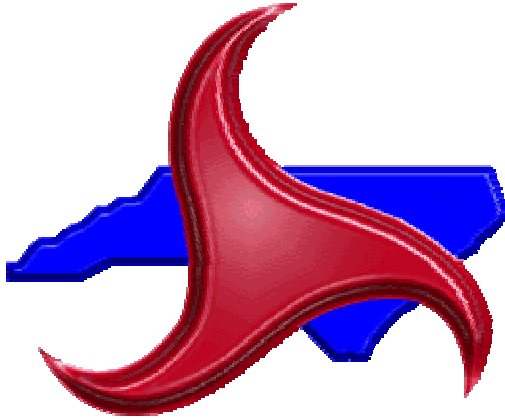


An Evaluation of the Effectiveness of School Zone Flashers



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Executive Summary

This report summarizes the effectiveness of placing flashing beacons on school zone speed limit signs to improve speed compliance in school zones. A sample set of fifteen treatment school zones with flashers and fifteen comparison school zones without flashers were selected for analysis throughout North Carolina. Speed data was collected at all sites during the reduced speed school zone hours of operation (school time) and outside the reduced speed school zone hours of operation (non-school time). The school time speed limits at all sites ranged between 25 mph to 45 mph. An evaluation of the treatment and comparison sites yield the following results:

- The speed distributions of both flasher and non-flasher locations were similar during the school time. It appears there was no practical difference in vehicle speeds between the flasher and non-flasher locations during school time hours.
- At the flasher sites, 5.6 percent fewer vehicles exceeded the speed limit and average speeds were 0.4 mph less than the non-flasher sites during school time. The 85th percentile speed was 0.1 mph higher at the flasher locations and the pace speeds were the same during school time.
- There was an 11.8 percent greater compliance to 35-mph or greater school time speed limits at flasher sites than non-flasher sites. On the other hand, there was a 2.9 percent greater compliance to 25-mph speed limits at non-flasher sites. The differences in speed data at 25-mph and 35-mph or greater school time speed limits are significant but not practical. The difference in average speeds was between one to two mph.
- Both locations with and without flashers had an extremely low compliance rate to the school time speed limit. The average speeds were approximately 6 mph above the school time speed limit, with the 85th percentile speeds exceeding the speed limit by 12 mph.
- The school time speed distribution was noticeably shifted to the left from the non-school time speed distribution. It appears that vehicle speeds did decrease from non-school time hours to school-time hours at both flasher and non-flasher sites. It appeared that motorists are making an effort to reduce their speed during the school time, although the speed reductions are not enough to bring them into compliance with the school time speed limit.
- The vehicles exceeding the non-school time speed limit decreased by 30.2 and 25.2 percent from non-school time to school time at flasher and non-flasher sites, respectively. The average, 85th percentile, and pace speed were also lower during the school time than the non-school time.
- Crash rates were examined at flasher and non-flasher sites but due to small sample sizes it was difficult to draw any conclusions from the data.

Introduction

School zones, defined as the section of road that abuts the school grounds, merit special consideration in establishing speed limits. Special regulatory speed limits are often established in school zones in an attempt to lower vehicle speeds during certain hours of the day, usually surrounding the beginning and ending of the school day. The intent is that lowering vehicle speeds will provide a safer environment on the street for motorists and pedestrians entering and exiting the school. Past studies on the effectiveness of school zone limits have generally reported poor driver compliance (1). School zone speed limits typically “represent an exception to normal driving speeds, and adequate speed adaptation is a problem as drivers approach the zones” (1).

With a considerable increase in the number of schools in the State of North Carolina, there have been increasing concerns regarding safety and traffic speeds in school zones. One approach to increase drivers’ compliance to the school zone speed limit is to provide more effective traffic control devices. In an attempt to provide more awareness to the school zone speed limit and at the request of schools, the North Carolina Department of Transportation (NCDOT) has placed flashing beacons on school zone signs where warranted. The flashers operate during the school zone hours of operation. According to the North Carolina Administrative Code (NCAC) Title 19A Chapter 2 Subchapter B, effective July 1, 1978:

Standard signing and marking for school zones is the responsibility of the Department of Transportation. If a traffic and engineering investigation conducted by the Department of Transportation shows that there are hazardous conditions present adjacent to a school greater than those normally present in school areas, and that these conditions can be alleviated by the use of school flashers, then the Department of Transportation will install school flashers and maintain them.

The purposes of this report are:

- Determine if flashers located in reduced speed school zones decrease speeds and increase speed compliance when compared to reduced speed school zones without flashers
- Examine differences in vehicle speeds and compliance rates in school zones during reduced speed school zone hours of operation (school time) versus hours outside the reduced speed school zone hours of operation (non-school time).
- Determine if (and by how much) motorists slow down during reduced speed school time hours.

Measures of Effectiveness

In order to examine the objectives of this report, it was necessary to determine vehicle speeds and compliance to speed limits in school zones during:

- School Time when a flasher and school zone speed limit sign are present,
- School Time when only a school zone speed limit sign is present,
- Non-School Time when a flasher and school zone speed limit sign are present, and
- Non-School Time when only a school zone speed limit sign is present.

The measures of effectiveness for this project include percentage of vehicles exceeding the speed limit, average vehicle speed, 85th percentile speed, and pace speed.

Site Selection

The Traffic Safety Unit Regional Traffic Engineers helped create a statewide listing of candidate school zone sites with flashers. Four of the eight Regional Traffic Offices were able to provide at least a partial listing of flasher locations in their region. Only locations where the flashers had a known installation date and were installed for at least three years were included as candidate sites. This criteria narrowed down the list to 76 possible school zone locations through the state of North Carolina.

Candidate comparison sites without flashers were identified by the NCDOT Traffic Engineering Accident Analysis System (TEAAS) ordinance system. The TEAAS ordinance system provides information on the location of school zones with reduced speed limits and the date of effectiveness. This information, along with additional design, volume, and speed characteristics were used to select candidate comparison sites that appeared to match the treatment sites as closely as possible. All school zone speed limits had been effective for at least three years.

Once the candidate sites were identified, field visits were made to those locations and the final sites for evaluation were selected. Fifteen sites with flashers were selected as the treatment group for this project. The sites contained dual flashers that were either mounted on a pole on the side of the roadway or on span wire above the roadway. See Figure 1 for configurations of signs with flashers. Fifteen sites without flashers were used as a comparison group. See Table 1 for the selected treatment and comparison sites and *Appendix A* for a statewide map of all the locations analyzed in this project.

Sites were selected to include a mix of geometric features and geographic elements. They were also located in urban, suburban, and rural areas. School time speed limits ranged from 25 to 45 mph. Congested sites with the potential for long queues during school zone times were not included in the final list. These sites were avoided because congestion would impede vehicle speeds.

Figure 1. Sign and flasher assemblies at two of the treatment locations



Table 1. School Zone Treatment and Comparison Sites

Treatment: Flasher Sites

County	School	Route	2005 AADT	Sign & Flasher Placement	Flasher Size & Number	School Times	ST* Speed (mph)	Non-ST** Speed (mph)
Guilford	Colfax Elementary	SR 1008	13,000	Overhead	8" double	7:25-8:25AM & 2:05-3:05PM	25	35
Guilford	Oak Ridge Elementary	NC 150	6,840	Overhead	8" double	7:25-8:25AM & 2:05-3:05PM	25	35
Guilford	Pleasant Garden Elementary	SR 3402	4,800	Post	8" double	7:25-8:25AM & 2:05-3:05PM	25	35
Montgomery	Candor Elementary	US 220A	3,200	Post NB/Overhead SB	8" double	7:30-8:30AM & 2-3PM	25	35
Randolph	Randleman Elementary	US220B	9,100	Post	8" double	7:30-8:30AM & 2:30-3:30PM	25	35
Moore	Southern Pines Elementary	SR 2080	8,000	Post	8" EB/12" WB double	7:30-8:30AM & 2:30-3:30PM	25	35
Moore	Vass-Lakeview Elementary	US1B	7,000	Post	8" double	7:30-8:30AM & 2:30-3:30PM	25	45
Cumberland	Luther Nick Jeralds Middle	US 401B	35,000	Post	12" double	7:45-8:45AM & 3-4PM	35	45
Moore	West End Elementary	NC 211	13,000	Post	12" double	7:30-8:30AM & 2-3PM	35	45
Randolph	New Market Elementary	US 311	13,000	Post	12" double	7-8AM & 1:45-2:45PM	35	45
Alamance	Alexander Wilson Elementary	NC 54	12,100	Post	8" double	7:30-8:30AM & 2-3PM	35	50
Montgomery	East Middle/East Montgomery High	US 220A	5,000	Post	8" double	7:30-8:30AM & 2:30-3:30PM	35	55
Cumberland	Cape Fear High/Mac Williams Middle	SR 1006	5,500	Post	12" double	7:50-8:50AM & 3-4PM	35	55
Alamance	Western High	NC 87	6,300	Overhead	8" double	7:45-8:45AM & 2:30-3:30PM	40	50
Cumberland	Raleigh Road Elementary	US 401	8,400	Post	8" double	7:30-8:30AM & 1:45-2:45PM	45	55



Comparison: Non-Flasher Sites

County	School	Route	2005 AADT	Sign Placement	Flasher Size & Number	School Times	ST* Speed	Non-ST** Speed
Wake	Broughton High	Peace St	20,000	Post	None	7:30-9:30AM & 2:45-4:15PM	25	35
Randolph	Donna Lee Loflin School	SR 1451	5,200	Post	None	7:25-8:25AM & 1:55-2:55PM	25	35
Cumberland	Douglas Byrd Junior & Senior High/ Fayetteville Christian/ Ireland Dr Middle	SR 1219	12,000	Post	None	7:50-9AM & 2-4PM	25	35
Forsyth	Griffith Elementary & High/ Middle School Academy	SR 2747	15,000	Post	None	7:50-8:50AM, 12:15-1:15PM, 2:20-3:20PM	25	35
Cumberland	Hope Mills Middle	SR 1131	12,000	Post	None	8-9AM & 3-4PM	25	35
Cumberland	Rockfish Elementary	SR 1112	12,000	Post	None	7:30-8:30AM & 1:45-2:45PM	25	35
Montgomery	Troy Elementary	SR 1333	1,500	Post	None	7:30-8:30AM & 2:30-3:30PM	25	35
Wake	Vandora Springs Elementary	SR 2713	5,100	Post	None	8:45-9:45AM & 3:15-4:15PM	25	35
Cumberland	Elizabeth Cashwell Elementary	SR 1132	12,000	Post	None	7:30-8:30AM & 1:45-2:45PM	35	45
Forsyth	Kerwin Baptist /Cash Elementary	NC 66	13,000	Post	None	7:50-8:50AM & 2:20-3:20PM	35	45
Cumberland	Southview Senior High and Middle	SR 1363	6,600	Post	None	7:55-9AM & 2:55-4PM	35	45
Guilford	Vandalia Christian School	SR 3505	6,300	Post	None	7:30-8:30AM & 2:30-3:30PM	35	45
Randolph	Level Cross Elementary	SR 2115	1,600	Post	None	7:15-8:15AM & 2-3PM	35	55
Alamance	Western Middle	NC 87	4,300	Post	None	7:25-8:25AM & 2:30-3:30PM	40	50
Randolph	Farmer Elementary	NC 49	5,800	Post	None	7:30-8:30AM & 2-3PM	45	55

* ST denotes School Time or the reduced speed school zone hours of operation.

** Non-ST denotes Non-School Time or the hours outside the reduced speed school zone hours of operation.

Data Collection

Speed collection was done with a Lidar gun. Data was collected in both directions of travel within the limits of the school zone on typical weekdays (Tuesday, Wednesday, or Thursday) when school was in session. The data collection dates ranged from December 2006 through March 2007. School calendars for the 30 sites were obtained and reviewed to ensure that data was not collected during holiday weeks or on teacher workdays. All data collection was done under favorable, dry weather conditions. See *Appendix B* for data collection sheets completed for each flasher site and *Appendix C* for data collection sheets completed for each non-flasher site.

Speed data was collected at each site for the morning and afternoon school time for the entire duration (approx. one hour) that the reduced speed limit was in effect. School times varied by school between the hours of 7:00 AM to 9:45 AM and 1:45 PM to 4:15 PM. At least 100 speed samples or one hour of data collection was also obtained at each site in the morning and afternoon during non-school time hours. Non-school time data collection began (ended) at least 30 minutes after (before) the school time.

Data collectors targeted only unimpeded vehicles that were setting their own speed. Vehicles in platoons were excluded from the study, as they were not actively choosing the speed at which they were travelling. This allows us to determine if the traffic control has an effect on the drivers that are selecting their own speeds.

All attempts were made to collect data from an inconspicuous spot so as not to influence the driver's speed. Parking the vehicle in a highly visible location when collecting data may influence drivers to slow down.

Results

Speed Data Analysis

Table 2 contains the results of the speed data analysis. The speed data was organized by school time and non-school time data sets for flasher and non-flasher sites. Separate calculations were also made for the school time data set with speeds referenced from both the school time speed limit and the non-school time speed limit. School time data with speeds referenced from the non-school time speeds limit were included so that a comparison could be made between speeds in school time and non-school time hours.

Various characteristics of the distribution of speeds were calculated for each group analyzed, including the percent vehicles exceeding the speed limit, average speed, standard deviation, 85th percentile speed, and pace speed. The percentage of vehicles exceeding the speed limit provides information on the level of compliance. The average speed is the mean speed, a common measure of the central tendency (1). The standard deviation provides information on the dispersion in speeds, which effects the potential for vehicle conflicts (1). Studies have shown a correlation between increasing speed dispersion and crash rates (1). In general, speed dispersion increases as the difference between the design speed of the roadway and the speed limit increases (1). The 85th percentile traffic speed is important because it is a common factor considered in setting speed zone limits and is a measure of the vehicle dispersion. Safety is enhanced as the spread between the average speed and the 85th percentile speed is reduced. The pace speed is the 10-mph range that includes the greatest percentage of vehicles. In Table 2, the 10-mph range and the percentage of vehicles in the range are provided. The pace speed provides another measure of speed dispersion. Safety may be enhanced when the pace speed includes more than 70 percent of vehicles (1).

