GAL-160-9.68

SR-160 at SR-554
Abbreviated Safety Study
Final Report
July 2, 2019

ODOT District 10

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STATE OF OHIO DEPARTMENT OF TRANSPORTATION

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I. Purpose and Need

The purpose of this study is to analyze the existing safety conditions and identify potential countermeasures to reduce the crash frequency at the intersection of SR-160 & SR-554 in Gallia County. The data and recommendations in this study could be utilized to apply for Highway Safety Improvement Program (HSIP) funding to implement safety improvements at the study intersection. The study intersection is on the Governor's Top 150 List and is ranked #174 on the 2017 HSIP Rural Intersection List. The intersection has been ranked on the HSIP List consistently since 2015. A project location map is provided in **Figure 1** and a study intersection map is provided in **Figure 2**.

Figure 1 – Project Location Map

Figure 2 – Study Intersection Map

II. Existing Conditions

A. Land Use

The study intersection is located in Springfield Township east of the unincorporated community of Bidwell, Ohio. The Korner store and gas station is located in the northwest quadrant with four full-movement access points: two on SR-160 and two on SR-554. Single-family houses are located in the southwest quadrant with drives onto SR-554. The Springfield Township Fire Department is just east of the intersection of SR-554. River Valley High School and Middle School are approximately 0.6 miles south of the study intersection. Undeveloped fields surround the remaining area.

B. Roadway Conditions

SR-160 is a north-south connector between Gallipolis and villages to the north such as Wilkesville, Vinton, Radcliff, and Hamden. SR-160 is classified as a Rural Major Collector. It is a two-lane roadway with a posted speed limit of 55 MPH. Lane widths are approximately 12 feet each, and the existing shoulders have an approximate width of four feet. These dimensions meet the minimum criteria specified in the ODOT Location and Design Manual, Volume 1. Raised pavement markers (RPMs) are installed along the center line. No rumble strips or stripes are present.

SR-554 serves as an east-west connector from the SR-325 interchange with IR-35 to the Village of Cheshire. It is a two-lane roadway that is classified as a Rural Major Collector and has a posted speed limit of 45 MPH. Lane widths are approximately 10 feet each, and the existing shoulders west of the intersection have an approximate width of four feet. The shoulders narrow on the east side and their width varies from approximately four feet to one foot in some areas. These dimensions do not meet the minimum criteria specified in the ODOT Location and Design Manual, Volume 1. RPMs are installed on the edge lines and centerlines on each approach, which is consistent with the ODOT Standard Construction Drawings. No rumble strips or stripes are present.

C. Intersection Conditions

The intersection of SR-160 & SR-554 is two-way stop-controlled with dual stop signs with LED Blinker Signs (solar powered) on both sides of the road on the SR-554 approaches. Each stop sign also has red sign post reflectors. The LED Blinker Signs were installed in March 2016 to replace the existing red-ball flashers that were posted above the stop signs on the right side of both stop-controlled approaches. "Stop ahead" warning signs are posted approximately 300 feet from the westbound approach and approximately 600 feet from the eastbound approach. Intersection crossing warning signs are posted approximately 1000 feet from the intersection on both the northbound and southbound approaches. Intersection sight distance on SR-554 and stopping sight distance on SR-160 appear to exceed 1000 feet. No roadway lighting is present in the study area.

D. Data Collection

Vehicle turning movement counts were collected at the study intersection of SR-160 & SR-554 on Thursday, May 16, 2019 while school was in session. The counts were conducted from 6:30 AM - 6:30 PM. The AM peak hour for SR-160 & SR-554 was determined to be 7:00 - 8:00 AM, and the PM peak hour was determined to be 4:00 - 5:00 PM.

Growth rates for the intersection were calculated by comparing current count data to historic count data. Negative growth was calculated for all approaches except for the southbound approach. A growth rate of 0% was assumed for all approaches except for the southbound approach, which was determined to be 0.18%. Traffic volumes were projected to the Horizon Year of 2040 using the linear annual growth rates. Count data, growth rate calculations, and traffic volume calculations are provided in **Appendix A**.

E. Field Observations

Field observations were conducted during the afternoon school dismissal hour and PM peak hour on May 15, 2019 and the AM peak hour on May 16, 2019. The negative grade for the northbound approach appeared to contribute to higher approach speeds. Skid marks were noted in the northbound lane on the intersection approach, which reinforces the speed concerns (see **Figure 3**). Driver frustration/impatience on SR-554 was noted when intersection delay and queueing increased. Under these conditions, inadequate gaps were selected by some drivers. Intersection sight distance is excellent for stopped traffic looking to the north and south. However, a possible sight distance obstruction was noted for eastbound traffic approaching the stop line. The SR-554 and SR-160 route marker signs

south of the intersection are placed in a location that obstructs the view of northbound traffic from eastbound drivers looking to the right when approaching the stop line. The Korner store had frequent traffic in and out of the property which adds to the overall intersection volume. The attention of drivers approaching and/or departing the intersection is taken by vehicles using these driveways.

Figure 3 – Skid Marks on SR-160 Northbound

F. Review of Previous Studies

A 2015 HSIP Abbreviated Safety Study of SR-160 & SR-554 was provided by ODOT District 10. The study stated that it was prompted by several concerns expressed by the public regarding the intersection. Crash trends noted include: angle, left turn, and rear end crash types. Signal warrant analysis was conducted using February 2016 volumes. It was determined the signal did not meet warrants. Left turn lane warrant analysis was also conducted. It was determined that the northbound left turn met warrants during the PM peak hour. The turn lane was not recommended due to the fear that it could compound the angle crash issue. It was recommended that the effectiveness of the LED Blinker Signs be monitored, and the intersection be revisited if there is not a reduction in crashes. This previous study is provided in **Appendix B**.

III. Analysis

A. Capacity Analysis

Existing conditions intersection capacity was evaluated using the Highway Capacity Manual (HCM) module of Synchro Version 10 at the study intersection using 2019 and 2040 traffic volumes. Levels of service (LOS) and vehicle delay are summarized in **Table 1**. Detailed capacity analysis results are provided in **Appendix C**.

Table 1 – Existing Conditions Capacity Analysis Results Summary

Approach	2019		2040	
	AM	PM	AM	PM
Eastbound	B/11.8	B/14.1	B/11.9	B/14.2
Westbound	C/15.2	C/15.7	C/15.4	C/15.8
Northbound	A/3.1	A/1.5	A/3.1	A/1.5
Southbound	A/0.6	A/1.2	A/0.6	A/1.2

Letter/Number – LOS/ Average Delay per Vehicle in seconds

Capacity analysis of the intersection shows that the intersection operated with acceptable LOS in all scenarios. The worst approach LOS is the westbound 2040 PM scenario with a delay of 15.8 seconds.

B. Signal Warrant Analysis

The eight-hour vehicular volume, four-hour vehicular volume, and peak hour signal warrants were assessed at the study intersection in both the existing (2019) and Horizon (2040) Year scenarios. A signal was not warranted in either of the analysis years. Full signal warrant analysis can be seen in **Appendix D**.

C. Turn Lane Warrant Analysis

A turn lane warrant analysis was conducted at the study intersection using ODOT standard turn lane warrant graphs. The length of these turn lanes, if warranted, were also calculated using ODOT methodology. SR-160 has a posted speed limit of 55 MPH, so a design speed of 60 MPH was used.

Results of the turn lane warrant analysis show a 345' northbound left turn lane is warranted in both the 2019 and 2040 analysis years. Southbound left, southbound right, and northbound right turn lanes are not warranted in any scenario. Full turn lane warrant analysis is provided in **Appendix E.**

IV. Crash Data

A. Crash Data Summary

Crash data was obtained from ODOT Transportation Information Mapping System (TIMS) for the study intersection for five years of available data (2014-2018). A total of 17 crashes were obtained. The OH-1 report for each documented crash was reviewed to correct information, where necessary, and to properly locate crashes within the study limits. The original crash data query included 18 crashes, which was adjusted to 17 crashes after reviewing and relocating crashes as necessary. **Table 2** represents a breakdown of the crash data. Crash data for the study intersection was plotted on an aerial to identify crash patterns and probable causes. The crash diagram for the study intersection is included in **Appendix F**.

Table 2 - Crash Statistics

Crash Year	Number	Percent
2014	7	41.2%
2015	4	23.5%
2016	4	23.5%
2017	1	5.9%
2018	1	5.9%

Hour of Day	Number	Percent
6:00 AM	1	5.9%
9:00 AM	1	5.9%
12:00 PM	2	11.8%
1:00 PM	1	5.9%
2:00 PM	1	5.9%
3:00 PM	2	11.8%
4:00 PM	1	5.9%
5:00 PM	3	17.6%
6:00 PM	3	17.6%
8:00 PM	1	5.9%
11:00 PM	1	5.9%

Crash Severity	Number	Percent
Injury Crash	10	58.8%
Property Damage Crash	7	41.2%

Crash Type	Number	Percent
Angle	12	70.6%
Rear End	3	17.6%
Backing	1	5.9%
Left Turn	1	5.9%

Day of Week	Number	Percent
Monday	3	17.6%
Tuesday	4	23.5%
Wednesday	1	5.9%
Friday	5	29.4%
Saturday	2	11.8%
Sunday	2	11.8%

Road Condition	Number	Percent
Dry	16	94.1%
Wet	1	5.9%

B. Probable Causes

Noteworthy crash patterns at the study intersection are summarized with supporting details and probable causes as follows:

- **Angle Crashes**
  Angle crashes were the most prevalent crash type at the study intersection. A total of 12 angle crashes were reported, seven resulting in injury. Angle crashes represent 70.6 percent of the crashes reported at the study intersection, higher than the statewide average of 16.0 percent. Failure to yield was the contributing factor

for all of the angle crashes except one. The breakdown of the angle crashes are as follows:

- Five involved a westbound vehicle striking a southbound vehicle
- Three involved a westbound vehicle striking a northbound vehicle
- Two involved an eastbound vehicle striking a northbound vehicle
- One involved an eastbound vehicle striking a southbound left turning vehicle
- One involved a northbound left turning vehicle striking an eastbound vehicle

Most (66.7 percent) angle crashes occurred during the daylight and all but one occurred under dry pavement conditions. The crashes were concentrated during the AM peak (46.1 percent taking place from 6-10 AM) and PM peak (46.1 percent taking place from 3-7 PM).

- **Rear End Crashes**
  Rear end crashes were the second most prevalent crash type at the study intersection. A total of three rear end crashes were reported during the analysis period, two of which resulted in injury. Rear end crashes represent 17.6 percent of the crashes reported at the study intersection, lower than the statewide average of 31.1 percent. Two of the rear end crashes occurred on the southbound approach and one occurred on the northbound approach. All three of the rear end crashes occurred under dry road conditions with one occurring after dark and the other two during daylight. All three of the crashes occurred between 1-6 PM. The rear end crashes are likely occurring due to a lack of turn lanes and vehicles not expecting to have to stop behind a vehicle waiting to complete a turning movement from SR-160.
- **Reduction in total annual crashes**
  The LED Blinker stop signs were installed in March of 2016; the frequency of crashes per year has consistently reduced since then. The crashes after the installation of the LED Blinker stop signs include:
  - The trailer of a northbound left turning articulated truck swung wide and struck an eastbound vehicle stopped at the stop line of the intersection.
  - Westbound left turning vehicle failed to yield at the stop sign and struck a northbound through vehicle. This crash occurred in the dark and resulted in injury.
  - Westbound through vehicle failed to yield at the stop sign and struck a northbound through vehicle.
  - A southbound right turning articulated truck caused southbound vehicles behind it, following too closely, to have a rear end crash. This crash resulted in injury.

  While the frequency of crashes per year has consistently reduced since the LED Blinker stop signs were installed, there were still two crashes that should have been mitigated by the enhanced signage. This shows the existing crash issue may have been lessened but is still present.
- **Driver Age**
  With the proximity of the River Valley High School to the study intersection, it was suspected that some drivers of the at-fault vehicles may be younger drivers. The data shows that only two crashes had at-fault drivers who were 18 years old or younger.

C. Highway Safety Manual

The Highway Safety Manual (HSM) predictive method for rural two-lane, two-way intersections was applied to the study intersection to determine the potential for safety improvement. See **Appendix G** for an overview of the HSM methodology. The results presented in **Table 3** show the expected crash frequency calculated using HSM predictive method with cleaned crash data and existing conditions for the study intersection.

