

# **Effectiveness of Red Light Cameras in Tucson, AZ**

PhotoTicketing.com

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## INTRODUCTION

The city of Tucson operates photo ticketing machines at 8 intersections plus 2 mobile safety vans. Over the years, the city has issued reports to quantify and justify the continued operation of these machines.

All photo ticketing machines at intersections issue tickets for red light running, and some also issue tickets for exceeding the posted speed limit.

Tucson's reports used the simplistic approach of counting "before" crashes and comparing them with "after" crash counts. The problem with this approach is that it ignores macro trends that may be influencing the data. Such examples might be changes in miles driven, safer automobiles, increased general awareness, or changes in enforcement of laws (such as stricter DUI laws). To compensate for these effects it is necessary to compare trends and data of monitored intersections with control intersections, the entire city, or even the entire state.

## BACKGROUND

Tucson has permanent photo ticketing machines installed at these locations:

Location	Placed in Operation
Grant Rd & Tanque Verde Rd	29-Oct-07
Nogales Highway & Valencia	26-Jan-08
22nd St & Wilmot Rd	20-Feb-08
River Rd & Oracle Rd	29-Mar-08
Speedway Blvd and Kolb Rd	26-Nov-10
Grant Rd & Swan Rd	17-Dec-10
Broadway Blvd & Craycroft Rd	27-Feb-11
6th Ave & Ajo Way	31-Oct-11

## METHODOLOGY

To complete this report, the ADOT crash databases were obtained for years 2005-2014. These databases were then queried to generate the data used in this report. These statewide databases allow the comparison of data for an intersection with another intersection, the whole city, or even the whole state. Additionally, mileage statistics were obtained from ADOT, as there should be a strong correlation between miles driven and crashes.

Due to lack of available information, we were unable to consider other factors that may have impacted safety such as road design improvements (construction) or changes in light timing during the time period studied.

Because most charts compare dissimilar data sets, normalization of the data is required to compare trends. For example, the number of crashes in Tucson citywide ranges from 4,586 to 14,458, while crashes at an intersection is typically 30 or less. Microsoft Excel was used to chart the data trends and the software automatically normalizes the data so that trends can be compared. The actual numbers are not as important as the comparison of the trends and whether the trends are similar, converge, or diverge.

Comparing intersection data to citywide data will help compensate for larger macro changes, such as an increase or decrease in miles driven (traffic count), change in enforcement, or changes in reporting methodology.

### **LIMITATIONS**

Due to limitations on resources and available data, this analysis does not include a consideration of regression to the mean, use of traffic data for each individual intersection, or comparison to control (unmonitored) intersections.

## TUCSON VS ARIZONA

Tucson has complicated the comparison of data by changing its accident reporting methodology in 2011. Throughout this report there will be a noticeable downward jump in Tucson reported crashes starting in 2011. Otherwise, when we compare Tucson injury and fatality trends to the entire state, there is a clear, direct proportional relationship. Fortunately, this does not seem to materially affect comparisons between an intersection in Tucson and whole city.

Due to the scale of the data, statewide numbers will appear more consistent due to the larger dataset. Conversely, Tucson data will vary more due to the smaller dataset.

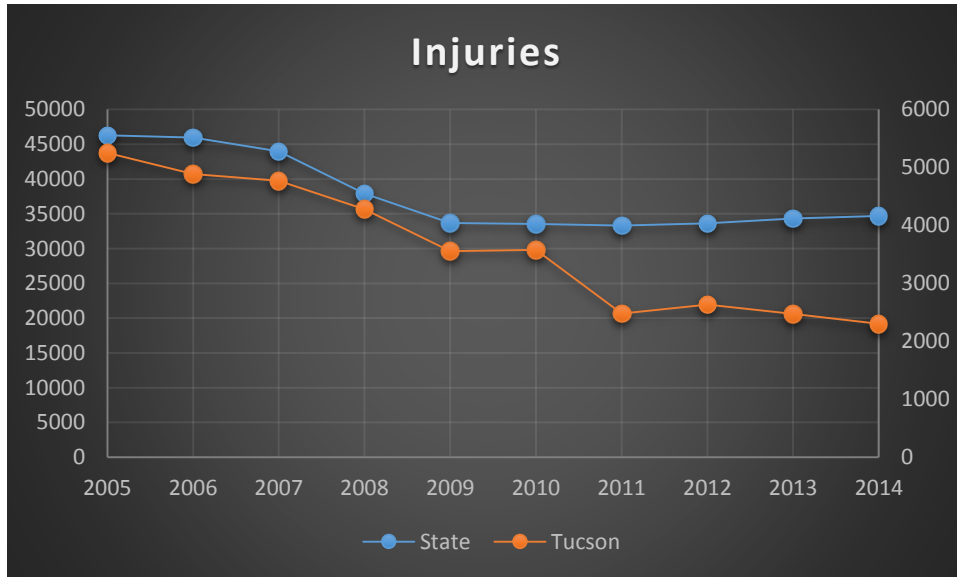


Figure 1

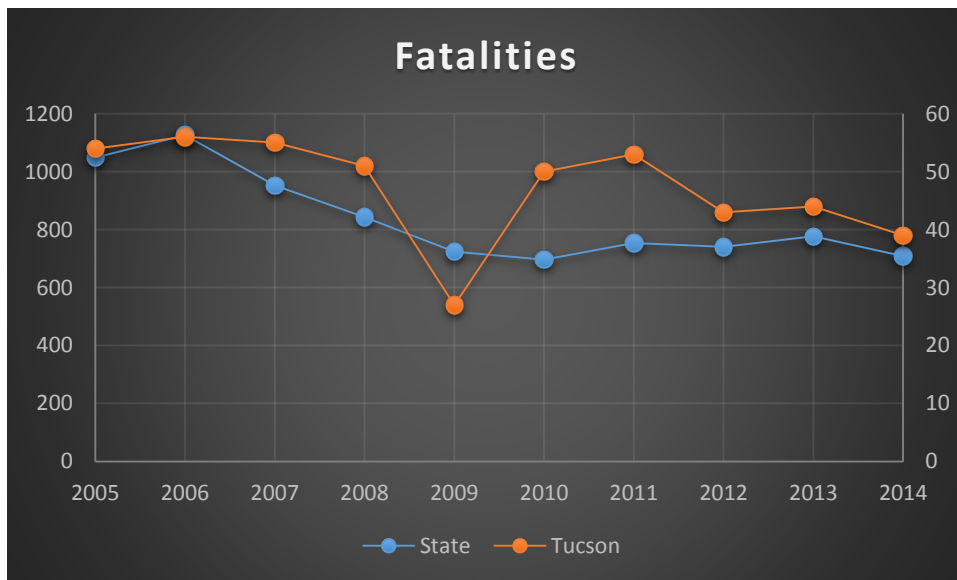


Figure 2

## MILES vs CRASHES

When statewide mileage data is compared to statewide total crash numbers, there is a clear and strong direct correlation of 97% if 2005 is ignored. With this strong correlation established, it is clear that the reduction in crashes from 2006-2012 can be attributed almost exclusively to the drop in miles driven.

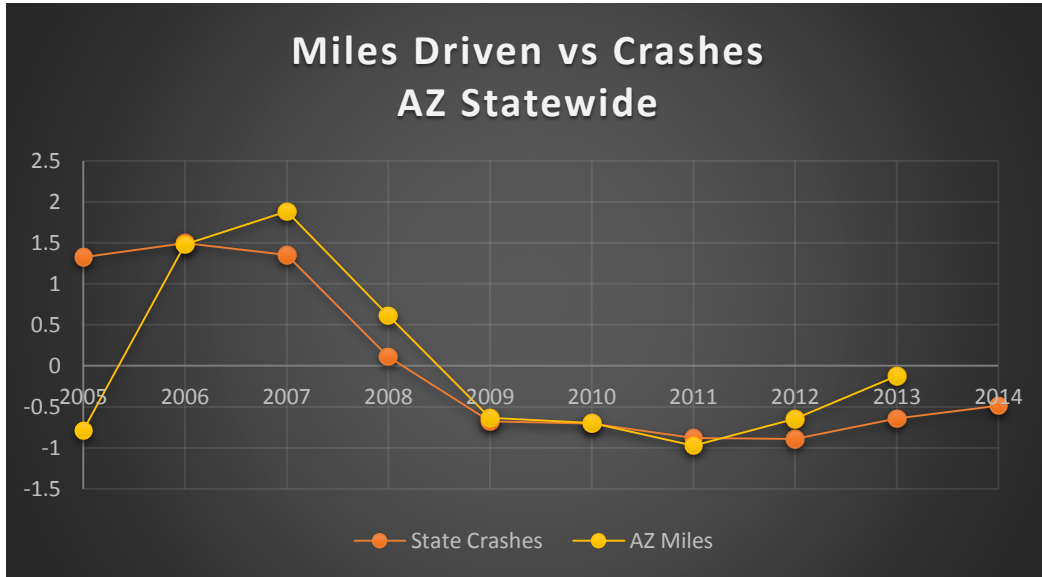


Figure 3

When city mileage data is compared to city crash numbers, there is a 92% correlation from 2006-2013. Again, this indicates that the consistent reduction in crashes seen for most of the past decade can be mostly attributed to a reduction in miles driven.

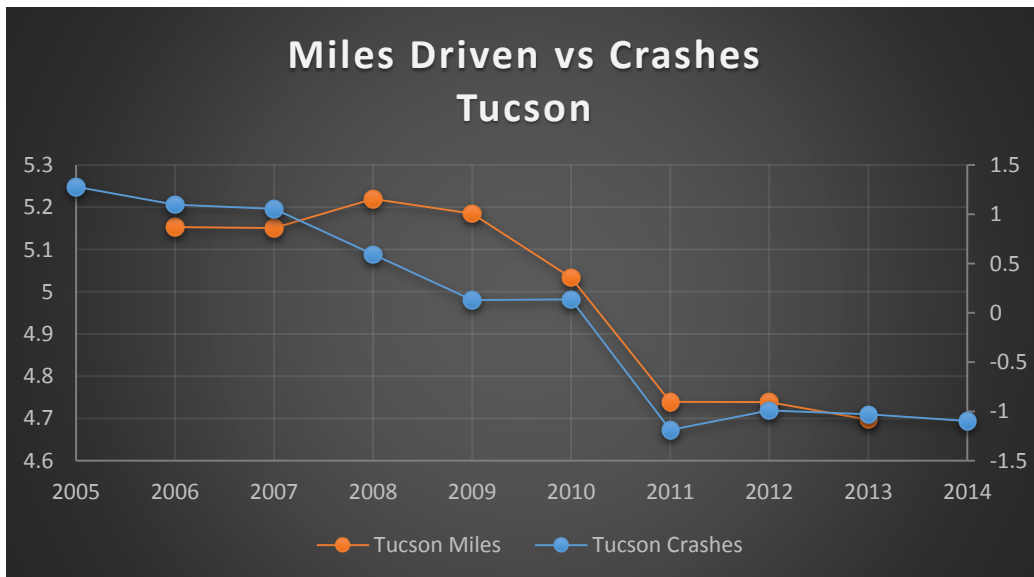


Figure 4

## INTERSECTION BY INTERSECTION ANALYSIS

### GRANT RD & TANQUE VERDE RD

Tucson installed its first camera at SB E Grant Rd and Tanque Verde Rd and it went live October 29, 2007.

A comparison of trends between the intersection and the city shows a close correlation. There is no significant difference between the city wide trend and this intersection, indicating that this camera has had very little impact on crashes on NB/SB Grant Road at Tanque Verde Rd.

