

November 2, 2021

Allegan County Road Commission
1308 Lincoln Road
Allegan, MI 49010

Attn: Mr. Craig Atwood, P.E.

Re: Traffic Analysis
Blue Star Highway at Old Allegan Road and Lake Street

HRC Job No. 20210784

Dear Mr. Atwood:

At your request, Hubbell, Roth & Clark, Inc. (HRC) has prepared a Traffic Analysis for two intersections on Blue Star Highway. The intersections are in the City of Saugatuck and Saugatuck Township, Allegan County.

The Study Intersections include:

- ≡ Blue Star Highway at Lake Street (City of Saugatuck)
- ≡ Blue Star Highway at Old Allegan Road (Saugatuck Township)

As part of the study, HRC has completed the following tasks for each intersection:

- ≡ Collected 24-hour turning movements counts at the study intersections and reviewed traffic volumes
 - HRC reviewed traffic volumes to determine if Blue Star Highway volumes were higher due to active construction on I-196, per the RFP.
- ≡ Conducted a Signal Warrant Analysis
- ≡ Conducted a crash analysis over a 5-year period
- ≡ Analyzed intersections for multi-modal traffic uses
- ≡ Summarized analysis in letter report to provide recommendations

Study Area

The study area includes two intersections: Blue Star Highway at Lake Street and Blue Star Highway at Old Allegan Road.

Blue Star Highway

- ≡ Allegan County Road (A-2)
- ≡ Classified as a minor arterial
- ≡ 2-lane undivided highway with auxiliary left turn lanes
- ≡ Speed limit:
 - Signed at 35 mph at Lake Street
 - Signed at 50 mph at Old Allegan Road

Lake Street

- ≡ Classified as a local road
- ≡ Signed at 25 mph.
- ≡ One right turn lane, one left turn lane, and one receiving lane
- ≡ Stop controlled on SB approach to Blue Star Highway

Bloomfield Hills
555 Hulet Drive
Bloomfield Hills,
MI 48302
248-454-6300

Delhi Township
2101 Aurelius Rd.
Ste. 2A
Holt, MI 48842
517-694-7760

Detroit
535 Griswold Street
Buhl Building
Suite 1650
Detroit, MI 48226-3698

Howell
105 W. Grand River
Howell, MI 48843
517-552-9199

Jackson
401 S. Mechanic St.
Suite B
Jackson, MI 49201
517-292-1295

Kalamazoo
834 King Highway
Suite 107
Kalamazoo, MI 49001
269-665-2005

Lansing
215 S. Washington SQ
Suite D
Lansing, MI 48933
517-292-1488

Old Allegan Road

- ≡ Classified as a local road west of Blue Star Highway, minor collector east of Blue Star Highway
- ≡ Speed limit:
 - Signed at 25 mph west of Blue Star Highway
 - Signed at 45 east of Blue Star Highway
- ≡ Both approaches to intersection have one left, thru, right lane, and one receiving lane
- ≡ Stop controlled on the EB and WB approaches to Blue Star Highway

The two study intersections are shown within a map of the study area in **Figure 1**.



Figure 1. Map of Study Area

Non-motorized Traffic Characteristics

Blue Star Highway at Lake Street

Non-motorized facilities at this intersection are characterized by facilities for bicyclists and pedestrians. A sidewalk exists on the north side of the west leg of Blue Star Highway leading to the west side of Lake Street. This path provides a connection between the cities of Douglas and Saugatuck. There is no pedestrian facility to facilitate travel along Blue Star Highway east of this intersection.

A westbound conventional bike lane is signed to begin on the east leg of this intersection. The eastbound conventional bike lane is signed to end on the east leg of the intersection, as the shoulder tapers to an inadequate width. The EB and WB bike lanes continue along Blue Star Hwy west of the intersection across the bridge over the Kalamazoo River. Ultimately, both bike lanes converge to a two-way separated bike lane as part of the Blue Star Trail.