Table 3 - HSM Results for Existing Conditions for All Crashes (shown in crashes/year)

Predicted Average Crash Frequency	4.1688
Expected Average Crash Frequency – Existing Conditions	3.8151
Expected Excess Crashes	-0.3537
Potential for Improvement	No

The results conclude the expected crash frequency is less than the predicted crash frequency for the study intersection. This suggests the intersection experiences less average crashes per year than its peers, and it does not have a potential to reduce crashes based on HSM methodology. While there is not a significant need for improvement based on the HSM analysis, crash history and field observations indicate there may be cost-effective countermeasures to reduce crash frequencies at the study intersection. HSM output reports is provided in **Appendix G**.

V. Countermeasures

The following section addresses possible countermeasures to mitigate the prevalent crash types at the study intersection. Short-term and long-term countermeasures may be independent solutions and are not necessarily recommended to be implemented concurrently.

A. Countermeasures Considered But Not Recommended

- **Add northbound left turn lane**
  Even though a northbound left turn lane is warranted, it is recommended that the conclusion of the previous safety study be adhered to. The crash trend is angle crashes due to failure to yield from SR-554. An increase in roadway width has the potential to increase the number of angle crashes as vehicles will have a wider roadway to cross. The addition of a northbound left turn lane would be an appropriate countermeasure to mitigate northbound rear end crashes. There was only one northbound rear end crash (which resulted in injury) in the previous five years which could have been mitigated by the addition of a northbound left turn lane. For these reasons, a northbound left turn lane is not recommended at this time.

B. Short Term Countermeasures

- **Upgrade intersection ahead warning signage**
  Add oversized intersection warning signs on each SR-160 approach to the study intersection. It is recommended that these sign assemblies be posted on both sides of the roadway and include sign post reflectors. The assemblies could also be

supplemented with a beacon or LED Blinkers (similar to the east/west stop signs). These enhanced warning signs can be installed in the same location as the existing signs. See **Figure 4**.

Figure 4 – Short Term Countermeasures Concept Plan – Intersection Warning Signs

- **Revise route sign placement**
  As noted in the Field Observations section, the existing route marker sign placement for southbound traffic, south of the study intersection, can potentially create a sight distance obstruction. It is recommended that the SR-554 route assembly be relocated further west, away from the stop line. See **Figure 5**.

Figure 5 – Short Term Countermeasures Concept Plan – Route Marker Sign Relocation

- **Add intersection lighting**
  Four of the total crashes occurred in the dark, three of those crashes resulted in injury. This shows the lack of intersection lighting could be a contributing factor in the frequency of injury crashes. It is recommended that roadway lighting be constructed at the study intersection.

C. Long Term Countermeasures

- **Reconfigure intersection to be a roundabout**
  A roundabout could be considered for implementation at this intersection. The FHWA Office of Safety identified roundabouts as a Proven Safety Countermeasure because of their ability to greatly reduce the types of crashes that result in serious injury or fatality. By reducing the number and severity of conflict points at the intersection, and because of the lower speeds of vehicles moving through the intersection, roundabouts are a proven, safer type of intersection. While the frequency of crashes per year has consistently reduced since the LED Blinker stop signs were installed, there were still two crashes that should have been mitigated by the enhanced signage. This shows the existing crash issue may have been lessened but is still present. The implementation of a roundabout is expected to reduce this crash issue. However, roundabouts may be unfamiliar to most people, especially if it is the first roundabout in an area. If selected for implementation, this would be the first roundabout in Gallia County. Successful implementation of a roundabout requires extra outreach and education in these cases in order for safety and operational benefits to be realized.

  Capacity analysis was conducted using Sidra Intersection 7.0 with 2019 and 2040 traffic volumes to assess the capacity of the proposed roundabout configuration. Results are provided in LOS and vehicle delay are summarized in **Table 4**. Detailed capacity analysis results are provided in **Appendix C**.

Table 4 – Roundabout Capacity Analysis Results Summary

Approach	2019		2040	
	AM	PM	AM	PM
Eastbound	A/6.5	A/6.3	A/6.5	A/6.3
Westbound	A/7.2	A/7.3	A/7.2	A/7.3
Northbound	A/6.6	A/5.5	A/6.6	A/5.5
Southbound	A/5.3	A/5.3	A/5.3	A/5.3
Total	**A/6.1**	**A/5.9**	**A/6.2**	**A/5.9**

Letter/Number – LOS/ Average Delay per Vehicle in seconds

  Capacity analysis shows a single-lane circulating roundabout, without additional turn lanes, will operate with acceptable LOS in 2019 and 2040. A conceptual, planning-level layout of the proposed roundabout configuration is provided in **Figure 6.** Note that the center circle of the roundabout is pushed slightly east of the center of the intersection. This was done in an effort to reduce right-of-way impacts, reduce impacts to The Korner store drives, and make maintenance of traffic for construction less impactful.

D. Countermeasures for Future Consideration

- **Access management**
  While driveway-related crashes are not prominent at the study intersection, it was noted during field observations that The Korner store had frequent traffic. The Korner store currently has four access drives, located close to the intersection. If this site redevelops in the future, we recommend considering a reduction in the number of access drives and locating them further from the intersection, if possible.

Figure 6 – Proposed Conceptual Planning-Level Roundabout Configuration

VI. Benefit-Cost Analysis

Benefit-cost analysis is a tool used to determine the financial benefits of a project by comparing the net present value (NPV) of a project to the NPV of the safety benefit provided by that project. Benefit-cost values greater than one indicate a positive return on the original investment. Preferred countermeasures are those having the highest NPV of safety benefits. A benefit-cost analysis for the recommended long-term countermeasures was prepared using the ODOT Economic Crash Analysis Tool (ECAT).

Two separate cost estimates and ECAT analyses were prepared for this project: one for short term countermeasures and one for long term countermeasures. Each construction cost estimate assumes the following:

- 15 percent engineering design
- 30 percent contingency
- 2.5 percent inflation rate for an estimated 2020 construction year (short term)
- 9.6 percent inflation rate for an estimated 2022 construction year (long term)
- Estimated right-of-way costs (for long term countermeasures only)
- Cost for utility relocation is not included

Crash modification factors (CMF) were applied for the following improvements. This analysis does not account for all recommended improvements, rather only those countermeasures that have CMF values.

Short term countermeasures for the study intersection include:

- **Add intersection lighting:** A CMF of 0.9996 was included in the project for the implementation of this proposed countermeasure. This is a standard Part C CMF offering in ECAT, which was used to calculate the Combined CMF.

Long term countermeasures for the study intersection include:

- **Add intersection lighting:** A CMF of 0.9996 was included in the project for the implementation of this proposed countermeasure. This is a standard Part C CMF offering in ECAT, which was used to calculate the Combined CMF.
- **Convert intersection with minor-road stop control to modern roundabout (rural):** A CMF of 0.13 was applied to all crashes except property damage only crashes in which a CMF of 0.29 was applied. This is a standard CMF offering in ECAT.

The estimated cost is $34,300 for the short term countermeasures and $1,430,900 for the long term countermeasures. The cost estimate is included in **Appendix H** and benefit-cost analysis reports from ECAT are included in **Appendix I**. **Table 5** summarizes the benefit-cost analysis results.

Table 5 - Benefit-Cost Analysis

	Short Term Countermeasures	Long Term Countermeasures
Expected Annual Crash Adjustment	-0.002	-2.974
NPV of Project	$47,995.00	$1,305,580.00
NPV of Safety Benefit	$981.29	$2,482,666.97
Benefit-Cost Ratio	0.02	1.90

The benefit-cost ratio for the short term countermeasures is less than 1.0, indicating that the ECAT methods predict the cost of the project is not justified solely based on the calculated value of safety benefits to be obtained. However, the overall cost of the improvements is relatively low, and a CMF for the intersection ahead warning signage upgrade was not available. It is expected that this improvement will help reduce crashes, even though it is not shown in the benefit-cost analysis. These short term countermeasures should still be considered for implementation, if the long term countermeasures are not chosen for implementation.

The benefit-cost ratio for the long term countermeasures is greater than 1.0. This shows that the implementation of a roundabout with intersection lighting should have a positive return on the original investment.

Appendix A

Count Data, Growth Rate Calculations, and Volume Calculations

Appendix A

SR-160 and SR-554 - TMC

Thu May 16, 2019
Full Length (6:30 AM-6:30 PM)
All Classes (Motorcycles, Cars, Light Goods Vehicles, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 656315, Location: 38.926252, -82.282593

Provided by: Carpenter Marty (CM) Transportation Inc.
6612 Singletree Drive,
Columbus, OH, 43229, US