Table 2. Summary of School Zone Speed Data Collected at Flasher and Non-Flasher Sites During School Time and Non-School Time Hours

A) Speed Data Collected During School Time Hours (With Speeds Referenced From The School Time Speed Limit)

	Observations	Vehicles Exceeding Speed Limit	Average Speed Above (+) / Below (-) Speed Limit (mph)	Standard Deviation (mph)	85th Percentile Speed Above (+) / Below (-) Speed Limit (mph)	Pace Speed Above (+) / Below (-) Speed Limit (mph)
Flashers - Total	6386	76.3%	+5.6	6.7	+12.1	0 to +10 (64%)
Flashers (25 mph ST)	2813	86.1%	+7.8	6.7	+14.0	+1 to +11 (60%)
Flashers (35+ mph ST)	3573	68.6%	+3.9	6.2	+10.1	-2 to +8 (63%)
NonFlashers - Total	5669	81.90%	+6.0	5.9	+12.0	0 to +10 (64%)
NonFlashers (25 mph ST)	3079	83.20%	+6.3	5.9	+12.4	0 to +10 (64%)
NonFlashers (35+ mph ST)	2590	80.40%	+5.7	6.0	+11.5	0 to +10 (64%)

B) Speed Data Collected During School Time Hours (With Speeds Referenced From The Non-School Time Speed Limit)

	Observations	Vehicles Exceeding Speed Limit	Average Speed Above (+) / Below (-) Speed Limit (mph)	Standard Deviation (mph)	85th Percentile Speed Above (+) / Below (-) Speed Limit (mph)	Pace Speed Above (+) / Below (-) Speed Limit (mph)
Flashers - Total	6386	16.0%	-6.5	7.2	+0.3	-11 to -1 (59%)
Flashers (25 mph ST)	2813	23.5%	-3.7	5.8	+1.9	-9 to +1 (66%)
Flashers (35+ mph ST)	3573	10.1%	-8.7	7.5	-1.9	-13 to -3 (58%)
NonFlashers - Total	5669	22.10%	-4.4	6.3	+1.8	-10 to 0 (62%)
NonFlashers (25 mph ST)	3079	24.40%	-3.7	5.9	+2.5	-10 to 0 (64%)
NonFlashers (35+ mph ST)	2590	19.30%	-5.2	6.6	+1.1	-10 to 0 (60%)

C) Speed Data Collected During Non-School Time Hours (With Speeds Referenced From The Non-School Time Speed Limit)

	Observations	Vehicles Exceeding Speed Limit	Average Speed Above (+) / Below (-) Speed Limit (mph)	Standard Deviation (mph)	85th Percentile Speed Above (+) / Below (-) Speed Limit (mph)	Pace Speed Above (+) / Below (-) Speed Limit (mph)
Flashers - Total	6020	46.20%	-0.1	6.1	+5.5	-5 to +5 (65%)
Flashers (25 mph ST)	2605	53.30%	+1.3	6.1	+7.0	-4 to +6 (65%)
Flashers (35+ mph ST)	3415	40.90%	-1.1	6.0	+4.4	-5 to +5 (65%)
NonFlashers - Total	5276	47.30%	0.0	5.9	+5.4	-5 to +5 (66%)
NonFlashers (25 mph ST)	2737	52.40%	+0.9	6.0	+6.4	-4 to +6 (64%)
NonFlashers (35+ mph ST)	2539	41.80%	-0.9	5.6	+4.3	-6 to +4 (69%)

For illustration purposes, assume a particular site has a 25 mph school time speed limit and a 35 mph non-school time speed limit. Table 2A is comprised of data collected while the 25 mph speed limit was in effect and the vehicle speeds are referenced above (or below) 25 mph. Table 2B is also comprised of data collected while the 25 mph speed limit was in effect but the vehicle speeds are referenced above (or below) 35 mph. This data is provided so that a comparison could be made between vehicle speeds in school time and non-school time hours. Table 2C is comprised of data collected while the 35 mph speed limit was in effect and the speeds are referenced above (or below) 35 mph.

The speed data in Table 2C shows that the treatment and comparison sites are similar. There are not conditions that would affect drivers' choice of speeds. The sites behaved the same during non-school time hours, which implies that the selected comparison group is a good match with the treatment group.

Flasher vs. Non-Flasher

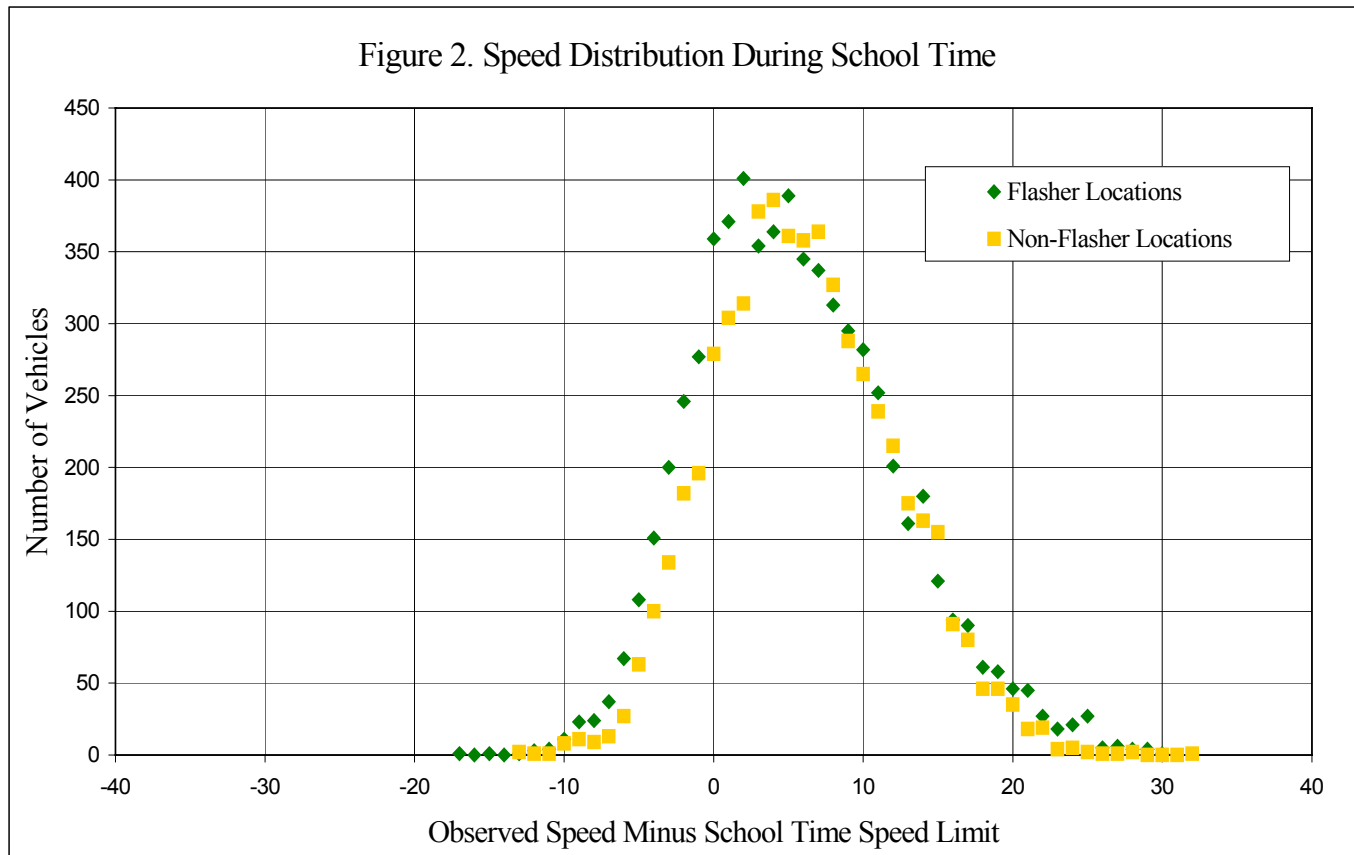
Table 3 and Figure 2 contain a summary of speed data collected at the treatment flasher locations and the comparison non-flasher locations during school time hours. As shown in Table 3, fewer vehicles exceeded the speed limit and average speeds were slightly lower at the flasher sites than the non-flasher sites. The 85th percentile speed was marginally higher at the flasher locations and the pace speeds were the same. As shown in Figure 2, the speed distributions of both flasher and non-flasher locations are similar during the school time. When considering the speed distribution information provided below, it appears there is only a minimal difference in speeds between the flasher and non-flasher locations. The flashers do not seem to be much more effective at lowering vehicle speeds than signing alone.

Both locations with and without flashers have an extremely low compliance rate to the school time speed limit. The average speeds were over 5 mph above the school time speed limit, with the 85th percentile speeds exceeding the speed limit by 12 mph.

Table 3. A Comparison of Speeds During School Time at Flasher and Non-Flasher Locations
(With Speeds Referenced from School Time Speed Limit)

	Non-Flashers	Flashers	Percent Difference
Vehicles Exceeding Speed Limit	81.9%	76.3%	-5.6*
Average Speed Above (+) / Below (-) Speed Limit (mph)	+6.0	+5.6	
85th Percentile Speed Above (+) / Below (-) Speed Limit (mph)	+12.0	+12.1	
Pace Speed Above (+) / Below (-) Speed Limit (mph)	0 to +10 (64%)	0 to +10 (64%)	

* Statistically Significant at the 95% Confidence Level



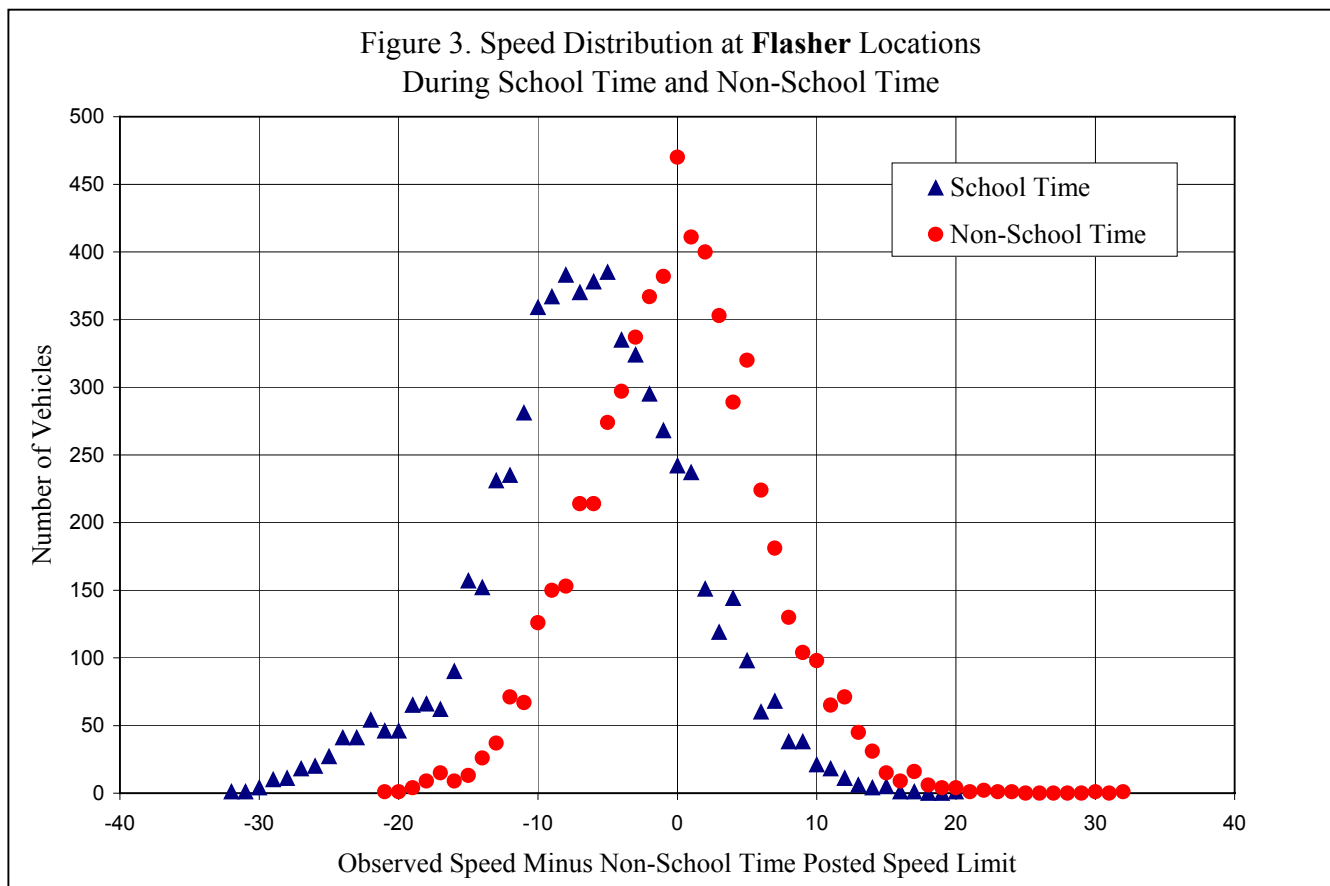
School Time vs. Non-School Time - Flashers

Table 4 and Figure 3 contain a summary of speed data collected at the treatment flasher locations during both school time and non-school time hours. The non-school time speed limit was used as the baseline speed so that school time and non-school time hours could be compared. As shown in Table 4, fewer vehicles exceeded the non-school speed limit and the average, 85th percentile, and pace speed were lower during the school time than the non-school time. As shown in Figure 3, the school time speed distribution is noticeably shifted to the left from the non-school time speed distribution. Average vehicle speeds decreased from non-school time hours to school-time hours at flasher sites by 5.2 mph.