Blue Star Highway at Old Allegan Road

There are facilities for non-motorized users at this intersection. A sidewalk exists on the north side of the west leg of Old Allegan Road. The sidewalk terminates approx. 65 ft. west of the intersection at a shared used path heading north along the west side of the north leg of Blue Star Highway, part of the Blue Star Trail. There are no pedestrian facilities at other legs of this intersection. There is an existing concrete sidewalk ramp and concrete pad across Old Allegan Road from the terminus of the sidewalk/shared use path. This may be employed for a future extension of the Blue Star Trail. There are no dedicated bicycle facilities, however, the shoulders are 8-10 ft. wide in this location.

US Bike Route 35 and Blue Star Trail

Currently, two designated non-motorized facilities exist along Blue Star Highway near or within the study intersections. US Bike Route (BR) 35 is routed through Douglas and Saugatuck as it travels from New Buffalo to Sault Ste. Marie. BR 35 travels along Blue Star Highway then turns north to Lake Street. Ultimately, BR 35 rejoins Blue Star Highway north of Old Allegan Road at Washington Road.

The Blue Star Trail is part of a plan to connect communities in Allegan County and surrounding counties using non-motorized facilities. The shared-use path on the north side of Old Allegan Road and Blue Star Highway, along with the two-way bike lane and shared use path south of the bridge over the Kalamazoo River are portions of the currently built Blue Star Trail. Friends of the Blue Star Trail indicate FY 2021 plans to connect the two previously described sections. Additionally, FY 2020 plans indicate a trail connection for the Old Allegan shared use path to BR 35 on the north side of the city of Saugatuck. Friends of the Blue Star Trail indicate that delays due to the pandemic pushed construction of the FY 2020 and FY 2021 Blue Star Trail extensions to 2023.

Existing Traffic Volumes

Turning movement counts were collected on September 8, 2021 at the two study intersections. Summaries of existing traffic volumes are provided in **Tables 1 and 2**. Turning movement counts are provided in **Attachment A**.

Table 1. Blue Star Highway at Lake St Existing Volumes (9/8/2021)

Time	Southbound	Eastbound	Westbound
	Lake St	Blue Star Hwy	Blue Star Hwy
12:00 AM	5	6	5
1:00 AM	0	8	4
2:00 AM	2	5	1
3:00 AM	1	4	1
4:00 AM	2	13	6
5:00 AM	5	43	12
6:00 AM	16	104	75
7:00 AM	40	306	297
8:00 AM	125	404	276
9:00 AM	100	358	348
10:00 AM	128	483	323
11:00 AM	174	490	352
12:00 PM	191	579	393
1:00 PM	208	530	402
2:00 PM	179	539	438
3:00 PM	241	691	411
4:00 PM	176	564	428
5:00 PM	171	584	414
6:00 PM	164	407	315
7:00 PM	186	304	247
8:00 PM	116	280	126
9:00 PM	85	133	66
10:00 PM	40	64	53
11:00 PM	5	8	9

Table 2. Blue Star Highway at Old Allegan Rd Existing Volumes (9/8/2021)

Time	Northbound	Southbound	Eastbound	Westbound
	Blue Star Hwy	Blue Star Hwy	Old Allegan Rd	Old Allegan Rd
12:00 AM	4	6	1	0
1:00 AM	6	4	2	1
2:00 AM	4	1	0	0
3:00 AM	4	1	1	0
4:00 AM	10	4	1	1
5:00 AM	45	10	1	2
6:00 AM	91	63	6	15
7:00 AM	213	273	25	76
8:00 AM	283	295	56	91
9:00 AM	281	316	33	77
10:00 AM	328	319	30	59
11:00 AM	329	343	41	72
12:00 PM	395	412	44	85
1:00 PM	362	370	63	70
2:00 PM	359	423	47	76
3:00 PM	488	378	102	83
4:00 PM	429	416	69	78
5:00 PM	396	417	67	68
6:00 PM	275	311	42	58
7:00 PM	213	232	53	45
8:00 PM	208	129	25	27
9:00 PM	100	71	54	10
10:00 PM	56	56	31	5
11:00 PM	8	12	5	1