Leg	SR-554						SR-554						SR-160						SR-160						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	Int
2019-05-16 6:30AM	4	3	9	0	**16**	0	7	9	2	0	**18**	0	0	1	1	0	**2**	0	8	16	11	0	**35**	0	**71**
6:45AM	1	2	12	0	**15**	0	11	6	2	0	**19**	0	2	3	1	0	**6**	0	1	25	7	0	**33**	0	**73**
Hourly Total	5	5	21	0	**31**	0	18	15	4	0	**37**	0	2	4	2	0	**8**	0	9	41	18	0	**68**	0	**144**
7:00AM	2	4	16	0	**22**	0	14	9	1	0	**24**	0	5	11	3	0	**19**	0	4	36	5	0	**45**	0	**110**
7:15AM	6	3	25	0	**34**	0	16	14	2	0	**32**	0	16	17	4	0	**37**	0	2	56	10	0	**68**	0	**171**
7:30AM	3	5	31	0	**39**	0	12	11	6	0	**29**	0	14	16	7	0	**37**	0	3	64	12	0	**79**	0	**184**
7:45AM	7	7	8	0	**22**	0	5	10	4	0	**19**	0	13	11	4	0	**28**	0	9	33	7	0	**49**	0	**118**
Hourly Total	18	19	80	0	**117**	0	47	44	13	0	**104**	0	48	55	18	0	**121**	0	18	189	34	0	**241**	0	**583**
8:00AM	3	2	10	0	**15**	0	8	9	0	0	**17**	0	0	11	2	0	**13**	0	4	24	11	0	**39**	0	**84**
8:15AM	4	2	6	0	**12**	0	5	14	3	0	**22**	0	10	11	6	0	**27**	0	4	18	7	0	**29**	0	**90**
8:30AM	6	5	10	0	**21**	0	8	7	2	0	**17**	0	11	17	5	0	**33**	0	2	29	5	0	**36**	0	**107**
8:45AM	6	2	6	0	**14**	0	4	3	2	0	**9**	0	6	15	0	0	**21**	0	3	18	7	0	**28**	0	**72**
Hourly Total	19	11	32	0	**62**	0	25	33	7	0	**65**	0	27	54	13	0	**94**	0	13	89	30	0	**132**	0	**353**
9:00AM	4	3	12	0	**19**	0	8	12	4	0	**24**	0	9	15	5	0	**29**	0	3	28	9	0	**40**	0	**112**
9:15AM	2	7	5	0	**14**	0	6	8	5	0	**19**	0	1	12	4	0	**17**	0	6	22	6	0	**34**	0	**84**
9:30AM	3	2	8	0	**13**	0	5	4	2	0	**11**	0	5	13	4	0	**22**	0	4	20	4	0	**28**	0	**74**
9:45AM	3	9	9	0	**21**	0	6	7	3	0	**16**	0	6	12	2	0	**20**	0	3	15	6	0	**24**	0	**81**
Hourly Total	12	21	34	0	**67**	0	25	31	14	0	**70**	0	21	52	15	0	**88**	0	16	85	25	0	**126**	0	**351**
10:00AM	2	7	9	0	**18**	0	7	5	1	0	**13**	0	8	11	3	0	**22**	0	4	22	8	0	**34**	0	**87**
10:15AM	1	7	5	0	**13**	0	4	6	2	0	**12**	0	7	14	8	0	**29**	0	3	30	5	0	**38**	0	**92**
10:30AM	3	5	15	0	**23**	0	7	4	1	0	**12**	0	7	12	6	0	**25**	0	0	18	4	0	**22**	0	**82**
10:45AM	3	6	10	0	**19**	0	7	6	4	0	**17**	0	13	12	6	0	**31**	0	1	16	8	0	**25**	0	**92**
Hourly Total	9	25	39	0	**73**	0	25	21	8	0	**54**	0	35	49	23	0	**107**	0	8	86	25	0	**119**	0	**353**
11:00AM	6	8	10	0	**24**	0	3	10	1	0	**14**	0	9	12	5	0	**26**	0	5	20	9	0	**34**	0	**98**
11:15AM	6	5	9	0	**20**	0	4	4	2	0	**10**	0	5	18	11	0	**34**	0	5	23	4	0	**32**	2	**96**
11:30AM	3	7	6	0	**16**	0	3	8	3	0	**14**	0	7	29	8	0	**44**	0	3	24	4	0	**31**	0	**105**
11:45AM	4	4	10	0	**18**	0	9	4	3	0	**16**	0	5	25	6	0	**36**	0	0	21	5	0	**26**	0	**96**
Hourly Total	19	24	35	0	**78**	0	19	26	9	0	**54**	0	26	84	30	0	**140**	0	13	88	22	0	**123**	2	**395**
12:00PM	4	4	14	0	**22**	0	4	6	1	0	**11**	0	9	23	3	0	**35**	0	4	14	7	0	**25**	0	**93**
12:15PM	4	7	10	0	**21**	0	2	5	2	0	**9**	0	11	18	8	0	**37**	0	4	18	9	0	**31**	0	**98**
12:30PM	6	7	14	0	**27**	0	3	5	2	0	**10**	0	9	19	7	0	**35**	0	2	26	3	0	**31**	0	**103**
12:45PM	7	7	6	0	**20**	0	7	3	1	0	**11**	0	12	22	11	0	**45**	0	1	21	4	0	**26**	0	**102**
Hourly Total	21	25	44	0	**90**	0	16	19	6	0	**41**	0	41	82	29	0	**152**	0	11	79	23	0	**113**	0	**396**
1:00PM	3	3	8	0	**14**	0	1	11	5	0	**17**	0	9	20	6	0	**35**	0	6	13	3	0	**22**	0	**88**
1:15PM	6	8	8	0	**22**	0	3	13	2	0	**18**	0	6	25	1	0	**32**	0	2	18	8	0	**28**	0	**100**
1:30PM	9	2	11	0	**22**	0	7	7	6	0	**20**	0	10	18	10	0	**38**	0	3	19	3	0	**25**	0	**105**
1:45PM	8	11	9	0	**28**	0	6	9	0	0	**15**	0	16	18	5	0	**39**	0	4	29	4	0	**37**	0	**119**
Hourly Total	26	24	36	0	**86**	0	17	40	13	0	**70**	0	41	81	22	0	**144**	0	15	79	18	0	**112**	0	**412**
2:00PM	2	6	16	0	**24**	0	6	10	0	0	**16**	0	9	19	2	0	**30**	0	3	22	6	0	**31**	0	**101**
2:15PM	1	7	13	0	**21**	0	4	8	5	0	**17**	0	14	14	10	0	**38**	0	3	29	4	0	**36**	0	**112**
2:30PM	2	6	12	0	**20**	0	6	10	6	0	**22**	0	25	27	23	0	**75**	0	3	25	4	0	**32**	0	**149**
2:45PM	8	11	14	0	**33**	0	4	9	7	0	**20**	0	30	42	3	0	**75**	0	3	21	12	0	**36**	0	**164**
Hourly Total	13	30	55	0	**98**	0	20	37	18	0	**75**	0	78	102	38	0	**218**	0	12	97	26	0	**135**	0	**526**
3:00PM	7	9	9	0	**25**	0	9	6	0	0	**15**	0	12	31	5	0	**48**	0	5	11	7	0	**23**	0	**111**
3:15PM	6	8	11	0	**25**	0	2	8	4	0	**14**	0	11	38	8	0	**57**	0	4	22	3	0	**29**	0	**125**
3:30PM	5	15	15	0	**35**	0	3	9	5	0	**17**	0	13	45	8	0	**66**	0	5	17	7	0	**29**	0	**147**
3:45PM	4	12	10	0	**26**	0	6	7	3	0	**16**	0	14	25	14	0	**53**	0	6	33	10	0	**49**	0	**144**
Hourly Total	22	44	45	0	**111**	0	20	30	12	0	**62**	0	50	139	35	0	**224**	0	20	83	27	0	**130**	0	**527**
4:00PM	12	15	14	0	**41**	0	5	6	3	0	**14**	0	13	45	17	0	**75**	0	4	16	1	0	**21**	0	**151**
4:15PM	7	8	16	0	**31**	0	9	9	6	0	**24**	0	16	43	7	0	**66**	0	7	30	5	0	**42**	0	**163**
4:30PM	5	10	12	0	**27**	0	6	10	1	0	**17**	0	15	47	22	0	**84**	0	3	25	6	0	**34**	0	**162**
4:45PM	5	10	14	0	**29**	0	7	10	0	0	**17**	0	14	49	14	0	**77**	0	7	25	11	0	**43**	0	**166**
Hourly Total	29	43	56	0	**128**	0	27	35	10	0	**72**	0	58	184	60	0	**302**	0	21	96	23	0	**140**	0	**642**
5:00PM	9	9	9	0	**27**	0	6	8	1	0	**15**	0	17	34	8	0	**59**	0	2	25	6	0	**33**	0	**134**
5:15PM	10	5	8	0	**23**	0	4	8	6	0	**18**	0	11	40	9	0	**60**	0	7	19	5	0	**31**	0	**132**
5:30PM	10	9	7	0	**26**	0	10	7	2	0	**19**	0	21	29	8	0	**58**	0	4	36	5	0	**45**	0	**148**
5:45PM	5	10	24	0	**39**	0	6	6	3	0	**15**	0	16	41	22	0	**79**	0	3	23	7	0	**33**	0	**166**
Hourly Total	34	33	48	0	**115**	0	26	29	12	0	**67**	0	65	144	47	0	**256**	0	16	103	23	0	**142**	0	**580**
6:00PM	8	11	17	0	**36**	0	8	6	6	0	**20**	0	15	35	8	0	**58**	0	6	23	7	0	**36**	0	**150**
6:15PM	9	6	7	0	**22**	0	4	7	3	0	**14**	0	21	27	10	0	**58**	0	4	24	11	0	**39**	2	**133**
Hourly Total	17	17	24	0	**58**	0	12	13	9	0	**34**	0	36	62	18	0	**116**	0	10	47	18	0	**75**	2	**283**
Total	244	321	549	0	**1114**	0	297	373	135	0	**805**	0	528	1092	350	0	**1970**	0	182	1162	312	0	**1656**	4	**5545**
% Approach	21.9%	28.8%	49.3%	0%	**-**	-	36.9%	46.3%	16.8%	0%	**-**	-	26.8%	55.4%	17.8%	0%	**-**	-	11.0%	70.2%	18.8%	0%	**-**	-	-
% Total	4.4%	5.8%	9.9%	0%	**20.1%**	-	5.4%	6.7%	2.4%	0%	**14.5%**	-	9.5%	19.7%	6.3%	0%	**35.5%**	-	3.3%	21.0%	5.6%	0%	**29.9%**	-	-
Motorcycles	1	5	3	0	**9**	-	2	2	2	0	**6**	-	3	11	1	0	**15**	-	0	11	6	0	**17**	-	47
% Motorcycles	0.4%	1.6%	0.5%	0%	**0.8%**	-	0.7%	0.5%	1.5%	0%	**0.7%**	-	0.6%	1.0%	0.3%	0%	**0.8%**	-	0%	0.9%	1.9%	0%	**1.0%**	-	0.8%
Cars	170	183	366	0	**719**	-	191	222	94	0	**507**	-	358	783	238	0	**1379**	-	93	860	205	0	**1158**	-	3763
% Cars	69.7%	57.0%	66.7%	0%	**64.5%**	-	64.3%	59.5%	69.6%	0%	**63.0%**	-	67.8%	71.7%	68.0%	0%	**70.0%**	-	51.1%	74.0%	65.7%	0%	**69.9%**	-	67.9%

Leg	SR-554						SR-554						SR-160						SR-160						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	**Int**
Light Goods Vehicles	62	114	148	0	**324**	-	90	123	34	0	**247**	-	146	270	98	0	**514**	-	78	259	81	0	**418**	-	1503
% Light Goods Vehicles	25.4%	35.5%	27.0%	0%	**29.1%**	-	30.3%	33.0%	25.2%	0%	**30.7%**	-	27.7%	24.7%	28.0%	0%	**26.1%**	-	42.9%	22.3%	26.0%	0%	**25.2%**	-	27.1%
Single-Unit Trucks	2	11	7	0	**20**	-	8	13	3	0	**24**	-	5	13	7	0	**25**	-	7	14	4	0	**25**	-	94
% Single-Unit Trucks	0.8%	3.4%	1.3%	0%	**1.8%**	-	2.7%	3.5%	2.2%	0%	**3.0%**	-	0.9%	1.2%	2.0%	0%	**1.3%**	-	3.8%	1.2%	1.3%	0%	**1.5%**	-	1.7%
Articulated Trucks	0	2	2	0	**4**	-	1	6	1	0	**8**	-	4	3	1	0	**8**	-	0	5	5	0	**10**	-	30
% Articulated Trucks	0%	0.6%	0.4%	0%	**0.4%**	-	0.3%	1.6%	0.7%	0%	**1.0%**	-	0.8%	0.3%	0.3%	0%	**0.4%**	-	0%	0.4%	1.6%	0%	**0.6%**	-	0.5%
Buses	9	6	23	0	**38**	-	5	7	1	0	**13**	-	12	12	5	0	**29**	-	4	12	11	0	**27**	-	107
% Buses	3.7%	1.9%	4.2%	0%	**3.4%**	-	1.7%	1.9%	0.7%	0%	**1.6%**	-	2.3%	1.1%	1.4%	0%	**1.5%**	-	2.2%	1.0%	3.5%	0%	**1.6%**	-	1.9%
Bicycles on Road	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	1	0	0	**1**	-	1
% Bicycles on Road	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0.1%	0%	0%	**0.1%**	-	0%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	4	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100%	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0%	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

SR-160 and SR-554 - TMC
Thu May 16, 2019
Full Length (6:30 AM-6:30 PM)
All Classes (Motorcycles, Cars, Light Goods Vehicles, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 656315, Location: 38.926252, -82.282593

Provided by: Carpenter Marty (CM) Transportation Inc.
6612 Singletree Drive,
Columbus, OH, 43229, US

SR-160 and SR-554 - TMC

Thu May 16, 2019
AM Peak (7 AM - 8 AM)
All Classes (Motorcycles, Cars, Light Goods Vehicles, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 656315, Location: 38.926252, -82.282593

Provided by: Carpenter Marty (CM)
Transportation Inc.
6612 Singletree Drive,
Columbus, OH, 43229, US

Leg	SR-554						SR-554						SR-160						SR-160						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	Int
2019-05-16 7:00AM	2	4	16	0	22	0	14	9	1	0	24	0	5	11	3	0	19	0	4	36	5	0	45	0	110
7:15AM	6	3	25	0	34	0	16	14	2	0	32	0	16	17	4	0	37	0	2	56	10	0	68	0	171
7:30AM	3	5	31	0	39	0	12	11	6	0	29	0	14	16	7	0	37	0	3	64	12	0	79	0	184
7:45AM	7	7	8	0	22	0	5	10	4	0	19	0	13	11	4	0	28	0	9	33	7	0	49	0	118
Total	18	19	80	0	117	0	47	44	13	0	104	0	48	55	18	0	121	0	18	189	34	0	241	0	583
% Approach	15.4%	16.2%	68.4%	0%	-	-	45.2%	42.3%	12.5%	0%	-	-	39.7%	45.5%	14.9%	0%	-	-	7.5%	78.4%	14.1%	0%	-	-	-
% Total	3.1%	3.3%	13.7%	0%	20.1%	-	8.1%	7.5%	2.2%	0%	17.8%	-	8.2%	9.4%	3.1%	0%	20.8%	-	3.1%	32.4%	5.8%	0%	41.3%	-	-
PHF	0.643	0.679	0.645	-	0.750	-	0.734	0.786	0.542	-	0.813	-	0.750	0.809	0.643	-	0.818	-	0.500	0.738	0.708	-	0.763	-	0.792
Motorcycles	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	1	0	0	1	-	1
% Motorcycles	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	0.5%	0%	0%	0.4%	-	0.2%
Cars	12	12	55	0	79	-	33	32	10	0	75	-	36	43	13	0	92	-	10	149	27	0	186	-	432
% Cars	66.7%	63.2%	68.8%	0%	67.5%	-	70.2%	72.7%	76.9%	0%	72.1%	-	75.0%	78.2%	72.2%	0%	76.0%	-	55.6%	78.8%	79.4%	0%	77.2%	-	74.1%
Light Goods Vehicles	2	5	17	0	24	-	11	11	3	0	25	-	11	11	2	0	24	-	8	34	6	0	48	-	121
% Light Goods Vehicles	11.1%	26.3%	21.3%	0%	20.5%	-	23.4%	25.0%	23.1%	0%	24.0%	-	22.9%	20.0%	11.1%	0%	19.8%	-	44.4%	18.0%	17.6%	0%	19.9%	-	20.8%
Single-Unit Trucks	0	0	0	0	0	-	0	1	0	0	1	-	0	0	2	0	2	-	0	0	0	0	0	-	3
% Single-Unit Trucks	0%	0%	0%	0%	0%	-	0%	2.3%	0%	0%	1.0%	-	0%	0%	11.1%	0%	1.7%	-	0%	0%	0%	0%	0%	-	0.5%
Articulated Trucks	0	0	0	0	0	-	0	0	0	0	0	-	1	0	0	0	1	-	0	0	0	0	0	-	1
% Articulated Trucks	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	2.1%	0%	0%	0%	0.8%	-	0%	0%	0%	0%	0%	-	0.2%
Buses	4	2	8	0	14	-	3	0	0	0	3	-	0	1	1	0	2	-	0	5	1	0	6	-	25
% Buses	22.2%	10.5%	10.0%	0%	12.0%	-	6.4%	0%	0%	0%	2.9%	-	0%	1.8%	5.6%	0%	1.7%	-	0%	2.6%	2.9%	0%	2.5%	-	4.3%
Bicycles on Road	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0
% Bicycles on Road	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

