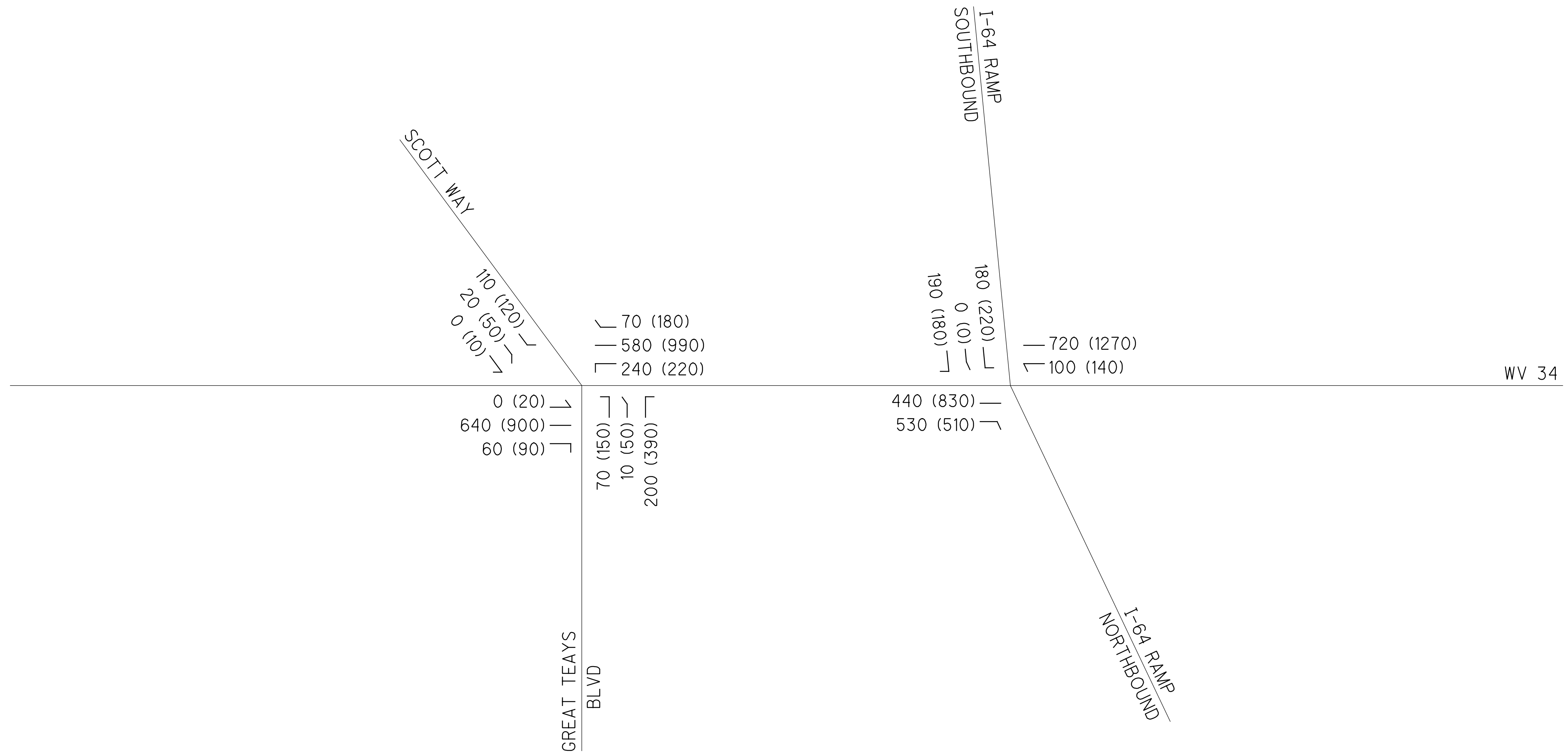


NOT TO SCALE

WV 34 ROAD SAFETY AUDIT
2020 ADJUSTED PEAK HOUR COUNTS

FIGURE 5

XX: 2040 FORECASTED VOLUMES 7:45AM TO 8:45AM
(XX): 2040 FORECASED VOLUMES 4:15PM TO 5:15PM



NOT TO SCALE

WV 34 ROAD SAFETY AUDIT
2040 FORECASTED PEAK HOUR COUNTS

FIGURE 6

5.0 Existing Capacity Analysis

Intersection capacity analysis was evaluated to assess existing intersection operations using 2020 traffic volumes and existing lane configurations and traffic control. Existing signal timings at the intersections were determined from timing traffic videos during the peak hours. *SimTraffic* was used to obtain the 95th percentile queue lengths. *SimTraffic* is the microsimulation package included with *Synchro.* The results of five microsimulation runs were averaged together to obtain the results provided herein. Existing operational analysis results from *Synchro* and *SimTraffic* are summarized in **Table 1** with analysis output provided in **Appendix C**.