A comparison was made using 2015 volumes taken at Blue Star Highway west of the Lake Street intersection. The 2015 volumes were collected from MDOT Transportation Data Management System and grown using a 1% growth rate to 2021 volumes.

$$\text{Growth Rate} = (1 + r)^n = 1.062$$

r = Annual Growth Rate (i.e. 1%)

n = Number of years (i.e. 6)

Using the growth rate of 1.062, the grown 2021 volumes were compared to actual 2021 volumes, and it was found that actual count volumes were, on average, 20% higher.

HRC received additional turning movement counts from Allegan County at Blue Star Highway and Wiley Road in Douglas in 2019. These counts were 3% higher than Old Allegan Road and 12% lower than Lake Street, respectively.

These percentages were utilized in signal warrant analysis to determine whether warrants were influenced by I-196 construction traffic. Given this information, HRC has determined that traffic volumes are higher than normal due to construction on I-196. Impacts of higher traffic volumes on signal warrant analysis is discussed in sections below.

Blue Star Highway Crash Analysis

HRC has reviewed the crashes at the two project intersections along Blue Star Highway. Crash data used for the five-year period was compiled using the Traffic Improvement Association Traffic Crash Analysis Tool (TCAT) website. For all intersection analyses, any crash within 250 ft. the intersection is considered an intersection crash.

Blue Star Highway at Lake Street

A summary of the crash characteristics for the intersection is shown in **Table 3**. A total of 15 crashes occurred in the five-year study period. All crashes were minor injury or property damage only.

Table 3. Blue Star Highway at Lake Street Crash Summary (2016-2020)

Crash Characteristic		2016	2017	2018	2019	2020	Total	%
Crash Severity	PDO	0	0	1	0	0	1	7%
	Injury C	0	0	3	6	5	14	93%
	Total	0	0	4	6	5	15	100%
Crash Type	Rear End	0	0	4	3	1	8	53%
	Rear End - Right Turn	0	0	0	1	3	4	27%
	Single Motor Vehicle	0	0	0	1	1	2	13%
	Other	0	0	0	1	0	1	7%
	Total	0	0	4	6	5	15	100%
Pavement Condition	Dry	0	0	3	5	5	13	87%
	Wet	0	0	1	1	0	2	13%
	Total	0	0	4	6	5	15	100%
Lighting Condition	Dark - Lighted	0	0	0	1	0	1	7%
	Dark - Unlighted	0	0	0	0	1	1	7%
	Daylight	0	0	4	5	4	13	87%
	Total	0	0	4	6	5	15	100%

The most frequent crash types were Rear End and Rear End - Right Turn, comprising 80% of crashes at the intersection. The next most frequent crash type was Single Motor Vehicle, representing 13% of the total. It is important to note that 10 of the 12 Rear End collisions (83%) occurred on the stop-controlled Lake Street approach at the intersection. MDOT indicates that installation of a Rural Box Span Signal is associated with up to a 40% reduction in all collision types other than Angle.

Blue Star Highway at Old Allegan Road

A summary of the crash characteristics for the intersection is shown in **Table 4**. A total of 12 crashes occurred in the five-year study period. The majority of crashes were minor injury or property damage only (75%). However, in the five-year period there were two (2) Level B Injury crashes and one (1) Level A Injury crash.

Level A Injury Crash:

- ≡ The Level A Injury crash occurred December 2018. A vehicle traveling WB on Old Allegan Road disregarded the stop sign at the intersection. The WB Vehicle then struck a vehicle traveling SB on Blue Star Highway. The driver of the SB vehicle was transported to the hospital for Level A injuries and stated they could not avoid the collision. The driver of the SB vehicle also stated they were impaired by medical marihuana prior to the collision. The WB driver was cited for disregarding a stop sign. The crash occurred under Dark – Lighted and Dry pavement conditions.