Table 4. A Comparison of Speeds at Flasher Locations During School Time and Non-School Time
(With Speeds Referenced from **Non-School Time Speed Limit**)

	Non-School Time	School Time	Percent Difference
Vehicles Exceeding Speed Limit	46.2%	16.0%	-30.2*
Average Speed Above (+) / Below (-) Speed Limit (mph)	-0.1	-6.5	
85th Percentile Speed Above (+) / Below (-) Speed Limit (mph)	+5.5	+0.3	
Pace Speed Above (+) / Below (-) Speed Limit (mph)	-5 to +5 (65%)	-11 to -1 (59%)	

* Statistically Significant at the 95% Confidence Level



School Time vs. Non-School Time – Non-Flashers

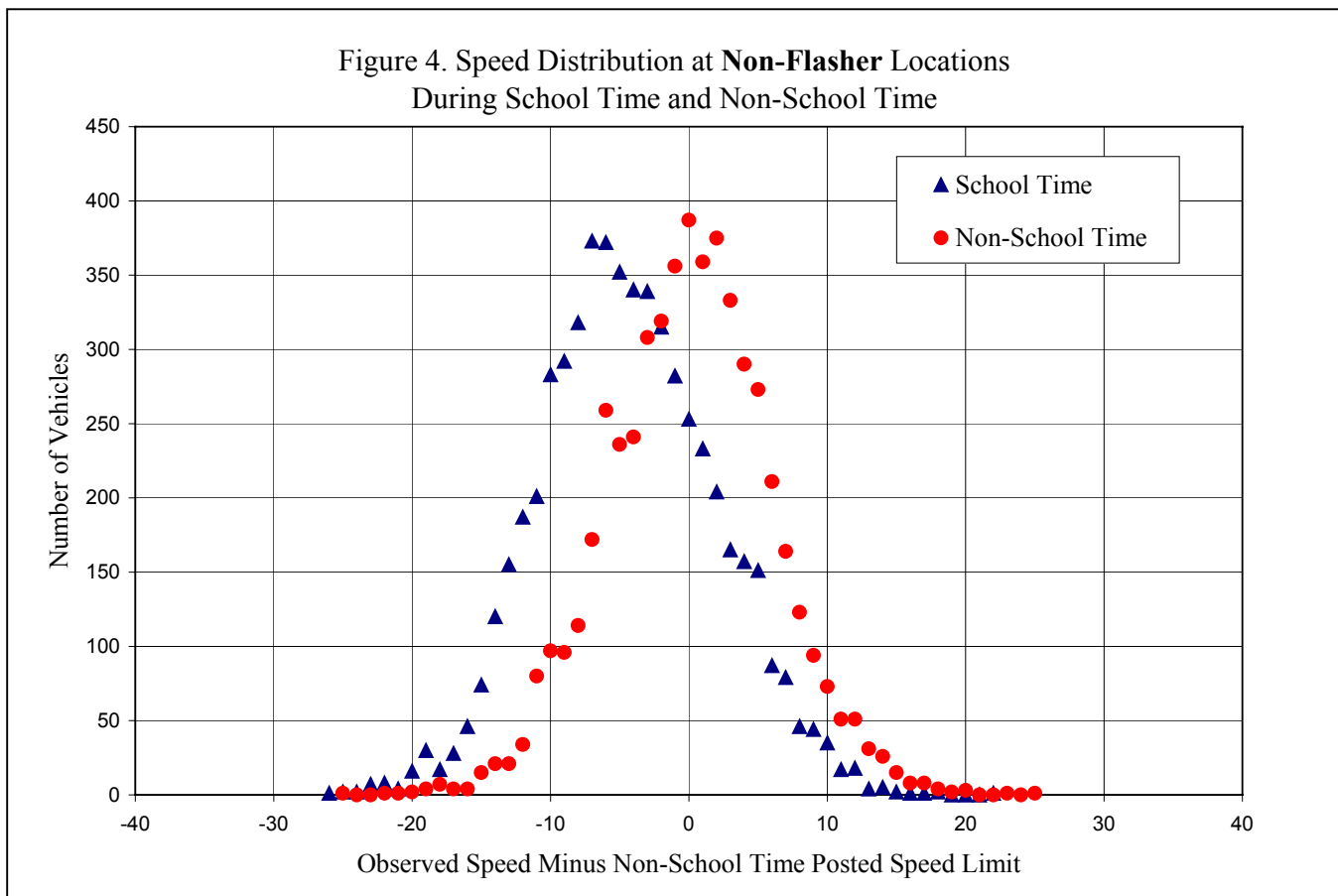
Table 5 and Figure 4 contain a summary of speed data collected at the comparison non-flasher locations during both school time and non-school time hours. As shown in Table 5, fewer vehicles exceeded the non-school speed limit and the average, 85th percentile, and pace speed were lower during the school time than the non-school time. As shown in Figure 4, similar to the flasher sites, the school time speed distribution is noticeably shifted to the left from the non-school time speed distribution. Average vehicle speeds decreased from non-school time hours to school-time hours at non-flasher sites by 4.4 mph.

Average vehicle speeds during school time hours were above the school time speed limit but below the non-school time speed limit at both flasher and non-flasher sites. This indicates that a majority of motorists are making an active effort to reduce their speed during the school time, although the speed reductions are not enough to bring them into compliance with the school time speed limit.

Table 5. A Comparison of Speeds at Non-Flasher Locations During School Time and Non-School Time (With Speeds Referenced from **Non-School Time Speed Limit**)

	Non-School Time	School Time	Percent Difference
Vehicles Exceeding Speed Limit	47.3%	22.1%	-25.2*
Average Speed Above (+) / Below (-) Speed Limit (mph)	0.0	-4.4	
85th Percentile Speed Above (+) / Below (-) Speed Limit (mph)	+5.4	+1.8	
Pace Speed Above (+) / Below (-) Speed Limit (mph)	-5 to +5 (66%)	-10 to 0 (62%)	

* Statistically Significant at the 95% Confidence Level



25-mph vs. 35-mph+ School Time Speed Limit

Table 6 contains a summary of speed data collected at the treatment flasher locations and the comparison non-flasher locations during school time hours. The data provides a comparison of vehicle speeds for locations with 25-mph and 35-mph or greater school time speed limits. As shown in Table 6, it appears there was greater compliance to 35-mph or greater school time speed limits at flasher sites than non-flasher sites. On the other hand, there was greater compliance to 25-mph speed limits at non-flasher sites.

The differences in speed compliance were statistically significant but not large enough to be practical. The difference in average speeds between flasher and non-flasher sites was only 1.5-mph for 25-mph school time speed limits and 1.8-mph for 35-mph or greater school time speed limits. A difference in average vehicle speeds of less than 2-mph have a minimal effect on safety regardless of whether the road is posted at 25 or 35 mph, as it represents only a 5 to 8 percent change in average speeds (1).

Table 6. A Comparison of Speeds During School Time at Locations with 25-mph and 35-mph or Greater School Time Speed Limits (With Speeds Referenced from School Time Speed Limit)

	25 mph School Time Speed Limit		
	Non-Flashers	Flashers	Percent Difference
Vehicles Exceeding Speed Limit	83.2%	86.1%	2.9*
Average Speed Above (+) / Below (-) Speed Limit (mph)	+6.3	+7.8	
85th Percentile Speed Above (+) / Below (-) Speed Limit (mph)	+12.4	+14.0	
Pace Speed Above (+) / Below (-) Speed Limit (mph)	0 to +10 (64%)	+1 to +11 (60%)	

	35-mph+ School Time Speed Limit		
	Non-Flashers	Flashers	Percent Difference
Vehicles Exceeding Speed Limit	80.4%	68.6%	-11.8*
Average Speed Above (+) / Below (-) Speed Limit (mph)	+5.7	+3.9	
85th Percentile Speed Above (+) / Below (-) Speed Limit (mph)	+11.5	+10.1	
Pace Speed Above (+) / Below (-) Speed Limit (mph)	0 to +10 (64%)	-2 to +8 (63%)	

* Statistically Significant at the 95% Confidence Level

Note: At flasher locations with 25-mph school time speed limits, six locations had a 10-mph drop and one location had a 20-mph drop from the non-school time to school time speed limits. At flasher locations with 35-mph+ school time speed limits, five locations had a 10-mph drop, one location had a 15-mph drop, and two locations had a 20-mph drop from the non-school time to school time speed limits.

Note: At non-flasher locations with 25-mph school time speed limits, all eight locations had a 10-mph drop from the non-school time to school time speed limits. At non-flasher locations with 35-mph+ school time speed limits, six locations had a 10-mph drop and one location had a 20-mph drop from the non-school time to school time speed limits.

Crash Analysis

Crash rates were evaluated to provide a complete study. Note, however, that due to the relative infrequency of crashes (and therefore small sample sizes) at these sites it is difficult to draw precise conclusions from the crash rate data. Table 7 contains a summary of the crash rates calculated for the flasher and non-flasher locations. The crash frequencies are provided next to each respective crash rate in parentheses. The crash data consisted of three years of reported crashes from November 1, 2003 through October 31, 2006. The ending date for this analysis was determined by the available crash data at the time the crash analysis was completed. See *Appendix D* for a crash data summary by site.

The Total Crash Rate included all crashes that occurred within the school zone limits. The School Time Crash Rate included only those crashes that occurred within the school time hours on a day in which school was in operation. The school days of operation were assumed using school calendars from 2006-2007. A School Time Day was calculated assuming an average of two one-hour school times per day and 192 school days per year (excluding weekends, summer vacation, and holidays). The Non-School Time Crash Rate included all crashes not occurring within the school time hours.

Table 7. Crash Rate Analysis for Flasher and Non-Flasher Locations

	Non-Flashers	Flashers	Percent Difference
Total Crash Rate in Crashes/Mi/100 Days	1.757 (82)	2.172 (88)	23.6
ST* Crash Rate in Crashes/Mi/100 ST Days	13.201 (27)	15.203 (27)	15.2
Non-ST** Crash Rate in Crashes/Mi/100 Non-ST Days	1.233 (55)	1.575 (61)	27.7

* ST denotes School Time or the reduced speed school zone hours of operation.

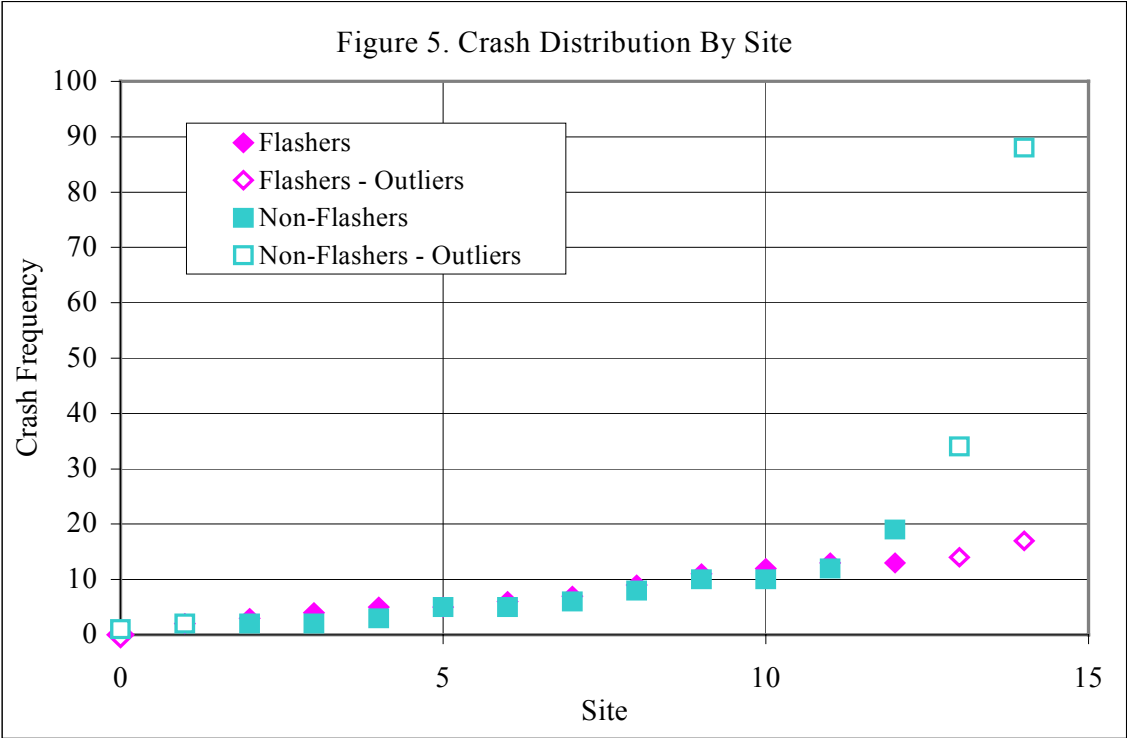
** Non-ST denotes Non-School Time or the hours outside the reduced speed school zone hours of operation.

As shown in Table 7, the School Time Crash Rate was lower at non-flasher locations than at flasher locations. The Non-School Time Crash Rate was also lower at the non-flasher locations, which means that these locations are experiencing fewer crashes regardless of school time effects.

Both flasher and non-flasher locations experienced an approximately 90 percent decrease in crash rates from school time to non-school time hours. It appears that a large proportion (approximately 30 percent) of crashes at the sites are occurring within the short time frame that schools are opening and closing, when school related traffic is at its peak and there are higher proportions of turning and stopping traffic.

During school time hours there may be a higher than average number of pedestrians traversing the school zone. Especially vulnerable are exposed children. Due to this fact, the number of pedestrian crashes was also examined at all 30 sites. There were five total pedestrian crashes (2 percent of total crashes). None occurred during school time hours. Only one pedestrian related crash involved a school-aged child (5-18 years old) but it took place on a Saturday evening.

Note that the top and bottom two crash locations were excluded from the flasher and non-flasher crash rate calculation. The removal of outliers was appropriate because of the crash totals at two non-flasher locations, Broughton High School and Elizabeth Cashwell Elementary, that contained over 50 percent of the total non-flasher crashes. Since we excluded outliers from the top of the distribution, for balance, we excluded the bottom two. See Figure 5 for a scatter plot of crash frequencies by location.



Conclusion

This study examined whether flashers located in school speed zones decrease speeds and increase compliance with the speed limit during school time hours when compared to sites without flashers. A minimal decrease in vehicle speeds and in the percentage of vehicles exceeding the speed limit occurred at the flasher sites. The speed distributions of both flasher and non-flasher locations appeared distinctly similar during the school time hours. Both groups had extremely low compliance rates to the school time speed limit. The average speeds for all sites were over 5 mph above the school time speed limit, with the 85th percentile speeds exceeding the speed limit by 12 mph. Overall, the flashers did not appear to be more effective at lowering vehicle speeds in school zones than signing and pavement markings alone.

The difference in vehicle speeds and compliance rates from non-school time hours to school time hours was also examined for both flasher and non-flasher sites. At all sites, vehicle speeds decreased during school-time hours. Fewer vehicles exceeded the non-school speed limit and the speed distribution was noticeably shifted during school time hours as compared to non-school time hours. Average vehicle speeds during school time hours were above the school time speed limit but below the non-school time speed limit at both flasher and non-flasher sites. This indicates that regardless of the presence of flashers a majority of motorists were making an effort to reduce their speed during the school time, although the speed reductions were not enough to bring them into compliance with the school time speed limit.

This study also analyzed differences in vehicle speeds and speed compliance when the school zone speed limits were set at different speeds. The results showed a greater compliance to the school time speed limit at flasher locations than at non-flasher locations when it was set at higher speeds (35-mph or greater). However, when the school time speed limit was set at a lower speed (25-mph) the compliance rates were greater at non-flasher locations. The results were statistically significant but not practically different. The difference in average speeds between flasher and non-flasher sites was only 1.5-mph for 25-mph school time speed limits and 1.8-mph for 35-mph or greater school time speed limits. A difference in average vehicle speeds of less than 2-mph have a minimal effect on safety regardless of whether the road is posted at 25 or 35 mph, as it represents only a 5 to 8 percent change in average speeds (1).

Crash data was examined to provide a more comprehensive evaluation, but due to the sample sizes it was difficult to draw any solid conclusions. Crash rates were calculated for flasher and non-flasher sites during school time and non-school time hours. A comparison of crash data revealed that crash rates were lower at non-flasher locations during both school time and non-school time hours. Whether or not the presence of flashers affected the crash rates is unclear. Both flasher and non-flasher sites experienced substantial increases in crash rates during school time hours.