Table 1: Operational Analysis Results for Existing (2020) Conditions

WV 34 & Great Teays Boulevard / Scott Way												
	Overall Intersection	Eastbound Scott Way			Westbound Great Teays Blvd			Northbound WV 34			Southbound WV 34	
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
AM Peak Hour												
LOS	C	E			D	D		B	C		B	B
Delay	23.6	55.3			46.6	43.3		17.6	21.9		15.7	13.4
v/c		0.74			0.37	0.6		0.01	0.42		0.49	0.31
95th % Queue		140'			97'	110'		2'	205'		116'	108'
		E – 55.3			D – 44.2			C – 21.9			B – 14.0	
PM Peak Hour												
LOS	C	E			D	E		C	C		B	B
Delay	31.1	60.5			46.7	69.7		23.3	25.9		18.8	18.0
v/c		0.83			0.68	0.94		0.06	0.63		0.58	0.57
95th % Queue		172'			146'	310'		56'	318'		169'	252'
		E – 60.5			E – 61.8			C – 25.8			B – 18.1	
WV 34 & I-64 Eastbound Ramps												
	Overall Intersection	Eastbound I-64 EB Off Ramp						Northbound WV 34			Southbound WV 34	
		LT		RT				TH		RT	LT	TH
AM Peak Hour												
LOS	B	E		F				A		A	A	A
Delay	18.9	56.8		81.5				3.6		0.0	4.6	4.0
v/c		0.72		0.88				0.15		0.0	0.11	0.24
95th % Queue		187'		77'				35'		0'	61'	113'
		E – 69.7						A – 3.6			A – 4.1	
PM Peak Hour												
LOS	B	E		E				A		A	A	A
Delay	14.2	58.3		55.3				8.2		0.0	5.7	5.2
v/c		0.83		0.75				0.34		0.0	0.22	0.42
95th % Queue		229'		80'				170'		0'	76'	196'
		E – 58.3						A – 9.2			A – 5.3	

Under existing conditions, both intersections operate overall at LOS C or better. The movements on the side streets at both intersections have approaches operating at LOS E due to the existing signal timings favoring the mainline approaches because of the amount of volume on WV 34. Additionally, it was found that the left-turn protected phase was not triggered during the peak hour of 4:15 PM, so the westbound right-turn overlap was not occurring. This contributed to the poor operations for the westbound right-turn movement.

Operational analysis was also conducted for the No-Build scenario for 2040 conditions. This scenario used the existing lane configurations and optimized signal timing. Analysis results are summarized in **Table 2** with output presented in **Appendix D**.

Table 2: Operational Analysis Results for No-Build (2040) Conditions (With Optimized Signal Timings)

WV 34 & Great Teays Boulevard / Scott Way													
	Overall Intersection	Eastbound Scott Way			Westbound Great Teays Blvd			Northbound WV 34			Southbound WV 34		
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
AM Peak Hour													
LOS	C	E			D		D	B	C		B	B	
Delay	24.7	59.4			47.5		44.5	18.1	23.5		17.2	12.8	
v/c		0.81			0.45		0.66	0.01	0.50		0.60	0.34	
95th % Queue		142'			109'		132'	20'	263'		133'	88'	
		E – 59.4			D – 45.4			C – 23.5			B – 14.0		
PM Peak Hour													
LOS	D	E			D		E	C	D		C	C	
Delay	36.7	67.6			45.4		69.8	28.7	37.0		29.1	20.9	
v/c		0.86			0.69		0.96	0.11	0.82		0.77	0.67	
95th % Queue		269'			146'		341'	87'	399'		197'	317'	
		E – 67.6			E – 61.5			C – 36.7			C – 22.2		
WV 34 & I-64 Eastbound Ramps													
	Overall Intersection	Eastbound I-64 EB Off Ramp						Northbound WV 34			Southbound WV 34		
		LT		RT				TH		RT	LT		TH
AM Peak Hour													
LOS	B	D		D				A		A	A		A
Delay	16.5	48.0		54.7				8.3		0.0	5.6		5.0
v/c		0.72		0.85				0.21		0.0	0.15		0.29
95th % Queue		210'		100'				119'		0'	63'		161'
		D – 54.7						A – 8.3			A – 5.1		
PM Peak Hour													
LOS	B	E		D				B		A	A		A
Delay	15.3	57.3		54.9				10.3		0.0	6.8		6.6
v/c		0.85		0.78				0.38		0.0	0.29		0.49
95th % Queue		260'		124'				214'		0'	87'		247'
		E – 57.3						B – 10.3			A – 6.6		