Level B Injury Crashes:

- ≡ The first Level B crash occurred July 2017. A vehicle traveling WB on Old Allegan Road did not stop at the stop sign and struck a vehicle heading NB on Blue Star Highway. The NB vehicle spun and flipped into the NW quadrant of the intersection. The driver of the WB vehicle stated they were looking at a phone for directions and did not react in time to stop and avoid the collision. The driver of the NB vehicle was transported to the hospital for Level B injuries. The crash occurred in the Daylight and under Dry pavement conditions.
- ≡ The second Level B crash occurred September 2020. A vehicle heading WB on Old Allegan Road disregarded

the stop sign and entered the intersection. The NB vehicle ultimately struck the WB vehicle on the left side as it crossed the intersection. The driver of the NB vehicle was transported to the hospital for Level B injuries. The crash occurred in the Daylight and under Dry pavement conditions.

Table 4. Blue Star Highway at Old Allegan Road Crash Summary (2016-2020)

Crash Characteristic		2016	2017	2018	2019	2020	Total	%
Crash Severity	PDO	1	0	3	3	1	8	67%
	Injury C	1	0	0	0	0	1	8%
	Injury B	0	1	0	0	1	2	17%
	Injury A	0	0	1	0	0	1	8%
	Total	2	1	4	3	2	12	100%
Crash Type	Angle	1	1	2	1	1	6	50%
	Backing	0	0	1	0	0	1	8%
	Rear End	1	0	1	2	1	5	42%
	Total	2	1	4	3	2	12	100%
Pavement Condition	Dry	1	1	4	2	2	10	83%
	Snow	0	0	0	1	0	1	8%
	Wet	1	0	0	0	0	1	8%
	Total	2	1	4	3	2	12	100%
Lighting Condition	Dark - Lighted	0	0	1	0	0	1	8%
	Dawn	0	0	0	1	0	1	8%
	Daylight	2	1	3	2	2	10	83%
	Total	2	1	4	3	2	12	100%

The most frequent crash type was Angle, comprising 50% of the total. The next most frequent crash type was Rear End, entailing 42% of all crashes in the study period. MDOT has noted that installation of a Rural Box Span Signal is associated with a 75% reduction in Angle crashes and a 40% reduction in all other crash types. Additional reductions in Angle and Rear End crashes of up to 30% can be realized through upgrades to signing and pavement markings.

Traffic Signal Warrant Analysis

Signal warrants for both intersections were considered to be in isolated communities of 10,000 population or less. Combining the populations of the City of Saugatuck, Village of Douglas, and Saugatuck Township equals approx. 5,500. Results of traffic signal warrants are provided in **Attachment C** as spreadsheets.

Blue Star Highway at Lake Street

HRC performed a signal warrant analysis for Blue Star Highway at Lake Street. Based on existing traffic volumes at the intersection, provided in **Table 1**, HRC found the intersection meets the requirements for various signal warrants.

A summary of the traffic warrant analysis is shown in **Table 5**. Note Warrant 9 related to rail crossings is not applicable.

Table 5. Blue Star Highway at Lake Street Signal Warrant Analysis

Traffic Signal Warrants		Met?
Warrant 1: Eight-Hour Vehicular Volume	Condition A	YES*
	Condition B	YES*
	Combination of A & B	N/A
Warrant 2: Four-Hour Vehicular Volume		YES*
Warrant 3: Peak Hour		YES*
Warrant 4: Pedestrian Volume		No
Warrant 5: School Crossing		No
Warrant 6: Coordinated Signal System		No
Warrant 7: Crash Experience		No
Warrant 8: Roadway Network		No
Warrant 9: Intersection Near a Grade Crossing		N/A

* Indicates that warrant would also be met considering grown 2015 volumes and adjusted 2019 volumes on Blue Star Hwy

The Blue Star Highway at Lake Street Intersection met the warrants for Warrant 1 (Condition A and B): Eight-Hour Vehicular Volume, Warrant 2: Four-Hour Vehicular Volume, and Warrant 3: Peak Hour Volume. There were not enough crashes susceptible to correction by signalization to meet Warrant 7, as a majority were Rear End type.