References

1. Transportation Research Board. Special Report 254: Managing Speed, Review of Current Practice for Setting and Enforcing Speed Limits. TRB, National Research Council, Washington, D.C., 1998.

APPENDICES

A) LOCATION MAP OF SCHOOL ZONES EVALUATED

B) DATA COLLECTION SHEETS FOR FLASHER SITES

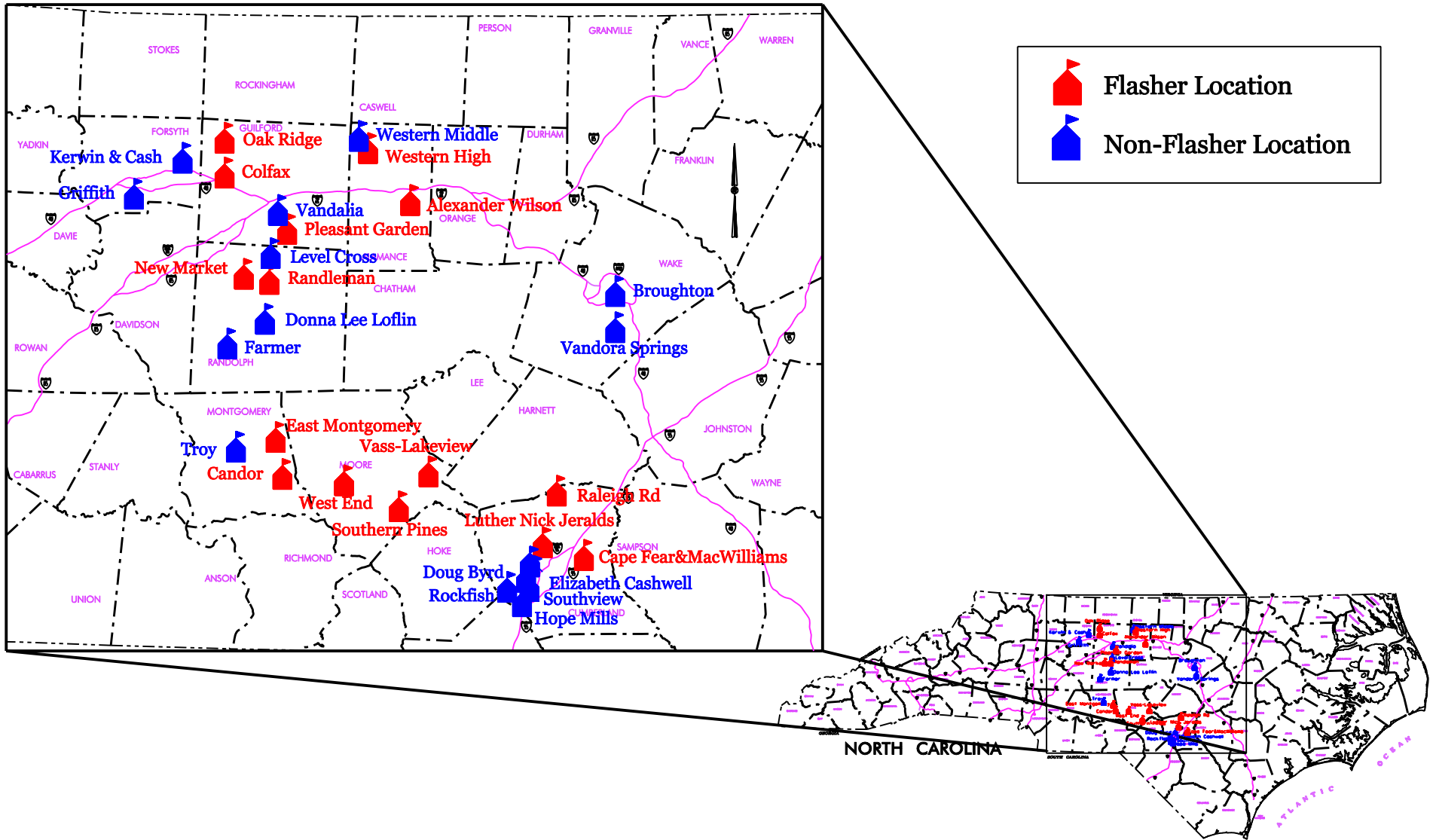
C) DATA COLLECTION SHEETS FOR NON-FLASHER SITES

D) CRASH DATA SUMMARY

APPENDIX A

LOCATION MAP OF SCHOOL ZONES EVALUATED

School Zone Locations Evaluated



APPENDIX B

DATA COLLECTION SHEETS FOR FLASHER SITES

New Market Elementary

6096 US 311; Sophia, NC

Flashers Installed: 10/8/98

35 mph speed limit on US 311 effective from 7:00 a.m. to 8:00 a.m. and 1:45pm to 2:45pm.
Speed limit is **45 mph** during **non-school zone hours**.



Speed Study on Tuesday, 1/9/07

Morning School Zone Data Collection 7:00-8:00AM

Afternoon School Zone Data Collection 1:45-2:45PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	38.7	39.8	45.5	43.3	42.1	41.5
85th Percentile Speed (mph)	43.3	44.8	51.4	48.5	49.0	47.2
Vehicles Exceeding ST Speed Limit (%)	73.6	82.1	91.4	86.3	82.5	84.2
Vehicles Exceeding Non-ST Speed Limit (%)	10.0	14.6	55.7	37.0	32.9	25.6
Total Observations	140	151	140	146	280	297

Morning Non-School Zone Data Collection 8:30-9:30AM

Afternoon Non-School Zone Data Collection 12:15-1:15PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	49.3	47.9	49.0	47.2	49.2	47.6
85th Percentile Speed (mph)	53.7	52.3	53.4	50.6	53.6	51.5
Vehicles Exceeding Non-ST Speed Limit (%)	83.3	71.6	77.1	64.1	80.4	67.8
Total Observations	114	116	105	117	209	233

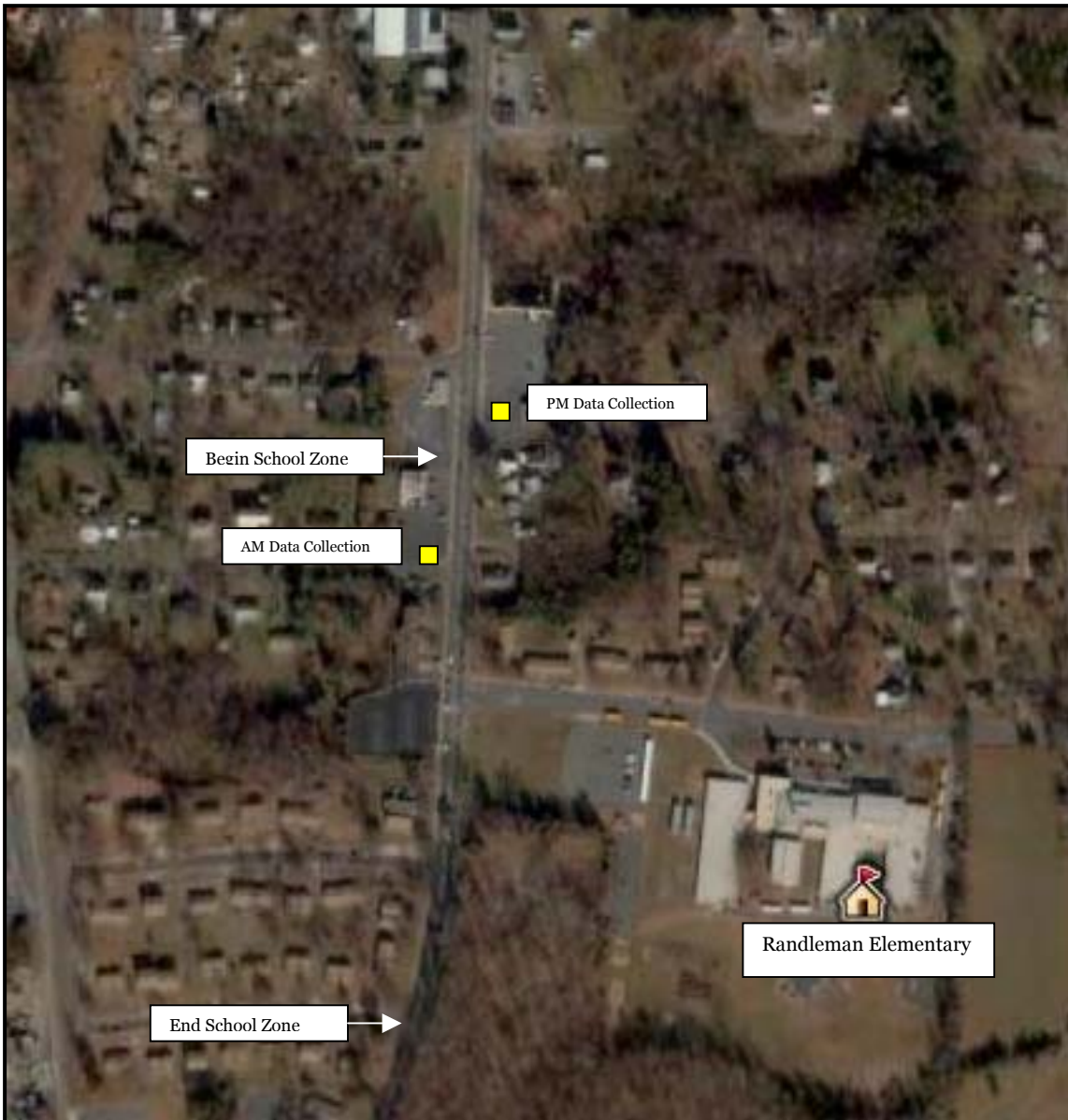
*School Time (ST) indicates when the lower speed limit is in effect.

Randleman Elementary

100 Swaim Street; Randleman, NC

Flashers Installed: 11/8/1993

25 mph speed limit on Swaim Street effective from 7:30 a.m. to 8:30 a.m. and 2:30pm to 3:30pm.
Speed limit is **35 mph during non-school zone hours**.



Speed Study on Wednesday, 1/10/07

Morning School Zone Data Collection 7:30-8:30AM

Afternoon School Zone Data Collection 2:30-3:30PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	33.7	35.7	31.6	34.1	38.7	42.5
85th Percentile Speed (mph)	38.0	40.0	36.5	39.0	59.3	59.5
Vehicles Exceeding ST Speed Limit (%)	92.5	100.0	84.7	95.8	88.4	97.8
Vehicles Exceeding Non-ST Speed Limit (%)	33.1	48.1	25.0	39.4	28.9	43.6
Total Observations	133	133	144	142	277	275

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 1:00-2:00PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	36.2	36.2	35.6	37.5	35.9	36.8
85th Percentile Speed (mph)	39.9	39.5	39.4	40.5	39.7	39.9
Vehicles Exceeding Non-ST Speed Limit (%)	50.9	54.2	51.1	68.4	51.0	61.3
Total Observations	112	96	92	95	204	191

*School Time (ST) indicates when the lower speed limit is in effect.

Candor Elementary

414 South Main Street; Candor, NC

Flashers Installed: 8/24/1976

25 mph speed limit on Main Street effective from 7:30 a.m. to 8:30 a.m. and 2:00pm to 3:00pm.
Speed limit is **35 mph during non-school zone hours**.



Speed Study on Thursday, 1/11/07

Note that speed data collection was interrupted for portions of both the morning and afternoon school zone times due to several events. A police car was parked at the school entrance on South Main Street with its flashers on from 7:30-7:55AM and 2:30-2:38PM. A traffic guard also stopped traffic at 2:35 PM. In addition, the flashers on at least one of the school zone signs was not activated from 2:00-2:15PM. These time periods were excluded from the data below.

Morning School Zone Data Collection 7:30-8:30AM

Afternoon School Zone Data Collection 2:00-3:00PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	32.6	33.2	31.0	31.8	31.6	32.4
85th Percentile Speed (mph)	36.7	39.0	35.5	36.2	36.3	37.6
Vehicles Exceeding ST Speed Limit (%)	88.9	88.2	78.3	88.5	82.3	88.4
Vehicles Exceeding Non-ST Speed Limit (%)	25.0	32.4	16.7	21.2	19.8	25.6
Total Observations	36	34	60	52	96	86

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 1:00-2:00PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	35.0	37.2	35.2	33.7	35.1	35.5
85th Percentile Speed (mph)	41.3	41.6	40.0	38.4	40.6	40.4
Vehicles Exceeding Non-ST Speed Limit (%)	40.8	62.9	47.1	33.3	44.4	48.9
Total Observations	76	70	102	63	178	133

*School Time (ST) indicates when the lower speed limit is in effect.

East Montgomery Middle and High

1834 US 220A; Biscoe, NC

Flashers Installed: 11/5/1990

35 mph speed limit on US 220A effective from 7:30 a.m. to 8:30 a.m. and 2:30pm to 3:30pm.
Speed limit is **55 mph during non-school zone hours.**



Speed Study on Tuesday, 1/16/07

Note that speed data collection was interrupted for portions of both the morning and afternoon school zone times. A police car was parked at the middle school entrance on US 220A with its flashers on from 7:35-7:50AM and 3:20-3:30PM. The police officer directed traffic and let buses out of the school entrance. Because traffic was not free flow during these time periods, they were excluded from the data below.

Morning School Zone Data Collection 7:30-8:30AM

Afternoon School Zone Data Collection 2:30-3:30PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	45.7	46.5	45.3	44.3	45.5	45.3
85th Percentile Speed (mph)	52.2	53.1	52.4	50.7	52.2	51.2
Vehicles Exceeding ST Speed Limit (%)	93.6	98.1	94.7	88.3	94.3	92.9
Vehicles Exceeding Non-ST Speed Limit (%)	2.1	5.8	6.7	1.7	4.9	3.6
Total Observations	47	52	75	60	122	112

Morning Non-School Zone Data Collection 9:10-10:10AM

Afternoon Non-School Zone Data Collection 1:00-2:00PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	50.3	51.2	51.4	51.3	51.0	51.2
85th Percentile Speed (mph)	56.5	55.1	56.1	55.8	56.3	55.7
Vehicles Exceeding Non-ST Speed Limit (%)	17.5	15.1	22.7	23.0	20.7	19.7
Total Observations	57	73	88	100	145	173

*School Time (ST) indicates when the lower speed limit is in effect.

Raleigh Road Elementary

8330 Ramsey Street; Linden, NC

Flashers have been installed for greater than 3 years; however no exact installation date.

45 mph speed limit on Ramsey Street effective from 7:30 a.m. to 8:30 a.m. and 1:45 p.m. to 2:45 p.m.
Speed limit is **55 mph during non-school zone hours**.