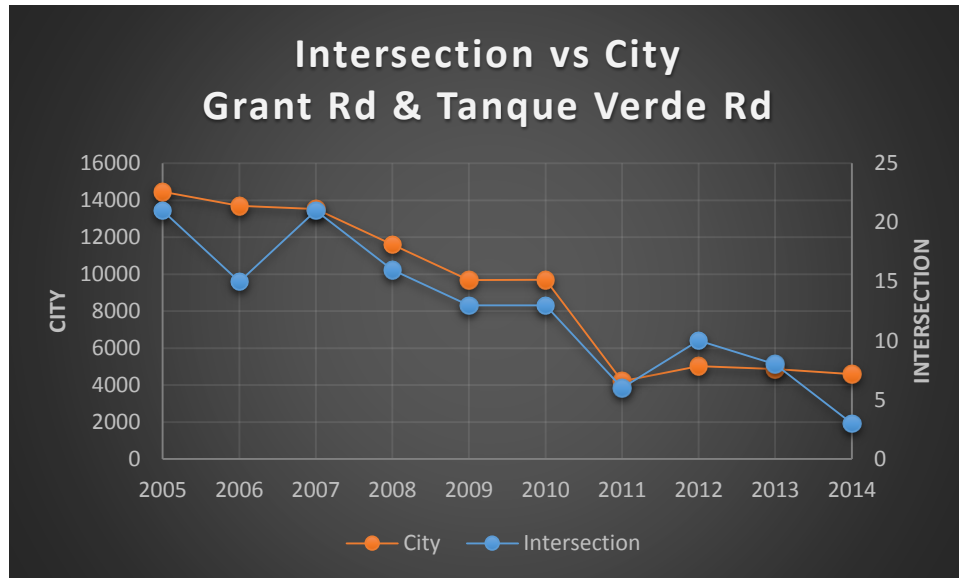


Figure 5

A look at total crashes for all approaches of the Grant Rd & Tanque Verde intersection shows that overall, crashes seem to have increased relative to the rest of the city after installing a camera.

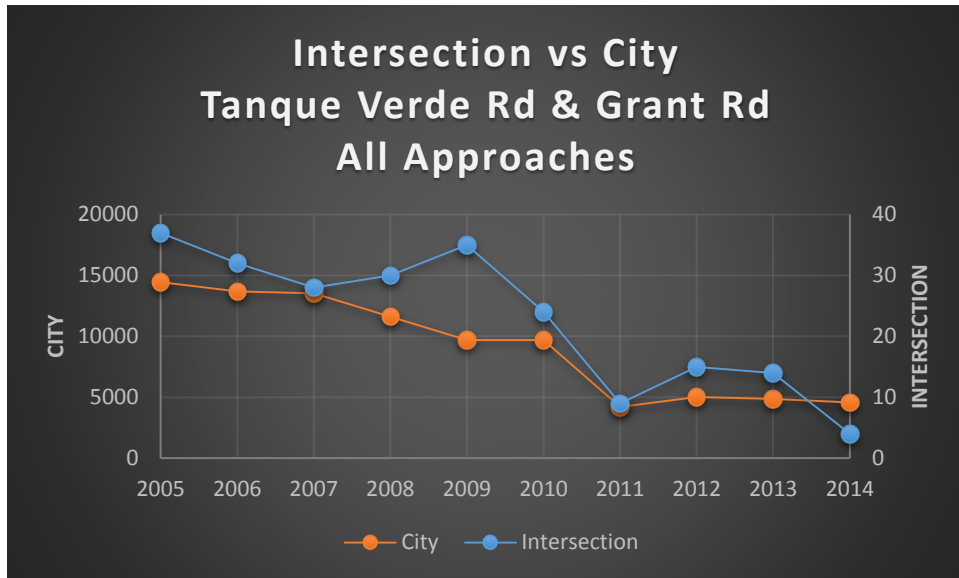


Figure 6

A comparison of number of crashes resulting in injuries shows a similar result:

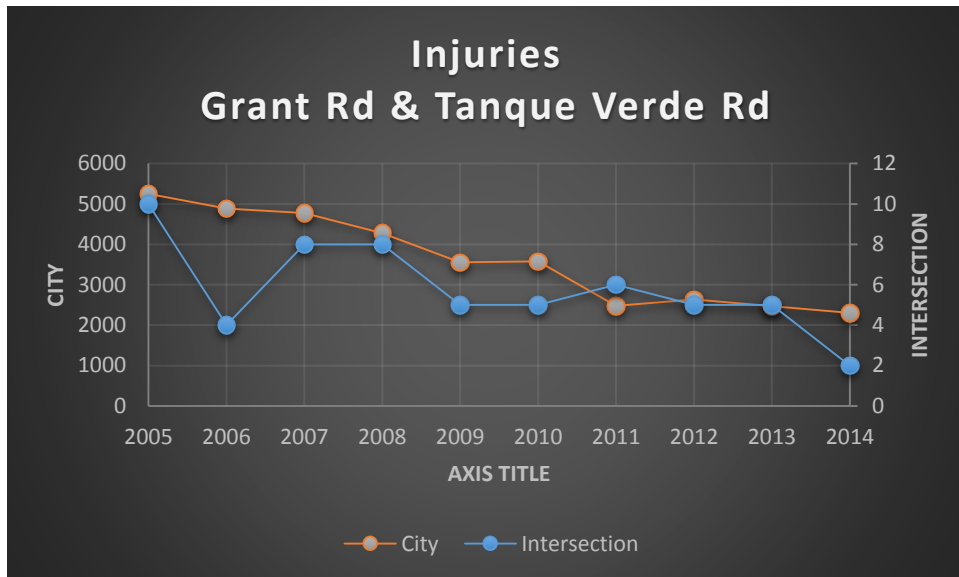
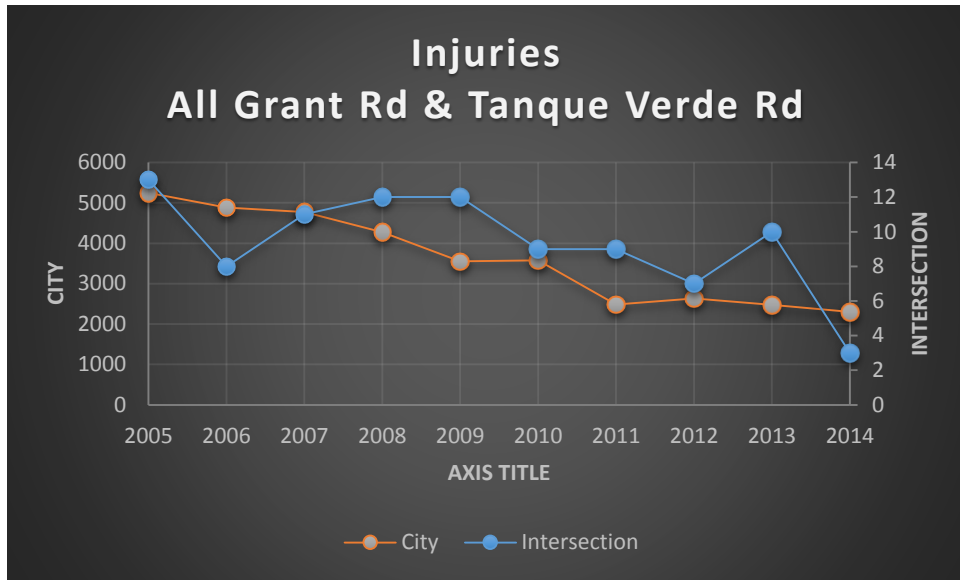


Figure 7



*Figure 8*

**GRANT RD & TANQUE VERDE RD CONCLUSION:**

The cameras have not reduced the number of collisions and have possibly lead to a small increase in number of crashes and the number of injury crashes.



## NOGALES HIGHWAY & VALENCIA RD

A few months later, Tucson installed two cameras at WB E Valencia Rd & S Nogales Highway and NB S Nogales Highway and E Valencia Rd. They went live January 26, 2008.

A comparison of trends between the intersection and the city shows a general correlation. There is no significant difference between the city wide trend and this intersection, indicating that this camera has had very little impact on crashes on WB E Valencia Rd & S Nogales Highway.

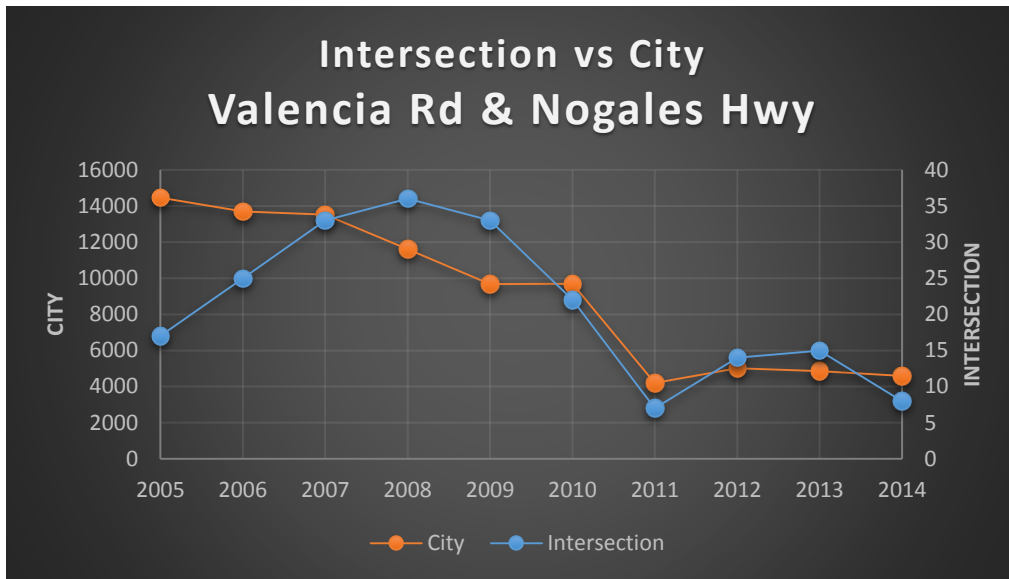


Figure 9

The same is true for the other approach:

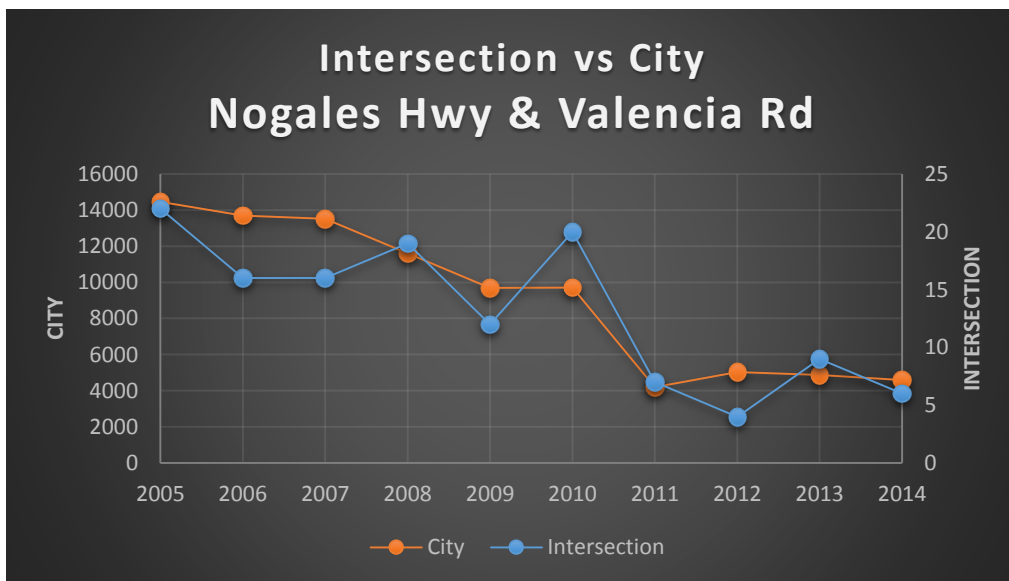


Figure 10

Injuries for the entire intersection follow the city-wide trend with 2 significant spikes occurring in the year when the camera was installed and again in 2013.