Under 2040 No Build conditions, both intersections operate overall at LOS D or better. Again, due to the signal timings favoring the mainline approaches because the amount of volume along WV 34, the side street approaches at both intersections are operating at LOS E in the PM peak hour.

6.0 Existing Safety Analysis

Crash Trends and Analysis

Crash data from January 1, 2016 to December 31, 2018 was downloaded from the ReportBeam website. Each crash report was reviewed to determine potential factors contributing to crashes. A collision diagram that shows crash patterns by illustrating the approximate location of each reported crash is provided in **Appendix E**. In the three-year study period, there were 124 crashes with 23 (18 percent) resulting in injury. One fatality occurred in the study area when a northbound vehicle was turning left into the KFC and failed to yield to a southbound vehicle. The 53-year-old male passenger of the northbound vehicle passed away at the hospital. **Figure 7** shows the crash frequency by year and severity.

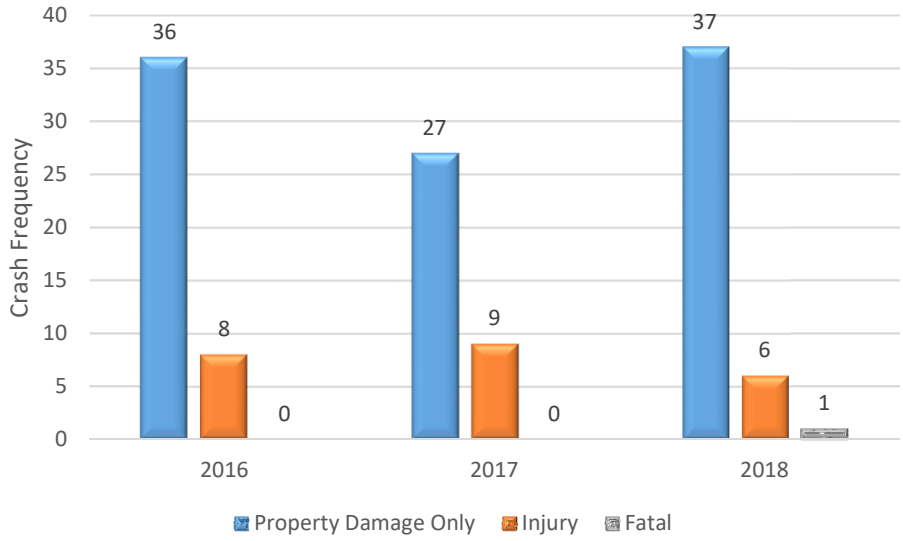


Figure 7: Frequency of Crashes by Year and Severity

Figure 8 shows the crash frequency of the study area by crash type. The majority of the left-turn (27 percent) and angle (27 percent) collisions were related to conflicts at unsignalized intersections and driveways along the corridor. Several crash reports also mentioned that another driver had waved them out while they were waiting to turn, and when they entered the roadway, they were struck by a vehicle approaching in an adjacent lane. Due to the high traffic volume, it is very difficult for vehicles to find gaps to turn into and out of businesses. Additionally, it can be difficult to accurately judge gaps in traffic due to the many vehicles entering and exiting the road from differing locations. The rear end collisions (26 percent) occurred most often on the approaches of the two signalized intersections. There were also several instances of vehicles being rear ended after slowing down to turn into the driveways along WV 34.