Speed Study on Wednesday, 1/24/07

Morning School Zone Data Collection 7:30-8:30AM

Afternoon School Zone Data Collection 1:45-2:45PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	45.8	45.8	47.5	48.8	46.7	47.3
85th Percentile Speed (mph)	48.9	50.0	52.7	54.7	51.6	53.5
Vehicles Exceeding ST Speed Limit (%)	50.0	45.4	64.8	69.2	57.6	57.1
Vehicles Exceeding Non-ST Speed Limit (%)	6.9	7.4	6.5	13.5	6.7	10.4
Total Observations	102	108	108	104	210	212

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 12:15-1:15PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	58.0	58.5	57.2	58.2	57.6	58.4
85th Percentile Speed (mph)	61.8	61.7	60.8	62.7	61.0	62.3
Vehicles Exceeding Non-ST Speed Limit (%)	75.0	78.6	68.9	70.8	72.0	74.8
Total Observations	108	112	103	106	211	218

*School Time (ST) indicates when the lower speed limit is in effect.

Oak Ridge Elementary

2050 Oak Ridge Rd; Oak Ridge, NC

Flashers Installed: 2/1990

25 mph speed limit on Oak Ridge Rd effective from 7:25 a.m. to 8:25 a.m. and 2:05 p.m. to 3:05 p.m.
Speed limit is **35 mph during non-school zone hours.**



Speed Study on Tuesday, 2/6/07

Note that speed data was not collected from 7:50-8:00am because a police officer was questioning the data collector.

Morning School Zone Data Collection 7:25-8:25AM

Afternoon School Zone Data Collection 2:05-3:05PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	WB	EB	WB	EB	WB	EB
Average Speed (mph)	33.3	31.2	33.8	33.8	33.6	32.6
85th Percentile Speed (mph)	39.4	37.4	41.2	41.9	40.4	40.7
Vehicles Exceeding ST Speed Limit (%)	93.8	79.8	85.2	83.7	89.2	81.8
Vehicles Exceeding Non-ST Speed Limit (%)	28.1	27.4	41.7	34.8	35.3	31.3
Total Observations	96	84	108	92	204	176

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 12:30-1:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	WB	EB	WB	EB	WB	EB
Average Speed (mph)	40.1	40.2	39.8	40.6	39.9	40.4
85th Percentile Speed (mph)	43.9	45.7	43.1	44.9	43.6	45.3
Vehicles Exceeding Non-ST Speed Limit (%)	85.9	80.2	87.1	87.2	86.5	83.4
Total Observations	78	101	85	86	163	187

*School Time (ST) indicates when the lower speed limit is in effect.

Vass-Lakeview Elementary

141 James Street; Vass, NC

Flashers Installed: 1/7/1994

25 mph speed limit on US 1 Business effective from 7:30 a.m. to 8:30 a.m. and 2:30pm to 3:30pm.
Speed limit is **45 mph during non-school zone hours.**



Speed Study on Thursday, 2/8/07

Morning School Zone Data Collection 7:30-8:30AM
Afternoon School Zone Data Collection 2:30-3:30PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	39.2	38.4	42.2	42.5	41.4	40.4
85th Percentile Speed (mph)	45.3	43.5	49.1	48.5	48.0	47.5
Vehicles Exceeding ST Speed Limit (%)	100.0	100.0	99.3	100.0	99.5	100.0
Vehicles Exceeding Non-ST Speed Limit (%)	16.1	12.1	26.4	42.9	23.5	27.4
Total Observations	56	99	144	98	200	197

Morning Non-School Zone Data Collection 9:00-10:00AM
Afternoon Non-School Zone Data Collection 1:00-2:00PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	43.5	45.6	44.4	43.4	44.1	44.8
85th Percentile Speed (mph)	49.8	50.8	48.9	46.6	49.2	49.6
Vehicles Exceeding Non-ST Speed Limit (%)	37.9	43.8	41.2	36.6	39.9	41.0
Total Observations	58	112	85	71	143	183

*School Time (ST) indicates when the lower speed limit is in effect.

Western Alamance High

1731 North NC 87; Elon College, NC

Flashers Installed: 4/1990

40 mph speed limit on NC 87 effective from 7:45 a.m. to 8:45 a.m. and 2:30p.m. to 3:30p.m.
Speed limit is **50 mph during non-school zone hours.**



Speed Study on Wednesday, 2/14/07

Note that speed data collection was interrupted for portions of both the morning and afternoon data collection times.

Morning School Time: Note that data was not collected from 7:45 - 8:05AM because traffic was queued on NC 87 in front of the school and was not free flow during these time periods.

Afternoon Non-School Time: Note that data was not collected from 1:10 – 2:40PM due to a traffic collision on NC87 just south of the southern school zone limits. Due to congestion around the collision site and on-looker delays, traffic was not free flow during these time periods. Afternoon Non-School Time data is not provided.

Afternoon School Time: Note that data collection did not begin until 2:40PM, when the collision scene was totally cleared and traffic was free flow again.

Morning School Zone Data Collection 7:45-8:45AM
Afternoon School Zone Data Collection 2:30-3:30PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	42.6	43.2	43.6	42.0	43.2	42.4
85th Percentile Speed (mph)	46.7	49.3	47.4	46.4	47.1	47.4
Vehicles Exceeding ST Speed Limit (%)	63.2	62.2	80.8	64.3	73.1	63.5
Vehicles Exceeding Non-ST Speed Limit (%)	3.5	13.3	5.5	2.9	4.6	7.0
Total Observations	57	45	73	70	130	115

Morning Non-School Zone Data Collection 9:15-10:15AM
Afternoon Non-School Zone Data Collection 1:00-2:00PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	49.1	49.4	N/A	N/A	49.1	49.4
85th Percentile Speed (mph)	51.9	52.7	N/A	N/A	51.9	52.7
Vehicles Exceeding Non-ST Speed Limit (%)	36.6	40.6	N/A	N/A	36.6	40.6
Total Observations	71	69	N/A	N/A	71	69

*School Time (ST) indicates when the lower speed limit is in effect.

Speed Study on Wednesday, 2/20/07

Note that Morning School Time data is not provided because data was collected for the incorrect time period.

Morning School Zone Data Collection 7:45-8:45AM
Afternoon School Zone Data Collection 2:30-3:30PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	N/A	N/A	39.3	41.6	39.3	41.6
85th Percentile Speed (mph)	N/A	N/A	44.3	44.8	44.3	44.8
Vehicles Exceeding ST Speed Limit (%)	N/A	N/A	40.8	59.3	40.8	59.3
Vehicles Exceeding Non-ST Speed Limit (%)	N/A	N/A	1.9	0.0	1.9	0.0
Total Observations	N/A	N/A	103	86	103	86

Morning Non-School Zone Data Collection 9:00-10:00AM
Afternoon Non-School Zone Data Collection 1:00-2:00PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	44.8	46.3	43.7	44.3	44.2	45.4
85th Percentile Speed (mph)	47.9	50.3	48.2	47.9	48.1	49.1
Vehicles Exceeding Non-ST Speed Limit (%)	5.1	16.5	5.4	5.1	5.3	11.3
Total Observations	78	115	112	98	190	213

*School Time (ST) indicates when the lower speed limit is in effect.

Alexander Wilson Elementary

2518 NC 54; Graham, NC

Flashers Installed: 4/5/1999

35 mph speed limit on NC 54 effective from 7:30 a.m. to 8:30 a.m. and 2:00pm to 3:00pm.
Speed limit is **50 mph during non-school zone hours.**



Speed Study on Thursday, 2/15/07

Morning School Zone Data Collection 7:30-8:30AM
Afternoon School Zone Data Collection 2:00-3:00PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	39.6	40.2	39.4	40.5	39.5	40.4
85th Percentile Speed (mph)	44.6	44.9	44.4	45.8	44.5	45.4
Vehicles Exceeding ST Speed Limit (%)	77.1	80.7	79.2	79.5	78.2	80.1
Vehicles Exceeding Non-ST Speed Limit (%)	0.8	0.9	0.0	0.0	0.4	0.5
Total Observations	118	109	120	112	238	221

Morning Non-School Zone Data Collection 9:00-10:00AM
Afternoon Non-School Zone Data Collection 12:30-1:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	44.6	45.6	47.1	47.1	45.9	46.4
85th Percentile Speed (mph)	48.9	49.2	50.4	50.4	50.0	50.1
Vehicles Exceeding Non-ST Speed Limit (%)	10.1	10.5	19.6	19.0	15.2	15.5
Total Observations	89	76	102	105	191	181

*School Time (ST) indicates when the lower speed limit is in effect.

Colfax Elementary School

9112 West Market St; Graham, NC

Flashers Installed: 3/1990

25 mph speed limit on Market St effective from 7:25 a.m. to 8:25 a.m. and 2:05 p.m. to 3:05 p.m.
Speed limit is **35 mph during non-school zone hours.**



Speed Study on Wednesday, 3/7/07

Morning School Zone Data Collection 7:25-8:25AM

Afternoon School Zone Data Collection 2:05-3:05PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	30.4	29.9	31.5	29.6	30.9	29.8
85th Percentile Speed (mph)	35.2	34.0	36.8	34.5	36.3	34.2
Vehicles Exceeding ST Speed Limit (%)	80.5	79.3	88.4	81.0	84.5	80.2
Vehicles Exceeding Non-ST Speed Limit (%)	15.3	12.1	23.1	13.8	19.2	12.9
Total Observations	118	116	121	116	239	232

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 12:30-1:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	43.8	40.7	44.2	40.5	44.0	40.6
85th Percentile Speed (mph)	48.1	44.9	49.7	45.5	49.0	45.3
Vehicles Exceeding Non-ST Speed Limit (%)	94.2	90.0	93.2	82.9	93.7	86.2
Total Observations	104	90	117	105	221	195

*School Time (ST) indicates when the lower speed limit is in effect.

Cape Fear High and Mac Williams Middle School

4762, 4644 Clinton Rd; Fayetteville, NC

Flashers have been installed for greater than 3 years; however no exact installation date.

35 mph speed limit on Clinton Rd effective from 7:50 a.m. to 8:50 a.m. and 3:00pm to 4:00pm.
Speed limit is **55 mph during non-school zone hours**.



Speed Study on Wednesday, 2/14/07

Morning School Zone Data Collection 7:50-8:50AM

Afternoon School Zone Data Collection 3:00-4:00PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	35.5	34.1	35.1	34.0	35.3	34.0
85th Percentile Speed (mph)	39.5	38.7	39.7	38.1	39.6	38.4
Vehicles Exceeding ST Speed Limit (%)	50.0	34.3	44.6	32.8	47.3	33.6
Vehicles Exceeding Non-ST Speed Limit (%)	0.0	0.0	0.0	0.0	0.0	0.0
Total Observations	106	134	101	125	207	259

Morning Non-School Zone Data Collection 9:20-10:20AM

Afternoon Non-School Zone Data Collection 1:30-2:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	48.0	45.7	47.9	47.0	48.0	46.4
85th Percentile Speed (mph)	52.9	51.9	53.4	53.3	53.2	52.7
Vehicles Exceeding Non-ST Speed Limit (%)	5.7	4.8	7.7	6.9	6.8	5.9
Total Observations	70	83	78	87	148	170

*School Time (ST) indicates when the lower speed limit is in effect.

Luther Nick Jeralds Middle School

2517 Ramsey St; Fayetteville, NC

Flashers have been installed for greater than 3 years; however no exact installation date.

35 mph speed limit on Ramsey St effective from 7:45 a.m. to 8:45 a.m. and 3:00pm to 4:00pm.
Speed limit is **45 mph during non-school zone hours**.



Speed Study on Thursday, 3/15/07

Note that a crossing guard directed traffic for a large portion of the morning school zone times. Because only free flowing traffic speeds (where traffic speeds were not affected by the crossing guard) were measured during these time periods, they were deemed viable and included in the data below.

Morning School Zone Data Collection 7:45-8:45AM

Afternoon School Zone Data Collection 3:00-4:00PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	39.4	40.6	37.0	38.9	38.2	39.7
85th Percentile Speed (mph)	43.5	46.5	42.0	45.5	43.1	45.9
Vehicles Exceeding ST Speed Limit (%)	80.8	78.6	56.0	64.0	68.3	71.0
Vehicles Exceeding Non-ST Speed Limit (%)	9.1	22.3	6.0	18.9	7.5	20.6
Total Observations	99	103	100	111	199	214

Morning Non-School Zone Data Collection 9:15-10:15AM

Afternoon Non-School Zone Data Collection 1:30-2:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	45.5	47.9	44.8	46.9	45.2	47.5
85th Percentile Speed (mph)	49.5	53.0	48.6	51.8	49.1	52.4
Vehicles Exceeding Non-ST Speed Limit (%)	51.4	65.1	43.2	60.3	47.7	62.9
Total Observations	138	152	118	126	256	278

*School Time (ST) indicates when the lower speed limit is in effect.

Southern Pines Elementary School

255 South May St; Southern Pines, NC

Flashers Installed: 9/2/1987

25 mph speed limit on May St. effective from 7:30 a.m. to 8:30 a.m. and 2:30 p.m. to 3:30 p.m.
Speed limit is **35 mph during non-school zone hours.**



Speed Study on Tuesday, 2/20/07

Morning School Zone Data Collection 7:30-8:30AM

Afternoon School Zone Data Collection 2:30-3:30PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	31.9	31.4	31.7	31.8	31.8	31.6
85th Percentile Speed (mph)	35.5	35.3	35.9	35.9	35.7	35.6
Vehicles Exceeding ST Speed Limit (%)	94.7	91.4	91.1	88.8	93.0	90.2
Vehicles Exceeding Non-ST Speed Limit (%)	19.1	17.1	21.5	24.0	20.2	20.4
Total Observations	152	140	135	125	287	265

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 1:00-2:00PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	33.9	35.3	34.3	34.8	34.1	35.0
85th Percentile Speed (mph)	38.2	37.9	38.8	38.4	38.4	38.1
Vehicles Exceeding Non-ST Speed Limit (%)	29.7	45.7	34.5	47.2	32.4	46.5
Total Observations	111	105	139	123	250	228

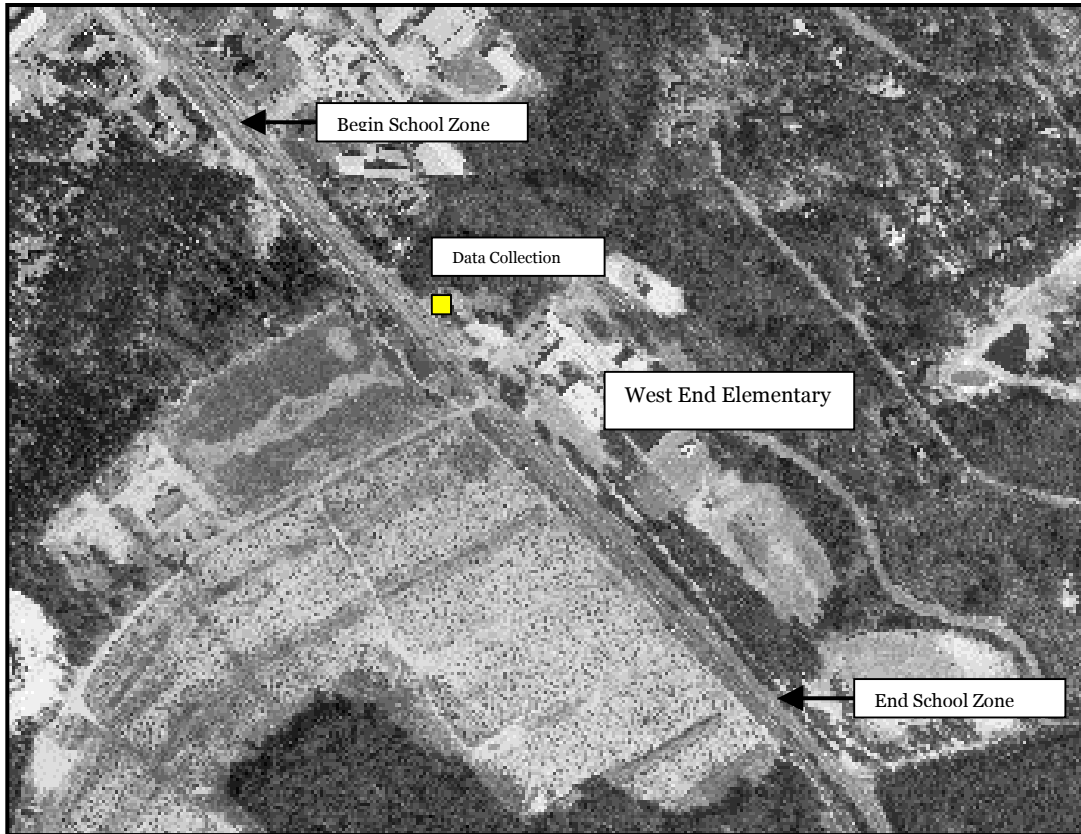
*School Time (ST) indicates when the lower speed limit is in effect.