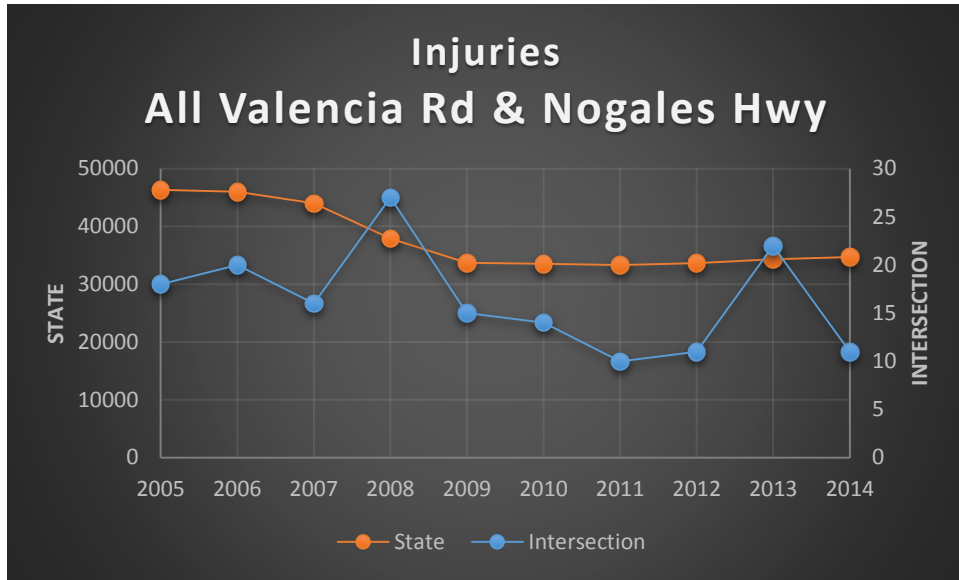


Figure 11

**NOGALES HIGHWAY & VALENCIA RD CONCLUSION:**

The cameras have had no significant effect on the number of collisions and have possibly lead to an increase in injuries crashes.

## E 22<sup>nd</sup> ST & S WILMOT RD

A few weeks later, Tucson installed two cameras at WB and EB E 22<sup>nd</sup> St & S Wilmot Rd. They went live Feb 20, 2008.

A comparison of trends between the intersection and the city shows a general correlation. There is no significant difference between the city wide trend and this intersection, indicating that this camera has had very little impact on crashes on E 22<sup>nd</sup> St & S Wilmot Rd.

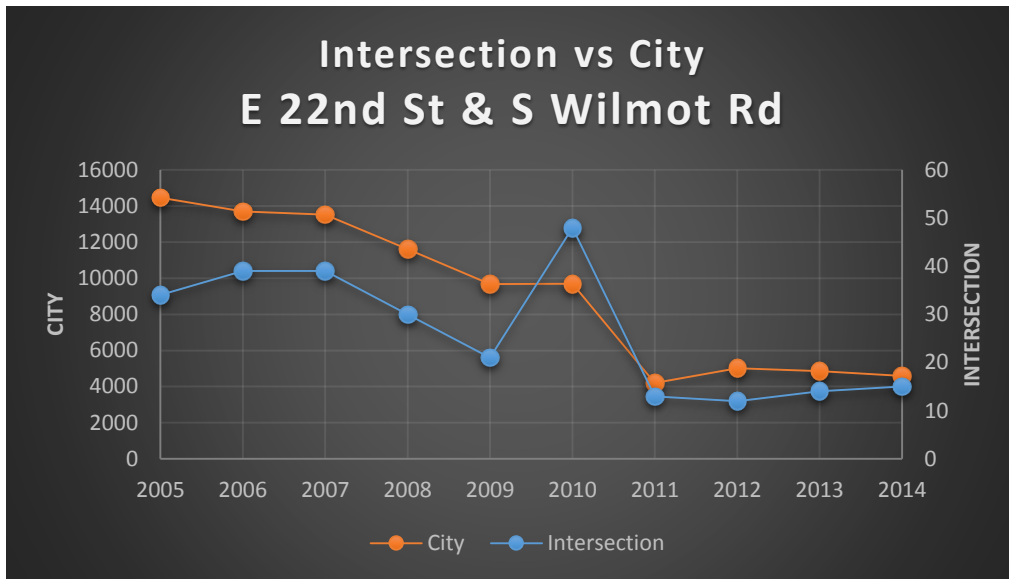


Figure 12

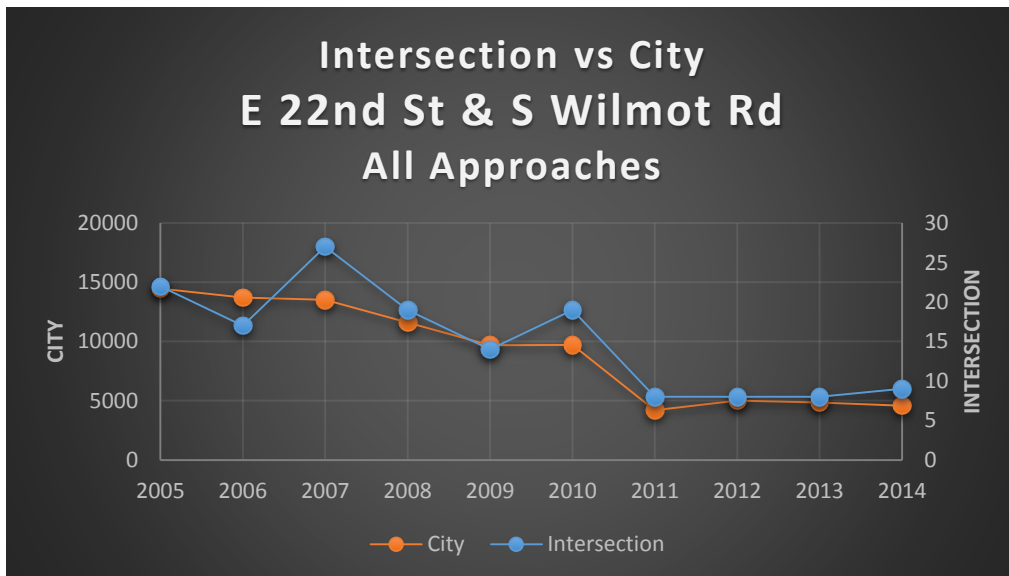


Figure 13

Crashes with injuries for the monitored approach as well as the entire intersection essentially follows the city-wide trend resulting in no net improvement.

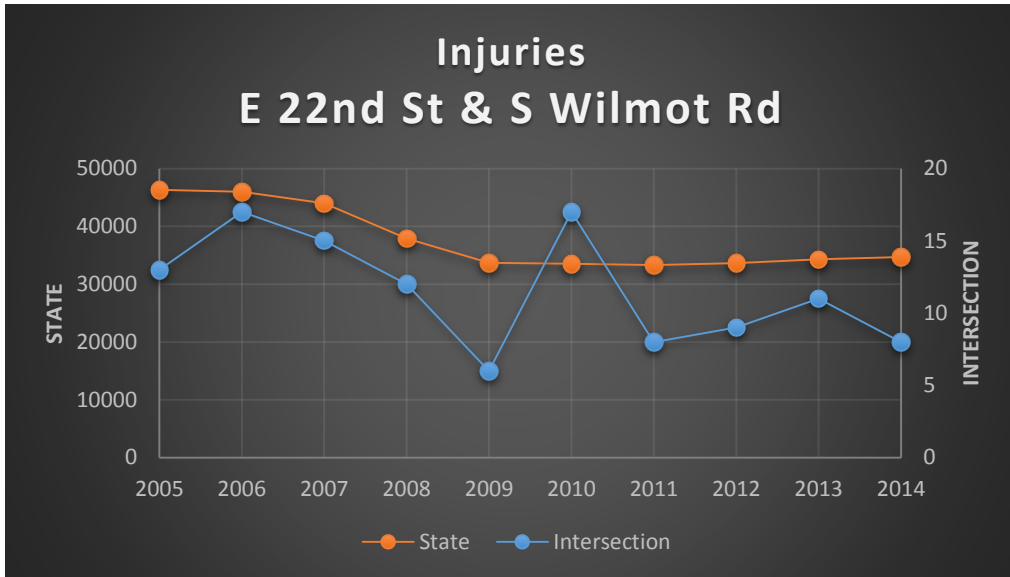


Figure 14

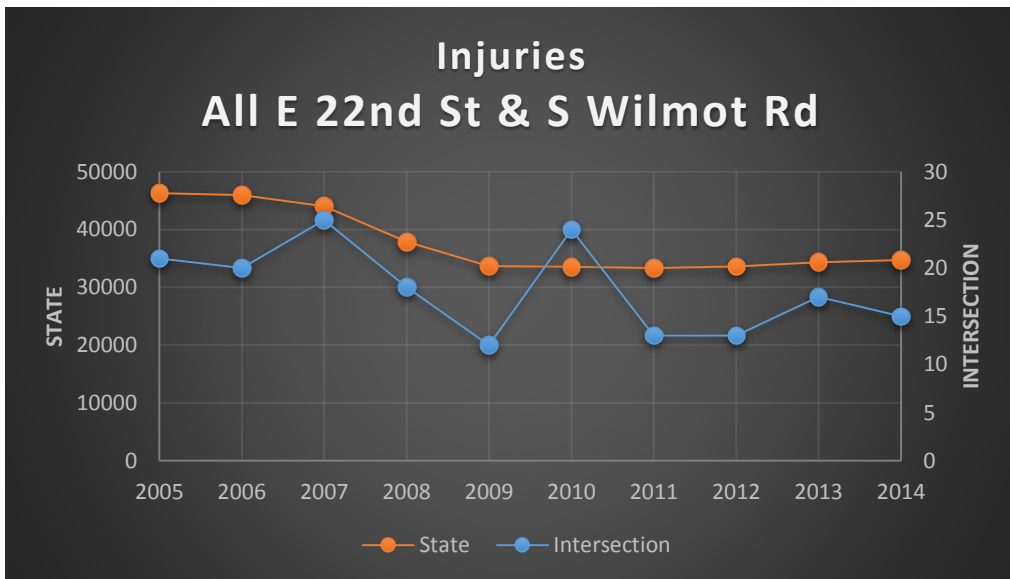


Figure 15

**E 22<sup>nd</sup> ST & S WILMOT RD CONCLUSION:**

The cameras have had no significant effect on the number of collisions and have possibly lead to an increase in injuries crashes.

## N ORACLE RD & W RIVER RD

A month later, Tucson installed two cameras at SB and NB Oracle Rd & W River Rd. They went live March 29, 2008.

A comparison of trends between the intersection and the city shows a strong correlation. There is no significant difference between the city wide trend and this intersection, indicating that this camera has had very little impact on crashes on N Oracle Rd & W River Rd.

