AN EVALUATION OF REAR-END CRASHES AT INTERSECTIONS MONITORED BY RED-LIGHT-RUNNING CAMERAS

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EXECUTIVE SUMMARY

The City of Palm Bay implemented its Red-Light-Running Camera program during the last quarter of the calendar year 2009. This report presents a "before and after" crash analysis to determine whether the presence of red-light-running cameras has led to increases in rear-end collisions at the selected intersections that are currently being monitored. Approximately two and half years of collision data was reviewed. The analysis was conducted at two levels, namely per intersection, and per monitored approach. The analysis per intersection showed that of the three study intersections, the intersection of Malabar Road and Emerson Drive showed a significant increase in rear-end crashes. The analysis per monitored approach showed that of the five currently monitored approaches, the eastbound lane group of the intersection of Malabar Road and Emerson Drive, and the northbound approach of the intersection of Malabar Road and San Filippo Drive showed a significant increase in rear-end crashes.

TABLE OF CONTENTS

List of Tables

INTRODUCTION

The City of Palm Bay implemented its Red-Light-Running Camera program during the last quarter of the calendar year 2009. Under this program selected approaches to selected signalized intersections are monitored with camera equipment to detect and record red-light-running (RLR) violations. After a technical review and other legal requirements, an offending vehicle owner is issued a fine. The legal details and ramifications of the program are beyond the scope of this study. Past experience in other jurisdiction the State of Florida, as well as nationwide, suggests that RLR monitoring programs of this nature lead to a significant increase in rear-end crashes at the associated intersections. City staff was asked to perform a "before and after" traffic engineering analysis to evaluate and establish whether the advent of RLR monitoring equipment has led to increases in rear-end crashes at the selected intersections that are currently being monitored.

The specific intersections and approaches currently monitored by RLR equipment are:

1. Malabar Road and San Filippo Drive: Northbound and westbound approaches.
2. Malabar Road and Emerson Drive: Eastbound approach.
3. Malabar Road and Minton Road: Northbound and eastbound approaches.

Detailed descriptions and photographs of the study intersections can be found in the Appendix.

OBJECTIVES

The objectives of this study are to:

1. Collect crash data for each intersection for a minimum of 12 months (but not exceeding 24 months) prior to the operation of the RLR. cameras

2. Collect crash data for each intersection for the period from the installation of the RLR equipment to the present time..

3. Perform a statistical analysis to establish crash rates before the RLR equipment, and after the RLR equipment.

4. Identify areas for improvement.

5. Establish thresholds and indicators for future performance/ compliance.

STUDY PROCEDURES

The data collection and analysis procedures used in this study are consistent with the Florida Department of Transportation (FDOT) references Manual on Uniform Traffic Studies (MUTS) and the Institute of Transportation Engineers (ITE) Traffic Engineering Handbook. The statistical analysis procedures follow that of the federal Engineering Statistics Handbook[1].

[1] *NIST/SEMATECH e-Handbook of Statistical Methods*, http://www.itl.nist.gov/div898/handbook/, Accessed May 31, 2010.

DATA COLLECTION

The crash events were queried from the Growth Management Department's *CrashStats* database. The full crash reports were then obtained from the Police Departments' records through the *Laserfische* system. In the reviews, events occurring on private driveways, parking lots, or not associated with a relevant intersection were eliminated from further consideration. A summary of the data used for this study is provided in Table 1. The individual crash reports can be found in Appendix A. The collision diagrams summarizing the events at each intersection are presented in Appendix B.

Table 1: Crash data summary

Intersection	Date of RLR Equip. Monitoring	"Before" Period	"After" Period
Malabar@ San Filippo	11/18/2009	1/1/2008 to 10/31/2009	12/01/2009 to 7/1/2010
Malabar@ Emerson	11/18/2009	1/1/2008 to 10/31/2009	12/1/2009 to 7/1/2010
Malabar@ Minton	12/04/2009	1/1/2008 to 11/30/2009	12/1/2009 to 7/1/2010

ANALYSIS

Two levels of analysis were performed in this study. The first analysis looks at each study intersection overall, whereas the second analysis presented is from the perspective of the particular approach being monitored.

Analysis Per Overall Intersection

The first objective of the analysis is to establish whether the rear-end crash rates for each intersection are statistically higher than those of similar intersections in the City, in both the "before" and "after" conditions. To do this a rear-end crash rate representing Palm Bay intersections of similar status and operations was established using data from a total of 13 Palm Bay intersections on arterials and/ or major collectors. Crash rate is expressed as the number of crashes per million vehicles entering the intersection (MEV). The computational details of MEVs are presented in Appendix C. A summary of the establishment of the "Palm Bay" rear-end crash rate is presented in Table 2. The 95% confidence interval (CI) represents values of the "Palm Bay" rear-end crash rate would achieve 95% of the time if the experiment was repeated an infinitely large number of times. Therefore if a crash rate at a particular intersection falls within the CI then there is 95% confidence it is the same as the "Palm Bay" rear-end crash rate. However if the intersection's crash rate falls above the CI then the conclusion is that the crash rate at that intersection is different and higher than that of Palm Bay. Such an intersection therefore has an over-representation of rear-end crashes when compared to Palm Bay in general and is therefore a location of concern from a traffic crash perspective.