West End Elementary School

4483 NC 211; West End, NC

Flashers Installed: 7/10/1987

35 mph speed limit on NC 211 effective from 7:30 a.m. to 8:30 a.m. and 2:00pm to 3:00pm.
Speed limit is **45 mph during non-school zone hours.**



Speed Study on Wednesday, 2/21/07

Morning School Zone Data Collection 7:30-8:30AM

Afternoon School Zone Data Collection 2:00-3:00PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	38.5	39.8	42.4	41.8	40.7	40.9
85th Percentile Speed (mph)	42.3	44.7	48.4	46.5	46.7	45.3
Vehicles Exceeding ST Speed Limit (%)	72.9	83.8	90.4	90.9	82.5	87.6
Vehicles Exceeding Non-ST Speed Limit (%)	7.1	14.1	27.9	18.2	18.5	16.3
Total Observations	85	99	104	110	189	209

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 12:30-1:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	45.5	44.8	45.4	45.7	45.5	45.2
85th Percentile Speed (mph)	48.7	48.8	49.2	49.5	49.0	49.1
Vehicles Exceeding Non-ST Speed Limit (%)	55.3	42.1	52.3	52.9	53.8	47.4
Total Observations	103	107	109	104	212	211

*School Time (ST) indicates when the lower speed limit is in effect.

Pleasant Garden Elementary School

4833 Pleasant Garden Rd; Pleasant Garden, NC

Flashers Installed: 9/19/1996

25 mph speed limit on Pleasant Garden Rd effective from 7:25 a.m. to 8:25 a.m. and 2:05 p.m. to 3:05 p.m.
Speed limit is **35 mph** during **non-school zone hours**.



Speed Study on Thursday, 2/22/07

Morning School Zone Data Collection 7:25-8:25AM

Afternoon School Zone Data Collection 2:05-3:05PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	25.8	25.2	25.5	24.9	25.6	25.0
85th Percentile Speed (mph)	29.1	28.1	28.8	27.8	28.9	27.9
Vehicles Exceeding ST Speed Limit (%)	50.0	50.8	50.0	45.9	50.0	48.1
Vehicles Exceeding Non-ST Speed Limit (%)	1.4	1.7	0.0	1.4	0.7	1.5
Total Observations	72	59	74	74	146	133

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 12:30-1:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	30.6	30.8	29.0	28.9	29.8	29.8
85th Percentile Speed (mph)	34.4	34.9	33.1	32.6	33.8	33.8
Vehicles Exceeding Non-ST Speed Limit (%)	9.4	14.3	7.8	7.1	8.6	10.4
Total Observations	85	70	90	84	175	154

*School Time (ST) indicates when the lower speed limit is in effect.

APPENDIX C

DATA COLLECTION SHEETS FOR NON-FLASHER SITES

Vandora Springs Elementary

1300 Vandora Springs Rd; Garner, NC

No Flashers

Ordinance Effective Date: 4/1/1980

25 mph speed limit on SR 2713 (Vandora Springs Rd.) effective from 8:45 a.m. to 9:45 a.m. and 3:15pm to 4:15pm. Speed limit is **35 mph during non-school zone hours.**



Speed Study on Thursday, 12/21/06

Morning School Zone Data Collection 8:45-9:45AM

Afternoon School Zone Data Collection 3:15-4:15PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	33.1	30.5	34.1	30.7	33.7	30.6
85th Percentile Speed (mph)	38.7	36.5	39.6	36.2	39.0	36.4
Vehicles Exceeding ST Speed Limit (%)	89.0	83.2	95.2	78.1	92.3	80.5
Vehicles Exceeding Non-ST Speed Limit (%)	37.6	18.7	46.0	22.8	42.1	20.8
Total Observations	109	107	124	114	233	221

Morning Non-School Zone Data Collection 10:15-11:15AM

Afternoon Non-School Zone Data Collection 1:45-2:45PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	37.1	35.8	37.7	33.4	37.4	34.5
85th Percentile Speed (mph)	42.1	39.8	41.6	37.8	41.7	38.9
Vehicles Exceeding Non-ST Speed Limit (%)	59.5	50.0	67.5	30.1	64.3	38.9
Total Observations	84	90	123	113	207	203

*School Time (ST) indicates when the lower speed limit is in effect.

Griffith Elementary and Independence High

1385 West Clemmons Rd; Winston-Salem, NC

No Flashers

Ordinance Effective Date: 2/26/1999

25 mph speed limit on West Clemmons Rd effective from 7:50 a.m. to 8:50 a.m., 12:15 p.m. to 1:15 p.m., and 2:20p.m. to 3:20p.m. Speed limit is **35 mph during non-school zone hours.**



Speed Study on Wednesday, 1/17/07

Note that a crossing guard directed traffic for a large portion of the morning and afternoon school zone times. The crossing guard was directing traffic from 8:05-8:31AM and 2:35-3:10PM. Because only free flowing traffic speeds (where traffic speeds were not affected by the crossing guard) were measured during these time periods, they were deemed viable and included in the data below.

Also note that the school zone time from 12:15-1:15PM was not included in the data collection.

Morning School Zone Data Collection 7:50-8:50AM

Afternoon School Zone Data Collection 2:20-3:20PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	30.4	30.9	32.6	33.6	31.3	32.1
85th Percentile Speed (mph)	36.5	36.4	39.8	38.9	38.2	38.1
Vehicles Exceeding ST Speed Limit (%)	76.2	84.2	84.4	91.8	79.6	87.6
Vehicles Exceeding Non-ST Speed Limit (%)	20.8	21.7	34.4	41.2	26.5	30.4
Total Observations	130	120	96	97	226	217

Morning Non-School Zone Data Collection 9:30-10:30AM

Afternoon Non-School Zone Data Collection 1:15-2:15PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	38.6	39.8	37.9	38.1	38.2	39.0
85th Percentile Speed (mph)	43.0	44.7	41.7	41.7	42.4	43.3
Vehicles Exceeding Non-ST Speed Limit (%)	78.0	81.3	74.7	75.5	76.4	78.3
Total Observations	100	96	99	102	199	198

*School Time (ST) indicates when the lower speed limit is in effect.

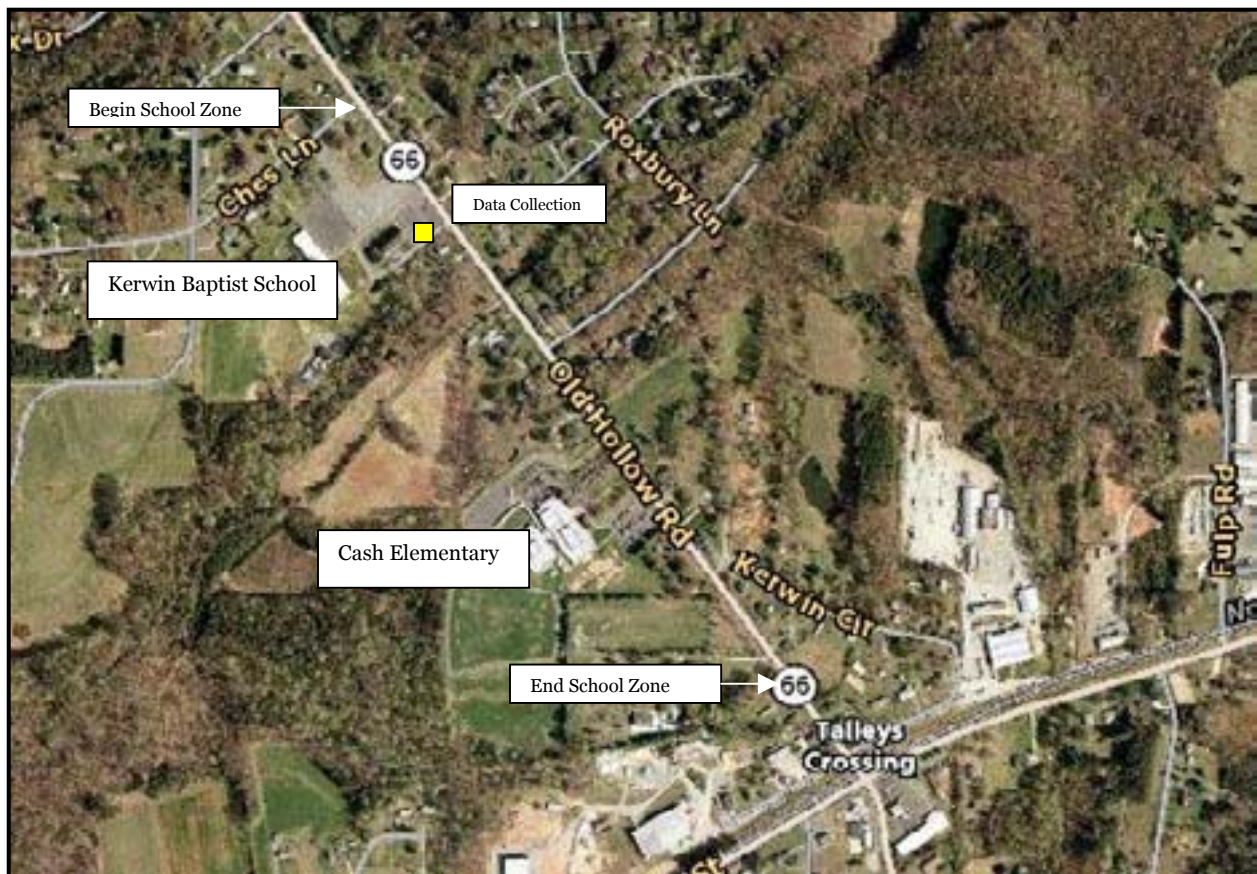
Kerwin Baptist School and Cash Elementary

Old Hollow Rd; Kernersville, NC

No Flashers

Ordinance Effective Date: 7/10/1992

35 mph speed limit on Old Hollow Road effective from 7:50 a.m. to 8:50 a.m. and 2:20pm to 3:20pm.
Speed limit is **45 mph during non-school zone hours.**



Speed Study on Tuesday, 1/23/07

Morning School Zone Data Collection 7:50-8:50AM
Afternoon School Zone Data Collection 2:20-3:20PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	44.1	45.0	42.3	42.7	43.1	43.6
85th Percentile Speed (mph)	49.2	50.7	47.1	48.6	47.8	49.5
Vehicles Exceeding ST Speed Limit (%)	94.6	93.3	88.9	85.3	91.3	88.6
Vehicles Exceeding Non-ST Speed Limit (%)	40.2	44.4	22.9	30.2	30.2	36.1
Total Observations	112	90	153	129	265	219

Morning Non-School Zone Data Collection 9:30-10:30AM
Afternoon Non-School Zone Data Collection 12:30-1:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	46.6	47.5	46.0	47.1	46.3	47.3
85th Percentile Speed (mph)	51.7	51.0	50.5	52.1	51.0	51.1
Vehicles Exceeding Non-ST Speed Limit (%)	62.3	66.7	55.1	61.2	58.6	64.2
Total Observations	114	123	118	103	232	226

*School Time (ST) indicates when the lower speed limit is in effect.

Broughton High School

723 Saint Marys St; Raleigh, NC
Wake County

No Flashers

No Ordinance in TEAAS, but has been in effect for greater than 3 years.

25 mph speed limit on Peace St. effective from 7:30 a.m. to 9:30 a.m. and 2:45pm to 4:15pm.
Speed limit is **35 mph during non-school zone hours.**



Speed Study on Thursday, 1/25/07

Morning School Zone Data Collection 7:30-9:30AM

Afternoon School Zone Data Collection 2:45-4:15PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	27.3	29.3	27.1	31.0	27.2	29.9
85th Percentile Speed (mph)	31.0	32.2	31.3	36.9	31.2	33.4
Vehicles Exceeding ST Speed Limit (%)	62.6	84.2	64.8	88.8	63.6	86.1
Vehicles Exceeding Non-ST Speed Limit (%)	2.0	6.4	1.6	19.8	1.8	11.8
Total Observations	147	171	128	116	275	287

Morning Non-School Zone Data Collection 10:00-11:20AM

Afternoon Non-School Zone Data Collection 12:45-2:15PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	30.4	32.3	27.1	29.3	28.7	30.8
85th Percentile Speed (mph)	35.0	35.5	30.2	32.6	32.6	34.3
Vehicles Exceeding Non-ST Speed Limit (%)	15.0	16.8	1.9	0.0	8.3	8.5
Total Observations	100	101	106	100	206	201

*School Time (ST) indicates when the lower speed limit is in effect.