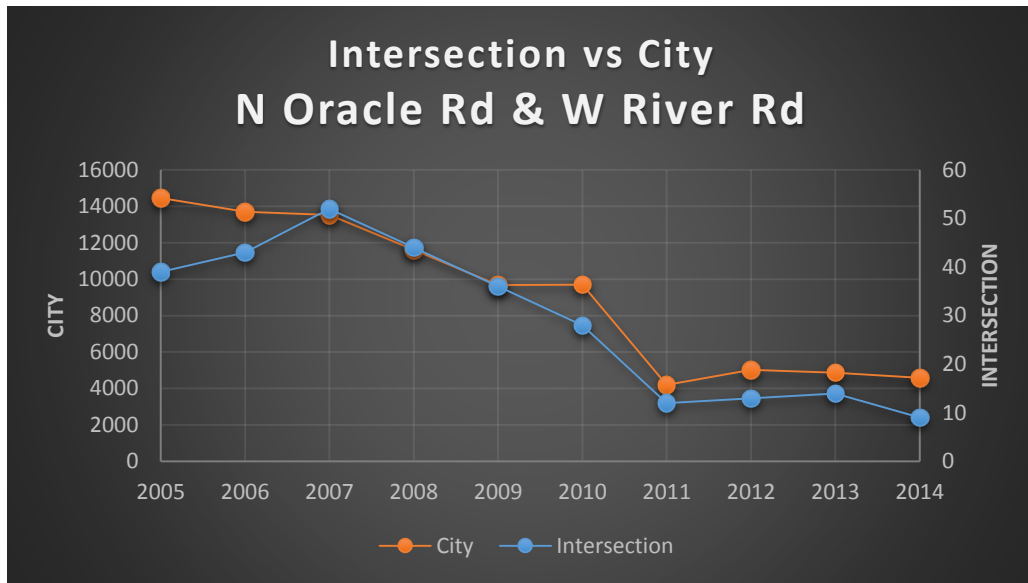


Figure 16

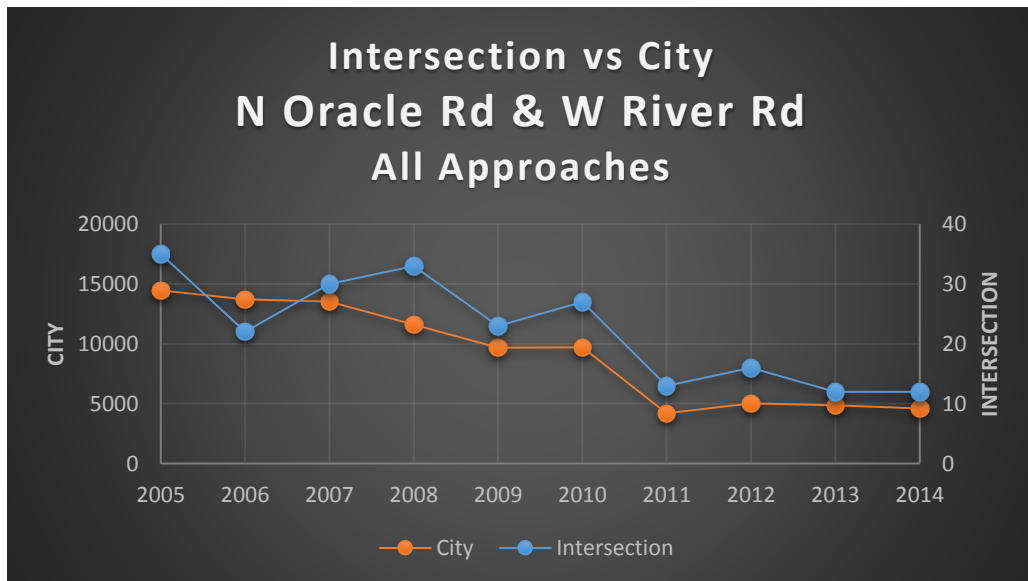


Figure 17

Crashes with injuries for the monitored approach as well as the entire intersection essentially follows the city-wide trend resulting in no net improvement.

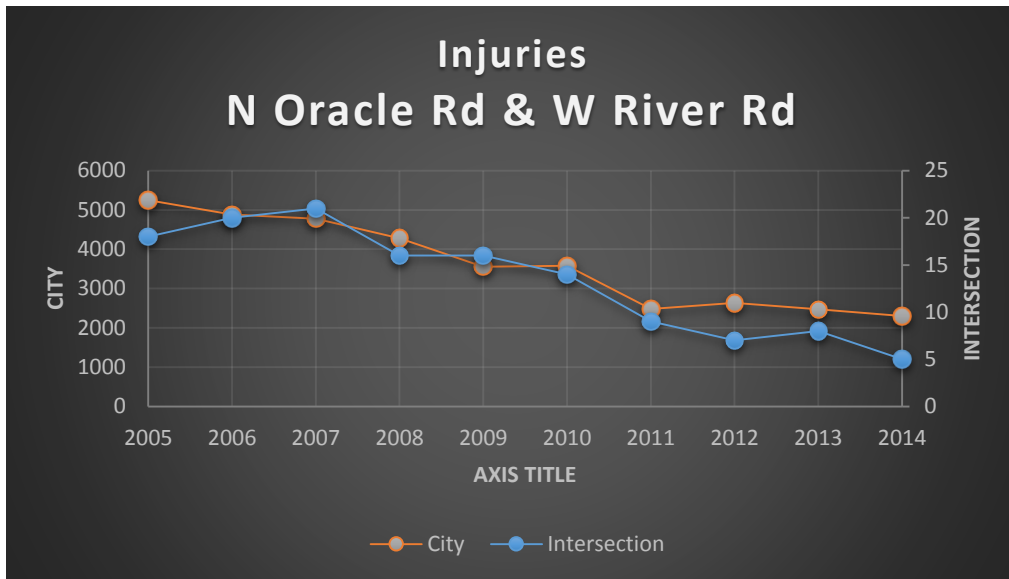


Figure 18

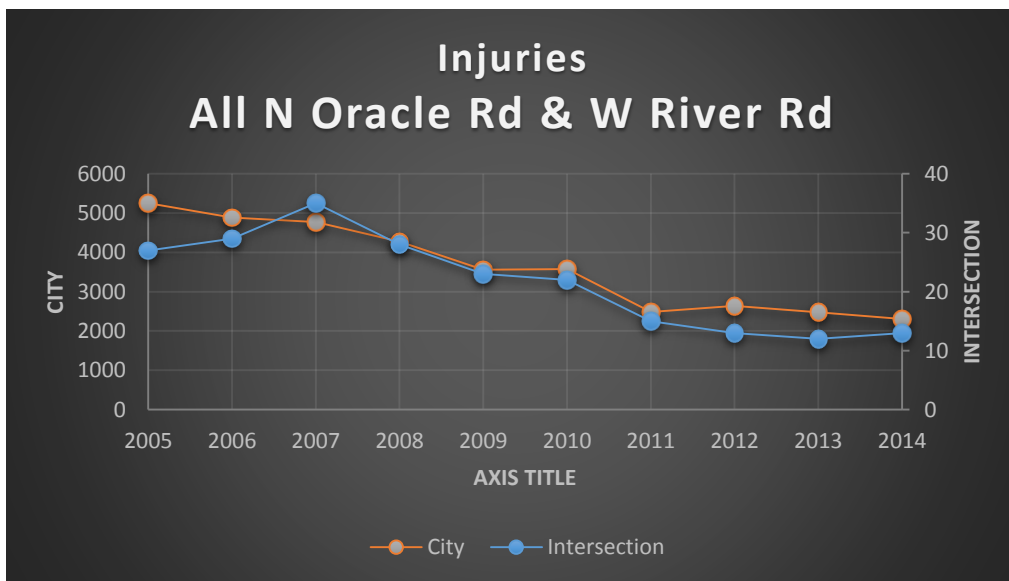


Figure 19

**N ORACLE RD & W RIVER RD CONCLUSION:**

The cameras have had no significant effect on the number of collisions and injuries since cameras have been installed.

## N KOLB RD & E SPEEDWAY BLVD

Over two years later, Tucson installed four cameras at all approaches at N Kolb Rd & E Speedway Blvd. They went live Nov 26, 2010.

A comparison of trends between the intersection and the city shows a general correlation. There is no significant difference between the city wide trend and this intersection, indicating that this camera has had very little impact on crashes on N Kolb Rd & E Speedway Blvd.

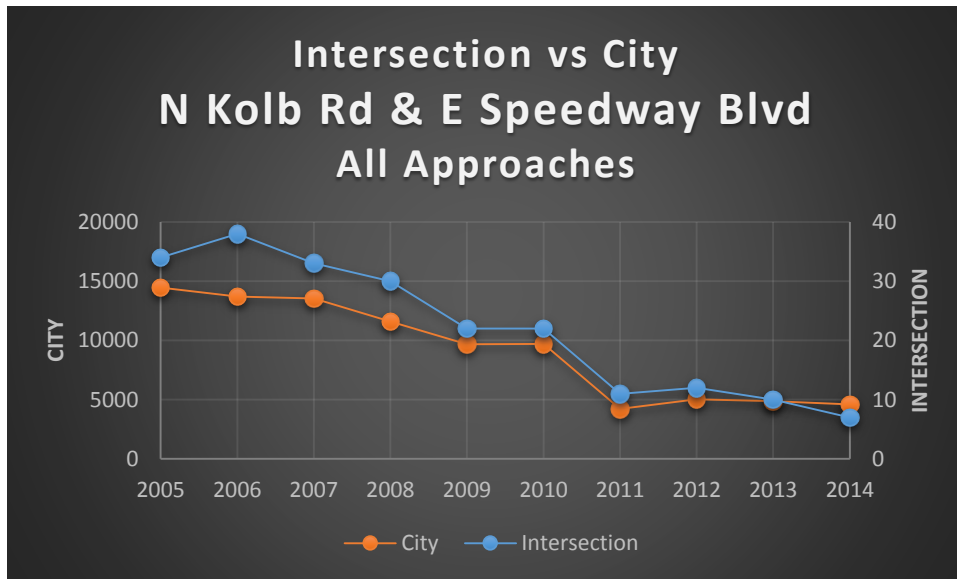


Figure 20

Crashes with injuries for the monitored approach as well as the entire intersection essentially follows the city-wide trend resulting in no net improvement.

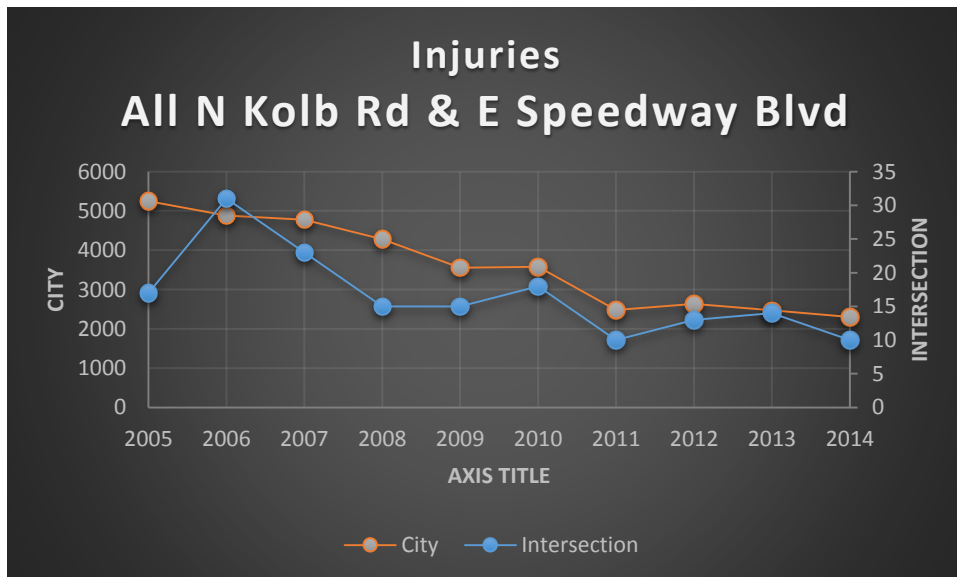


Figure 21

**N KOLB RD & E SPEEDWAY BLVD CONCLUSION:**

The cameras have had no significant effect on the number of collisions and injuries since cameras have been installed.



## E GRANT RD & N SWAN RD

At the end of 2010, Tucson installed two cameras at E Grant Rd & N Swan Rd. They went live Dec 17, 2010.

A comparison of trends between the intersection and the city shows a general correlation. There is no significant difference between the city wide trend and this intersection, indicating that this camera has had very little impact on crashes on E Grant Rd & N Swan Rd.