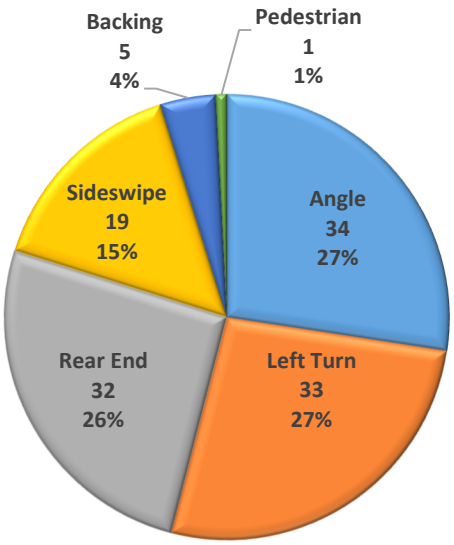


Figure 8: Crash Frequency by Crash Type

Figure 9 illustrates the breakdown of crashes in the study area by hour of the day, showing peaks at 7:00 AM, between 11:00 AM and 1:00 PM and between 3:00 PM and 7:00 PM corresponding to the usual peak hours for restaurants. Lack of lighting along the corridor is not a main contributing factor to crashes in the study area as 75 percent of the collisions occurred in the daylight.

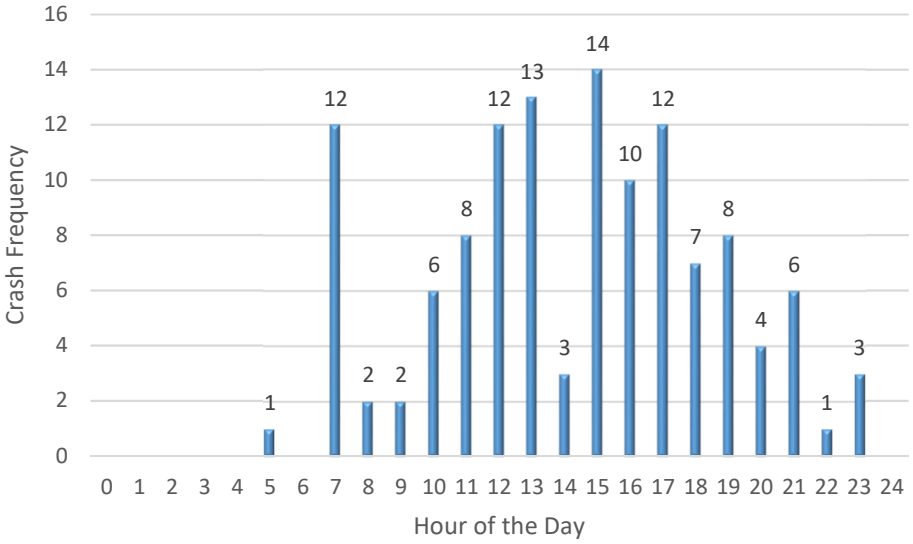


Figure 9: Crash Frequency by Hour of the Day

WV 34 and I-64 Eastbound Ramps

The main crash type at this intersection is rear end collisions, with the main pattern occurring on the I-64 Eastbound Off-Ramp. This pattern of rear end crashes likely occur when the right-turning vehicle closest to the stop bar begins to accelerate after finding a gap in traffic along WV 34. The driver then realizes that the gap is not adequate and abruptly brakes and is rear ended by the vehicle behind

them. There were three left-turn crashes occurring when southbound vehicles failed to yield to northbound vehicles while turning onto the I-64 Eastbound On-Ramp.

WV 34 and Great Teays Boulevard

The main crash pattern at this intersection involved southbound left-turning vehicles and northbound through vehicles. As previously mentioned, the left-turn arrow did not seem to be properly functioning during the field review and traffic counts which results in an increase in delays and driver frustration. When drivers are frustrated or delayed, they are more likely to select inadequate gap, resulting in a collision. Left-turning vehicles were also observed to clear the intersection during the yellow or red clearance intervals. There were also several sideswipe crashes on the westbound and southbound approaches. Abrupt and unsafe lane changes as well as the number of driveways within the functional area of the intersection likely contribute to these crashes.