In the "before" scenarios, all three study intersections have crash rates that are NOT overrepresented when compared to the overall Palm Bay network. In the "after" scenario, there is an increase (statistically significant increase) in the rear-end crash rate at Malabar@ Emerson and

Table 2: Analysis of crash rates per intersection

Intersection		BEFORE RED LIGHT CAMERAS				AFTER RED LIGHT CAMERAS			
Street 1	Street 2	Period of Data (years)	Vehicles Entering Intersection (Ave. Daily Traff.)	Rear-End Crashes	Crash rate (MEV)	Period of Data (years)	Vehicles Entering Intersection (Ave. Daily Traff.)	Rear-End Crashes	Crash rate (MEV)
Malabar	Emerson	1.83	34,852	18	0.7732	0.58	34,852	13	1.7620
Malabar	Minton	1.92	34,084	22	0.9210	0.58	34,084	7	0.9701
Malabar	San Filippo	1.83	41,978	25	0.8916	0.58	41,978	4	0.4501
Malabar	Babcock	1.83	60,621	56	1.3830	0.58	60,621	14	1.0909
Malabar	Jupiter	1.83	19,610	12	0.9161	0.58	19,610	6	1.4453
Malabar	Eldron	1.83	24,242	12	0.7411	0.58	24,242	0	0.0000
Babcock	Port Malabar	1.83	43,800	42	1.4356	0.58	43,800	10	1.0785
Babcock	Charles	1.83	30,284	11	0.5438	0.58	30,284	4	0.6239
Minton	Emerson	1.83	53,350	43	1.2067	0.58	53,350	18	1.5937
Emerson NW	Jupiter	1.83	24,147	7	0.4340	0.58	24,147	0	0.0000
Jupiter	Emerson	1.83	13,947	4	0.4294	0.58	13,947	2	0.6774
Jupiter	Pace	1.83	12,642	4	0.4737	0.58	12,642	2	0.7473
Eldron	Bayside Lakes	1.83	11,010	3	0.4079	0.58	11,010	1	0.4290
"Palm Bay"				Mean	0.8121			Mean	0.8360
				Std Dev	0.3588			Std Dev	0.5579
		95%	Confidence Interv.	(0.5953 ,	1.0289)	95%	Confidence Interv	(0.499 ,	1.173)

at Malabar@ Minton, however the new rear-end crash rate at Malabar@ Minton falls within the "after" confidence interval and is therefore not a cause for concern when compared to Palm Bay overall.

Analysis per Approach

Unlike the previous section, in this analysis only the specific approach (lane group) monitored by the RLR equipment at each study intersection is considered in the calculation of the crash rate. This provides a more targeted perspective to the evaluation. It shall be assumed that the confidence intervals established for intersections in Palm Bay also apply to the approaches (lane groups) within the intersections. The "before" versus "after" hypothesis test establishes whether there is a significant increase in rear-end crashes after the monitoring equipment is implemented. This is based on the t-test (see Appendix D for details). A summary of the results of this analysis is shown in Table 3.

Malabar@Emerson Eastbound: After the equipment was implemented there was a statistically significant increase in the rear-end crash rate which also resulted in the crash rate moving out of the CI to a magnitude of concern.

Malabar@Minton Northbound: After the equipment was implemented there was a statistically significant increase in the rear-end crash rate which also resulted in the crash rate moving from lower than expected to a condition of overrepresentation. This is a location of concern.

COMMENTS AND CONCLUSIONS

The Florida Department of Transportation requires a minimum of 12 months of crash history for any and all formal purposes. In the "after" scenario of this study, this could not be achieved at this point in time. This study therefore shall be used as indicative but not conclusive until the data collection up to at least 12 months has been satisfied. It is recommended that the data collection and the analysis be updated until 12 months beyond the date of installation of the RLR equipment at each study location.

The analysis at the intersection level showed mixed results. The results suggest that the intersection of Malabar and Emerson has experienced an increase in rear-end crashes since the RLR equipment was installed at the intersection, and that the increased crash rate is above the crash rate generally experienced in Palm Bay. The intersection of Malabar and Minton also experienced an increase in crash rate, however new crash rate is not statistically different than that of other locations in Palm Bay. The intersection of Malabar and San Filippo experienced a reduction in the crash rate after the RLR equipment was installed.

An analysis was also conducted from the perspective of the specific movement/ lane group being monitored at the relevant intersections. Malabar at Emerson eastbound showed an increase in the rear-end crash rate with crashes for this movement being overrepresented when compared with other locations in the City. Malabar at San Filippo experienced a reduction of the crash rate on both monitored approaches. Malabar at Minton eastbound recorded a reduction in the crash rate. The northbound approach an increase in the rear-end crash rate with the new crash rate significantly overrepresented when compared to crashes at other locations in Palm Bay.

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Table 3: Analysis of crash rates per approach

		BEFORE RED LIGHT CAMERAS					AFTER RED LIGHT CAMERAS						
Intersection		Period of Data (years)	Vehicles Entering Intersection (Ave. Daily Traff.	Rear-end Crashe	Crash rate (MEV)	Crash rate versus CI	Period of Data (years)	Vehicles Entering Intersection (Ave. Daily Traff.)	Rear-end Crashes	Crash rate (MEV)	Crash rate versus CI	Hypothesis Test" Before vs After	
Street 1	Street 2											Statistic	Conclusion
Malabar	Emerson Eastbound	1.83	8,768	3	0.5122	within CI	0.58	8,768	4	2.1550	high crashes	199.71	increase
Malabar	San Filippo Northbound	1.83	4,842	11	3.4011	high crashes	0.58	4,842	1	0.9756	within CI	-294.86	decrease
	Westbound	1.83	24,021	10	0.6233	within CI	0.58	24,021	1	0.1966	low crashes	-51.86	decrease
Malabar	Minton Northbound	1.92	3,810	1	0.3755	low crashes	0.58	3,810	2	2.4796	high crashes	255.79	increase
	Eastbound	1.92	7,600	6	1.1295	high crashes	0.58	7,600	0	0.0000	low crashes	-137.31	decrease

Appendix A – Crash Reports

Appendix B – Collision Diagrams

Appendix C – Crash Rate Calculations

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Appendix D – Statistical Analysis

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T test

Appendix E – Photographs