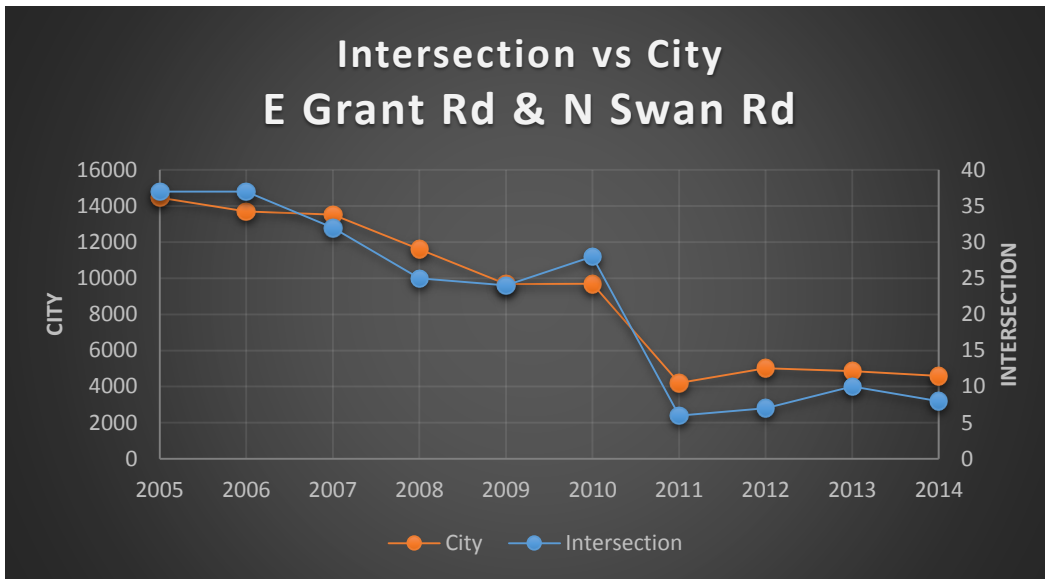


Figure 22

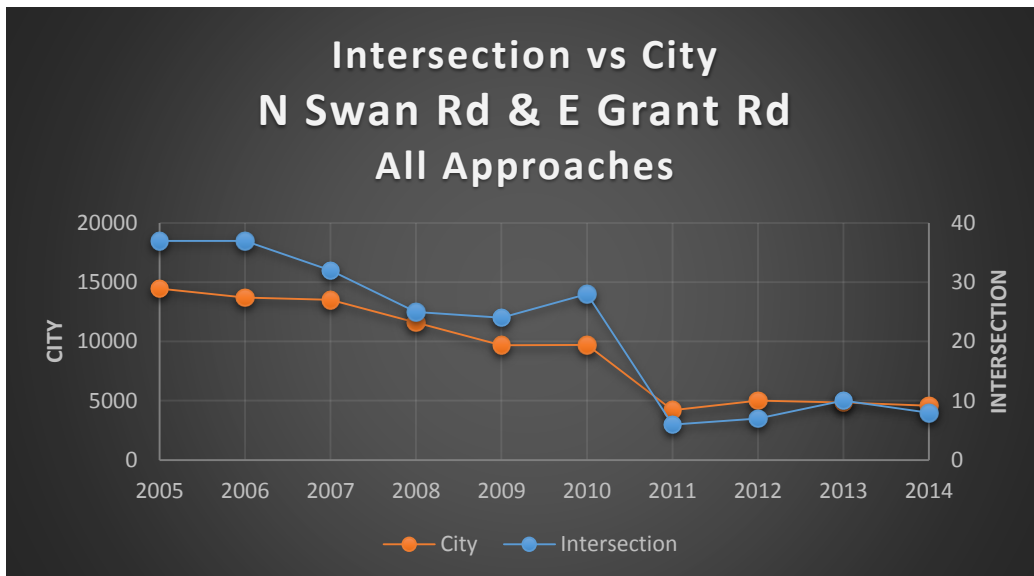


Figure 23

Crashes with injuries for the monitored approach as well as the entire intersection essentially follows the city-wide trend resulting in no net improvement.

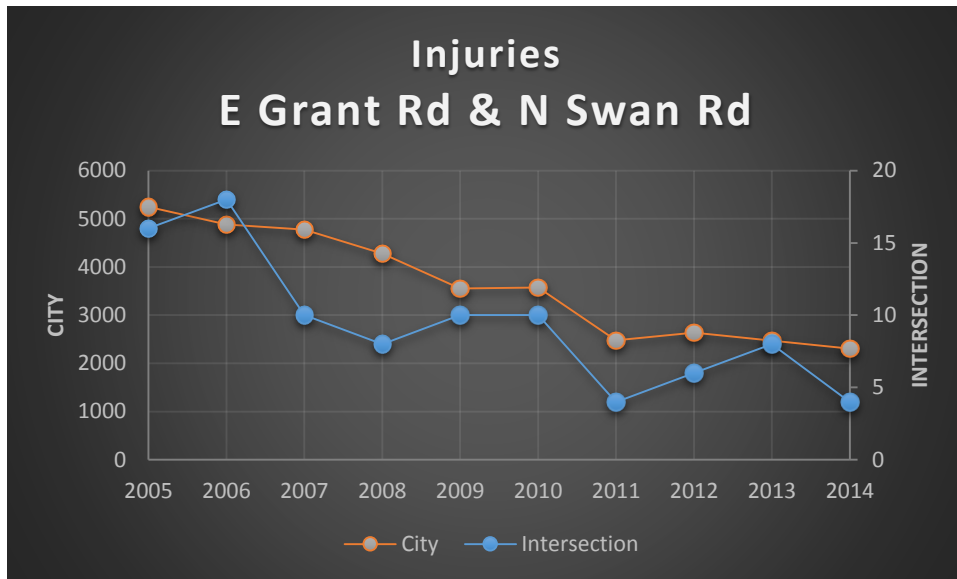


Figure 24

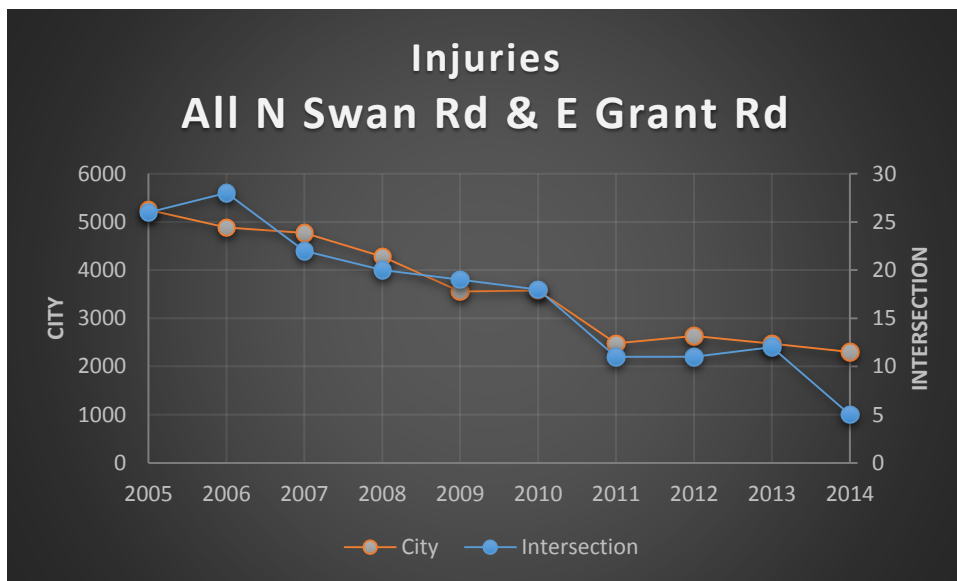


Figure 25

**E GRANT RD & N SWAN RD CONCLUSION:**

The cameras have had no significant effect on the number of collisions and injuries since cameras have been installed.

## E BROADWAY BLVD & S CRAYCROFT RD

Two months later, Tucson installed three cameras at E Broadway Blvd & S Craycroft Rd. They went live Feb 27, 2011.

A comparison of trends between the intersection and the city shows a general correlation. There is no significant difference between the city wide trend and this intersection, indicating that this camera has had very little impact on crashes on E Broadway Blvd & S Craycroft Rd.