Highway Safety Manual Analysis

Using the Interactive Highway Safety Design Model (IHSDM) an analysis was conducted using the methodologies outlined in the *Highway Safety Manual* (HSM). The following three factors are calculated from the HSM analysis:

- **Predicted Crash Frequency ($N_{predicted}$)** – How the site would be expected to perform relative to 1,000 similar sites with comparable volumes.
- **Expected Crash Frequency ($N_{expected}$)** – Average performance of the site over an extended period of time based on actual crash history.
- **Potential for Safety Improvement (PSI)** – Difference between expected crash frequency and predicted crash frequency. A positive PSI indicates that the location is performing poorly compared to similar locations and safety improvements would likely have a significant impact in reducing the crash frequency.

The study area for the HSM analysis includes the segment of WV 34 between Great Teays Boulevard to I-64 Eastbound Ramps as well as the two signalized intersections. The results from the IHSDM Analysis for each segment and intersection are summarized in **Table 3.** Output from the IHSDM is included in **Appendix F**.

Table 3: Existing Conditions HSM Results

		Fatal and Injury Crashes	Property Damage Only Crashes	Total Crashes
WV 34 & Great Teays Blvd	$N_{predicted}$	2.46	2.21	**4.67**
	$N_{expected}$	1.72	11.45	**13.17**
	PSI	-0.74	9.24	8.50
WV 34 between Great Teays Blvd & I-64 Eastbound Ramps	$N_{predicted}$	1.81	4.46	**6.27**
	$N_{expected}$	2.56	11.14	**13.70**
	PSI	0.75	6.68	7.43
WV 34 & I-64 Eastbound Ramps	$N_{predicted}$	2.73	4.89	**7.62**
	$N_{expected}$	2.29	4.52	**6.81**
	PSI	-0.44	-0.37	-0.81

Both the intersection of WV 34 and Great Teays Boulevard and the WV 34 segment were performing worse than other locations with similar volumes and geometric characteristics. The intersection at WV 34 and I-64 Eastbound Ramps is performing slightly better than other similar locations.

7.0 Countermeasures for Consideration

The following countermeasures were identified to mitigate crashes and improve safety within the study area.

- **Check vehicular clearance intervals:** Clearance intervals that are too short can contribute to rear end collisions related to drivers stopping abruptly. Short clearance intervals can also lead to angle crashes because vehicles could still be clearing the intersection when a conflicting approach is given the green indication. Conversely, clearance intervals that are too long can encourage drivers to disrespect the interval thereby contributing to angle crashes when vehicles run the red light. In order to improve safety throughout the study area, it is recommended that the yellow and all-red clearance intervals be recalculated at all the signalized intersections.
- **Implement coordinated signal timings along WV 34**: In order to improve traffic flow along WV 34, optimized, coordinated signal timings should be implemented. Coordinating timings will minimize queuing between the intersections and the likelihood that traffic will queue into adjacent intersections, thus reducing the potential for rear end collisions.
- **Access Modification:** With every driveway along a corridor, the potential for conflicts increases. Fewer driveways spaced further apart result in fewer conflict points and fewer challenges for drivers to navigate with entering and exiting traffic at driveways. Closing the driveways along WV 34 at the Go-Mart, KFC, Taco Bell, and Scott Junction Plaza will reduce the number of driveways along WV 34 (see **Figure 10**). These businesses all have access through other driveways along WV 34 or Grille Lane. While the driveways along the east side of WV 34 would ideally be closed or consolidated, the lack of provided cross access or a backage road restricts the feasibility of access modifications to these businesses. Additionally, to prevent the confusion and conflicts at the TA Travel Center, the circulation into and out of the driveways could be reversed to provide a more typical configuration. The parking area behind the TA Travel Center would need to be reversed. This reconfiguration may result in left-turning traffic blocking outbound left-turning traffic. However, given the proximity to I-64, most of the exiting traffic is expected to turn right from the TA Travel Center. All of these modifications would require coordination with the businesses being affected. Curb and sidewalk would be constructed across the closed driveways.
- **Roundabout Corridor:** Given the amount of crashes in the corridor occurring at the many driveways, wholesale access management improvements would mitigate several crashes. Converting all driveways to right-in/right-out (RIRO) configurations through the construction of a median down the center of WV 34. To facilitate left-turns, roundabouts would be constructed at the I-64 Eastbound Ramps and Great Teays Boulevard as illustrated in **Figure 11**. The roundabouts at these intersections would also mitigate the number of crashes at these signalized intersections. However, there will be property impacts including the loss of some parking spaces in the northwest and southeast corners of the Great Teays Boulevard intersection. Theses impacts could be refined in final design to minimize the loss of parking spaces. Rather than requiring semi-truck traffic to use the Great Teays Boulevard roundabout to make a U-turn to access the TA Travel Center, a left-turn lane will be constructed to