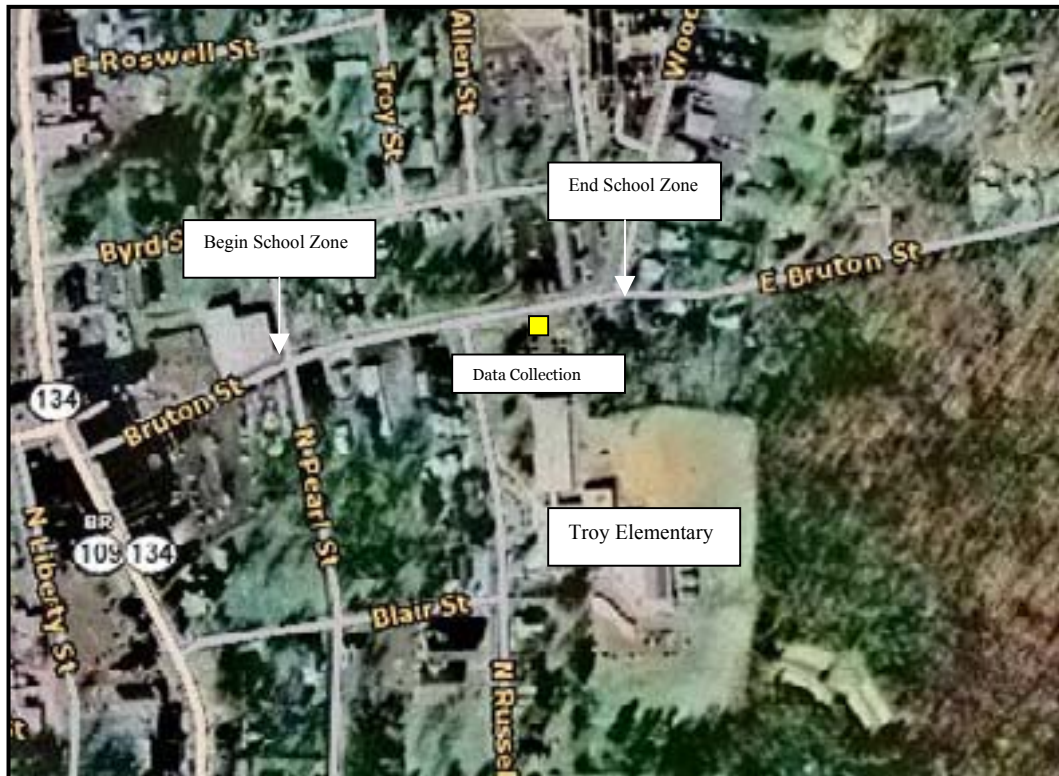
Troy Elementary School

310 N. Russell St, Troy, NC
Montgomery County

No Flashers

Ordinance Effective Date: 11/29/1999

25 mph speed limit on Bruton Street effective from 7:30 a.m. to 8:30 a.m. and 2:30 p.m. to 3:30 p.m.
Speed limit is **35 mph** during non-school zone hours.



Speed Study on Tuesday, 1/30/07

Poor location with few observations.

School Zone is only 0.1 miles long with a hill located in the middle and no good location for data collection.

Morning School Zone Data Collection 7:30-8:30AM

Afternoon School Zone Data Collection 2:30-3:30PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	28.3	30.9	26.5	28.0	27.9	29.8
85th Percentile Speed (mph)	31.9	35.4	31.1	31.8	31.5	35.0
Vehicles Exceeding ST Speed Limit (%)	71.4	87.2	50.0	69.2	66.7	80.0
Vehicles Exceeding Non-ST Speed Limit (%)	4.8	20.5	0.0	7.7	3.7	15.4
Total Observations	21	39	6	26	27	65

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 1:00-2:00PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	26.6	30.2	26.5	30.9	26.5	30.5
85th Percentile Speed (mph)	31.6	33.4	32.1	34.4	31.8	33.9
Vehicles Exceeding Non-ST Speed Limit (%)	0.0	0.0	0.0	9.5	0.0	4.3
Total Observations	12	25	13	21	25	46

*School Time (ST) indicates when the lower speed limit is in effect.

Farmer Elementary School

3557 Grange Hall Rd, Asheboro, NC
Randolph County

No Flashers

Ordinance Effective Date: 2/26/1993

45 mph speed limit on Grange Hall Rd effective from 7:30 a.m. to 8:30 a.m. and 2:00 p.m. to 3:00 p.m.

Speed limit is **55 mph** during non-school zone hours.



Speed Study on Wednesday, 1/31/07

Morning School Zone Data Collection 7:30-8:30AM
Afternoon School Zone Data Collection 2:00-3:00PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	53.5	52.5	55.7	52.4	54.7	52.5
85th Percentile Speed (mph)	58.9	58.5	61.0	58.3	59.9	58.4
Vehicles Exceeding ST Speed Limit (%)	92.6	88.3	95.4	85.0	94.1	86.4
Vehicles Exceeding Non-ST Speed Limit (%)	34.7	35.1	55.6	36.0	45.8	35.6
Total Observations	95	77	108	100	203	177

Morning Non-School Zone Data Collection 9:00-10:00AM
Afternoon Non-School Zone Data Collection 12:30-1:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	57.4	56.0	57.8	56.0	57.6	56.0
85th Percentile Speed (mph)	61.0	61.1	60.9	59.5	61.0	60.3
Vehicles Exceeding Non-ST Speed Limit (%)	70.6	60.7	80.9	62.2	76.4	61.5
Total Observations	68	61	89	82	157	143

*School Time (ST) indicates when the lower speed limit is in effect.

Donna Lee Loflin School

405 S. Park St; Asheboro, NC

No Flashers

Ordinance Effective Date: 5/1/1975

25 mph speed limit on South Park Street effective from 7:25 a.m. to 8:25 a.m. and 1:55 p.m. to 2:55 p.m. Speed limit is **35 mph during non-school zone hours.**



Speed Study on Wednesday, 2/7/07

Morning School Time: Note that a crossing guard and a police officer directed traffic for a large portion of the morning school zone. Also, an additional police officer was clocking vehicle speeds. The only three vehicles to exceed 35 mph were pulled over for speeding. Because only free flowing traffic speeds were measured during these time periods, they included in the data below. Note however, that the traffic speeds were most likely affected by the police officer visibly clocking vehicles.

Afternoon Non-School Time: Note that speed data was not collected from 1:05 - 1:25pm due to road maintenance and a lane closure (with flagman directing traffic) on Park St.

Afternoon School Time: Note that a crossing guard was directing traffic from 2:10 - 2:50pm. A police officer also directed traffic from 2:20 - 2:55pm. There were many queued vehicles during these time periods. Because only free flowing traffic speeds (where traffic speeds were not affected by the crossing guard/police officer) were measured during these time periods, they were deemed viable and included in the data below.

Morning School Zone Data Collection 7:25-8:25AM
Afternoon School Zone Data Collection 1:55-2:55PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	SB	NB	SB	NB	SB	NB
Average Speed (mph)	26.8	27.5	28.3	29.2	27.5	28.2
85th Percentile Speed (mph)	29.7	31.5	32.9	34.1	30.8	32.0
Vehicles Exceeding ST Speed Limit (%)	66.2	71.1	69.6	80.0	67.9	75.0
Vehicles Exceeding Non-ST Speed Limit (%)	0.0	3.6	8.7	9.2	4.4	6.1
Total Observations	68	83	69	65	137	148

Morning Non-School Zone Data Collection 9:00-10:00AM
Afternoon Non-School Zone Data Collection 12:25-1:25PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	32.8	32.7	32.3	32.2	32.6	32.5
85th Percentile Speed (mph)	36.3	36.3	36.4	38.1	36.3	37.2
Vehicles Exceeding Non-ST Speed Limit (%)	21.3	23.2	21.4	31.1	21.4	26.0
Total Observations	75	82	42	45	117	127

*School Time (ST) indicates when the lower speed limit is in effect.

Vandalia Christian School

3919 Pleasant Garden Road; Greensboro, NC

No Flashers

Ordinance Effective Date: 7/28/1995

35 mph speed limit on Pleasant Garden Road effective from 7:30 a.m. to 8:30 a.m. and 2:30pm to 3:30pm. Speed limit is **45 mph during non-school zone hours**.



Speed Study on Thursday, 2/22/07

Morning School Zone Data Collection 7:30-8:30AM

Afternoon School Zone Data Collection 2:30-3:30PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	41.5	38.3	41.2	40.4	41.3	39.5
85th Percentile Speed (mph)	46.9	43.4	46.1	45.3	46.5	44.5
Vehicles Exceeding ST Speed Limit (%)	88.4	66.1	87.6	77.6	88.0	72.6
Vehicles Exceeding Non-ST Speed Limit (%)	21.1	8.5	17.5	15.8	19.3	12.6
Total Observations	95	59	97	76	192	135

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 1:00-2:00PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	43.8	42.3	44.1	42.6	43.9	42.5
85th Percentile Speed (mph)	50.5	47.7	48.2	46.9	49.4	47.4
Vehicles Exceeding Non-ST Speed Limit (%)	38.7	31.5	34.6	29.9	36.8	30.6
Total Observations	93	73	78	97	171	170

*School Time (ST) indicates when the lower speed limit is in effect.

Western Alamance Middle School

2100 Eldon Drive; Elon College, NC

No Flashers

Ordinance Effective Date: 4/24/1998

40 mph speed limit on NC 87 effective from 7:25 a.m. to 8:25 a.m. and 2:30pm to 3:30pm.
Speed limit is **50 mph during non-school zone hours**.



Speed Study on Tuesday, 2/27/07

Morning School Zone Data Collection 7:25-8:25AM

Afternoon School Zone Data Collection 2:30-3:30PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	45.7	42.8	45.6	43.7	45.6	43.4
85th Percentile Speed (mph)	50.0	47.9	50.8	48.6	50.4	48.6
Vehicles Exceeding ST Speed Limit (%)	80.0	70.7	80.0	72.6	80.0	72.1
Vehicles Exceeding Non-ST Speed Limit (%)	15.0	7.3	17.8	7.4	16.7	7.4
Total Observations	60	41	90	95	150	136

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 1:00-2:00PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	51.8	49.8	49.3	46.3	50.7	48.0
85th Percentile Speed (mph)	56.3	55.1	53.9	51.6	55.7	52.8
Vehicles Exceeding Non-ST Speed Limit (%)	58.1	43.4	36.0	20.0	48.9	31.5
Total Observations	105	83	75	85	180	168

*School Time (ST) indicates when the lower speed limit is in effect.

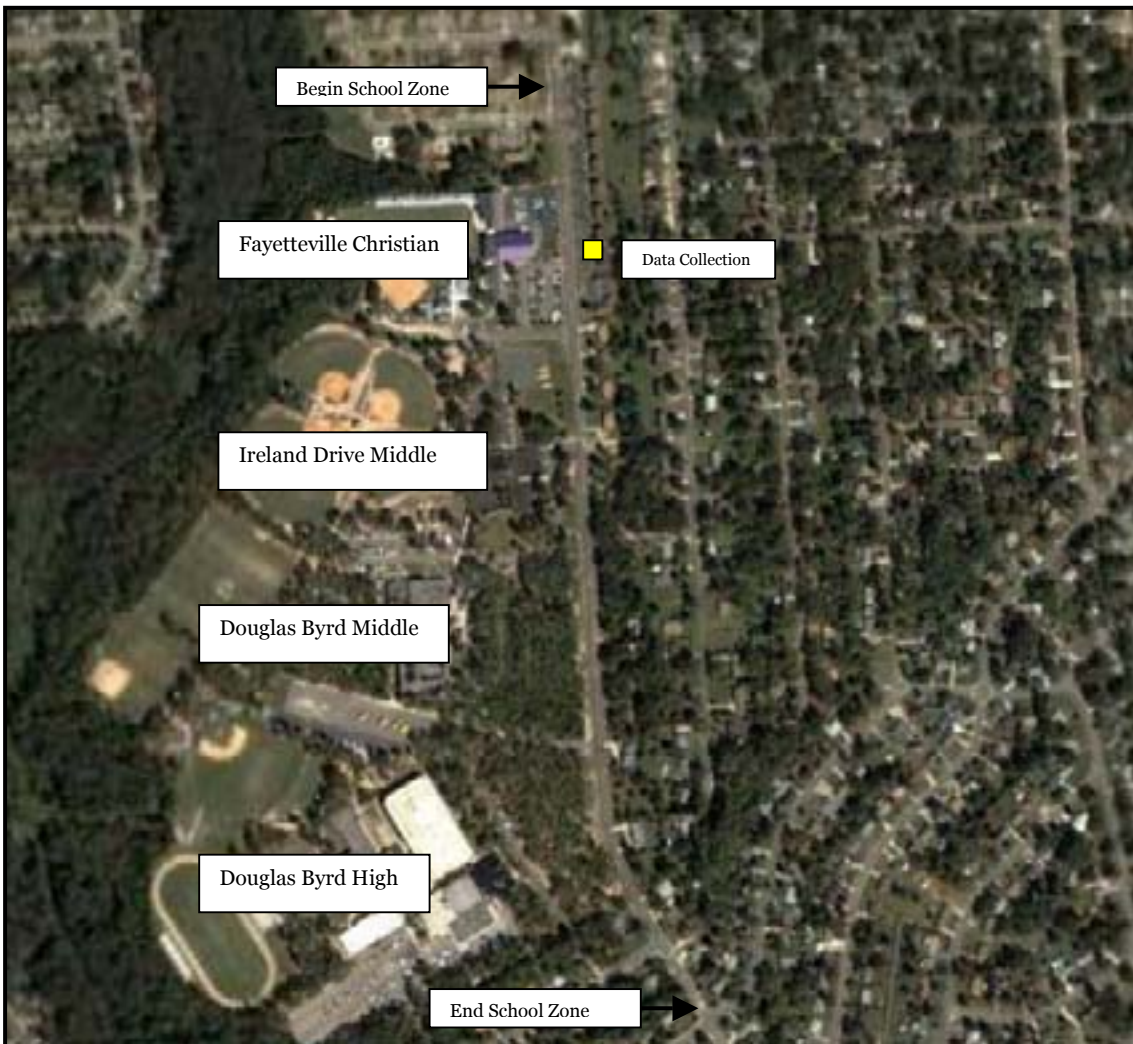
Douglas Byrd Middle, Ireland Drive Middle, Douglas Byrd High, and Fayetteville Christian School

1616 Ireland Drive; Fayetteville, NC

No Flashers

Ordinance Effective Date: 12/27/1991

25 mph speed limit on Ireland Drive effective from 7:50 a.m. to 9:00 a.m. and 2:00pm to 4:00pm.
Speed limit is **35 mph during non-school zone hours**.