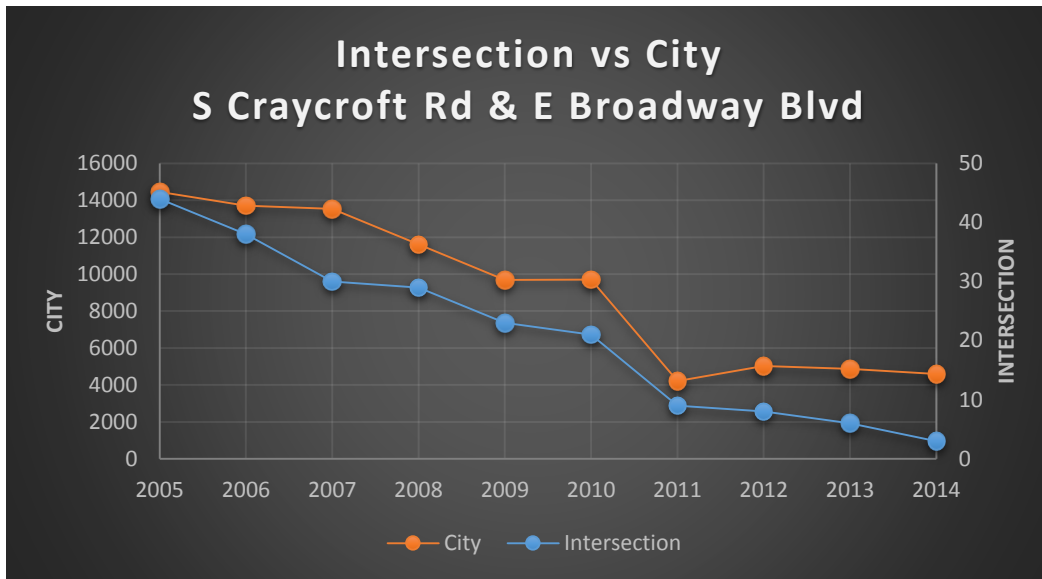


Figure 26

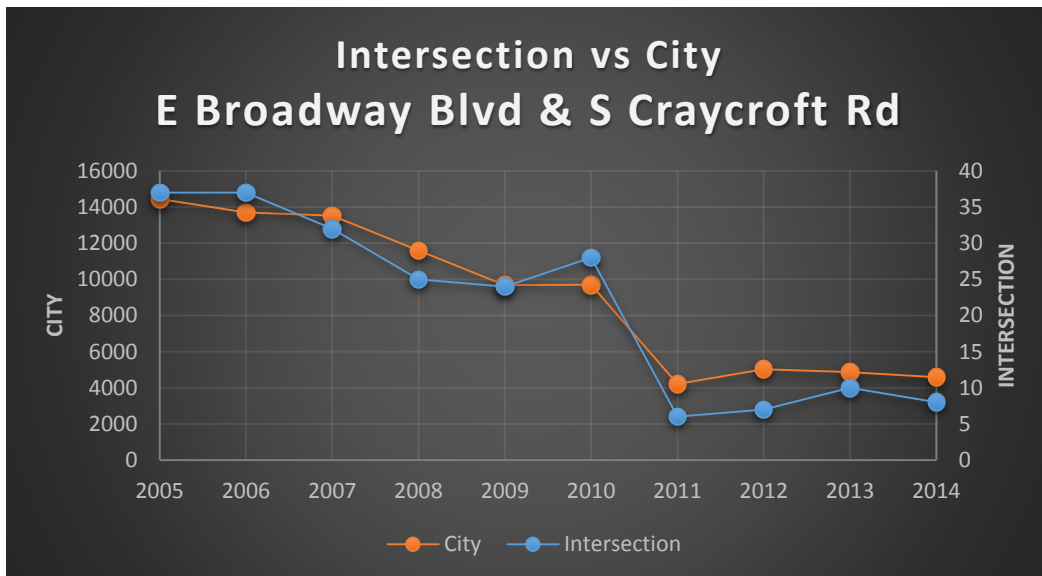


Figure 27

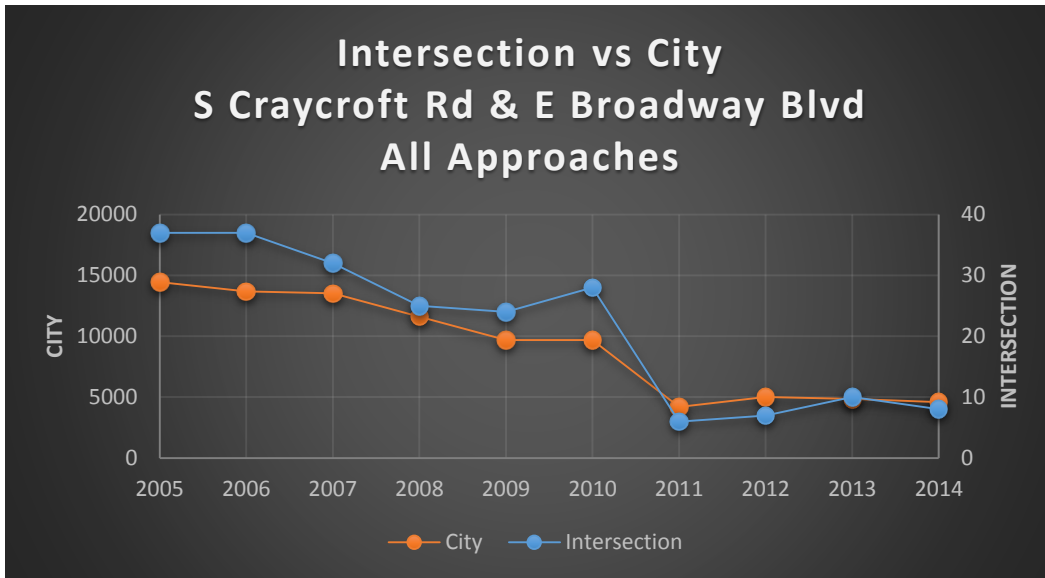


Figure 28

Crashes with injuries for the monitored approach as well as the entire intersection essentially follows the city-wide trend resulting in no net improvement.

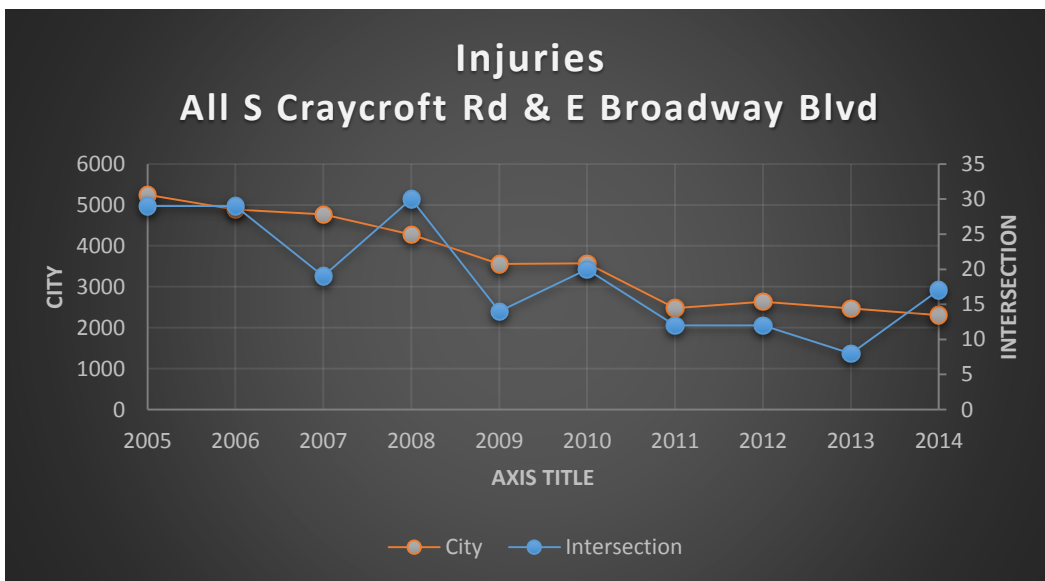


Figure 29

**E BROADWAY BLVD & S CRAYCROFT RD CONCLUSION:**

The cameras have had no significant effect on the number of collisions and injuries since cameras have been installed.

## E 6<sup>TH</sup> AVE & E AJO WAY

In late 2011, Tucson installed four cameras at E Ajo Way & S 6th Ave. They went live Oct 31, 2011.

A comparison of trends between the intersection and the city shows a general correlation. There is no significant difference between the city wide trend and this intersection, indicating that this camera has had very little impact on crashes on E Ajo Way & S 6th Ave.

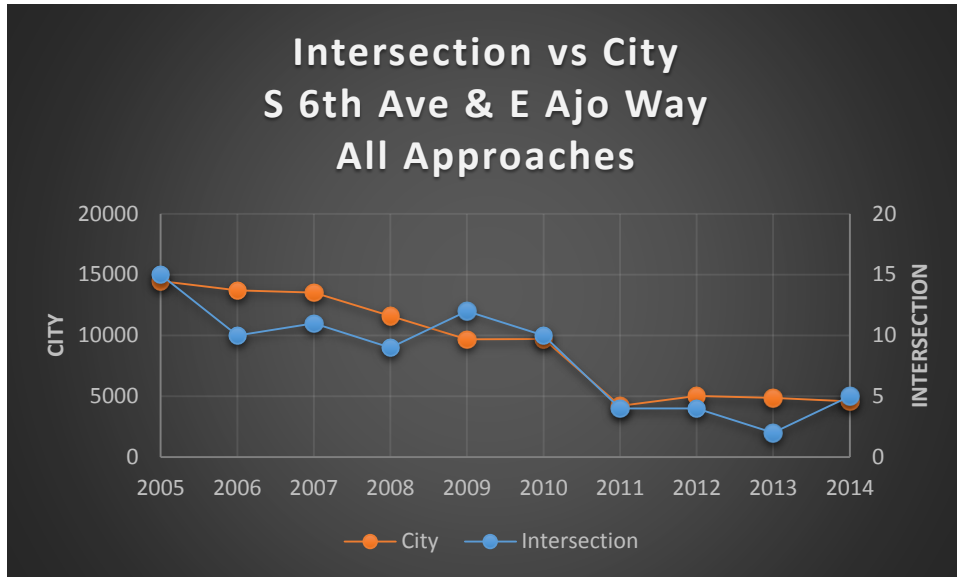


Figure 30

Injury crashes at this intersection have increased slightly since installation of the cameras.

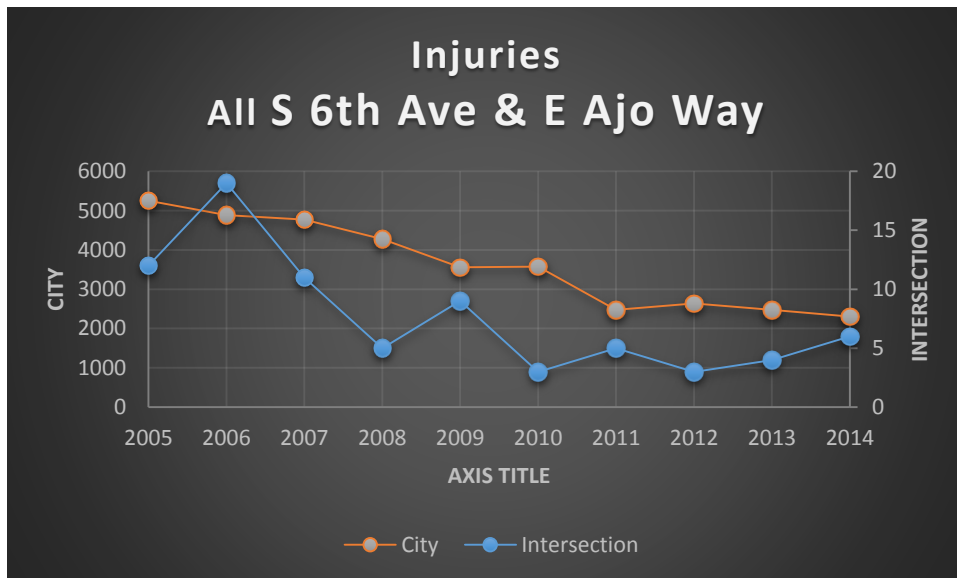


Figure 31

**E 6<sup>TH</sup> AVE & E AJO WAY CONCLUSION:**

The cameras have had no significant effect on the number of collisions and injuries since cameras have been installed.

### ALL PHOTO TICKETED INTERSECTIONS

Four intersections received cameras in the late 2007 and early 2008 time frame, and another four intersections received them in late 2010 and early 2011. Recall that Tucson changed its crash reporting guidelines for 2011 which explains the significant drop in crashes for that year.

A comparison of crash numbers for the first four intersections or the last 4 intersections shows no material difference when compared with the crash number for the entire city.