Left-Turn Analysis

HRC performed a left-turn phasing analysis and determined that a permissive-protected left turn phase is warranted for EB Blue Star Highway. Included in implementing the left turn phasing is installing a flashing yellow arrow signal and installing a doghouse signal for Lake St. The doghouse signal allows for a protected right turn phase on SB Lake Street while the EB protected left turn phase is active. Results are provided in **Attachment B**.

Blue Star Highway at Old Allegan Road

HRC conducted a signal warrant analysis for Blue Star Highway at Old Allegan Road. Based on existing traffic volumes, provided in **Table 2**, HRC found the intersection meets the requirements for various signal warrants.

A summary of the traffic warrant analysis is shown in **Table 6**. Note Warrant 9 related to rail crossings is not applicable.

Table 6. Blue Star Highway at Old Allegan Road Signal Warrant Analysis

Traffic Signal Warrants		Met?
Warrant 1: Eight-Hour Vehicular Volume	Condition A	No
	Condition B	YES*
	Combination of A & B	N/A
Warrant 2: Four-Hour Vehicular Volume		YES*
Warrant 3: Peak Hour		No*
Warrant 4: Pedestrian Volume		No
Warrant 5: School Crossing		No
Warrant 6: Coordinated Signal System		No
Warrant 7: Crash Experience		No
Warrant 8: Roadway Network		No
Warrant 9: Intersection Near a Grade Crossing		N/A

* Indicates that warrant would also be met considering grown 2015 volumes and adjusted 2019 volumes on Blue Star Hwy.

The Blue Star Hwy at Old Allegan Rd intersection met the warrants for Warrant 1 (Condition B): Eight-Hour Vehicular Volume and Warrant 2: Four-Hour Vehicular Volume. The results of the crash analysis from 2016-2020 found a total of 12 crashes. Over the five-year period, six (6) crashes, Angle, are correctable by signalization. However, a minimum of five (5) must occur in a 12-month period to meet Warrant 7.

Left-Turn Analysis

HRC performed a left-turn phasing analysis and determined left-turn phasing is not warranted. Results are provided in **Attachment B**. Note that there is currently a left turn lane on NB Blue Star Highway only. The left-turn phasing analysis did not indicate warranting on the other three intersection approaches.

Construction Impacts on Signal Warrants

As previously mentioned, the construction on I-196 has significantly increased traffic on Blue Star Highway. The signal warrant analyses were conducted considering three traffic volume frameworks:

- ≡ Actual 2021 counts
- ≡ 2015 MDOT counts grown to 2021 volumes
- ≡ 2021 counts adjusted proportionally by Allegan County 2019 counts

In all three scenarios, the warrants met by the actual 2021 counts are still met when traffic is adjusted to levels not impacted by construction. This provides evidence as to the accuracy of the signal warrants met by actual 2021 counts.

Conclusions and Recommendations

Results of the crash analysis indicate that the frequency and severity of crashes are low at the two study intersections. The majority of crashes at the Lake Street intersection were Rear End type and the majority at Old Allegan Rd were Angle.

HRC recommends that Allegan County Road Commission consider the upcoming Blue Star Trail extension when considering installation of signals. Increases to pedestrian and bicycle traffic at the study intersections could present new opportunities for signalization to improve multi-modal road user safety.

Blue Star Highway at Lake Street

Given that Lake Street meets multiple signal warrants, HRC recommends installing a traffic signal at this intersection. Volumes are sufficiently high at this intersection, and the signal could provide additional safety for bicyclists and pedestrians once multi-modal connections are completed. HRC recommends implementing the left-turn phasing and associate signals. HRC also recommends installing pedestrian signals on the north leg of the intersection, given upcoming extension of the multimodal trail. Non-motorized signals should be revisited after the trail extension is completed.