SR-160 and SR-554 - TMC
Thu May 16, 2019
AM Peak (7 AM - 8 AM)
All Classes (Motorcycles, Cars, Light Goods Vehicles, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 656315, Location: 38.926252, -82.282593

Provided by: Carpenter Marty (CM) Transportation Inc.
6612 Singletree Drive,
Columbus, OH, 43229, US

SR-160 and SR-554 - TMC
Thu May 16, 2019
Midday Peak (12 PM - 1 PM)
All Classes (Motorcycles, Cars, Light Goods Vehicles, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 656315, Location: 38.926252, -82.282593

Provided by: Carpenter Marty (CM)
Transportation Inc.
6612 Singletree Drive,
Columbus, OH, 43229, US

Leg	SR-554						SR-554						SR-160						SR-160						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	Int
2019-05-16 12:00PM	4	4	14	0	22	0	4	6	1	0	11	0	9	23	3	0	35	0	4	14	7	0	25	0	93
12:15PM	4	7	10	0	21	0	2	5	2	0	9	0	11	18	8	0	37	0	4	18	9	0	31	0	98
12:30PM	6	7	14	0	27	0	3	5	2	0	10	0	9	19	7	0	35	0	2	26	3	0	31	0	103
12:45PM	7	7	6	0	20	0	7	3	1	0	11	0	12	22	11	0	45	0	1	21	4	0	26	0	102
Total	21	25	44	0	90	0	16	19	6	0	41	0	41	82	29	0	152	0	11	79	23	0	113	0	396
% Approach	23.3%	27.8%	48.9%	0%	-	-	39.0%	46.3%	14.6%	0%	-	-	27.0%	53.9%	19.1%	0%	-	-	9.7%	69.9%	20.4%	0%	-	-	-
% Total	5.3%	6.3%	11.1%	0%	22.7%	-	4.0%	4.8%	1.5%	0%	10.4%	-	10.4%	20.7%	7.3%	0%	38.4%	-	2.8%	19.9%	5.8%	0%	28.5%	-	-
PHF	0.750	0.893	0.786	-	0.833	-	0.571	0.792	0.750	-	0.932	-	0.854	0.891	0.659	-	0.844	-	0.688	0.760	0.639	-	0.911	-	0.961
Motorcycles	0	0	0	0	0	-	0	0	0	0	0	-	0	3	0	0	3	-	0	0	2	0	2	-	5
% Motorcycles	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	3.7%	0%	0%	2.0%	-	0%	0%	8.7%	0%	1.8%	-	1.3%
Cars	14	12	28	0	54	-	13	8	2	0	23	-	22	45	17	0	84	-	5	56	15	0	76	-	237
% Cars	66.7%	48.0%	63.6%	0%	60.0%	-	81.3%	42.1%	33.3%	0%	56.1%	-	53.7%	54.9%	58.6%	0%	55.3%	-	45.5%	70.9%	65.2%	0%	67.3%	-	59.8%
Light Goods Vehicles	7	11	15	0	33	-	3	10	3	0	16	-	18	30	12	0	60	-	4	21	6	0	31	-	140
% Light Goods Vehicles	33.3%	44.0%	34.1%	0%	36.7%	-	18.8%	52.6%	50.0%	0%	39.0%	-	43.9%	36.6%	41.4%	0%	39.5%	-	36.4%	26.6%	26.1%	0%	27.4%	-	35.4%
Single-Unit Trucks	0	2	0	0	2	-	0	1	1	0	2	-	0	2	0	0	2	-	2	2	0	0	4	-	10
% Single-Unit Trucks	0%	8.0%	0%	0%	2.2%	-	0%	5.3%	16.7%	0%	4.9%	-	0%	2.4%	0%	0%	1.3%	-	18.2%	2.5%	0%	0%	3.5%	-	2.5%
Articulated Trucks	0	0	0	0	0	-	0	0	0	0	0	-	0	2	0	0	2	-	0	0	0	0	0	-	2
% Articulated Trucks	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	2.4%	0%	0%	1.3%	-	0%	0%	0%	0%	0%	-	0.5%
Buses	0	0	1	0	1	-	0	0	0	0	0	-	1	0	0	0	1	-	0	0	0	0	0	-	2
% Buses	0%	0%	2.3%	0%	1.1%	-	0%	0%	0%	0%	0%	-	2.4%	0%	0%	0%	0.7%	-	0%	0%	0%	0%	0%	-	0.5%
Bicycles on Road	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0
% Bicycles on Road	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	-	0%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

SR-160 and SR-554 - TMC
Thu May 16, 2019
Midday Peak (12 PM - 1 PM)
All Classes (Motorcycles, Cars, Light Goods Vehicles, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 656315, Location: 38.926252, -82.282593

Provided by: Carpenter Marty (CM) Transportation Inc.
6612 Singletree Drive,
Columbus, OH, 43229, US

SR-160 and SR-554 - TMC

Thu May 16, 2019

PM Peak (4 PM - 5 PM) - Overall Peak Hour

All Classes (Motorcycles, Cars, Light Goods Vehicles, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

All Movements

ID: 656315, Location: 38.926252, -82.282593

Provided by: Carpenter Marty (CM)
Transportation Inc.
6612 Singletree Drive,
Columbus, OH, 43229, US

Leg	SR-554						SR-554						SR-160						SR-160						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	Int
2019-05-16 4:00PM	12	15	14	0	**41**	0	5	6	3	0	**14**	0	13	45	17	0	**75**	0	4	16	1	0	**21**	0	**151**
4:15PM	7	8	16	0	**31**	0	9	9	6	0	**24**	0	16	43	7	0	**66**	0	7	30	5	0	**42**	0	**163**
4:30PM	5	10	12	0	**27**	0	6	10	1	0	**17**	0	15	47	22	0	**84**	0	3	25	6	0	**34**	0	**162**
4:45PM	5	10	14	0	**29**	0	7	10	0	0	**17**	0	14	49	14	0	**77**	0	7	25	11	0	**43**	0	**166**
Total	29	43	56	0	**128**	0	27	35	10	0	**72**	0	58	184	60	0	**302**	0	21	96	23	0	**140**	0	**642**
% Approach	22.7%	33.6%	43.8%	0%	**-**	-	37.5%	48.6%	13.9%	0%	**-**	-	19.2%	60.9%	19.9%	0%	**-**	-	15.0%	68.6%	16.4%	0%	**-**	-	**-**
% Total	4.5%	6.7%	8.7%	0%	**19.9%**	-	4.2%	5.5%	1.6%	0%	**11.2%**	-	9.0%	28.7%	9.3%	0%	**47.0%**	-	3.3%	15.0%	3.6%	0%	**21.8%**	-	**-**
PHF	0.604	0.717	0.875	-	**0.780**	-	0.750	0.875	0.417	-	**0.750**	-	0.906	0.939	0.682	-	**0.899**	-	0.750	0.800	0.523	-	**0.814**	-	0.967
Motorcycles	0	0	1	0	**1**	-	0	0	0	0	**0**	-	0	5	0	0	**5**	-	0	0	1	0	**1**	-	7
% Motorcycles	0%	0%	1.8%	0%	**0.8%**	-	0%	0%	0%	0%	**0%**	-	0%	2.7%	0%	0%	**1.7%**	-	0%	0%	4.3%	0%	**0.7%**	-	1.1%
Cars	24	24	40	0	**88**	-	15	25	8	0	**48**	-	43	133	50	0	**226**	-	14	69	14	0	**97**	-	459
% Cars	82.8%	55.8%	71.4%	0%	**68.8%**	-	55.6%	71.4%	80.0%	0%	**66.7%**	-	74.1%	72.3%	83.3%	0%	**74.8%**	-	66.7%	71.9%	60.9%	0%	**69.3%**	-	71.5%
Light Goods Vehicles	5	14	14	0	**33**	-	12	9	2	0	**23**	-	13	45	10	0	**68**	-	7	24	5	0	**36**	-	160
% Light Goods Vehicles	17.2%	32.6%	25.0%	0%	**25.8%**	-	44.4%	25.7%	20.0%	0%	**31.9%**	-	22.4%	24.5%	16.7%	0%	**22.5%**	-	33.3%	25.0%	21.7%	0%	**25.7%**	-	24.9%
Single-Unit Trucks	0	3	0	0	**3**	-	0	1	0	0	**1**	-	1	0	0	0	**1**	-	0	2	0	0	**2**	-	7
% Single-Unit Trucks	0%	7.0%	0%	0%	**2.3%**	-	0%	2.9%	0%	0%	**1.4%**	-	1.7%	0%	0%	0%	**0.3%**	-	0%	2.1%	0%	0%	**1.4%**	-	1.1%
Articulated Trucks	0	1	1	0	**2**	-	0	0	0	0	**0**	-	0	1	0	0	**1**	-	0	0	0	0	**0**	-	3
% Articulated Trucks	0%	2.3%	1.8%	0%	**1.6%**	-	0%	0%	0%	0%	**0%**	-	0%	0.5%	0%	0%	**0.3%**	-	0%	0%	0%	0%	**0%**	-	0.5%
Buses	0	1	0	0	**1**	-	0	0	0	0	**0**	-	1	0	0	0	**1**	-	0	1	3	0	**4**	-	6
% Buses	0%	2.3%	0%	0%	**0.8%**	-	0%	0%	0%	0%	**0%**	-	1.7%	0%	0%	0%	**0.3%**	-	0%	1.0%	13.0%	0%	**2.9%**	-	0.9%
Bicycles on Road	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0
% Bicycles on Road	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

SR-160 and SR-554 - TMC
Thu May 16, 2019
PM Peak (4 PM - 5 PM) - Overall Peak Hour
All Classes (Motorcycles, Cars, Light Goods Vehicles, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 656315, Location: 38.926252, -82.282593

Provided by: Carpenter Marty (CM) Transportation Inc.
6612 Singletree Drive,
Columbus, OH, 43229, US

CARPENTER MARTY transportation	Year	Period	Scenario	Plate
			Growth Rate Calculations	

^
N

2009 Count Data

2016 Count Data

2019 Count Data

Approach	Year	Count	Growth Rate
	2009	1129	
Eastbound	2016	1149	0.00%
	2019	1114	
	2009	1635	
Southbound	2016	1667	0.18%
	2019	1656	
	2009	877	
Westbound	2016	813	0.00%
	2019	805	
	2009	2068	
Northbound	2016	1878	0.00%
	2019	1970	

0% growth assumed when calculated growth was negative

GAL - SR 160 - 9.68 (SR-160 at SR-554)
Traffic Volume Calculations

	Year	Period	Scenario	Plate
CARPENTER MARTY transportation	2019	AM	Count Data	

^
N

	Year	Period	Scenario	Plate
CARPENTER MARTY transportation	2040	AM	Grown Data	

^
N

Growth Rate	
SR-160 n/o SR-554	0.18%
SR-554 e/o SR-160	0.00%
SR-160 s/o SR-554	0.00%
SR-554 w/o SR-160	0.00%

CARPENTER MARTY transportation	Year	Period	Scenario	Plate
	2019	PM	Count Data	

^
N

CARPENTER MARTY transportation	Year	Period	Scenario	Plate
	2040	PM	Grown Data	

^
N

Growth Rate	
SR-160 n/o SR-554	0.18%
SR-554 e/o SR-160	0.00%
SR-160 s/o SR-554	0.00%
SR-554 w/o SR-160	0.00%

Appendix B

Previous Safety Study

Appendix B

Purpose

ODOT District 10 has received a number of public concerns regarding the intersection of SR 160 and SR 554 near the communities of Porter and Bidwell in Gallia County. The intersection of SR 160 and SR 554 was ranked as #68 on the 2015 Safety Analyst Rural Intersection List as a location for potential improvement. The intersection is also listed in the District 10 potential projects list as a priority location. The purpose of this study is to determine crash trends and identify countermeasures to address the crashes.