facilitate left-turn movements into the TA Travel Center. However, left-turns out of the TA Travel Center will use the roundabout at the I-64 Eastbound Ramps. The access management improvements previously detailed along the west side of WV 34 could still be implemented with this improvement to minimize the number of conflict points along WV 34.

RIC RSA
WV 34 - Restricting Drive Access
August 31, 2020

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N

0 50
25 100
SCALE IN FEET

GIS RIGHT-OF-WAY/PROPERTY LINES

SCOTT WAY
TACO BELL
GRILLE LN
KFC
GO MART
GAS STATION
GRILLE LN
WV 34
GREAT TEAYS BLVD
CLOSE DRIVEWAYS
ENTRANCE
EXIT
TA TRUCK
SERVICE

Construction Cost Estimate: $150,000
Notes:
- Cost estimate does not include right-of-way or utility relocations

Access Management Improvements Along WV 34

FIGURE 10

RIC RSA
WV 34 - Roundabouts
August 31, 2020

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0 50
25 100
SCALE IN FEET

GIS RIGHT-OF-WAY/PROPERTY LINES

APPROXIMATELY 2 PARKING SPACES LOST

COULD CLOSE DRIVEWAYS

SCOTT WAY

GRILLE LN

GRILLE LN

CLOSE DRIVE

WV-34

APPROXIMATELY 8 PARKING SPACES LOST

CLOSE DRIVE

ROUNDABOUT LOCATION COULD BE SHIFTED IN FINAL DESIGN TO ADJUST IMPACTS

GREAT TEAYS BLVD

TA TRUCK SERVICE

I-64

A

Construction Cost Estimate: $3.1 M
Notes:
- Cost estimate does not include right-of-way or utility relocations
- All shading shown is assumed to be resurfacing, with full depth at the roundabouts except for restriping at Kanawha St.
A Ramp can be striped out since only 1 lane is exiting the roundabout.

Roundabout Corridor Along WV 34

FIGURE 11

8.0 Countermeasure Evaluation

8.1 Operational Analysis

Operational analysis was conducted for the proposed roundabouts using *Sidra* and forecasted 2040 traffic volumes. The number of entry and exit lanes were optimized to balance the operational performance of the intersection with the property impacts. Analysis results are summarized in **Table 4** with output provided in **Appendix G**.

Table 4: 2040 Roundabout Operational Analysis Results

WV 34 & Great Teays Boulevard / Scott Way												
	Overall Intersection	Eastbound Scott Way			Westbound Great Teays Blvd			Northbound WV 34			Southbound WV 34	
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
AM Peak Hour												
LOS	A	B			A	B		A	A		A	A	
Delay	8.6	10.3			8.7	10.9		9.8	9.8		7.0	7.0	
v/c		0.28			0.16	0.36		0.45	0.45		0.42	0.42	
95th % Queue		26’			14’	39’		68’	68’		65’	65’	
		B – 10.3			B – 10.3			A – 9.8			A – 7.0		
PM Peak Hour												
LOS	B	C			C	D		B	B		B	B	
Delay	19.1	24.0			20.1	45.8		14.7	14.7		14.4	14.4	
v/c		0.54			0.52	0.88		0.64	0.64		0.72	0.72	
95th % Queue		61’			63’	228’		161’	161’		309’	309’	
		C – 24.0			D – 37.1			B – 14.7			B – 14.4		
WV 34 & I-64 Eastbound Ramps												
	Overall Intersection	Eastbound I-64 EB Off Ramp						Northbound WV 34			Southbound WV 34	
		LT	TH	RT				TH	RT		LT	TH
AM Peak Hour												
LOS	A	B		B				B			A	
Delay	9.8	14.1		12.1				11.3			6.4	
v/c		0.40		0.37				0.58			0.36	
95th % Queue		45’		40’				135’			50’	
		B – 13.0						B – 11.3			A – 6.4	
PM Peak Hour												
LOS	C	D		D				C			B	
Delay	20.2	41.1		44.3				23.3			10.7	
v/c		0.74		0.72				0.83			0.62	
95th % Queue		104’		92’				449’			128’	
		D – 42.5						C – 23.3			B – 10.7	

