Bright View Engineering
Moving you forward

August 7, 2019

VIA EMAIL
mdecarlo@veronanj.com

Michael DeCarlo
Engineering Manager
Township of Verona Engineering Dept.
10 Commerce CT., Verona, NJ 07044
(973) 239-8146

Re: **Multi-Way STOP Analysis & Traffic Calming**
Elmwood Road from Bloomfield Ave (CR 506) and Woodland Ave
Township of Verona, Essex County, NJ
Project No.: 192551

Dear Mr. DeCarlo,

Bright View Engineering, LLC, was tasked by The Township of Verona (*the Township here-in*) with performing an evaluation of the existing traffic pattern at the intersections of Elmwood Road & Lanning Road/Overhill Road, Elmwood Road & Elk Road, and the Elmwood Road roadway segment between Woodland Ave & Bloomfield Ave (*CR 506*). This analysis was performed to assess the implementation of a Multi-Way STOP control at the subject intersections, and to assess the necessity for any traffic calming measures along Elmwood Road.

Bright View Engineering (*BVE here-in*), in coordination with the Township, collected data during various site visits and was provided data by the Township to assess the existing conditions at the project intersections and roadway segment. The collected data and observations were utilized to determine if the existing traffic conditions in the project area justify the implementation of the new traffic pattern. This analysis was performed per the standards set forth within NJSA 39:4-8, 39:4-138 & 39:4-197 (*Title 39*), the applicable requirements of the Federal Highway Administration's (*FHWA*) Manual on Uniform Traffic Control Devices (*MUTCD*), and the American Association of State Highway and Transportation Officials' (*AASHTO*) A Policy on Geometric Design of Highways and Streets (*The Green Book*). The following points were considered within the scope of our study:

- An inventory of the roadway facilities in the project vicinity, including the existing physical and traffic operating characteristics;
- Accident data along roadway segments interconnecting the study intersections;
- Traffic volume and speed data collection along roadway segments interconnecting the study intersections; and
- Summary and Conclusions.

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EXISTING CONDITIONS

Multiple field investigations were conducted to obtain an inventory of existing roadway conditions, posted traffic controls, adjacent land uses, lane configurations of the roadways in the study area, and existing vehicular and pedestrian traffic patterns. The following is a brief description of the roadways:

Elmwood Road is a north-south oriented roadway which spans approximately 0.60 miles through the Township of Verona. The Township's jurisdiction along the subject roadway ranges from Bloomfield Ave (*CR 506*) to the south to just passed Woodland Ave to the north. There are no NJDOT Straight-line Diagrams available for this roadway. We did not observe any speed limit signs posted in the study area, however, based on the surrounding land uses (residential in nature, school, and public green space) and the operating characteristics of the roadway, it is our opinion that the speed limit should be posted at 25 MPH. Per New Jersey Statutes Title 39, Chapter 4, Section 98, and the provisions set forth in R.S.39:4-96 and R.S.39:4-97, it is our opinion that the study area should be posted at 25 MPH as it is mainly residential in nature.

Elmwood Road operates as the mainline at the study intersections and is allowed free flow movement throughout most of the roadway segment; exception for the intersection of Elmwood Road & Claremont Ave where there is a Multi-Way STOP Control in place. The roadway provides for approximately 26 feet of pavement width. The roadway segment provides for two-way circulation. On-street parking is generally permitted along both sides of the roadway throughout the study area. Crosswalks were present along the mainline and intersecting streets utilizing a "standard" striping pattern. Based on our review of its operating characteristics, it is our opinion that this roadway should be classified as a "*Local Road*" under Municipal jurisdiction.

Lanning Road is an east-west oriented roadway which spans approximately 0.13 miles through the Township of Verona. There are no NJDOT Straight-line Diagrams available for this roadway. Lanning Road is bounded by Otsego Road to the west and Elmwood Road to the east. We did not observe a posted speed limit along the roadway segment. Based on the surrounding land uses (residential, school, public green space) and the operating characteristics of the roadway, it is our opinion that the speed limit should be posted at 25 MPH. Per New Jersey Statutes Title 39, Chapter 4, Section 98, and the provisions set forth in R.S.39:4-96 and R.S.39:4-97, the study area should be posted at 25 MPH as it is mainly residential in nature.