Background

The SR 160 / SR 554 intersection is a two way stop controlled intersection with single lane approaches. SR 160 is a north south route that connects Gallipolis to the south and the Village of Hamden in Vinton County to the north. SR 554 extends from the Village of Rio Grande to the west to the Village of Cheshire at SR 7 near the Ohio River. Both SR 160 and SR 554 are classified as Major Collectors.

The general area around the intersection would be considered rural in nature. There is a restaurant/convenient store/gas station in the northwest quadrant of the intersection. The other

quadrants are vacant with residences nearby. The southern leg of SR 160 has some sparse commercial development within a mile of the intersection. There is a high school located approximately 0.75 mi south of the intersection.

SR 160 was realigned in the early 1970s. The alignment was shifted to the west to allow the route to be straightened and widened. The alignment prior to the project was narrow and lined with residential housing. There is a -4% grade when approaching the SR 554 intersection from the south. North of the intersection the grade flattens to less than 1%.

Crash History

Since this location has been an ongoing concern, a 5 year crash analysis was performed (2011-2015). During the 5 year period there was a total of 19 crashes at the intersection. This includes two crashes that occurred at the gas station access along SR 160 that is in the intersection influence area.

About half (47%) of the crashes were injury crashes. There were only three crash types: Angle (68%), Left Turn (16%), and Rear End (16%). Almost all of the crashes happened under favorable weather conditions with dry pavement. Most (68%) of the crashes happened during daylight hours.

Traffic Control

The intersection is a four leg unsignalized intersection with single lane approaches. SR 554 is stop controlled. There are dualled stop ahead warning signs on both SR 554 approaches. Dualled 48 inch stop signs are used on SR 554. The stop signs on the right were supplemented with flashing beacons until March 31, 2016 when all four signs were upgraded to 48 inch LED enhanced signs. There are dualled intersection warning signs with 1000 FEET plaques on both SR 160 approaches. The long line markings through the intersection are in good condition and the centerline is refreshed annually through a district wide pavement marking plan. The stop bar on the eastbound approach showed signs of wear and is included in the auxiliary portion of FY 2017 Pavement Marking Plan.

Sight Distance

Intersection sight distance from the SR 554 stop approaches are well over 1000 FT in both directions. Stopping sight distance on the SR 160 approaches also exceeds 1000 FT.

Traffic Counts

Section traffic counts were last taken in Gallia County in 2016. SR 160 has and AADT of 4924 vehicles per day (vpd) south of the intersection and 3064 vpd north of the intersection. SR 554 has an AADT of 2877 vpd west of the intersection and 1397 east of the intersection. The truck percentage on SR 160 and SR 554 was about 6%.

An intersection turning movement count was taken in February of 2016. The counts were used to perform and signal warrant analysis. The intersection did not meet volume warrants for a traffic signal. The turning movement counts were also used to check left turn lane warrants on SR 160. The warrant was met for a northbound left turn lane during the PM peak hour.

This intersection was identified on the 2012 FHWA systematic intersection upgrade list. The intersection already met the FHWA guide. The advance intersection warning sign were replaced to refresh the sign sheeting.

Comments and Recommendations

Although a northbound left turn lane is warranted, the added intersection width may compound the angle crash problem. The current crash problem is angle crashes involving traffic trying to cross SR 160. The added width of a turn lane will increase the crossing time and may increase angle crashes.

The gas station has four access points to state routes – 2 on SR 160 and 2 on SR 554. One of the SR 554 access points is well within the intersection influence area. During the 5 year crash analysis there were no crashes associated with that drive. During observations, the drive seems to be a westbound entrance only, but nothing prohibits other movements.

The intersection has evolved to help warn motorist of the intersection. The latest evolution was to provide LED enhanced signs. If angle crashes continue, the next step may be an intersection conflict warning system or a countermeasure that limits movements at the intersection.

It is recommended at this time to monitor the effectiveness of the LED enhanced signs and revisit the location if there is not a reduction in crashes.

Appendix C

Capacity Analysis Results

Appendix C

Intersection	
Int Delay, s/veh	6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	18	19	80	47	44	13	48	55	18	18	189	34
Future Vol, veh/h	18	19	80	47	44	13	48	55	18	18	189	34
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	20	21	87	51	48	14	52	60	20	20	205	37

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	469	448	224	492	456	70	242	0	0	80	0	0
Stage 1	264	264	-	174	174	-	-	-	-	-	-	-
Stage 2	205	184	-	318	282	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	505	506	815	487	501	993	1324	-	-	1518	-	-
Stage 1	741	690	-	828	755	-	-	-	-	-	-	-
Stage 2	797	747	-	693	678	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	440	478	815	403	473	993	1324	-	-	1518	-	-
Mov Cap-2 Maneuver	440	478	-	403	473	-	-	-	-	-	-	-
Stage 1	711	680	-	794	724	-	-	-	-	-	-	-
Stage 2	704	716	-	591	668	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	11.8	15.2	3.1	0.6
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1324	-	-	654	467	1518	-	-
HCM Lane V/C Ratio	0.039	-	-	0.194	0.242	0.013	-	-
HCM Control Delay (s)	7.8	0	-	11.8	15.2	7.4	0	-
HCM Lane LOS	A	A	-	B	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.7	0.9	0	-	-

Intersection	
Int Delay, s/veh	5.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	29	43	56	27	35	10	58	184	60	21	96	23
Future Vol, veh/h	29	43	56	27	35	10	58	184	60	21	96	23
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	32	47	61	29	38	11	63	200	65	23	104	25

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	546	554	117	576	534	233	129	0	0	265	0	0
Stage 1	163	163	-	359	359	-	-	-	-	-	-	-
Stage 2	383	391	-	217	175	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	448	440	935	428	452	806	1457	-	-	1299	-	-
Stage 1	839	763	-	659	627	-	-	-	-	-	-	-
Stage 2	640	607	-	785	754	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	390	410	935	346	421	806	1457	-	-	1299	-	-
Mov Cap-2 Maneuver	390	410	-	346	421	-	-	-	-	-	-	-
Stage 1	796	749	-	625	595	-	-	-	-	-	-	-
Stage 2	561	576	-	675	740	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	14.1	15.7	1.5	1.2
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1457	-	-	535	415	1299	-	-
HCM Lane V/C Ratio	0.043	-	-	0.26	0.189	0.018	-	-
HCM Control Delay (s)	7.6	0	-	14.1	15.7	7.8	0	-
HCM Lane LOS	A	A	-	B	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	1	0.7	0.1	-	-

Intersection	
Int Delay, s/veh	5.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	18	19	80	47	44	13	48	55	18	19	196	35
Future Vol, veh/h	18	19	80	47	44	13	48	55	18	19	196	35
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	20	21	87	51	48	14	52	60	20	21	213	38

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	479	458	232	502	467	70	251	0	0	80	0	0
Stage 1	274	274	-	174	174	-	-	-	-	-	-	-
Stage 2	205	184	-	328	293	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	497	499	807	480	493	993	1314	-	-	1518	-	-
Stage 1	732	683	-	828	755	-	-	-	-	-	-	-
Stage 2	797	747	-	685	670	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	432	471	807	396	465	993	1314	-	-	1518	-	-
Mov Cap-2 Maneuver	432	471	-	396	465	-	-	-	-	-	-	-
Stage 1	702	672	-	794	724	-	-	-	-	-	-	-
Stage 2	704	716	-	583	659	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	11.9	15.4	3.1	0.6
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1314	-	-	646	459	1518	-	-
HCM Lane V/C Ratio	0.04	-	-	0.197	0.246	0.014	-	-
HCM Control Delay (s)	7.9	0	-	11.9	15.4	7.4	0	-
HCM Lane LOS	A	A	-	B	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.7	1	0	-	-

Intersection	
Int Delay, s/veh	5.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	29	43	56	27	35	10	58	184	60	22	100	24
Future Vol, veh/h	29	43	56	27	35	10	58	184	60	22	100	24
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	32	47	61	29	38	11	63	200	65	24	109	26

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	553	561	122	583	542	233	135	0	0	265	0	0
Stage 1	170	170	-	359	359	-	-	-	-	-	-	-
Stage 2	383	391	-	224	183	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	444	436	929	424	447	806	1449	-	-	1299	-	-
Stage 1	832	758	-	659	627	-	-	-	-	-	-	-
Stage 2	640	607	-	779	748	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	386	405	929	342	416	806	1449	-	-	1299	-	-
Mov Cap-2 Maneuver	386	405	-	342	416	-	-	-	-	-	-	-
Stage 1	790	743	-	625	595	-	-	-	-	-	-	-
Stage 2	561	576	-	669	733	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	14.2	15.8	1.5	1.2
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1449	-	-	530	410	1299	-	-
HCM Lane V/C Ratio	0.044	-	-	0.263	0.191	0.018	-	-
HCM Control Delay (s)	7.6	0	-	14.2	15.8	7.8	0	-
HCM Lane LOS	A	A	-	B	C	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	1	0.7	0.1	-	-

Appendix D

Signal Warrant Analysis

Appendix D

CARPENTER MARTY transportation

Traffic Signal Warrant Analysis

GAL - SR 160 - 9.68 (SR-160 at SR-554)

Gallia County, OH

Location: **SR 160 & SR 554**

2019 Traffic Volumes

Period From	Period To	Approach to Intersection: SR 160 NB	SR 160 SB	SR 554 EB	SR 554 WB	NB +SB	EB +WB	TOTAL	"Warrant A" NB+ SB> 350	EB or WB> 105	Both	"Warrant B" NB+ SB> 525	EB or WB> 53	Both	"Combination of A & B" 80% Warrant A NB+ SB> 280	EB or WB> 84	80% Warrant B NB+ SB> 420	EB or WB> 42	Both
0:00	1:00	0	0	0	0	0	0	0											
1:00	2:00	0	0	0	0	0	0	0											
2:00	3:00	0	0	0	0	0	0	0											
3:00	4:00	0	0	0	0	0	0	0											
4:00	5:00	0	0	0	0	0	0	0											
5:00	6:00	0	0	0	0	0	0	0											
6:00	7:00	8	68	31	37	76	68	144											
7:00	8:00	121	241	117	104	362	221	583	X	X	X		X		X	X		X	
8:00	9:00	94	132	62	65	226	127	353					X					X	
9:00	10:00	88	126	67	70	214	137	351					X					X	
10:00	11:00	107	119	73	54	226	127	353					X					X	
11:00	12:00	140	123	78	54	263	132	395					X					X	
12:00	13:00	152	113	90	41	265	131	396					X			X		X	
13:00	14:00	144	112	86	70	256	156	412					X			X		X	
14:00	15:00	218	135	98	75	353	173	526	X				X		X	X		X	
15:00	16:00	224	130	111	62	354	173	527	X	X	X		X		X	X		X	
16:00	17:00	302	140	128	72	442	200	642	X	X	X		X		X	X	X	X	X
17:00	18:00	256	142	115	67	398	182	580	X	X	X		X		X	X		X	
18:00	19:00	116	75	58	34	191	92	283					X					X	
19:00	20:00	0	0	0	0	0	0	0											
20:00	21:00	0	0	0	0	0	0	0											
21:00	22:00	0	0	0	0	0	0	0											
22:00	23:00	0	0	0	0	0	0	0											
23:00	0:00	0	0	0	0	0	0	0											
									5	4	4	0	12	0	5	7	1	12	1
									Warrant NOT Met			Warrant NOT Met			Warrant NOT Met				

Combination (80%) Warrant NOT Met

Peak Hour Totals:

A.M.							
Period Start	10:45	7:00	7:00	6:45	7:00	7:00	7:00
Hour Volume	135	241	117	104	362	221	583
Noon							
Period Start	13:45	13:45	13:15	13:00	13:45	13:15	13:45
Hour Volume	182	136	96	70	318	165	481
P.M.							
Period Start	16:00	17:30	15:30	14:00	16:00	15:30	16:00
Hour Volume	302	153	133	75	442	204	642
Evening							
Period Start	20:00	20:00	20:00	20:00	20:00	20:00	20:00
Hour Volume	0	0	0	0	0	0	0
Daily							
Period Start	16:00	7:00	15:30	6:45	16:00	7:00	16:00
Hour Volume	302	241	133	104	442	221	642

Values use to set warrant thresholds:

Lanes on major st.	**1**
Lanes on minor st.	**1**
Population<10,000 or Speed>40 mph?	**TRUE**

(if TRUE reduce thresholds to 70%)

Warrant 1 - Minimum Vehicular Volume

Lanes Major	Lanes Minor	Tot. Vol. Major	Tot. Vol. Minor	High Vol. Major	High Vol. Minor	80%Vol. Major	80%Vol. Minor
1	1	500	150	400	120		
2+	1	600	150	480	120		
2+	2+	600	200	480	160		
1	2+	500	200	400	160		

Warrant 2 - Interruption of Continuous Traffic

Lanes Major	Lanes Minor	Tot. Vol. Major	Tot. Vol. Minor	High Vol. Major	High Vol. Minor	80%Vol. Major	80%Vol. Minor
1	1	750	75	600	60		
2+	1	900	75	720	60		
2+	2+	900	100	720	80		
1	2+	750	100	600	80		

Approach	Start:	Day	Date	Time	Totals	Ref. #
Northbound		Thu	5/16/2019	6:30	1,970	1
Southbound		Thu	5/16/2019	6:30	1,656	2
Eastbound		Thu	5/16/2019	6:30	1,114	3
Westbound		Thu	5/16/2019	6:30	805	4

Approaches	Totals
NB+SB	3,626
EB+WB	1,919
Intersection	5,545

Traffic Signal Warrant Analysis

GAL - SR 160 - 9.68 (SR-160 at SR-554)

Gallia County, OH

Location: **SR 160 & SR 554**

2019 Traffic Volumes

Traffic Signal Warrant Analysis

GAL - SR 160 - 9.68 (SR-160 at SR-554)

Gallia County, OH

Location: **SR 160 & SR 554**

2040 Traffic Volumes

Period From	Period To	Approach to Intersection: SR 160 NB	SR 160 SB	SR 554 EB	SR 554 WB	NB +SB	EB +WB	TOTAL	"Warrant A" NB+ SB> 350	EB or WB> 105	Both	"Warrant B" NB+ SB> 525	EB or WB> 53	Both	"Combination of A & B" 80% Warrant A NB+ SB> 280	80% Warrant A EB or WB> 84	80% Warrant B NB+ SB> 420	80% Warrant B EB or WB> 42	Both
0:00	1:00	0	0	0	0	0	0	0											
1:00	2:00	0	0	0	0	0	0	0											
2:00	3:00	0	0	0	0	0	0	0											
3:00	4:00	0	0	0	0	0	0	0											
4:00	5:00	0	0	0	0	0	0	0											
5:00	6:00	0	0	0	0	0	0	0											
6:00	7:00	8	70	31	37	78	68	146											
7:00	8:00	121	251	117	104	372	221	593	X	X	X		X		X	X		X	
8:00	9:00	94	136	62	65	230	127	357					X					X	
9:00	10:00	88	131	67	70	219	137	356					X					X	
10:00	11:00	107	123	73	54	230	127	357					X					X	
11:00	12:00	140	127	78	54	267	132	399					X					X	
12:00	13:00	152	117	90	41	269	131	400					X			X		X	
13:00	14:00	144	116	86	70	260	156	416					X			X		X	
14:00	15:00	218	139	98	75	357	173	530	X				X		X	X		X	
15:00	16:00	224	135	111	62	359	173	532	X	X	X		X		X	X		X	
16:00	17:00	302	146	128	72	448	200	648	X	X	X		X		X	X	X	X	X
17:00	18:00	256	147	115	67	403	182	585	X	X	X		X		X	X		X	
18:00	19:00	116	77	58	34	193	92	285					X					X	
19:00	20:00	0	0	0	0	0	0	0											
20:00	21:00	0	0	0	0	0	0	0											
21:00	22:00	0	0	0	0	0	0	0											
22:00	23:00	0	0	0	0	0	0	0											
23:00	0:00	0	0	0	0	0	0	0											
									5	4	4	0	12	0	5	7	1	12	1
									Warrant NOT Met			Warrant NOT Met			Warrant NOT Met				

Combination (80%) Warrant NOT Met

Peak Hour Totals:

A.M.							
Period Start	10:45	7:00	7:00	6:45	7:00	7:00	7:00
Hour Volume	135	251	117	104	372	221	593
Noon							
Period Start	13:45	13:45	13:15	13:00	13:45	13:15	13:45
Hour Volume	182	140	96	70	322	165	485
P.M.							
Period Start	16:00	16:15	15:30	14:00	16:00	15:30	16:00
Hour Volume	302	158	133	75	448	204	648
Evening							
Period Start	20:00	20:00	20:00	20:00	20:00	20:00	20:00
Hour Volume	0	0	0	0	0	0	0
Daily							
Period Start	16:00	7:00	15:30	6:45	16:00	7:00	16:00
Hour Volume	302	251	133	104	448	221	648

Values use to set warrant thresholds:

Lanes on major st.	**1**
Lanes on minor st.	**1**
Population<10,000 or Speed>40 mph?	**TRUE**

(if TRUE reduce thresholds to 70%)

Warrant 1 - Minimum Vehicular Volume

Lanes Major	Lanes Minor	Tot. Vol. Major	Tot. Vol. Minor	High Vol. Major	High Vol. Minor	80%Vol. Major	80%Vol. Minor
1	1	500	150	400	120		
2+	1	600	150	480	120		
2+	2+	600	200	480	160		
1	2+	500	200	400	160		

Warrant 2 - Interruption of Continuous Traffic

Lanes Major	Lanes Minor	Tot. Vol. Major	Tot. Vol. Minor	High Vol. Major	High Vol. Minor	80%Vol. Major	80%Vol. Minor
1	1	750	75	600	60		
2+	1	900	75	720	60		
2+	2+	900	100	720	80		
1	2+	750	100	600	80		

Approach	Start:	Day	Date	Time	Totals	Ref. #
Northbound		Thu	5/16/2019	6:30	1,970	1
Southbound		Thu	5/16/2019	6:30	1,715	2
Eastbound		Thu	5/16/2019	6:30	1,114	3
Westbound		Thu	5/16/2019	6:30	805	4

Approaches	Totals
NB+SB	3,685
EB+WB	1,919
Intersection	5,604

Traffic Signal Warrant Analysis

GAL - SR 160 - 9.68 (SR-160 at SR-554)

Gallia County, OH

Location: **SR 160 & SR 554**

2040 Traffic Volumes

Appendix E

Turn Lane Warrant and Length Calculations

Appendix E

CARPENTER MARTY transportation

2-Lane Highway Left Turn Lane Warrant
(> 40 mph or 70 kph Posted Speed)

Turn Lane Length Calculations

AM Peak	Design Speed	60	mph	
	Traffic Control	Unsignalized		
	Cycle Length	Unsignalized		
	Cycles Per Hour	60	*Assume 60*	
	Turn Lane Volume	19	VPH	
	Advancing Traffic	250	VPH	
	Opposing Volume	121	VPH	
	Left Turn Percentage	8%		
	Location Type	Through Road		
	Condition	B		
	Vehicles/Cycle	1		
	Turn Lane Length	345		** Turn Lane Length includes 50 ft diverging taper*
	Offset Width	12		
	Approach Taper	720		
PM Peak	Design Speed	60	mph	
	Traffic Control	Unsignalized		
	Cycle Length	Unsignalized		
	Cycles Per Hour	60	*Assume 60*	
	Turn Lane Volume	22	VPH	
	Advancing Traffic	146	VPH	
	Opposing Volume	302	VPH	
	Left Turn Percentage	15%		
	Location Type	Through Road		
	Condition	B or C		
	Vehicles/Cycle	1		
	Turn Lane Length	See Column to Right	345	** Turn Lane Length includes 50 ft diverging taper*
	Offset Width	12		
	Approach Taper	720		
Is Left Turn Warrant Met		No	No Left Turn Lane Required	

2-Lane Highway Right Turn Lane Warrant
(> 40 mph or 70 kph Posted Speed)

Turn Lane Length Calculations

AM Peak	Design Speed	60	mph	
	Traffic Control	Unsignalized		
	Cycle Length	Unsignalized		
	Cycles Per Hour	60	*Assume 60*	
	Turn Lane Volume	35	VPH	
	Advancing Traffic	250	VPH	
	Right Turn Percentage	14%		
	Location Type	Through Road		
	Condition	B or C		
	Vehicles/Cycle	1		
	Turn Lane Length	See Column to Right	345	** Turn Lane Length includes 50 ft diverging taper*
PM Peak	Design Speed	60	mph	
	Traffic Control	Unsignalized		
	Cycle Length	Unsignalized		
	Cycles Per Hour	60	*Assume 60*	
	Turn Lane Volume	24	VPH	
	Advancing Traffic	146	VPH	
	Right Turn Percentage	16%		
	Location Type	Through Road		
	Condition	B or C		
	Vehicles/Cycle	1		
	Turn Lane Length	See Column to Right	345	** Turn Lane Length includes 50 ft diverging taper*
Is Right Turn Warrant Met		No	No Right Turn Lane Required	

2-Lane Highway Left Turn Lane Warrant
(> 40 mph or 70 kph Posted Speed)

Turn Lane Length Calculations

AM Peak	Design Speed	60	mph	
	Traffic Control	Unsignalized		
	Cycle Length	Unsignalized		
	Cycles Per Hour	60	*Assume 60*	
	Turn Lane Volume	48	VPH	
	Advancing Traffic	121	VPH	
	Opposing Volume	250	VPH	
	Left Turn Percentage	40%		
	Location Type	Through Road		
	Condition	B or C		
	Vehicles/Cycle	1		
	Turn Lane Length	See Column to Right	345	** Turn Lane Length includes 50 ft diverging taper*
	Offset Width	12		
	Approach Taper	720		
PM Peak	Design Speed	60	mph	
	Traffic Control	Unsignalized		
	Cycle Length	Unsignalized		
	Cycles Per Hour	60	*Assume 60*	
	Turn Lane Volume	58	VPH	
	Advancing Traffic	302	VPH	
	Opposing Volume	146	VPH	
	Left Turn Percentage	19%		
	Location Type	Through Road		
	Condition	B or C		
	Vehicles/Cycle	1		
	Turn Lane Length	See Column to Right	345	** Turn Lane Length includes 50 ft diverging taper*
	Offset Width	12		
	Approach Taper	720		
Is Left Turn Warrant Met		Yes	**See Above**	

2-Lane Highway Left Turn Lane Warrant
(> 40 mph or 70 kph Posted Speed)

Turn Lane Length Calculations

AM Peak	Design Speed	60	mph	
	Traffic Control	Unsignalized		
	Cycle Length	Unsignalized		
	Cycles Per Hour	60	*Assume 60*	
	Turn Lane Volume	48	VPH	
	Advancing Traffic	121	VPH	
	Opposing Volume	241	VPH	
	Left Turn Percentage	40%		
	Location Type	Through Road		
	Condition	B or C		
	Vehicles/Cycle	1		
	Turn Lane Length	See Column to Right	345	** Turn Lane Length includes 50 ft diverging taper*
	Offset Width	12		
	Approach Taper	720		
PM Peak	Design Speed	60	mph	
	Traffic Control	Unsignalized		
	Cycle Length	Unsignalized		
	Cycles Per Hour	60	*Assume 60*	
	Turn Lane Volume	58	VPH	
	Advancing Traffic	302	VPH	
	Opposing Volume	140	VPH	
	Left Turn Percentage	19%		
	Location Type	Through Road		
	Condition	B or C		
	Vehicles/Cycle	1		
	Turn Lane Length	See Column to Right	345	** Turn Lane Length includes 50 ft diverging taper*
	Offset Width	12		
	Approach Taper	720		
Is Left Turn Warrant Met		Yes	**See Above**	

2-Lane Highway Right Turn Lane Warrant
(> 40 mph or 70 kph Posted Speed)