These roundabouts are shown to have a significant improvement over No-Build conditions and will mitigate congestion and queuing along the corridor. During the PM peak hour, the northbound approach at the I-64 EB Ramp intersection performs worse than the No-Build conditions. The high volume of northbound traffic contributes to these queues and delay. However, the overall intersection operates acceptably at LOS C.

8.2 Safety Performance Analysis

A safety analysis was also performed for the No-Build conditions and two Build conditions - the access management alternative and the roundabout alternative. All analyses were conducted using the forecasted 2040 traffic volumes. In the No-Build Condition, the existing lane configurations are maintained but were analyzed using the 2040 volumes. The build output from IHSDM is provided in **Appendix H.**

The results of the HSM analysis of the access modifications are summarized in **Table 5.** The total crash frequency decreased slightly in both fatal and injury crashes and property damage collisions. Only the WV 34 segment between Great Teays Boulevard and I-64 was changed from the No-Build analysis as the intersections were not affected. The total predicted crashes along this corridor was decreased by approximately one crash per year by closing the driveways.

Table 5: Safety Analysis for Access Management Improvements

	Fatal and Injury Crashes	Property Damage Only Crashes	Total Crashes
$N_{predicted}$ - No Build	8.16	13.72	21.88
$N_{predicted}$ - Access Management	7.91	13.13	21.04
Change in Crashes	-0.25	-0.59	-0.84

Table 6 summarizes the HSM analysis results for the roundabout corridor. The total crash frequency decreased in all crash severities, with fatal and injury collisions having the largest reduction. The crash frequency decreased for the segment and both intersections compared to the No-Build except for the intersection of WV 34 and Great Teays Boulevard. While the fatal and injury collisions decreased at this intersection, the property damage crashes slightly increased. An increase of property damage only crashes is not atypical when converting signalized intersections to roundabouts. However, the decrease in fatal and injury crashes far outweigh the impacts of increased property damage only crashes. Overall the total predicted crashes are estimated to decrease by over nine crashes per year by implementing the roundabout corridor.

Table 6: Safety Analysis for Roundabout Corridor

	Fatal and Injury Crashes	Property Damage Only Crashes	Total Crashes
$N_{predicted}$ - No Build	8.16	13.72	21.88
$N_{predicted}$ - Roundabout Corridor	2.42	10.2	12.62
Change in Crashes	-5.74	-3.52	-9.26

8.3 Cost Considerations

The cost estimate, safety benefit and benefit/cost ratio for the two alternatives are summarized in **Table 7**. A detailed breakdown of the construction cost estimates is provided in **Appendix I**. Cost estimates included a 30 percent contingency and were inflated for a 2025 construction year. The

cost estimates do not include right-of-way costs or utility relocation which may be required as a result of the roundabouts. The monetized safety benefit was calculated assuming a 20-year service life of the improvement. A detailed breakdown of the safety benefit calculations is provided in **Appendix J**. Both alternatives have a high benefit/cost ratio, with the roundabout corridor having the highest.

Table 7: Benefit/Cost Summary

	Safety Benefit	Cost Estimate	Benefit/Cost Ratio
Access Management Improvements along WV 34	$827,583	$149,500	5.54
Roundabout Corridor	$17,544,934	$ 3,127,000	5.61

9.0 Conclusions and Recommendations

Based on the crash patterns and traffic operations in the study corridor, the following countermeasures are recommended:

Short-Term

- Check vehicular clearance intervals.
- Implement coordinated signal timing along WV 34.
- Work with the TA Travel Center to reverse the circulation and reduce confusion and conflicts at the entrance and exit on WV 34.

Medium-Term

Construct roundabout corridor. This alternative has the most potential to reduce crashes and improve operations in the corridor. While this improvement is costly, the benefit-to-cost ratio is 5.61. While securing funding for this improvement, the access management modifications that close the Go-Mart, KFC, Taco Bell, and Scott Junction Plaza could be implemented to improve safety in the interim.