Multi-Modal Recommendations

- ≡ Upgrade pavement markings and install 24" stop bars
- ≡ Install high emphasis crosswalk marking to improve pedestrian safety
- ≡ Investigate continuing bike lanes where they terminate north of bridge
- ≡ Install green bicycle conflict pavement markings
- ≡ Install green bike boxes to allow opportunities for safe wayfinding to existing and future bicycle routes

Blue Star Highway at Old Allegan Road

Old Allegan Rd met two of the warrants for vehicular volume. The most common crash type at this intersection was Angle, noted by MDOT to experience a 75% reduction after signalization. The most severe crashes (Injury A and B) were all Angle type crashes. However, there were not enough crashes susceptible to correction to meet Warrant 7. As vehicular and multimodal volumes increase, there is a potential for greater frequency of crashes. The signal would provide an additional safety measure for all road users. Given these factors, HRC recommends installing a traffic signal at this intersection. HRC

also recommends installing pedestrian signals on the west leg of the intersection, located dependent on alignment of upcoming extension of the multimodal trail. Non-motorized signals should be revisited after the trail extension is completed.

Multi-Modal Recommendations

- ≡ Upgrade pavement markings and install 24" stop bars
- ≡ Install high emphasis crosswalk marking to improve pedestrian safety
- ≡ Install green bicycle conflict pavement markings
- ≡ Install green bike boxes to allow opportunities for safe wayfinding to existing and future bicycle routes

Alternative Recommendations

Should the county choose to not pursue installation of signals, HRC presents the following alternative recommendations for the intersections:

- ≡ Install dual 36" Stop (R1-1) signs
 - Install Cross Traffic Does Not Stop Plaques (W4-4) under 36" signs
 - Install Stop Ahead (W3-1) signs in appropriate locations
- ≡ Consider overhead flasher if crashes continue and/or increase, and with consideration of potential increasing bicycle volumes

HRC notes that a roundabout is recommended as a viable alternative at the intersection of Blue Star Highway and Old Allegan Road. Roundabouts are noted as a Proven Safety Countermeasure by the Federal Highway Administration (FHWA). The FHWA notes roundabouts lower speeds and reduce conflict points, thus reducing severe crashes. The configuration of a roundabout provides multiple opportunities to provide crossing locations for non-motorized traffic. Reducing speeds, lowering conflict points, and creating additional crossing locations benefits the safety of all road users. There is forest and little development surrounding this intersection, reducing the likelihood of major right-of-way conflicts from man-made obstruction or difficulty in potential acquisition. The geography of the intersection surroundings may create challenges to constructing a roundabout. The road surface of Blue Star Highway is elevated from ground level, with relatively steep foreslopes and guardrail. In addition, the alignment of this section of Blue Star Highway is on a high-speed horizontal curve. As mentioned above, the lack of development could allow ample opportunity to reconfigure the intersection. With the necessary reduction of speeds for a potential roundabout, the horizontal curve may be re-designed for a lower design speed. This may allow the county to take advantage of existing grades when building the new facility.

Multi-Modal Recommendations

- ≡ Upgrade pavement markings and install 24" stop bars
- ≡ Install high emphasis crosswalk marking to improve pedestrian safety
- ≡ Install green bicycle conflict pavement markings

If you have any questions or require any additional information, please contact the undersigned.

Very truly yours,

HUBBELL, ROTH & CLARK, INC.



Cole G. Villalobos, P.E., PTOE
Staff Engineer – Transportation Department

CGV/jdh

Attachments:

- A– Turning Movement Counts
- B– Left Turn Warrants Graphs
- C– Traffic Signal Warrants Spreadsheets

Enclosure

pc: HRC; File, Lia Michaels, Larry Hummel, Jordan Hankin