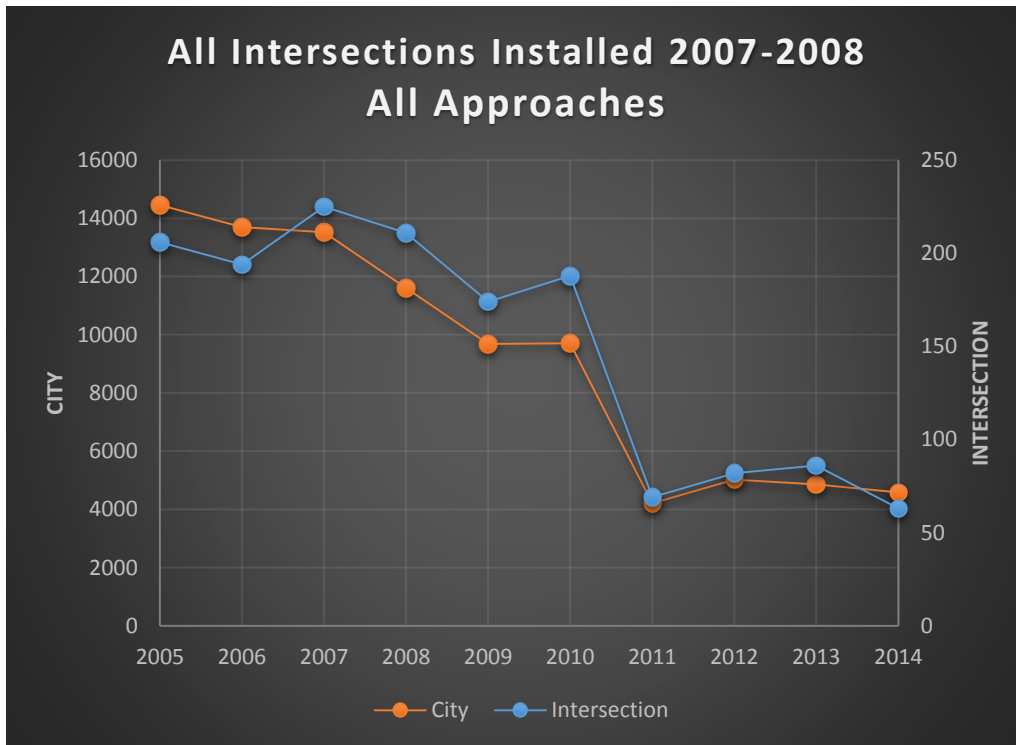


Figure 32

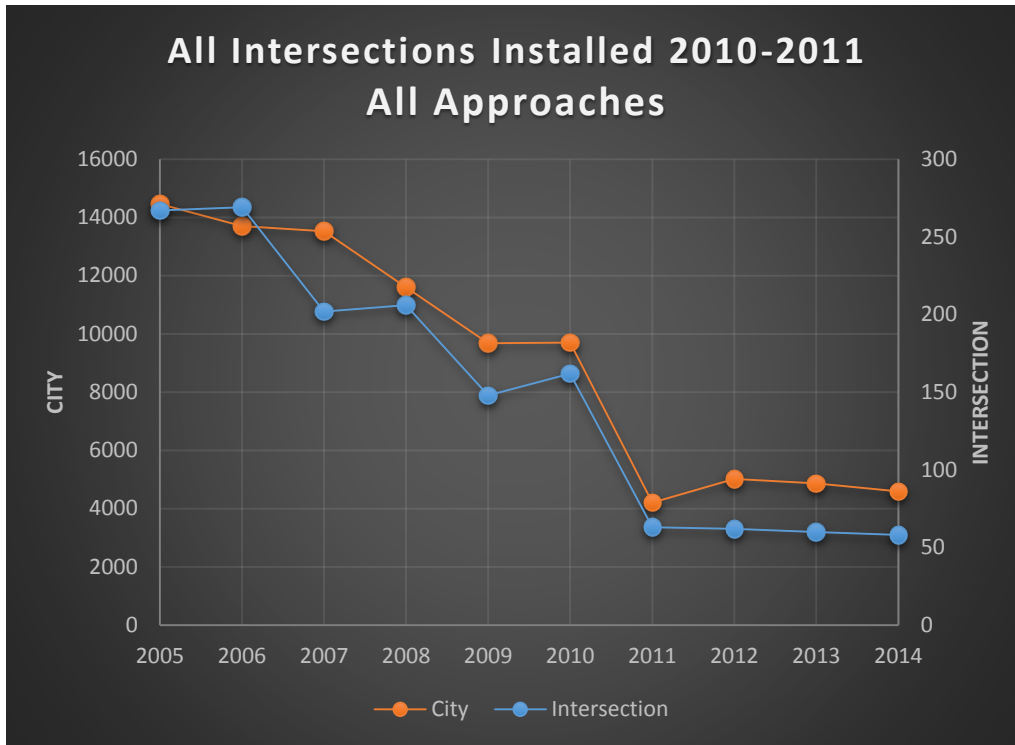


Figure 33

## CRASH CAUSATION

The ADOT crash database has 2 fields for violations that can be attributed to drivers involved in a crash. The database allows up to 2 violations to be attributed to a driver.

Below is an analysis of violations from 2005-2014 for each crash at the monitored intersections (2995 total crashes).

Exceeded Lawful Speed (Exceeded Posted Speed Limit)	0.6%
Disregarded Traffic Signal (Ran Stop Light)	6.1%
Too Fast for Conditions	23.5%
Inattention/Distracted or Elec Communications Device	27.4%

Table 1- 2005-2014 Crash Violations at Monitored Intersections

Speeding (exceeding the lawful speed limit) is cited as a violation in less than 1% of all monitored intersection crashes. Running a red light is cited as a violation in only 6.1%.

An investigation of crash causes prior to installation of photo ticketing machines (2005-2007 for the first four intersections, 2005-2010 for the last four), shows the following tabulation of crash violations.

Exceeded Lawful Speed (Exceeded Posted Speed Limit)	0.4%
Disregarded Traffic Signal (Ran Stop Light)	4.0%
Too Fast for Conditions	14.9%
Inattention/Distracted or Elec Communications Device	11.5%

Table 2- Crash Violations at Monitored Intersections Prior to Camera Installation



If a comparison is made to the crash causation prior to installing cameras to that of the entire period, it appears that *more* crashes were caused by exceeding the posted limit, disregarding traffic signals, and driving too fast for conditions *after* the photo ticketing began. In other words, these problems became worse after installing the cameras!

It should be noted "Too Fast For Conditions" does not mean the driver was exceeding the speed limit. Photo ticketing machines cannot detect cars that are going too fast for conditions if they are below the posted limit. If the cars were being driven above the posted limit, presumably the citation would be for Exceeding the Lawful Speed Limit rather than Too Fast For Conditions.

Prior to photo ticketing of vehicles exceeding the posted limit and running red lights, such activity was cited as a violation in less than 5% of crashes at these locations.

## INJURIES

A popular claim for photo ticketing is the claim that crashes are less severe after cameras are installed. An analysis of the number of crashes where there was at least one injury at all approaches at all photo ticketed intersections shows no conclusive improvement in injury crash numbers.

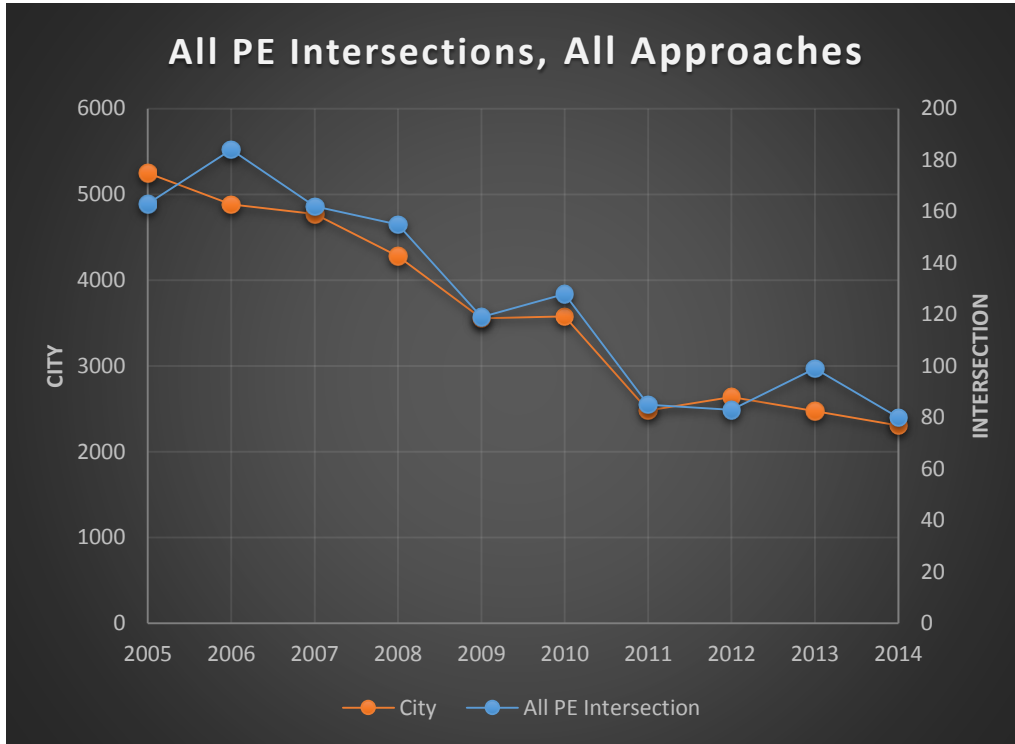


Figure 34

An analysis of injuries at intersections where photo ticketed systems were installed in 2007 and 2008 shows a possible increase in injuries relative to the prevailing trend.

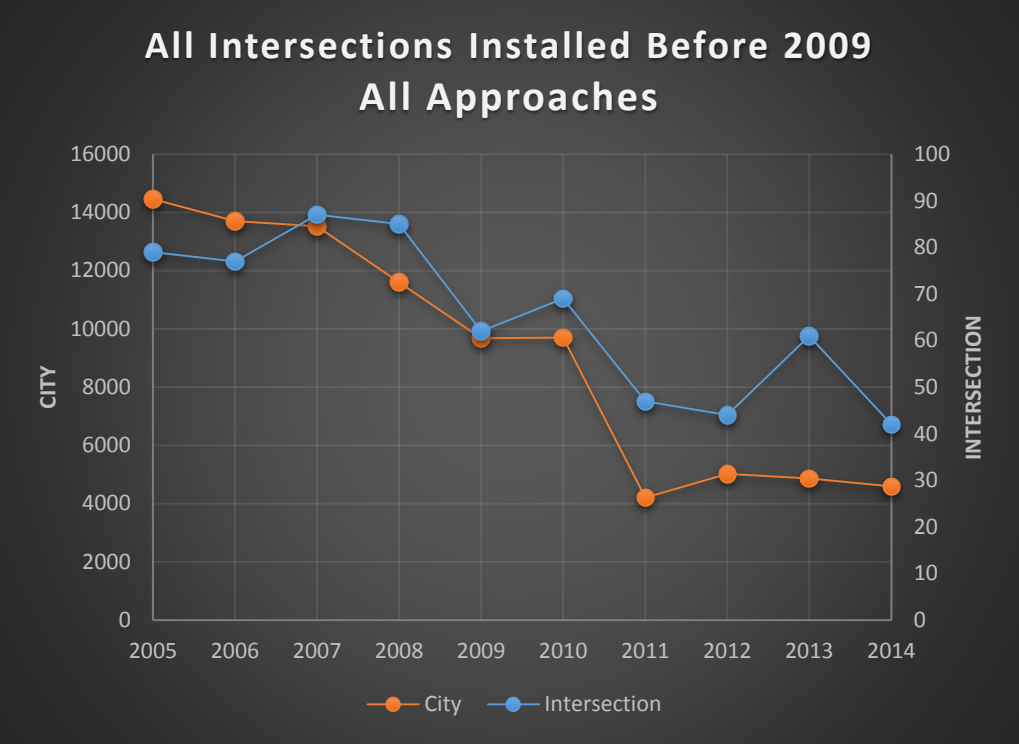


Figure 35

An analysis of injuries at intersections where photo ticketing systems were installed in 2010 and 2011 also shows a possible increase in injuries relative to the prevailing trend. Note that if the two trend lines were overlaid, they would line up almost perfectly from 2007-2010 and then starting in 2011 when these cameras were installed, the trend line would be higher than the citywide trend.

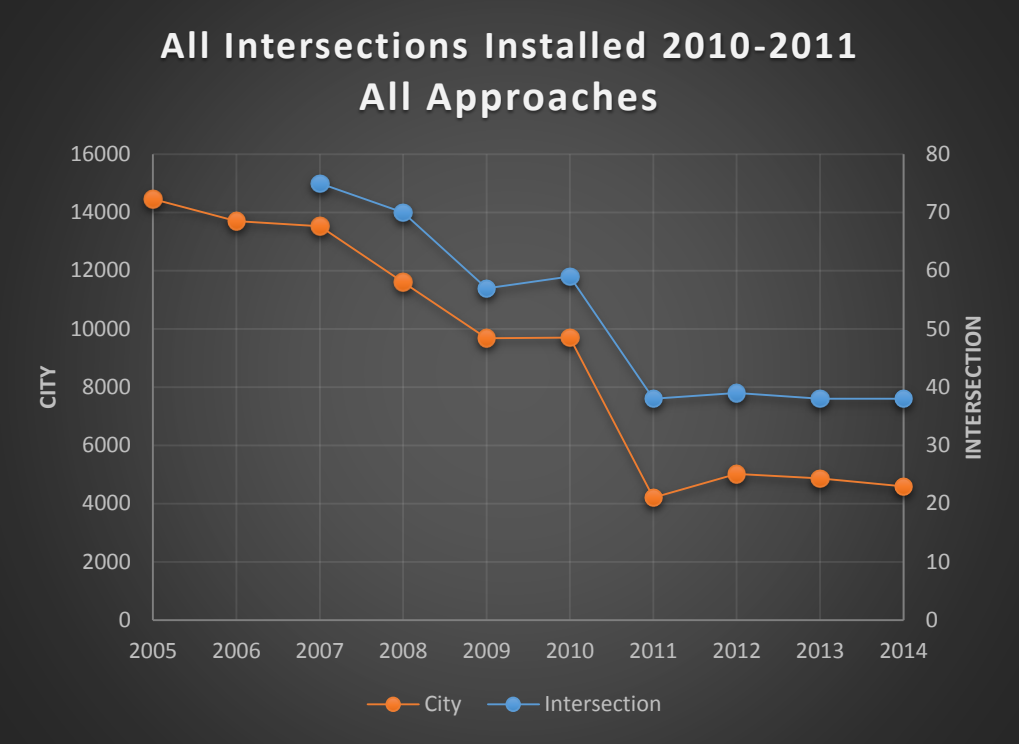


Figure 36



## FATALITIES

A popular claim for photo ticketing is that they save lives. With so few fatality crashes at monitored intersections it is not possible to draw meaningful conclusions. From this data it appears that drug and alcohol use are among the leading contributors to fatalities at photo ticketed intersections. There was one fatality due to speeding before the cameras were installed and one crash due to running a red light after the cameras were installed. It is difficult to see where increase enforcement of exceeding the posted limit and running red lights has or will reduce fatalities.