Turn Lane Length Calculations

AM Peak	Design Speed	60	mph	
	Traffic Control	Unsignalized		
	Cycle Length	Unsignalized		
	Cycles Per Hour	60	*Assume 60*	
	Turn Lane Volume	18	VPH	
	Advancing Traffic	121	VPH	
	Right Turn Percentage	15%		
	Location Type	Through Road		
	Condition	B or C		
	Vehicles/Cycle	1		
	Turn Lane Length	See Column to Right	345	** Turn Lane Length includes 50 ft diverging taper*
PM Peak	Design Speed	60	mph	
	Traffic Control	Unsignalized		
	Cycle Length	Unsignalized		
	Cycles Per Hour	60	*Assume 60*	
	Turn Lane Volume	60	VPH	
	Advancing Traffic	302	VPH	
	Right Turn Percentage	20%		
	Location Type	Through Road		
	Condition	B or C		
	Vehicles/Cycle	1		
	Turn Lane Length	See Column to Right	345	** Turn Lane Length includes 50 ft diverging taper*
Is Right Turn Warrant Met		No	No Right Turn Lane Required	

Appendix F
Crash Diagrams

Appendix F

Crash Totals

6	Property Damage Only
11	Injury or Fatal
17	Total Crashes

Symbols

Angle

Fixed Object

Left Turn

Head On

Rear End

Backing

Injury

Crash Text

1. Time, day, date
2. Road condition
3. NITE - dark outside

Note: Crash text is positioned with the at fault vehicle

HORIZONTAL SCALE IN FEET 0 10 20 40

CALCULATED ZTM
CHECKED GRS

Crash Diagram
2014 to 2018 Crash Data

GAL-SR. 160-9.68
Safety Study

1/1

P:\ODT\ST\VAR-STW Safety Studies No. 2019-4\109397\District 10\GAL 13/32 SR 160 13/32 9.68 (SR-160 at SR-554)\Analysis\Crash\160_554_Crash_Sheet001.dgn Sheet 6/3/2019 7:34:39 AM ccousins

Appendix G

HSM Overview and Report Outputs

Appendix G

CARPENTER MARTY transportation

Highway Safety Manual

The predictive method described in Part C of the Highway Safety Manual provides steps to estimate the expected average crash frequency of a site for a given time period, geometric design, traffic control features, and traffic volumes. The expected average crash frequency (Nexpected) is estimated using a predictive model estimate of crash frequency for a specific site type (Npredicted) together with observed crash frequency (where available).

Predicted average crash frequency: This step involves determination of the predicted crash frequency, which reflects how a site would be expected to perform relative to 1,000 similar sites. Calculation of predicted crash frequency utilizes Safety Performance Functions (SPF) for a base condition. Crash Modification Factors (CMF) are applied to account for specific site characteristics that differ from the base condition. A state-level calibration factor is then applied to normalize the base condition to localized conditions. The resulting value is the Predicted Crash Frequency (Npredicted).

Expected average crash frequency: The next step involves calculation of the expected average crash frequency, which reflects average performance of the site over an extended period of time based on actual crash history. This step incorporates the Empirical Bayes (EB) method, which combines actual (observed) crash history of the study site with predicted average crash frequency. These values are weighted based on an over-dispersion parameter (k) that is the measure of the strength of the model (safety performance factors). The resulting value is the expected average crash frequency (Nexpected).

The difference between the predicted and expected average crash frequencies is termed the "Expected Excess Crashes" for the site, as shown in the figure below. If the expected average crash frequency is greater than the predicted average crash frequency, then the site has potential for safety improvement. If expected frequency is less than predicted frequency, then the site is expected to experience fewer crashes per year on average than its peers.

Project Information

General Information

Project Name	GAL - SR 160 - 9.68	Contact Email	Gsprungle@cmtran.com
Project Description	SR-160 & SR-554	Contact Phone	614-656-2419
Reference Number	109397	Date Performed	5/30/2019
Analyst	GRS	Analysis Year	2018
Agency/Company	Carpenter Marty Transportation		
Perform Benefit Cost Analysis?	Yes		

Do the proposed improvements fundamentally change the conditions of the base safety performance function (SPF), Or is crash data unavailable for the analysis condition, Or is only predicted (and not expected) analysis needed for the existing or proposed condition?	**No**

(Examples: unsignalized to signalized, undivided to divided, increase or decrease in the number of lanes, change the number of approaches to an intersection, significant realignment of the roadway)

Project Elements Description Table

Project Element ID (Must be Unique)	Site Type	Intersection Control Type	Location Information					
			NLFID	Begin Logpoint/ Intersection Midpoint	End Logpoint *(Leave blank for Intersection)*	Length (mi) OR Intersection Radius Buffer (mi)	Cross Route NLFID(s)	Common Name
SR160; 9.68	Rural Two-Lane Two Way Intersection	Unsignalized	SGALSR00160**C	9.68		0.1	SGALSR0055	SR-160 & SR-554

Traffic Volume Growth Rate Calculation For Benefit Cost Analysis

	Year	AADT	
Present ADT (PADT)			veh / day
Future ADT (FADT)			veh / day
Annual Linear Growth Rate		0.0018	

Long Term Countermeasures

Select Other Non-Site Characteristic Based Countermeasures For Entire Project

CMF Nbr	Countermeasure	CMF KA Value	CMF B Value	CMF C Value	CMF O Value	CMF Valid for the Following Site Types
CMF 1	Convert intersection with minor-road stop control to modern roundabout (Rural)	0.13	0.13	0.13	0.29	2 / 10

Existing Conditions: General Information and Data for Rural Two-Lane Two-Way Intersection

General Information		Location Information	
Analyst	GRS	Route	SR160
Agency or Company	Carpenter Marty Transportation	Logpoint	9.68
Date Performed	05/30/19	Common Name	SR-160 & SR-554
Intersection	SR160; 9.68	Analysis Year	2018
Signalized/Unsignalized	Unsignalized		

Input Data					Existing Conditions				HSM Base Conditions
Intersection type (3ST, 4ST, 4SG)					4ST				--
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	14,700	(veh/day)		4,998				--
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	3,500	(veh/day)		2,921				--
Intersection skew angle (degrees) Skew Angle Help	Does skew differ for minor legs? Else, No.			No	Skew for Leg 1 (All):		Skew for Leg 2 (4ST only):		0
Number of uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)					0				0
Number of uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)					0				0
Intersection lighting (present/not present)					Not Present				Not Present
Calibration Factor, C_i					1.01				1.00
Locality:					State System				

Short Term Countermeasures

Proposed Conditions: Data for Rural Two-Lane Two-Way Intersection									
Input Data					**Proposed Conditions**				**Existing Conditions**
Intersection type (3ST, 4ST, 4SG)					4ST				4ST
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	14,700	(veh/day)		4,998				4,998
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	3,500	(veh/day)		2,921				2,921
Intersection skew angle (degrees)	Does skew differ for minor legs? Else, No.			No	Skew for Leg 1 (All):	0	Skew for Leg 2 (4ST only):	0	0
Number of uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)					0				0
Number of uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)					0				0
Intersection lighting (present/not present)					Present				Not Present
Calibration Factor, C_i					1.01				1.01
Locality:					State System				State System

Short Term Countermeasures

Proposed Intersection: Summary Results (Without Animal Crashes) (Crashes/Year)					
	KA	B	C	O	Total
$N_{predicted}$	0.3040	0.3040	0.9236	2.6372	**4.1688**
$N_{expected}$ - Existing Condtions	0.3290	0.7974	0.5311	2.1576	**3.8151**
$N_{potential\ for\ improvement}$ - Existing Conditions	**0.0250**	**0.4934**	-0.3925	-0.4796	**-0.3537**
$N_{expected}$ - Proposed Conditions Site CMFs	0.3289	0.7971	0.5309	2.1567	**3.8136**
$N_{expected}$ - Proposed Conditions All CMFs	0.3289	0.7971	0.5309	2.1567	**3.8136**

Short Term Countermeasures

Project Safety Performance Report

General Information

Project Name	GAL - SR 160 - 9.68	Contact Email	Gsprungle@cmtran.com
Project Description	SR-160 & SR-554	Contact Phone	614-656-2419
Reference Number	109397	Date Performed	5/30/2019
Analyst	GRS	Analysis Year	2018
Agency/Company	Carpenter Marty Transportation		

Summary of Anticipated Safety Performance of the Project (average crashes/year)

Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.3040	0.3040	0.9236	2.6372	4.1688
$N_{expected}$ - Existing Conditions	0.3290	0.7974	0.5311	2.1576	3.8151
$N_{potential\ for\ improvement}$ - Existing Conditions	0.0250	0.4934	-0.3925	-0.4796	-0.3537
$N_{expected}$ - Proposed Conditions	0.3289	0.7971	0.5309	2.1567	3.8136

Short Term Countermeasures

Project Safety Performance Report

General Information

Project Name	GAL - SR 160 - 9.68	Contact Email	Gsprungle@cmtran.com
Project Description	SR-160 & SR-554	Contact Phone	614-656-2419
Reference Number	109397	Date Performed	5/30/2019
Analyst	GRS	Analysis Year	2018
Agency/Company	Carpenter Marty Transportation		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR160; 9.68	SR-160 & SR-554	0.304	0.304	0.9236	2.6372	4.1688

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR160; 9.68	SR-160 & SR-554	0.329	0.7974	0.5311	2.1576	3.8151

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR160; 9.68	SR-160 & SR-554	0.025	0.4934	-0.3925	-0.4796	-0.3537

Proposed Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR160; 9.68	SR-160 & SR-554	0.3289	0.7971	0.5309	2.1567	3.8136

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Expected Crash Frequency
Unknown	0.6350	0.0147	-0.6203	0.0147
Head On	0.0358	0.0355	-0.0003	0.0355
Rear End	0.6836	0.8021	0.1185	0.8018
Backing	0.1593	0.1394	-0.0199	0.1393
Sideswipe - Meeting	0.1146	0.1120	-0.0026	0.1120
Sideswipe - Passing	0.1669	0.1656	-0.0013	0.1655
Angle	1.3456	1.5052	0.1596	1.5046
Parked Vehicle	0.1366	0.1256	-0.0110	0.1255
Pedestrian	0.0197	0.0212	0.0015	0.0212
Animal	0.0000	0.0000	0.0000	0.0000
Train	0.0003	0.0007	0.0004	0.0007
Pedalcycles	0.0127	0.0154	0.0027	0.0154
Other Non-Vehicle	0.0000	0.0003	0.0003	0.0003
Fixed Object	0.6144	0.6250	0.0106	0.6247
Other Object	0.0231	0.0207	-0.0024	0.0207
Overturning	0.0380	0.0414	0.0034	0.0414
Other Non-Collision	0.0527	0.0475	-0.0052	0.0475
Left Turn	0.1305	0.1428	0.0123	0.1427
Right Turn	0.0000	0.0000	0.0000	0.0000

Proposed Conditions: Data for Rural Two-Lane Two-Way Intersection								
Input Data				**Proposed Conditions**				**Existing Conditions**
Intersection type (3ST, 4ST, 4SG)				4ST				4ST
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	14,700	(veh/day)	4,998				4,998
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	3,500	(veh/day)	2,921				2,921
Intersection skew angle (degrees) Does skew differ for minor legs? Else, No.			No	Skew for Leg 1 (All):	0	Skew for Leg 2 (4ST only):	0	0
Number of uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)				0				0
Number of uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)				0				0
Intersection lighting (present/not present)				Present				Not Present
Calibration Factor, C_i				1.01				1.01
Locality:				State System				State System

Proposed Conditions: CMFs for Rural Two-Lane Two-Way Intersection				
(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)
1.0000	1.0000	1.0000	0.9996	0.9996
Indicate Below the Proposed CMFs to be Included in the Project				
1.0000	1.0000	1.0000	0.9996	0.9996
			X	

Long Term Countermeasures

Proposed Conditions: Summary of Other CMFs (Without Animal Crashes)						
CMF Nbr	Countermeasure	KA Value	B Value	C Value	O Value	Total
CMF 1	Convert intersection with minor-road stop control to modern roundabout (Rural)	-0.2861	-0.6934	-0.4619	-1.5313	-2.9727
		0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000
	Total	*-0.2861*	*-0.6934*	*-0.4619*	*-1.5313*	*-2.9727*