Speed Study on Thursday, 3/1/07

Morning School Zone Data Collection 7:50-9:00AM

Afternoon School Zone Data Collection 2:00-4:00PM

	Morning ST		Afternoon ST		AVG ST NB	AVG ST SB
	NB	SB	NB	SB		
Average Speed (mph)	34.3	33.1	36.6	33.7	35.6	33.4
85th Percentile Speed (mph)	39.4	37.9	42.3	39.1	41.3	38.7
Vehicles Exceeding ST Speed Limit (%)	92.2	88.2	96.6	95.2	94.7	92.4
Vehicles Exceeding Non-ST Speed Limit (%)	40.4	35.5	58.1	34.5	50.3	34.9
Total Observations	141	110	179	168	320	278

Morning Non-School Zone Data Collection 9:30-10:30AM

Afternoon Non-School Zone Data Collection 12:30-1:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST NB	AVG Non-ST SB
	NB	SB	NB	SB		
Average Speed (mph)	40.6	38.5	40.6	38.4	40.6	38.4
85th Percentile Speed (mph)	45.6	43.7	46.2	41.9	46.0	42.6
Vehicles Exceeding Non-ST Speed Limit (%)	85.6	72.5	84.3	76.1	84.9	74.3
Total Observations	118	109	134	117	252	226

*School Time (ST) indicates when the lower speed limit is in effect.

Elizabeth Cashwell Elementary School

2970 Legion Rd; Fayetteville, NC

No Flashers

Ordinance Effective Date: 5/1/1983

35 mph speed limit on Legion Rd effective from 7:30 a.m. to 8:30 a.m. and 1:45 p.m. to 2:45 p.m.
Speed limit is **45 mph during non-school zone hours**.



Speed Study on Tuesday, 3/6/07

Morning School Zone Data Collection 7:30-8:30AM

Afternoon School Zone Data Collection 1:45-2:45PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	39.1	41.7	39.0	40.7	39.0	41.1
85th Percentile Speed (mph)	43.7	46.5	44.2	45.6	43.9	46.0
Vehicles Exceeding ST Speed Limit (%)	78.8	89.4	73.8	88.4	76.4	88.9
Vehicles Exceeding Non-ST Speed Limit (%)	8.0	25.0	12.1	17.9	10.0	21.3
Total Observations	113	104	107	112	220	216

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 12:15-1:15PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	44.7	44.5	43.6	44.0	44.1	44.2
85th Percentile Speed (mph)	49.1	48.3	46.9	47.5	47.9	47.8
Vehicles Exceeding Non-ST Speed Limit (%)	38.1	43.0	35.0	34.9	36.4	38.4
Total Observations	126	128	143	169	269	297

*School Time (ST) indicates when the lower speed limit is in effect.

Rockfish Elementary School

5763 Rockfish Rd; Hope Mills, NC

No Flashers

Ordinance Effective Date: 8/1/1978

25 mph speed limit on Rockfish Rd effective from 7:30 a.m. to 8:30 a.m. and 1:45 p.m. to 2:45 p.m.
Speed limit is **35 mph** during **non-school zone hours**.



Speed Study on Thursday, 3/8/07

Morning School Zone Data Collection 7:30-8:30AM

Afternoon School Zone Data Collection 1:45-2:45PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	WB	EB	WB	EB	WB	EB
Average Speed (mph)	30.6	29.9	33.0	32.1	31.7	30.9
85th Percentile Speed (mph)	37.0	37.8	39.7	37.2	39.2	37.7
Vehicles Exceeding ST Speed Limit (%)	76.5	72.5	82.4	84.8	79.3	78.1
Vehicles Exceeding Non-ST Speed Limit (%)	25.5	23.9	35.2	25.0	30.1	24.4
Total Observations	102	109	91	92	193	201

Morning Non-School Zone Data Collection 9:00-10:00AM

Afternoon Non-School Zone Data Collection 12:15-1:15PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	WB	EB	WB	EB	WB	EB
Average Speed (mph)	38.2	38.1	39.5	38.0	38.8	38.1
85th Percentile Speed (mph)	43.2	42.6	46.2	44.5	44.7	43.9
Vehicles Exceeding Non-ST Speed Limit (%)	72.0	70.7	70.6	69.6	71.4	70.2
Total Observations	125	123	109	125	234	248

*School Time (ST) indicates when the lower speed limit is in effect.

Southview Middle and High School

4184 Elk Mill Rd; Hope Mills, NC

No Flashers

Ordinance Effective Date: 2/3/1995

35 mph speed limit on Elk Mill Rd effective from 7:55 a.m. to 9:00 a.m. and 2:55 p.m. to 4:00 p.m.
Speed limit is **45 mph during non-school zone hours.**



Speed Study on Tuesday, 3/13/07

Morning School Zone Data Collection 7:55-9:00AM

Afternoon School Zone Data Collection 2:55-4:00PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	36.7	35.6	37.2	37.4	37.0	36.4
85th Percentile Speed (mph)	41.0	39.9	43.3	42.5	42.2	41.1
Vehicles Exceeding ST Speed Limit (%)	57.0	49.3	59.0	63.6	58.1	55.8
Vehicles Exceeding Non-ST Speed Limit (%)	5.8	2.8	9.0	7.6	7.5	5.0
Total Observations	86	142	100	118	186	260

Morning Non-School Zone Data Collection 9:30-10:30AM

Afternoon Non-School Zone Data Collection 1:25-2:25PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	41.9	42.5	41.5	42.0	41.7	42.2
85th Percentile Speed (mph)	47.0	47.3	45.5	46.8	46.5	47.0
Vehicles Exceeding Non-ST Speed Limit (%)	24.3	27.3	16.7	23.8	20.3	25.4
Total Observations	74	110	84	122	158	232

*School Time (ST) indicates when the lower speed limit is in effect.

Level Cross Elementary School

5417 Old Greensboro Rd; Randleman, NC

No Flashers

Ordinance Effective Date: 9/3/1997

35 mph speed limit on Old Greensboro Rd effective from 7:15 a.m. to 8:15 a.m. and 2:00 p.m. to 3:00 p.m.

Speed limit is **55 mph during non-school zone hours.**



Speed Study on Tuesday, 3/27/07

Morning School Zone Data Collection 7:15-8:15AM
Afternoon School Zone Data Collection 2:00-3:00PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	41.5	38.1	42.3	39.9	41.9	39.2
85th Percentile Speed (mph)	46.2	41.2	47.2	46.6	46.9	45.0
Vehicles Exceeding ST Speed Limit (%)	95.2	75.0	89.8	75.0	92.4	75.0
Vehicles Exceeding Non-ST Speed Limit (%)	1.2	0.0	1.1	0.0	1.2	0.0
Total Observations	83	24	88	36	171	60

Morning Non-School Zone Data Collection 8:45-9:45AM
Afternoon Non-School Zone Data Collection 12:30-1:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	NB	SB	NB	SB	NB	SB
Average Speed (mph)	47.5	43.0	48.5	46.0	48.0	44.7
85th Percentile Speed (mph)	53.9	48.6	55.4	51.8	54.8	50.7
Vehicles Exceeding Non-ST Speed Limit (%)	9.3	4.3	19.0	3.6	14.1	3.9
Total Observations	43	23	42	28	85	51

*School Time (ST) indicates when the lower speed limit is in effect.

Hope Mills Middle School

4975 Cameron Rd; Hope Mills, NC

No Flashers

Ordinance Effective Date: 1/29/1999

25 mph speed limit on Cameron Rd effective from 8:00 a.m. to 9:00 a.m. and 3:00 p.m. to 4:00 p.m.
Speed limit is **35 mph** during **non-school zone hours**.



Speed Study on Wednesday, 3/28/07

Morning School Zone Data Collection 8:00-9:00AM

Afternoon School Zone Data Collection 3:00-4:00PM

	Morning ST		Afternoon ST		AVG ST	AVG ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	32.0	31.8	31.1	32.3	31.5	32.1
85th Percentile Speed (mph)	35.4	35.1	35.8	37.3	35.6	36.4
Vehicles Exceeding ST Speed Limit (%)	96.6	96.6	89.1	90.0	92.6	93.0
Vehicles Exceeding Non-ST Speed Limit (%)	17.2	15.3	18.8	28.6	18.0	22.5
Total Observations	58	59	64	70	122	129

Morning Non-School Zone Data Collection 9:30-10:30AM

Afternoon Non-School Zone Data Collection 1:30-2:30PM

	Morning Non-ST		Afternoon Non-ST		AVG Non-ST	AVG Non-ST
	EB	WB	EB	WB	EB	WB
Average Speed (mph)	34.2	34.7	33.0	35.4	33.6	35.0
85th Percentile Speed (mph)	38.0	38.2	36.8	39.8	37.5	39.2
Vehicles Exceeding Non-ST Speed Limit (%)	37.0	37.3	30.2	51.5	33.6	44.4
Total Observations	54	67	59	68	113	135

*School Time (ST) indicates when the lower speed limit is in effect.

APPENDIX D

CRASH DATA SUMMARY

Crash Data Summary By Site

FLASHERS														
Div	County	City	School	Route	Flasher Installation Date	Placement	School Zone Times	ST Speed	Non-ST Speed	Flasher Info	School Zone Length (miles)	2005 ADT	Total Crashes (3 Yrs)	Bike/Ped Crashes (3 Yrs)
8	Montgomery	Candor	Candor Elementary	US 220A	8/24/1976	Post NB/Overhead SB	7:30-8:30&2-3	25	35	8" double	0.32	3,200	0	0
7	Guilford	Colfax	Colfax Elementary	SR 1008	3/1990	Overhead	7:25-8:25 & 2:05-3:05	25	35	8" double	0.29	13,000	2	0
8	Moore	Southern Pines	Southern Pines Elementary	SR 2080	9/2/1987	Post	7:30-8:30&2:30-3:30	25	35	8" EB/12" WB double	0.20	8,000	3	0
6	Cumberland	Linden	Raleigh Road Elementary	US 401	> 3 Years	Post	7:30-8:30&1:45-2:45	45	55	8" double	0.30	8,400	4	0
8	Moore	Vass	Vass-Lakeview Elementary	US1B	1/7/1994	Post	7:30-8:30&2:30-3:30	25	45	8" double	0.20	7,000	5	0
8	Moore	West End	West End Elementary	NC 211	7/10/1987	Post	7:30-8:30&2-3	35	45	12" double	0.40	13,000	5	0
8	Montgomery	Biscoe	East Middle/East Montgomery High	US 220A	11/5/1990	Post	7:30-8:30&2:30-3:30	35	55	8" double	0.53	5,000	6	0
7	Guilford	Pleasant Garden	Pleasant Garden Elementary	SR 3402	9/19/1996	Post	7:25-8:25 & 2:05-3:05	25	35	8" double	0.14	4,800	7	0
8	Randolph	Randleman	Randleman Elementary	US220B	11/8/1993	Post	7:30-8:30 & 2:30-3:30	25	35	8" double	0.33	9,100	9	1
7	Guilford	Oak Ridge	Oak Ridge Elementary	NC 150	2/1990	Overhead	7:25-8:25 & 2:05-3:05	25	35	8" double	0.22	6,840	11	0
7	Alamance	Graham	Alexander Wilson Elementary	NC 54	4/5/1999	Post	7:30-8:30&2-3	35	50	8" double	0.40	12,100	12	0
6	Cumberland	Fayetteville	Luther Nick Jeralds Middle	US 401B	> 3 Years	Post	7:45-8:45&3-4	35	45	12" double	0.32	35,000	13	0
6	Cumberland	Fayetteville	Cape Fear High/Mac Williams Middle	SR 1006	> 3 Years	Post	7:50-8:50&3-4	35	55	12" double	0.66	5,500	13	0
8	Randolph	Sophia	New Market Elementary	US 311	10/8/1998	Post	7-8&1:45-2:45	35	45	12" double	0.46	13,000	14	0
7	Alamance	Elon College	Western High	NC 87	4/1990	Overhead	7:45-8:45&2:30-3:30	40	50	8" double	0.35	6,300	17	0
											5.12	10,006	121	1
											total	weighted average	total	total
NON FLASHERS														
Div	County	City	School	Route	Ordinance Date	Placement	School Zone Times	ST Speed	Non-ST Speed	Flasher Info	School Zone Length (miles)	2005 ADT	Total Crashes (3 Yrs)	Bike/Ped Crashes (3 Yrs)
8	Montgomery	Troy	Troy Elementary	SR 1333	11/29/1999	Post	7:30-8:30&2:30-3:30	25	35	None	0.140	1,500	1	0
9	Forsyth	Winston Salem	Griffith Elem. High, Middle School Academy	SR 2747	2/26/1999	Post	7:50-8:50, 12:15-1:15, 2:20-3:20	25	35	None	0.210	15,000	2	1
7	Guilford	Greensboro	Vandalia Christian School	SR 3505	7/28/1995	Post	7:30-8:30 & 2:30-3:30	35	45	None	0.231	6,300	2	0
8	Randolph	Randleman	Level Cross Elementary	SR 2115	9/3/1997	Post	7:15-8:15 & 2-3	35	55	None	0.37	1,600	2	0
5	Wake	Garner	Vandora Springs Elementary	SR 2713	4/1/1980	Post	8:45-9:45 & 3:15-4:15	25	35	None	0.280	5,100	3	0
6	Cumberland	Hope Mills	Rockfish Elementary	SR 1112	8/1/1978	Post	7:30-8:30&1:45-2:45	25	35	None	0.3	12,000	5	0
7	Alamance	Elon College	Western Middle	NC 87	4/24/1998	Post	7:25-8:25&2:30-3:30	40	50	None	0.2	4,300	5	0
8	Randolph	Asheboro	Farmer Elementary	NC 49	2/26/1993	Post	7:30-8:30 & 2-3	45	55	None	0.500	5,800	6	0
6	Cumberland	Hope Mills	Southview Senior High and Middle	SR 1363	2/3/1995	Post	7:55-9&2:55-4	35	45	None	0.6	6,600	8	0
6	Cumberland	Hope Mills	Hope Mills Middle	SR 1131	1/29/1999	Post	8-9&3-4	25	35	None	0.35	12,000	10	0
9	Forsyth	Kernersville	Kerwin Baptist /Cash Elementary	NC 66	7/10/1992	Post	7:50-8:50&2:20-3:20	35	45	None	0.600	13,000	10	0
8	Randolph	Asheboro	Donna Lee Loflin School	SR 1451	5/1/1975	Post	7:25-8:25 & 1:55-2:55	25	35	None	0.19	5,200	12	1
6	Cumberland	Fayetteville	Douglas Byrd Junior/Senior High (Fayetteville Christian&Ireland Dr Middle)	SR 1219	12/27/1991	Post	7:50-9&2-4	25	35	None	0.64	12,000	19	1
6	Cumberland	Fayetteville	Elizabeth Caswell Elementary	SR 1132	5/1/1983	Post	7:30-8:30&1:45-2:45	35	45	None	0.4	12,000	34	0
5	Wake	Raleigh	Broughton High	Peace St	> 3 Years	Post	7:30-9:30 & 2:45-4:15	25	35	None	0.402	20,000	88	1
											5.41	9,544	207	4
											total	weighted average	total	total