Year	Grant Rd & Tanque Verde Rd	Nogales Highway & Valencia	22nd St & Wilmot Rd	River Rd & Oracle Rd	Speedway Blvd and Kolb rd	Grant Rd & Swan Rd	Broadway Blvd & Craycroft Rd	6th Ave & Ajo Way	Total
2005	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0
2007	1	0	0	0	1	0	0	0	2
2008	0	0	0	0	0	1	0	0	1
2009	0	0	0	0	0	0	1	0	1
2010	1	0	0	0	0	0	0	0	1
2011	0	0	0	1	0	0	0	0	1
2012	0	0	0	1	0	0	0	0	1
2013	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0
<b>Sum</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>7</b>

Table 3- Fatalities

Year	Incident #	Type	Event	Location	Before or After Camera	Violation	Drugs or Alcohol
2007	1930210	Single Vehicle	OVERTURN_ROLLOVER	MEDIAN	Before	EXCEEDED_LAWFUL_SPEED	Alcohol
2007	1904198	Left Turn	MOTOR_VEHICLE_IN_TRANSPORT	ON ROADWAY	Before	FAILED_TO_YIELD_RIGHT_OF_WAY	None
2008	2334383	Left Turn	MOTOR_VEHICLE_IN_TRANSPORT	ON ROADWAY	Before	FAILED_TO_YIELD_RIGHT_OF_WAY	None
2009	2289559	Other	PEDESTRIAN	ON ROADWAY	Before	DID_NOT_USE_CROSSWALK	None
2010	2335264	Single Vehicle	TREE_BUSH_STUMP_STANDING	MEDIAN	After	FAILED_TO_KEEP_IN_PROPER_LANE	Drugs, Alcohol
2011	2590321	Rear End	ANIMAL_PET	Not Specified	After	DISREGARDED_TRAFFIC_SIGNAL, SPEED_TOO_FAST_FOR_CONDITIONS	Alcohol
2012	2664701	Single Vehicle	TRAFFIC_SIGNAL_SUPPORT	Not Specified	After	NONE	Alcohol

Table 4- Fatality List

## CONCLUSIONS

There is a 97% correlation between miles driven and number of crashes statewide. This indicates that the reduction in crashes seen statewide in the past ten years can be attributed mostly to a drop in the number of miles driven. The correlation for Tucson is also strong, at 92%.

The number of miles driven has dropped consistently from 2007 until 2011 both in Tucson and statewide. By using a simplistic approach to crash data that did not account for miles driven or other factors, city officials have mistakenly attributed reductions in crashes to photo ticketing equipment.

Since the importance of number of miles driven (and a corresponding traffic count) has been established as a primary factor affecting crash numbers, it cannot be ignored when assessing the performance of photo ticketing. Because of the strong correlation of city-wide crashes to city-wide miles driven, a comparison to the city-wide miles driven or city-wide number of crashes shows very similar trends and can be used almost interchangeably.

1. When crash numbers from all photo ticketed intersections are compared to the City of Tucson as a whole, the trends are almost identical with a 99% correlation, indicating almost no improvement or deviation from city wide trends.

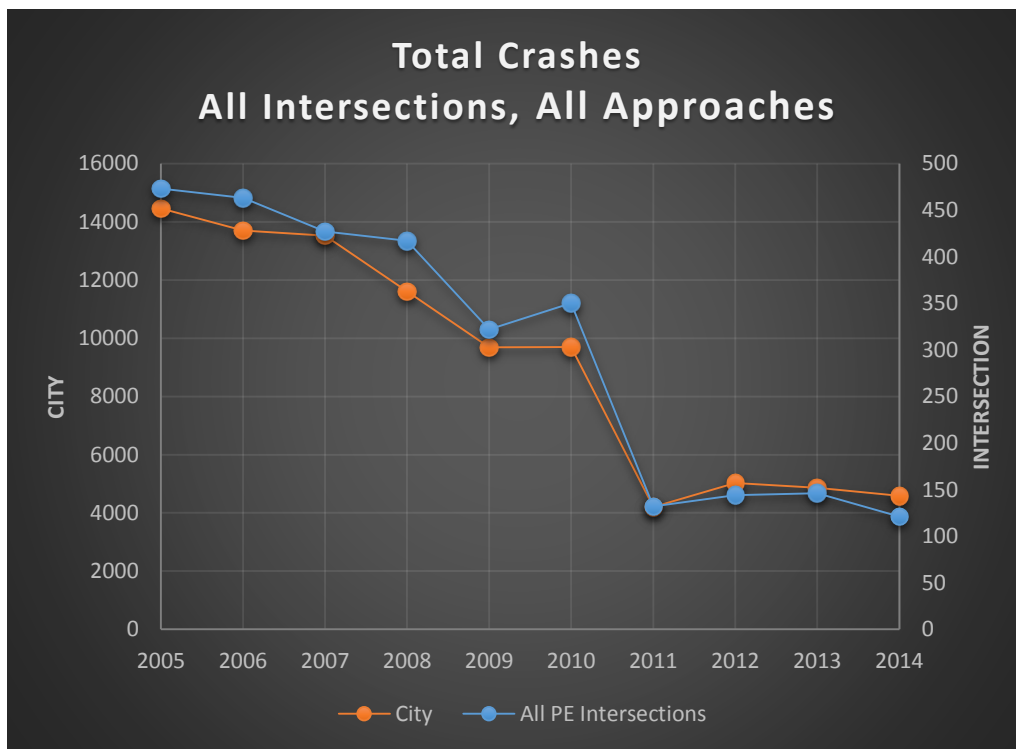


Figure 37

2. When injury crash numbers trends from photo ticketed intersections are compared to the city of Tucson as a whole, the trends are almost identical with a 99% correlation.

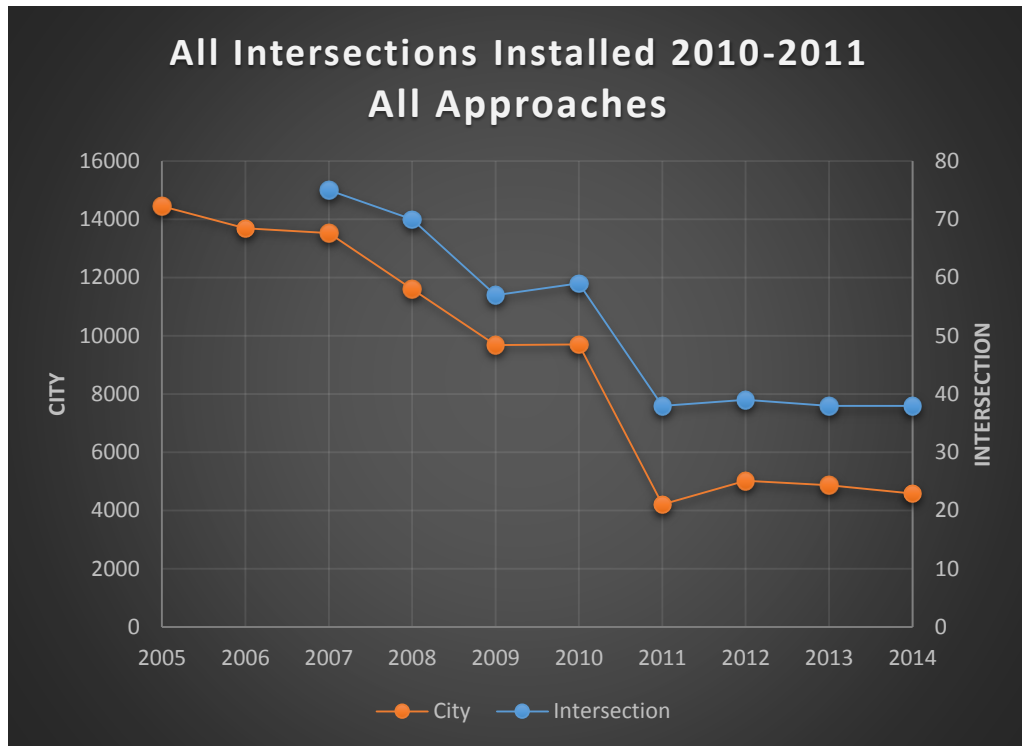


Figure 38

3. ADOT data suggests that only 5-6% of crashes at photo ticketed intersections are attributed to speeding and running red lights. If photo ticketing were to cure this problem completely (a farcical notion) then the best improvement that could be expected is a 5-6% reduction in crashes. Realistically, photo ticketing will not eliminate all crashes due to exceeding the posted limit and running red lights. Any theoretical improvement in crashes or injuries are or will be statistically imperceptible since these actions are the cause of so few crashes.



## COMMENTARY

A truly proper analysis of the photo ticketing system requires more data and analysis than was possible for this report. However, the methodology used for this report is sufficient to reliably draw the conclusions in the previous section.

A recent study by Barbara Landland-Orban of the Department of Health Policy and Management at the College of Public Health at the University of South Florida analyzed differences in Red Light Camera studies to determine why conclusions vary in analysis of red light camera studies (Explaining Differences in Crash and Injury Crash Outcomes in Red Light Camera Studies, <http://ehp.sagepub.com/content/early/2014/07/07/0163278714542245.abstract>). The research concluded that, "differences in findings were attributed to the evaluation methods used. If implementing an RLC program, communities should use sound public health evaluation methods to assess effectiveness." Landland-Orban says that sound studies should encompass all these criteria:

- Lack of bias in the selection of treated sites
- Lack of bias in the selection of comparison sites
- Integration of relevant control variables in the analysis
- Full disclosure of results of the statistical analysis

The City of Tucson has access to the correct staff and data to provide this analysis but has never done so. Instead of performing a proper analysis, Tucson has relied on non-technical police staff to perform and compare a simple tally of crashes both before and after camera installation in lieu of having professional traffic engineering staff perform a more rigorous analysis.

In this report, both Tucson and the entire state of Arizona experienced a continuous drop in total miles driven starting almost at the same time as cameras were installed until 2013. As there is a 92% correlation between miles driven and total number of crashes in Tucson, a simple plotting of total crash numbers shows that crashes decreased over this time period because less miles were being driven. The City of Tucson's limited analysis was quick to attribute the decrease in crashes at monitored intersections to the photo ticketing machines and without any consideration to a decline in traffic volume or any other factors. This limited analysis has lead Tucson to erroneously celebrate the success of their photo ticketing system rather than scrutinizing the performance and the results. In many reports, the city even goes so far as to correlate the quantity of tickets issued to the decline in crashes. We know that this correlation is invalid when a comparison is made to statewide miles-driven compared to statewide crash numbers compared to statewide tickets issued. We note that photo ticketing is fairly rare statewide, yet there is a 97% correlation between miles driven and number of crashes, while tickets for exceeding the posted limit and disregarding a traffic signal are not likely to have changed as significantly over that time period as they have for Tucson due to the high number of tickets issued by the system.

As for crash violation analysis, from a safety improvement standpoint it is difficult to see why the city would focus so heavily on violations for exceeding the posted limit and running red lights to improve safety at these intersections. With these causes accounting for less than 6% of all crashes as reported by Tucson police, the focus on speeding and red light violations seems to be misplaced if a true improvement in safety is the objective. To focus on what is the underlying cause of so few crashes at

these locations explains why there is little or no improvement in crashes or injuries at these intersections.