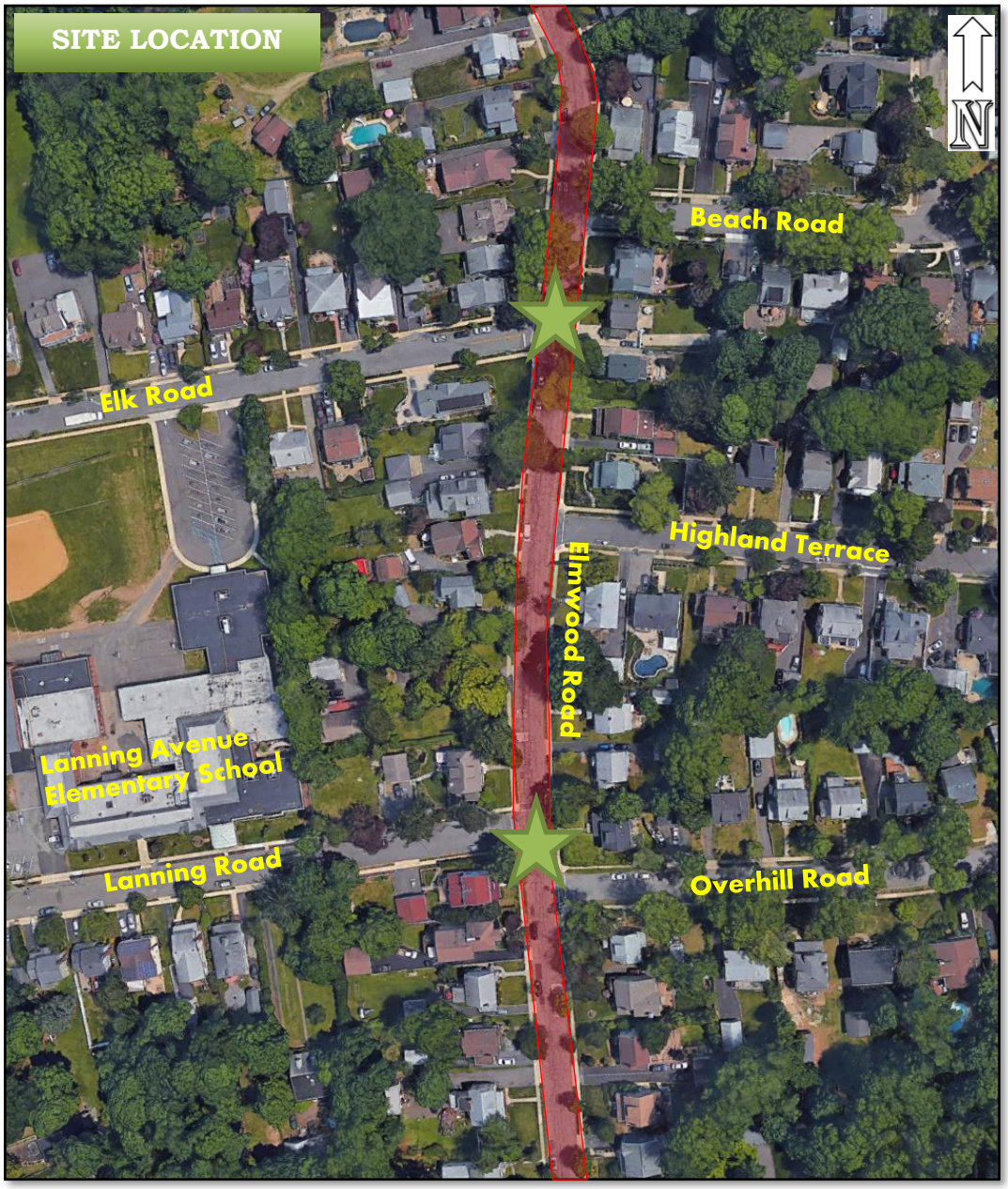
The roadway provides for approximately 30 feet of width at the intersection and allows for one-way travel westbound, away from Elmwood Road. Parking is permitted on the south of the roadway. Crosswalks are present in a "standard" striping pattern at the intersection of Lanning Road & Elmwood Road. We observed that there is utility pole located in the center of the curb ramp on the northwest corner of the intersection. Based on our review of its operating characteristics, it is our opinion that this roadway should be classified as a "*Local Road*" under Municipal jurisdiction. Lanning Road operates as the minor street approach. We also note that there is a school located within 200 feet of the intersection, off the north side of Lanning Road.

Overhill Road is an east-west oriented roadway which spans approximately 0.11 miles through the Township of Verona. There are no NJDOT Straight-line Diagrams available for this roadway. Overhill Road is bounded by Elmwood Road to the west and Martin Road to the east. We did not observe a posted speed limit along the roadway segment. Based on the surrounding land uses (mainly residential in nature) and the operating characteristics of the roadway, it is our opinion that the speed limit should be posted at 25 MPH. Per New Jersey Statutes Title 39, Chapter 4, Section 98, and the provisions set forth in R.S.39:4-96 and R.S.39:4-97, the study area should be posted at 25 MPH as it is mainly residential in nature.

The roadway provides for approximately 26 feet of width at the intersection and allows for two-way travel. Parking is permitted on the south side of the roadway. A crosswalk is present across Overhill Road in a "standard" striping pattern. Based on our review of its operating characteristics, it is our opinion that this roadway should be classified as a "*Local Road*" under Municipal jurisdiction. While we observed minimal traffic volume to/from Overhill Road's eastbound approach, we noted that this approach is uncontrolled at its intersection with Elmwood Road.

Elk Road is an east-west oriented roadway which spans approximately 0.16 miles through the Township of Verona. There are no NJDOT Straight-line Diagrams available for this roadway. Elk Road is bounded by Otsego Road to the west and Elmwood Road to the east. We did not observe a posted speed limit along the roadway segment. Based on the surrounding land uses (residential, school, public green space) and the operating characteristics of the roadway, it is our opinion that the speed limit should be posted at 25 MPH. Per New Jersey Statutes Title 39, Chapter 4, Section 98, and the provisions set forth in R.S.39:4-96 and R.S.39:4-97, the study area should be posted at 25 MPH as it is mainly residential in nature.

The roadway provides for approximately 26 feet of width at the intersection and allows for bidirectional travel between Elmwood Road and Otsego Road. Parking is permitted on the north of the roadway. Crosswalks are present in a "standard" striping pattern at the study intersection. Based on our review of its operating characteristics, it is our opinion that this roadway should be classified as a "*Local Road*" under Municipal jurisdiction. Elk Road operates as the minor street approach. We also note that there is a school located within 300 feet of the intersection, off the south side of the roadway. Elk Road is governed by a STOP Sign at the study intersection.



Bright View Engineering *Moving you forward*	**Elmwood Road & Lanning Rd/Overhill Rd** **Elmwood Road & Elk Road** **Multi-Way STOP Analysis & Traffic Calming** **Verona Twp., Essex County, NJ**	**FIGURE** **1**

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SIGHT DISTANCE

BVE performed a site visit throughout the course of this project. During our site visit to the study intersection we observed some issues with sight distance for stopped vehicles on the Overhill Road and Elk Road approaches. We observed foliage, landscaping treatments, signs, elevation changes, and roadway geometry which affect the site triangles along both approaches to Elmwood Road.

We based our findings upon guidance from *AASHTO's A Policy on Geometric Design of Highways and Streets, 2011 Edition*. From this design manual we utilized the guidance provided for sight distance for vehicles performing either a through/ right turn movement or a left turn movement from a full stop (*Tables 9-6 & 9-8*). Based on the speed limit, we estimated a Design Speed of 30 MPH for both roadways. We then used *Table 9-6* to determine a Stopping Sight Distance of 200' and an Intersection Sight Distance of 335' for a left turning vehicle from a full stop. This movement requires the greatest sight distance. We then used *Table 9-8* to determine an Intersection Sight Distance of 290' for a through/ right turning vehicle from a full stop.

Figure(s) 2, below, depicts the sight lines and sight triangle for a vehicle at an intersection.

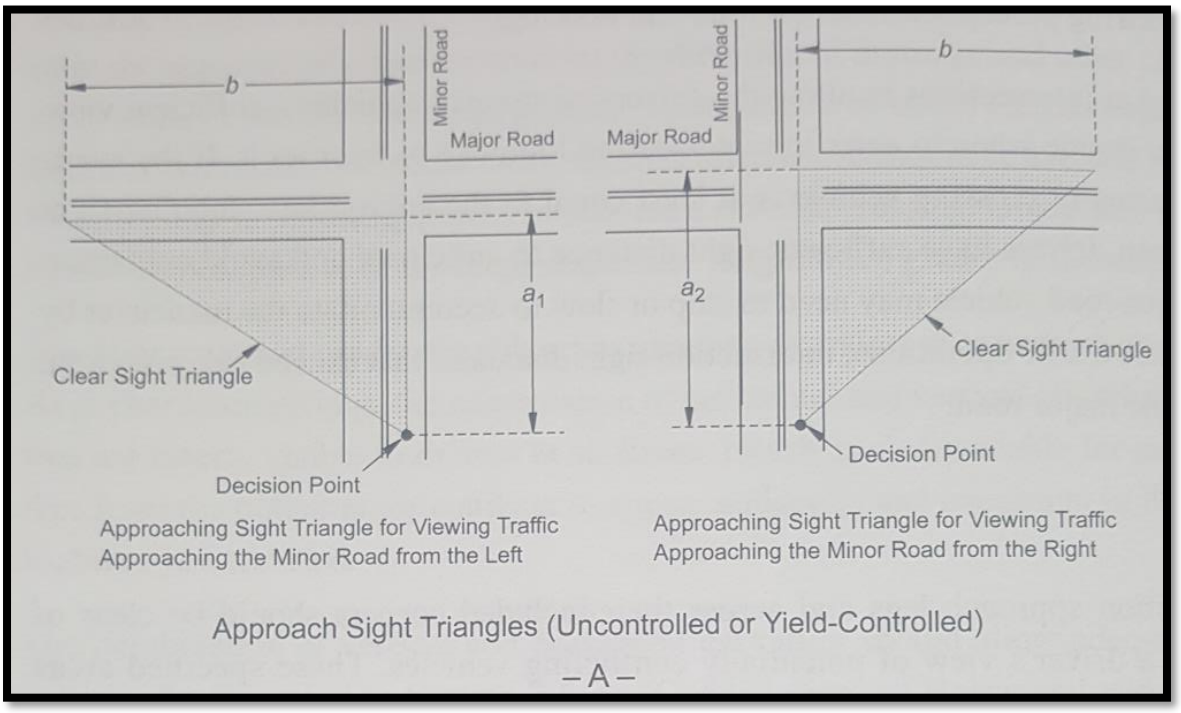


Figure 2 – Sight Triangles

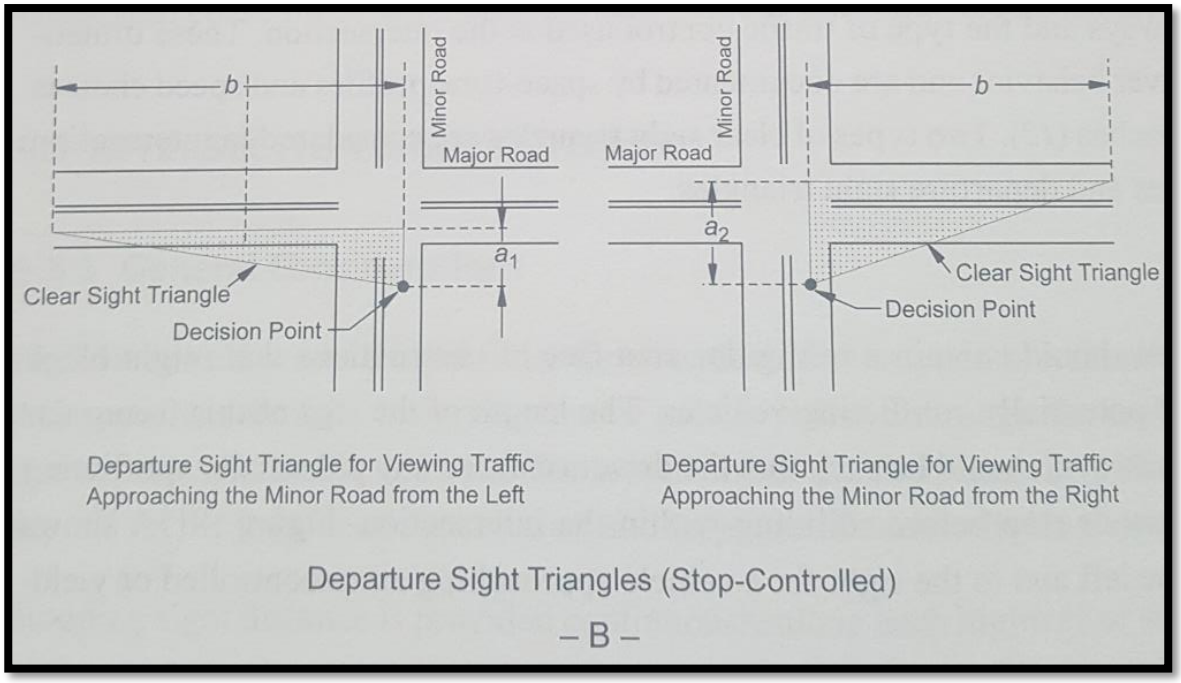


Figure 2 (*continued*)

We found both the Stopping Sight Distance for an approaching vehicle on Elmwood Road (*200' min. req.*) and Intersection Sight Distance for stopped vehicles on both Overhill Road and Elk Road (*335' min. req. for left; 290' for a through/ right*) to be insufficient. The Sight Triangles at the study intersections contained obstructions, which included both foliage along the corner properties, foliage within the grass strips between the sidewalk and roadway, and parked vehicles along the roadway in proximity to the intersection.

We did note, however, that if stopped vehicles pulled up into the crosswalk area along both approaches, they would have better visibility of oncoming traffic and would also be more visible themselves. We must also consider that both of these intersections lay along a school route and must consider the safety of pedestrians which utilize this route to access the Laning Avenue Elementary School.

Sight distance issues were also noted along the Elmwood Road segment approximately 150' north of Elk Road, where there is a bend in the roadway. This curvature in the road coupled with on-street parking which is permitted on both sides leading up to the curve creates an unsafe situation as opposing motorists cannot see on another until they clear the bend. The Township has reported instances where motorists navigating the bend drift into the center of the roadway and cause head-on conflicts with on-coming traffic.

It is our opinion based upon the AASHTO Guidelines that obstructions exist within the sight triangles at the study intersections and **sight distance requirements for both approaching and stopped vehicles are not met at Elk Road and Overhill Road**.

Additionally, due to the roadway geometry, pavement width, and on-street parking permitted on Elmwood Road approximately 150' north of Elk Road, it is our opinion that the existing conditions along the north leg of Elmwood Road create sight distance issues which are preventable.

Based upon the sight distance conditions observed at the study intersections, it is our opinion that these conditions present a safety concern for both vehicles and pedestrians, and that these locations meet the requirements set forth within the optional guidance presented within MUTCD for considering the implementation of a Multi-Way STOP control (*2B.07 – Parts 05.A, 05.C & 05.D*). The aforementioned requirements are outlined within the *Summary* section. Recommendations are also presented to improve sight distance concerns along the bend on Elmwood Road.

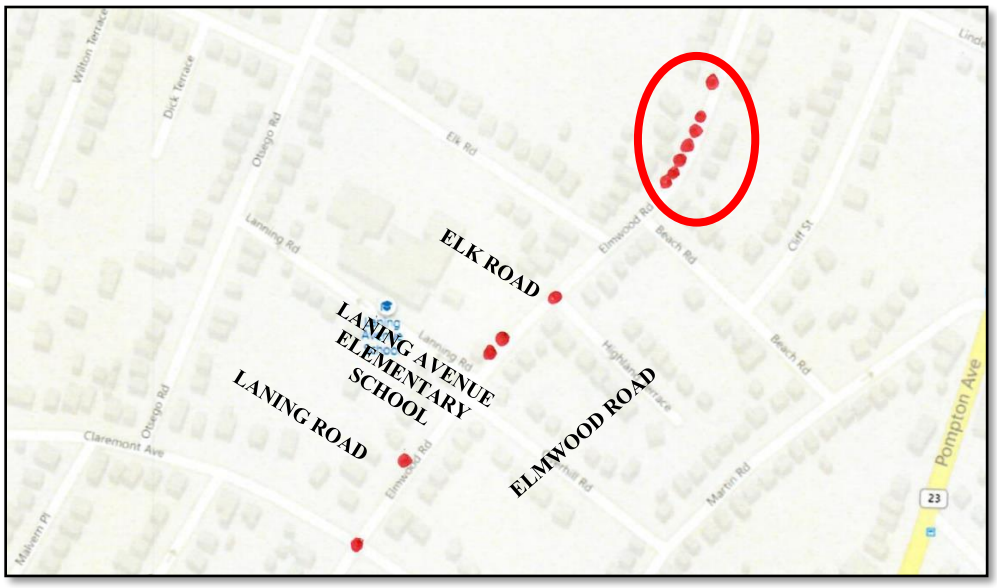
DATA COLLECTION

ACCIDENT HISTORY DATA

BVE was provided with an accident summary by the Verona Township Police Department. This accident data ranged from January 2014 to April 2019. Based upon the Department's analysis of Elmwood Road during this time frame there were eighteen (18) incidents reported throughout the study roadway. Below is a brief tabulation of the accident data provided:

Table 1 – Accident Data 01/14 – 04/19 (*Elmwood Road)*

TYPE	STREET	OCCURANCES
INTERSECTION	Elmwood Road	6
PARKED VEHICLE	Elmwood Road	5
DRIVEWAY	Elmwood Road	3
REAR END	Elmwood Road	2
TREE	Elmwood Road	2



ACCIDENT DIAGRAM PROVIDED BY VERONA PD.

Based upon the provided accident summary, we observed a concentration of incidents along Elmwood Road at its intersection with Linden Ave, and along the bend in Elmwood Road approximately 150' north of Elk Road.

The Verona Police also kindly provided raw accident data which ranged from January 2014 through December 2018. From this data we gleamed that eighteen (18) accidents were reported, with one (1) additional CAD report where the drivers resolved the issue without police assistance. Based upon this data we observed an accident frequency of approximately 4.8 accidents per year along Elmwood Road during this time frame (*January 2014 – December 2018*). The highest amount of accidents amongst this data was reported in 2018, when eight (8) accidents were reported. Based upon this accident data, two (2) accidents were report in the area of Laning Road and eight (8) accidents/ incidents were reported between Elk Road and Beach Road.

We note that this location does not meet or exceed the accident requirements set forth within MUTCD to fulfill the accident warrant criteria. The only 12-month period where five (5) incidents or more were reported was in 2015. However, of the eight (8) accidents reported that year only two (2) would be correctable by a STOP Control, and neither incident was reported at Elk Road or Overhill Road. However, based upon the residential make-up of the area, the elementary school in the area, and the frequency of accidents reported throughout the study roadway, it is our opinion that traffic calming measures should be implemented in order to minimize the occurrence of accidents and improve safety for both motorists and pedestrians. We provide recommendations for traffic treatments in our conclusions.

SPEED SURVEY DATA

Speed data was collected by the Bright View Engineering and analyzed as per the recommended ITE and MUTCD standards. Data was collected along Elmwood Road on 07/25/19 for both travel directions. The findings of the speed survey may be seen below:

Table 2 – Speed Survey Data

	North 15th Street			
	Average Speed (MPH)	**85th Speed (MPH)**	**% of Data Points Exceeding 25 MPH**	**Highest Recorded Speed (MPH)**
Direction 1 (NB)	28	32	74	40
Direction 2 (SB)	30	33	90	39
Roadway	29	32	82	40

From **Table 2** above we observe that the average of the speeds observed are greater than 25 MPH, while the 85th Percentile speeds of vehicles are greater than 30 MPH. The largest number of vehicles traveling over 25 MPH were observed in the southbound travel direction at a rate of approximately 90% while the northbound direction was observed at a rate of 74%. The highest speed observed for the roadway was 40 MPH in the northbound travel direction. We concluded from this data and our field observations that approximately less than a fifth of the volume on the road is not traveling above 25 MPH.

Based on the data presented above for the roadway, it is our opinion that speeding occurs along Elmwood Road, and it is an issue that should be addressed. Additionally, while none of the accidents presented within the accident data attribute causation to unsafe travel speeds, we must consider that the study area is residential in nature and that there is a school present. Based on this information, we recommend that the Township consider implementing traffic treatments in order to curb speeding along Elmwood Road. Such treatments may include, but are not limited to, additional striping, striping on-street parking aisles to both define parking areas and to narrow travel lanes down, striping a centerline to demarcate opposing travel directions and also narrow down travel lanes, posting speed limit signs more prominently throughout each roadway segment, and the use of solar-powered driver indication signs may also be considered. We have observed that when driver's are presented with live indications of their travel speed and speed limits are posted more prominently along a roadway, that drivers tend to slow down and travel more closely to the speed limit.

It is our opinion that areas of parking prohibition should also be more clearly signed and striped along the curb lines. Guidance on parking prohibition practices may be found in section 39:4-138 of Title 39. This should be implemented particularly in areas where sight distance is a concern,

such as the corners of an intersection, or where the roadway geometry causes drivers to shift into from their side of the travel lane into oncoming traffic; such as the bend in Elmwood Road north of Elk Road.

TRAFFIC VOLUME DATA

Traffic Volume data was collected by Bright View Engineering and analyzed as per the recommended ITE and MUTCD standards. Data was collected along Elmwood Road at the intersection with Lanning Road and Overhill Road on Thursday, July 25, 2019 for all travel directions. Thursday represents a typical weekday under normal traffic operation.

The traffic volume data was collected using Manual Turning Movement (MTM) counts. Counts were conducted between the weekday hours of 7:00 AM and 9:00 AM in the morning and 4:00 PM and 6:00 PM in the evening.

Based on the traffic volumes observed, the intersection AM Peak Hours occurred from 8:00 AM to 9:00 AM and PM Peak Hours were observed from 4:15 PM to 5:15 PM. The following table details the peak hour traffic volumes observed at the study interactions:

Table 3 – 2019 Existing Traffic Volumes

Peak Hour of Operation	Elmwood Road SB			Overhill Road WB			Elmwood Road NB			Lanning Road EB		
	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left
8:00 AM 9:00 AM	5	99	28	4	0	1	2	62	22	0	0	0
4:15 PM 5:15 PM	1	65	3	2	0	2	2	121	8	0	0	0

From **Table 3** above we noticed that Elmwood Road processes a much larger volume than Overhill Road. Based upon the existing traffic patterns and the traffic volume data collected at the study intersection, it appears that Elmwood Road is properly defined as the major street approach based upon the traffic volume which it is processing.

We observe from the Count Data above in **Table 3** that the volumes at the intersection of Elmwood Road and Lanning Road/Overhill Road do not meet the volume requirements set forth for a Multi-Way STOP:

- the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and

- the combined vehicular, pedestrian, and bicycle volume entering the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours.

We observe from the volume table above that the volumes for both the major and minor streets do not meet the 300 and 200 vehicles per hour volume requirements respectively during the peak hour. As such, the installation of a Multi-Way STOP at this location cannot be warranted based upon the volume requirements at this time. HOWEVER, due to the roadway geometry and sight distance concerns, we do recommend that a Multi-Way STOP control be implemented at this intersection to prevent any turning conflicts with vehicles traveling along the mainline.

Based upon the existing roadway geometry and sight distance conditions at Elk Road and Elmwood Road, we would recommend that the Multi-Way STOP Control be implemented at this location, creating a three-way STOP controlled intersection. It is our opinion that this is appropriate based upon the existing sight distance limitations at the intersection and safety concerns for the adjacent elementary school. Our recommendations are based upon the guidance presented within sections 2B.04, 2B.05, 2B.06, & 2B.07 of the MUTCD.

SUMMARY

BVE performed on-site observations and an in-depth review of both traffic volume, speed, and accident data provided by the Township of Verona for the study intersections.

The results of our analysis indicate that a Multi-Way STOP **is recommended** at the intersection of Overhill Road and Elmwood Road due to the existing geometric conditions. Additionally, foliage along the north and south corners of this approach should be trimmed back in order to improve sight distance at the intersection and help prevent any turning conflicts. A a three-way STOP control should be signed properly at this intersection.

Based upon the existing conditions present at the intersection of Elk Road and Elmwood Road **it is recommended** that a Multi-Way STOP control be implemented due to concerns with sight distance and the resulting safety issues for approaching vehicles and pedestrians seeking to access the adjacent elementary school. This intersection should be signed to create a three-way STOP Controlled intersection.

Parking prohibition should be implemented at all corners based upon the guidance presented within Title 39. Additionally, parking should be prohibited along the bend on Elmwood Road, approximately 150’ north of Elk Road. Prohibiting parking along this area with help reduce the potential for head-on conflicts, sideswipes, and conflicts with backing vehicles out of driveways.

We utilized the following criteria in evaluating the study location for the application of a Multi-Way STOP treatment. Based upon MUTCD, Section 2B.07 Multi-Way Stop Applications, the following justification is provided:

Support:

01 Multi-way stop control can be useful as a safety measure at intersections if certain traffic conditions exist. Safety concerns associated with multi-way stops include pedestrians, bicyclists, and all road users expecting other road users to stop. Multi-way stop control is used where the volume of traffic on the intersecting roads is approximately equal.

02 The restrictions on the use of STOP signs described in Section 2B.04 also apply to multi-way stop applications.

Guidance:

03 *The decision to install multi-way stop control should be based on an engineering study.*

04 *The following criteria should be considered in the engineering study for a multi-way STOP sign installation:*

A. *Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.*

B. *Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.*

C. *Minimum volumes:*

1. *The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and*
2. *The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but*
3. *If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.*

D. *Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.*

Option:

05 Other criteria that may be considered in an engineering study include:

A. The need to control left-turn conflicts;

B. The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes;

C. Locations where a road user, after stopping, cannot see conflicting traffic and is not able to negotiate the intersection unless conflicting cross traffic is also required to stop; and

D. An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop control would improve traffic operational characteristics of the intersection.

CONCLUSIONS & RECOMMENDATIONS

It is our opinion, based on our field observations, the above guidance from MUTCD, and the existing geometric conditions at the study intersections that a Multi-Way STOP application ***is recommended*** for Elk Road and Elmwood Road as well as Overhill Road and Elmwood Road, at this time. We provide the following reasons to substantiate our findings:

- We observed limited sight distance for both stopped vehicles and for vehicles approaching the study intersections along Elmwood Road. We found both the Stopping Sight Distance for a vehicle approaching on Elmwood Road (*200' min. req.*) and Intersection Sight Distance for stopped vehicles on Overhill Road/ Elk Road (*335' for left; 290' for right*) to be insufficient. Our findings were based upon guidance from AASHTO's Policy on Geometric Design of Highways and Streets;

- The sight triangles along the corners at the study intersections were obstructed due to foliage, fencing, sign poles, roadway geometry, changes in grade, and landscaping features adjacent to the travel way along adjacent property frontage;

- We recommend that the intersection be striped to prohibit parking near points of conflict per the guidance set forth in *MUTCD* and *Title 39:4-138*. This will help keep vehicles off of the corners at intersection and improve sight distance.

- Additionally, parking should be prohibited along the bend on Elmwood Road, approximately 150' north of Elk Road. Prohibiting parking along this area with help reduce the potential for head-on conflicts, sideswipes, and conflicts with backing vehicles out of driveways;

- The volumes observed at the intersection of Elmwood Road and Laning Road/ Overhill Road did not meet the criteria set forth by MUTCD for a Multi-Way STOP application. However, it is our opinion that a Multi-Way STOP Control should be implemented at the intersection due to the roadway's geometry, sight distance limitations, and to prevent turning conflicts;

- The accident data presented did not meet the requirements set forth within the MUTCD for a Multi-Way STOP Control (*5 correctable incidents within a 12-month period*). However, we observed that from January 2014 to December 2018 an accident frequency of approximately 4.8 accidents was experienced. Thus, we recommend that additional traffic calming measures be implemented to help reduce the frequency of accidents and improve safety along the roadway segment;

- We observed from the collected speed data, that average speeds along Elmwood Road are beginning to approach 30 MPH, while the 85TH Percentile Speed exceeds 30 MPH. We recommend that the Township consider re-striping the roadway segment to either incorporate a centerline or striped parking aisles to narrow down the travel way and deter speeding;

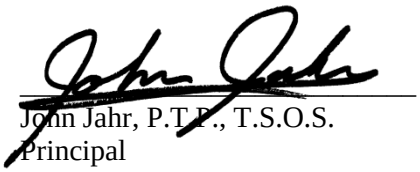
- We did not observe any speed limit signs during our field visits to the study intersection. We recommend that the Township consider posting speed limit signs more prevalently along the roadway segment, solar-powered driver feedback signs can also be considered. We have observed in the field that roadways which give live driver feedback for approaching vehicle travel speed tend to experience lower speeds than roadway segments which do not;

- It is our recommendation that the Township consider implementing an international crosswalk pattern throughout all its pedestrian crossings. This striping pattern should be comprised of white 24" wide bars, set 4' on center, and no less than 6' tall; we would recommend an 8' tall crossings from curb line to curb line, particularly around the elementary school. This pattern provides greater visibility for both pedestrians and motorists who approach the facility, greater painted surface area provides greater reflectivity during night-time lighting conditions, and due to how the pattern is laid out it may require less upkeep costs for the Township due to reduced wear and tear; and

- Additional treatments such as rumble strips, pavement surface treatments (*Safe-T-Grip*), or micro-milling should be considered along Elmwood Road near the elementary school. This, along with school zone signs, school crossings signs, and school zone flashing signs will make drivers more aware of the adjacent school facilities and help improve safety along the Elmwood Road school route. School zone striping which is in place along the pavement surface should be refreshed and striped more prominently along Elmwood Road in advance of the elementary school. We did not observe any school crossing signs near Elk Road.

Should you have any questions or require additional information please do not hesitate to contact us at (732) 236-7557.

Very truly yours,



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JJJ/jdr
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