Proposed Intersection: Summary Results (Without Animal Crashes) (Crashes/Year)					
	KA	B	C	O	Total
$N_{predicted}$	0.3040	0.3040	0.9236	2.6372	**4.1688**
$N_{expected}$ - Existing Condtions	0.3290	0.7974	0.5311	2.1576	**3.8151**
$N_{potential\ for\ improvement}$ - Existing Conditions	**0.0250**	**0.4934**	-0.3925	-0.4796	**-0.3537**
$N_{expected}$ - Proposed Conditions Site CMFs	0.3289	0.7971	0.5309	2.1567	**3.8136**
$N_{expected}$ - Proposed Conditions All CMFs	0.0428	0.1037	0.0690	0.6254	**0.8409**

Project Safety Performance Report

General Information

Project Name	GAL - SR 160 - 9.68	Contact Email	Gsprungle@cmtran.com
Project Description	SR-160 & SR-554	Contact Phone	614-656-2419
Reference Number	109397	Date Performed	5/30/2019
Analyst	GRS	Analysis Year	2018
Agency/Company	Carpenter Marty Transportation		

Summary of Anticipated Safety Performance of the Project (average crashes/year)

Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.3040	0.3040	0.9236	2.6372	4.1688
$N_{expected}$ - Existing Conditions	0.3290	0.7974	0.5311	2.1576	3.8151
$N_{potential\ for\ improvement}$ - Existing Conditions	0.0250	0.4934	-0.3925	-0.4796	-0.3537
$N_{expected}$ - Proposed Conditions	0.0428	0.1037	0.0690	0.6254	0.8409

Project Safety Performance Report

General Information

Project Name	GAL - SR 160 - 9.68	Contact Email	Gsprungle@cmtran.com
Project Description	SR-160 & SR-554	Contact Phone	614-656-2419
Reference Number	109397	Date Performed	5/30/2019
Analyst	GRS	Analysis Year	2018
Agency/Company	Carpenter Marty Transportation		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR160; 9.68	SR-160 & SR-554	0.304	0.304	0.9236	2.6372	4.1688

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR160; 9.68	SR-160 & SR-554	0.329	0.7974	0.5311	2.1576	3.8151

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR160; 9.68	SR-160 & SR-554	0.025	0.4934	-0.3925	-0.4796	-0.3537

Proposed Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR160; 9.68	SR-160 & SR-554	0.0428	0.1037	0.069	0.6254	0.8409

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Expected Crash Frequency
Unknown	0.6350	0.0147	-0.6203	0.0035
Head On	0.0358	0.0355	-0.0003	0.0062
Rear End	0.6836	0.8021	0.1185	0.1845
Backing	0.1593	0.1394	-0.0199	0.0390
Sideswipe - Meeting	0.1146	0.1120	-0.0026	0.0240
Sideswipe - Passing	0.1669	0.1656	-0.0013	0.0405
Angle	1.3456	1.5052	0.1596	0.3028
Parked Vehicle	0.1366	0.1256	-0.0110	0.0336
Pedestrian	0.0197	0.0212	0.0015	0.0032
Animal	0.0000	0.0000	0.0000	0.0000
Train	0.0003	0.0007	0.0004	0.0001
Pedalcycles	0.0127	0.0154	0.0027	0.0025
Other Non-Vehicle	0.0000	0.0003	0.0003	0.0000
Fixed Object	0.6144	0.6250	0.0106	0.1465
Other Object	0.0231	0.0207	-0.0024	0.0055
Overturning	0.0380	0.0414	0.0034	0.0074
Other Non-Collision	0.0527	0.0475	-0.0052	0.0122
Left Turn	0.1305	0.1428	0.0123	0.0291
Right Turn	0.0000	0.0000	0.0000	0.0000

Appendix H
Cost Estimates

Appendix H

CARPENTER MARTY transportation

Short Term Roadway Countermeasures

Item	Description	Quantity	Units	Unit Cost	Total Cost
625	Intersection Lighting	1	LUMP	$ 8,000.00	$ 8,000.00
630	Signage	1	LUMP	$ 5,000.00	$ 5,000.00
				Itemized Subtotal	**$ 13,000.00**
	Incidentals				
614	Maintenance of Traffic	1	LUMP	$ 10,000.00	$ 10,000.00
				Incidentals Subtotal	**$ 10,000.00**
				Engineering Design (15%)	**$ 3,500.00**
				Contingency (30%)	**$ 6,900.00**
				Subtotal	**$ 33,400.00**
				Inflation* (2.5%)	**$ 900.00**
				Total	**$ 34,300.00**

Note: Costs for utility relocation are not included
*Inflation based on 2020 Construction

Long Term Roadway Countermeasures

Item	Description	Quantity	Units	Unit Cost	Total Cost
202	Pavement Removed	4400	SY	$ 5.00	$ 22,000.00
203	Excavation	2000	CY	$ 15.00	$ 30,000.00
203	Embankment	2000	CY	$ 12.00	$ 24,000.00
448	Full Depth Asphalt Pavement	4922	SY	$ 50.00	$ 246,100.00
452	Full Depth Concrete Pavement	1548	SY	$ 55.00	$ 85,140.00
609	Curb	2917	FT	$ 20.00	$ 58,340.00
609	Concrete Traffic Island	253	SY	$ 75.00	$ 18,975.00
609	Mountable Truck Apron	264	FT	$ 40.00	$ 10,560.00
611	Drainage	1	LUMP	$ 125,000.00	$ 125,000.00
625	Highway Lighting	1	LUMP	$ 120,000.00	$ 120,000.00
630	Signage	1	LUMP	$ 10,000.00	$ 10,000.00
644	Yield Line	70	FT	$ 7.00	$ 490.00
644	Dotted Line	108	FT	$ 2.00	$ 216.00
644	Lane Arrow	8	EACH	$ 90.00	$ 720.00
644	Center Line	0.17	MILE	$ 5,650.00	$ 960.50
644	Edge Line	0.25	MILE	$ 3,500.00	$ 875.00

Subtotal $ 753,380.00

Incidentals					
614	Maintenance of Traffic	1	LUMP	$ 100,000.00	$ 100,000.00
619	Field Office	1	LUMP	$ 15,000.00	$ 15,000.00
623	Construction Layout Stakes	1	LUMP	$ 7,500.00	$ 7,500.00
624	Mobilization	1	LUMP	$ 20,000.00	$ 20,000.00

Subtotal $ 895,880.00

Engineering Design (15%) $ 134,390.00
Contingency (30%) $ 268,770.00
Right-of-way* $ 6,400.00

Subtotal $ 1,305,440.00

Inflation (9.6%) $ 125,400.00**

Total $ 1,430,900.00

Note: Costs for utility relocation are not included
*See Right-of-Way Cost Estimate for details
**Inflation based on 2022 Construction

GAL-SR 160-9.68 Safety Study
Right of Way Cost Estimate
Long Term Countermeasures

	Parcel 02800309000
Total Acreage	0.31
Total Value Today	$ 680.00
Per Acre Cost	$ 2,193.55
Estimated Take (ac)	0.31
Estimate value today	$ 680.00
Relocation Costs	$ -
Consultant Labor Costs	$ 4,000.00
Subtotal	$ 4,680.00
Adj. for Admin Settlement	$ 850.00
Adj. for Appropriations	$ 710.00
Adj. for Incidentals	$ 110.00
Subtotal	$ 6,400.00
Total Right-of-Way Cost	$ 6,400.00

Appendix I

Benefit-Cost Analysis

Appendix I

CARPENTER MARTY transportation

Short Term Countermeasures

Project Cost Estimate			
Project Name	GAL - SR 160 - 9.68	Contact Email	Gsprungle@cmtran.com
Project Description	SR-160 & SR-554	Contact Phone	614-656-2419
Reference Number	109397	Date Performed	5/30/2019
Analyst	GRS	Analysis Year	2018
Agency/Company	Carpenter Marty Transportation		

Engineering Design %	15%
Contingency %	30%

Countermeasures	Construction Costs	Right of Way Costs	Engineering Design Costs	Contingency Amount	Total Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value
Lighting	$13,100.00		$1,965.00	$3,930.00	**$18,995.00**		
Enhanced Intersection Ahead Warning Signs	$10,000.00		$1,500.00	$3,000.00	**$14,500.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
Totals	**$23,100.00**	**$0.00**	**$3,465.00**	**$6,930.00**	**$33,495.00**	**$0.00**	**$0.00**

Inflation %	3%

Final Costruction Cost:	**$34,332.38**

*Final construction cost should match the Project Cost Estimate

Short Term Countermeasures

Safety Benefit - Cost Analysis

General Information

Project Name	GAL - SR 160 - 9.68	Contact Email	Gsprungle@cmtran.com
Project Description	SR-160 & SR-554	Contact Phone	614-656-2419
Reference Number	109397	Date Performed	5/30/2019
Analyst	GRS	Analysis Year	2018
Agency/Company	Carpenter Marty Transportation		

Select Site Types to be used in Benefit-Cost Analysis:

All Sites

Comments:

Countermeasure Service Lives, Costs, and Safety Benefits

Countermeasures	Service Life (Years)	Initial Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value	Net Present Cost of Countermeasure	Total Cost of Countermeasures	Summary of Annual Crash Modifications	Net Present Value of Safety Benefits
Lighting	20	$18,995.00			$18,995.00	$18,995.00	-0.002	$981
Enhanced Intersection Ahead Warning Signs	10	$14,500.00			$29,000.00	$35,963.54		
		$0.00			$0.00	$0.00		
		$0.00			$0.00	$0.00		
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
Totals		**$33,495.00**	**$0.00**	**$0.00**	**$47,995.00**	**$54,958.54**	**-0.002**	**$981**

Benefit - Cost Calculator

Net Present Value of Project	$47,995.00
Net Present Value of Safety Benefits	$981.29
Net Benefit	($47,013.71)
Benefit / Cost Ratio	0.02

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	0.000
Number of Injury Crashes	-0.001
Number of Total Crashes	-0.002

Comments:

Long Term Countermeasures

Project Cost Estimate			
Project Name	GAL - SR 160 - 9.68	Contact Email	Gsprungle@cmtran.com
Project Description	SR-160 & SR-554	Contact Phone	614-656-2419
Reference Number	109397	Date Performed	5/30/2019
Analyst	GRS	Analysis Year	2018
Agency/Company	Carpenter Marty Transportation		

Engineering Design %	15%
Contingency %	30%

Countermeasures	Construction Costs	Right of Way Costs	Engineering Design Costs	Contingency Amount	Total Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value
Lighting	$142,000.00		$21,300.00	$42,600.00	**$205,900.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
CMF 1 - Convert intersection with minor-road stop control to modern roundabout (Rural)	$752,000.00	$6,400.00	$113,760.00	$227,520.00	**$1,099,680.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
Totals	**$894,000.00**	**$6,400.00**	**$135,060.00**	**$270,120.00**	**$1,305,580.00**	**$0.00**	**$0.00**

Inflation %	10%

Final Costruction Cost:	**$1,430,915.68**

*Final construction cost should match the Project Cost Estimate

Long Term Countermeasures

Safety Benefit - Cost Analysis

General Information

Project Name	GAL - SR 160 - 9.68	Contact Email	Gsprungle@cmtran.com
Project Description	SR-160 & SR-554	Contact Phone	614-656-2419
Reference Number	109397	Date Performed	5/30/2019
Analyst	GRS	Analysis Year	2018
Agency/Company	Carpenter Marty Transportation		

Select Site Types to be used in Benefit-Cost Analysis:

All Sites

Comments:

Countermeasure Service Lives, Costs, and Safety Benefits

Countermeasures	Service Life (Years)	Initial Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value	Net Present Cost of Countermeasure	Total Cost of Countermeasures	Summary of Annual Crash Modifications	Net Present Value of Safety Benefits
Lighting	20	$205,900.00			$205,900.00	$205,900.00	-0.002	$981
		$0.00			$0.00	$0.00		
		$0.00			$0.00	$0.00		
		$0.00			$0.00	$0.00		
CMF 1 - Convert intersection with minor-road stop control to modern roundabout (Rural)	20	$1,099,680.00			$1,099,680.00	$1,099,680.00	-2.973	$2,481,686
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
		$0.00			$0.00	$0.00	0.000	$0
Totals		**$1,305,580.00**	**$0.00**	**$0.00**	**$1,305,580.00**	**$1,305,580.00**	**-2.974**	**$2,482,667**

Benefit - Cost Calculator

Net Present Value of Project	$1,305,580.00
Net Present Value of Safety Benefits	$2,482,666.97
Net Benefit	$1,177,086.97
Benefit / Cost Ratio	1.90

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.286
Number of Injury Crashes	-1.442
Number of Total Crashes	-2.974

Comments: