Evaluation of In-Pavement, Flashing Warning Lights on Pedestrian Crosswalk Safety

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ABSTRACT

Collisions involving pedestrians in crosswalks commonly result in fatalities. In-pavement flashing warning lights have been proposed as a means of increasing the conspicuity of pedestrians in crosswalks. However these warning light systems are more expensive to install than conventional striping. This report describes work undertaken to determine the relative effects on pedestrian and driver behavior of high visibility marking and an in-pavement flashing warning light system installed on a crosswalk site in Denville, New Jersey. Comparisons of the same crosswalk before and after striping and after installation of the in-pavement flashing warning lights enable the relative benefits of these actions to be determined. From the data collected it is concluded that high visibility marking of a crosswalk enhances the noticeability of the crosswalk and reduces conflicts between pedestrians and vehicles but does not reduce the mean speed at which vehicles approach the crosswalk or the mean number of vehicles passing over the crosswalk while a pedestrian is waiting to cross. Adding an in-pavement flashing warning light system to a crosswalk that is already clearly striped further enhances the noticeability of the crosswalk, reduces the mean speed at which vehicles approach the crosswalk, and reduces the mean number of vehicles that pass over the crosswalk while a pedestrian is waiting. However, it was also observed that the impacts of adding an in-pavement flashing warning light system to a crosswalk that is already clearly striped tends to diminish over time. The experimental procedure, collected data and observations, and recommendations for the future use of in-pavement flashing warning light signals at crosswalks are presented.

INTRODUCTION

Collisions involving pedestrians in crosswalks commonly result in fatalities (*1*). A number of companies are now promoting systems for increasing the conspicuity of a crosswalk when a pedestrian is in it. These systems consist of a series of high-intensity luminaires buried in the pavement on both sides of the crosswalk that direct light along the road towards oncoming traffic (*2*, *3*). When activated, either by a pedestrian pressing a signal button or by some form of automatic pedestrian detection system, the lamps in the luminaire flash at a set rate for a fixed time. The bright flashing warning lights lining the crosswalk draw driver's attention to the crosswalk making it more likely that drivers will pay attention to what is happening there and act appropriately. Such systems can be integrated with other traffic signal lights if required. The 2000 Millennium edition of the Manual of Uniform Traffic Control Devices contains language that makes the use of in-pavement flashing warning lights at crosswalks acceptable and gives guidance for their application (*4*).

Previous evaluations of such in-road warning lights have been carried out in the states of California and Washington (5). The evaluations are based on observations of driver and pedestrian behavior and on the opinions of drivers and pedestrians. However, these studies were all before-and-after studies and did not systematically compare the relative effectiveness of the in-pavement warning lights to the conventional approach of striping. As striping is less expensive to install than in-pavement flashing warning light systems, the use of the latter will only be justifiable if it produces a marked improvement in drivers' behavior and fewer conflicts between pedestrians and vehicles than does striping alone.

The objective of this project is to determine the effect of an in-pavement flashing, warning light system installed on a crosswalk on pedestrian and driver behavior, relative to striping.

RESEARCH APPROACH

The research approach is a field evaluation of the impact of successive improvements to an existing crosswalk. The evaluation design consists of an escalating series of before-and-after comparisons. The starting point was the crosswalk, as it existed in 1999, with only one marked crosswalk delineated by eroded minimal striping. The first evaluation was made in these conditions. In 2000, another crosswalk was added, both crosswalks were striped and ADA ramps were provided. The second evaluation was then made. In September 2000, the in-pavement flashing warning light system and the associated pedestrian detectors were installed. An evaluation was made shortly after the installation of this system. Two further evaluations were made nine months and one year after the installation. Comparison of the same crosswalk before and after the striping and after the installation of the in-pavement flashing warning lights enables the impact of these modifications to be examined.

The evaluation was based on measurements of the behavior of drivers and pedestrians using the crosswalk, opinions of the pedestrians using the crosswalk, and the conspicuity of the crosswalk to unwarned drivers. In addition, details of the reliability of the in-road, flashing warning light system over a year of operation were collected. Here only the measurements of the behavior of drivers and pedestrians using the crosswalk are presented. Additional information of driver and pedestrian behavior, opinion, and details of the reliability of the system is presented in previous publication (*6*).

Evaluation Site

The Department of Transportation of the State of New Jersey identified a site for the evaluation in Denville, New Jersey. FIGURE 1 shows a plan of the site. Although no pedestrian collisions have been reported at this location it was felt that this complicated intersection is dangerous for pedestrians. The site is adjacent to a major traffic-signal-controlled intersection between US Route 46, a four-lane, divided highway, and Franklin Road, a two-lane road. To the North of Savage Road is Gardner Field, an extensive recreational area. The width of Savage Road is 24 ft at crosswalk 1 and 32 ft at crosswalk 2. The speed limit on Savage Road is 30 mph. The east leg of Savage Road (at Franklin Road) is one-way westbound. Access to the parking lot of Gardner Field is off Savage Road, just to the west of crosswalk 2. Egress from the parking lot is actually into the junction adjacent to crosswalk 1. This complicated pattern of lanes means there are six possible routes for drivers to pass through the junction between Franklin Road and Savage Road. The six directions include:

Direction 1 – West on Savage Road, straight through the intersection
Direction 2 – West on Savage Road, south onto Franklin Road
Direction 3 – North on Franklin Road, west onto Savage Road
Direction 4 – East on Savage Road, south onto Franklin Road
Direction 5 – South on Franklin Road, from Gardner Field
Direction 6 – West on Savage Road, from Gardner Field

Changes to the Crosswalks

Original State of the Crosswalk

The first evaluation was made on Saturday, 12th June 1999. At this time, there was only one marked crosswalk at the site, that being crosswalk 2. This crosswalk was linked to a sidewalk on the northwest side of Franklin Road. There was no sidewalk on the southeast side of Franklin Road so there was no marked crosswalk 1 at this point. FIGURE 2 shows the marking of crosswalk 2 from the sidewalk on Savage Road on the day of the evaluation. It is clear that the original marking of crosswalk 2 consisted of two parallel lines across the road, although by the time of the evaluation, the lines had been badly eroded by traffic.

Striping

The second evaluation took place on Saturday, 13th May 2000. By this time, a sidewalk had been constructed on the southeastern side of Franklin Road and a new crosswalk across Savage Road (crosswalk 1), complete with ADA ramps, had been finished. Both crosswalks had been newly striped and advanced warning signs were added. Specifically, the striping consisted of alternate 2-ft-wide bars of white paint and 2-ft-wide pieces of asphalt, arranged to form a grating pattern, the upper and lower boundaries of the grating being closed by a continuous white paint line of 9" thickness. This is commonly called a high visibility crosswalk. The overall width of both crosswalks was 7 ft. FIGURE 3 shows a view of crosswalk 2 at this stage.

The In-Pavement Flashing Warning Light Installation

The third evaluation took place on Saturday, September 23rd, 2000, one week after the completion of the installation of the in-pavement flashing warning lights. The in-pavement flashing warning lights (Model ZA230) were purchased from Traffic Safety Corporation of Sacramento, California and installed by the New Jersey Department of Transportation. FIGURE 4 shows a close-up of one of the in-pavement flashing warning light units as installed.

The unit was originally designed for use on airport runways. It is of rugged construction and designed to be set low in the pavement as not to be damaged by snowplows. The light source used in the unit is a 45 W tungsten halogen lamp. The light output of the unit is predominantly in two directions, through apertures set at 180° to each other. The unit is installed so that these directions are along the main axis of the road. In Denville, only the direction towards approaching traffic emits light (the other direction is sealed). The clear lens in the aperture of the unit directs a high luminous intensity beam along the road in the direction of approaching drivers. The color of the flashing warning lights was white. Four ZA 230 units were installed on crosswalk 1 and six units on crosswalk 2. FIGURE 5 shows the installation at crosswalk 1.

The activation of the in-pavement flashing warning light units was by four microwave detectors (Model AD1400) also purchased from Traffic Safety Corporation. One of these detectors was mounted on a pole at either end of both crosswalks. These devices detect the presence of a pedestrian in the detection area. The sensitivity of the detector, the detection area and the delay time are adjustable on site.

Evaluation Timing

Evaluations were made at the site on five occasions, from approximately 11 a.m. to dusk. TABLE 1 lists the dates of the evaluations, the status of the crosswalks, and the prevailing weather conditions. With one exception, the evaluations were made on a Saturday. This day was chosen because it was assumed that number and nature of the pedestrians using the crosswalks would be similar on that day through the summer, whereas pedestrian use on other days of the week would vary depending on the school year. All the evaluations were made during the summer or fall.

Measurements

At each evaluation, the following information was collected:

Traffic flow was counted in five directions, each direction being observed for ten minutes in every hour. The amount of traffic exiting Gardner Field was small so the totals for directions 5 and 6 were combined.
After the striping of the crosswalks and after the installation of the in-pavement flashing warning lights, pedestrians were interviewed about their opinions of the crosswalks

Observations were made of the behavior of drivers and pedestrians and the operational characteristics of the in-pavement flashing warning lights.

In addition, a video record of the crosswalks throughout the evaluation period was made from a position on the North side of Savage Road. This video was subsequently analyzed to obtain the following information:

Vehicle approach speeds from directions 1 and 2, in the absence of a pedestrian and when a pedestrian was waiting to cross or was actually crossing.
How many vehicles passed across the crosswalk while the pedestrian or group of pedestrians was waiting to cross.
The number of times a vehicle passed over the crosswalk while there was a pedestrian, or group of pedestrians, in the crosswalk, i.e., there was conflict between vehicle and pedestrian.

Finally, a video recording was made from the front passenger seat of a vehicle driving around Denville, during daytime when the roads were dry. This video was recorded as part of Evaluations 1, 2 and 4. This video was used in the measurement of the conspicuity of the crosswalks to drivers who were unfamiliar with Denville.

RESULTS

Traffic Flow

The number of vehicles per hour passing over the crosswalks in each direction was estimated by multiplying the number counted during a ten-minute interval by six. This method of estimating traffic flow was found to have good correlation with directly counting the number of vehicles in a one-hour period. The mean number of vehicles per hour passing over the crosswalks in each direction between 12:00 noon and 6:00 pm, for each evaluation are given in TABLE 2.

From TABLE 2 it can be seen that mean traffic flow is greatest for directions 1, 2 and 4, less for direction 3 and least for directions 5 and 6 combined. This pattern is stable over all five evaluations.

Driver Behavior - Approach Speeds

The mean speed at which drivers approached the crosswalks was measured from the video record for direction 1 only. This direction requires the vehicle to travel in a straight line. All other directions require the vehicle to slow down to change direction. The approach speed for each vehicle was calculated from the time taken for the vehicle to travel a distance of 126 ft along Savage Road to the first edge of Crosswalk 1. These approach speeds were measured only for a single approaching vehicle, or for the vehicle at the front of a series of vehicles, i.e., only for vehicles whose speed was not influenced by that of vehicles immediately ahead. Approach speeds were measured without any pedestrian in or near the crosswalk, and when a pedestrian was obviously waiting to cross or was actually in the crosswalk. The mean approach speeds for direction 1, with and without a pedestrian present, between 12:00 noon to 6:00 pm, for each evaluation are given in TABLE 3.

From TABLE 3 it can be seen that the mean approach speed when a pedestrian was present is always slower than when a pedestrian was absent. The effect of the various crosswalk-marking systems can be seen by examining the changes between the different evaluations. Initially (Evaluation 1), the difference in mean approach speed for a pedestrian absent and present is 4.5 mi/h. After reconstructing one crosswalk, installing a new crosswalk, and striping both (Evaluation 2), the difference in mean approach speed increases to 9.9 mi/h, mainly because of an increase in approach speed when no pedestrian is evident. Immediately after installing the in-pavement flashing warning lights (Evaluation 3) the difference in mean approach speeds decreases to 6.6 mi/h, but the mean approach speed when a pedestrian is present is a minimum for all the evaluations (21.6 mi/h). Over the next year (Evaluations 4 and 5) the difference in mean approach speeds decreases as the mean approach speed when a pedestrian is present increases until it is almost the same as when no pedestrian is present.

Driver Behavior - Crossing While Pedestrians are Waiting

The number of vehicles that passed over the crosswalk while a pedestrian or group of pedestrians was waiting was counted from the video record. To be included in this total, a vehicle had to cross the crosswalk while a pedestrian was standing at the edge of the crosswalk, clearly waiting to cross. The number of crossing events measured and mean number of vehicles crossing per event, between 12:00 noon to 6:00 pm, for each evaluation, are given in TABLE 4.

From TABLE 4 it can be seen that the number of vehicles passing over the crosswalk while a pedestrian was waiting to cross, per crossing event, was less for evaluations 3 - 5 than for evaluations 1 - 2, i.e., after the installation of the in-pavement flashing warning lights.

Driver Behavior - Conflicts in the Crosswalk

Another measure of driver behavior made from the video record was the number of times conflicts between pedestrians and drivers occurred over the use of the crosswalk. A conflict is defined as an occasion when a driver moves over the crosswalk while a pedestrian is in the crosswalk, the vehicle passing either in front or behind the pedestrian. The number of crossing events measured and mean number of conflicts per event, between 12:00 noon to 6:00 pm, for each evaluation, are given in TABLE 5. A χ^2 one-sample test was performed on the data in TABLE 5. Significance difference is found between the first evaluation and all of the others. However, no significant difference was found between evaluations 2 through 5.

From TABLE 5 it can be seen that the mean number of conflicts per crossing event was dramatically reduced by striping the crosswalks so that they were clearly identified as crosswalks, a status that was doubtful at the time of the first evaluation. Specifically, before striping the probability that a vehicle would cross either behind or in front of you while you were in the crosswalk was 32%. Once the crosswalks were properly striped this probability was reduced to zero. Over time, the probability increased slightly to about 5%. Adding the in-pavement flashing warning lights did not change this probability.

Laboratory experiment to assess noticeability

One aspect of the in-pavement flashing warning light system that might be expected to be of benefit to the safety of pedestrians using a sidewalk is the enhanced noticeability of the sidewalk when a pedestrian wishes to use it. To measure noticeability it is necessary to collect the reactions of drivers who have never been to Denville and so have no knowledge of the presence of a crosswalk. This was done by running an experiment in Troy, New York, with subjects resident in that area.

Video taken from the front passenger seat of a vehicle driving through Denville, during daytime when the roads were dry, was recorded as part of Evaluations 1, 2 and 4. This footage was edited onto three separate videotapes; one tape with video of the crosswalk from Evaluation 1, one with video of the crosswalk from Evaluation 2, and a third tape with video of the crosswalk from Evaluation 4. The clips from Evaluation 4 all showed the in-pavement lights flashing. Each tape contained a total of 20 video clips; two clips of the crosswalk, and 9 miscellaneous clips taken from other areas of Denville that were repeated one time each. Each clip lasted ten seconds and showed a straight-line movement along a road

Thirty people took part in this study. All participants had normal or corrected vision, and were licensed drivers of at least one-year experience. None of the participants were familiar with Denville or the crosswalk of interest. Participants were instructed that they would watch three videotapes showing the view forward from a vehicle driving through an urban area. They were told that there were 20 ten-second clips on each tape, and they would be shown one clip at a time. Subjects were then given a checklist of 18 driving-related items such as stop signs, traffic signals, cars ahead braking, roadwork obstacles, lane markings, etc., and instructed to look for these items in each clip, as they would when driving. They were also told that at the end of each clip they would be asked to rate the noticeability of each existing item on a five-point scale (1 = hardly noticeable at all; 5 = extremely easy to notice). If the subject did not notice the item at all a score of zero was assigned. Before the experiment began, three practice clips were presented to each subject in which the experimenter pointed out what each item on the checklist looked like. To control for order effects, the presentation of the tapes was counterbalanced using a full Latin Square throughout the experiment. The mean ratings (and the associated standard deviations) of noticeability of the crosswalk, for the three crosswalk conditions are given in TABLE 6.

These mean ratings and standard deviations are based on the sum of the two responses each subject gave to the same condition. This means the range of possible scores for a subject are from zero to ten. A score of zero means the subject failed to notice the crosswalk on the two occasions it was present. A score of ten means the subject the subject rated the crosswalk as extremely easy to notice on both occasions it was presented.

A single-factor repeated-measures analysis of variance (ANOVA) revealed a statistically significant effect on noticeability of the way the crosswalk was marked ($F(2,58) = 48.624$, $p < .001$). Paired sample t-tests were then performed to find out under what conditions the statistically significant effect occurred. It was found that striping the cross walk produced a large, statistically significant increase in noticeability from the original virtually unmarked crosswalk condition ($t = 5.94$, $p<.001$) and that adding the in-pavement flashing warning light system produced a smaller but still statistically significant increase in noticeability ($t = 3.55$, $p<.005$). The mean rating of the combined striped and in-pavement flashing warning light system is 6.63, which implies that it is noticeable although not impossible to miss, a state which would have been characterized by a mean rating close to 10.0.

It can be concluded that the activation of the in-pavement flashing warning light units does indeed increase the noticeability of the crosswalk to drivers who were unaware of its existence, over that provided by striping alone.

DISCUSSION

This project was undertaken to determine the effect of an in-pavement flashing, warning light system installed on a crosswalk on pedestrian safety, relative to striping. The effect of striping on what was originally a very poorly marked crosswalk is evident in two areas. First, from the laboratory experiment, it is evident that high visibility marking increased the noticeability of the crosswalk to drivers who were not familiar with the location (TABLE 6). Second, from the field observations it was found that high visibility marking eliminated conflicts between pedestrians and vehicles (TABLE 5). However, high visibility marking did not reduce the mean speed at which vehicles approached the crosswalk (TABLE 3), nor the mean number of vehicles passing over the crosswalk while a pedestrian was waiting to cross (TABLE 4). Indeed, if anything the effect of high visibility marking was to increase the number of vehicles passing over the crosswalk while a pedestrian was waiting to cross.

The question that now needs to be considered is what the addition of the in-pavement flashing warning light system adds to the effect of striping. One effect is to further enhance the noticeability of the crosswalk to drivers who are not aware of its location (TABLE 6). Another effect is to reduce the mean speed at which vehicles approach the crosswalk (TABLE 3). Adding the in-pavement flashing warning light system also reduces the mean number of vehicles that pass over the crosswalk while a pedestrian is waiting (TABLE 4). From the point of view of pedestrian safety these are all desirable changes. However, over time the mean number of conflicts per crossing event tended to increase slightly (TABLE 5), while the mean speed with which vehicles approach the crosswalk increased more dramatically (TABLE 3). These undesirable changes are probably due to the poor reliability of the particular activating system used in this case. What the impact of an accurately functioning system on drivers might be is a matter of conjecture, but it seems likely that it would be to enhance the beneficial effects found soon after installation and discussed above.

CONCLUSIONS

From the data collected, the following conclusions can be drawn regarding high visibility marking of crosswalks and the instillation of in-pavement flashing warning lights on crosswalks that are located in intersection locations similar to the one studied here:

High visibility marking of a crosswalk enhances the noticeability of the crosswalk to drivers who are not familiar with the location.
High visibility marking of a crosswalk reduces conflicts between pedestrians and vehicles, a conflict being defined as an occasion when a driver moves over the crosswalk while a pedestrian is in the crosswalk, the vehicle passing either in front or behind the pedestrian.
High visibility marking of a crosswalk does not reduce the mean speed at which vehicles approach the crosswalk.
High visibility marking of a crosswalk does not reduce the mean number of vehicles passing over the crosswalk while a pedestrian is waiting to cross.
Adding an in-pavement flashing warning light system to a crosswalk that is already clearly striped enhances the noticeability of the crosswalk to drivers who are not familiar with the location.
Adding an in-pavement flashing warning light system to a crosswalk that is already clearly striped reduces the mean speed at which vehicles approach the crosswalk.
Adding an in-pavement flashing warning light system to a crosswalk that is already clearly striped reduces the mean number of vehicles that pass over the crosswalk while a pedestrian is waiting.

The impact of adding an in-pavement flashing warning light system to a crosswalk that is already clearly striped on the mean speed at which vehicles approach the crosswalk tends to diminish over time.

RECOMMENDATIONS

The conclusions from this study support the view that adding an in-pavement flashing warning light system to a crosswalk that is already clearly striped does further modify driver behavior in such a way to imply benefits to pedestrian safety. Long-term collision data would have to be collected to determine conclusively if and to what degree the changes in driver behavior affect pedestrian safety. Additionally, whether these benefits are enough to justify the cost of installing such a system is a matter of judgment beyond the scope of this paper. However, if it is desired to install an in-pavement flashing warning light system, the following recommendations are made with the aim of producing an installation that is effective in modifying driver behavior. The recommendations are divided into two areas; those relating to where an in-pavement flashing warning light system might most usefully be used and those related to the implementation of such a system.

An in-pavement flashing warning light system is designed to attract attention to the crosswalk when it is use. An in-pavement flashing warning light system is most appropriately installed on crosswalks where:

The accident history of the crosswalk reveals that some additional advanced warning to drivers is necessary.
The crosswalk is in an unusual location, e.g., mid-block, so that drivers are not expecting a crosswalk.
There are many other features of the surrounding environment besides the crosswalk competing for the driver's attention.
The distance from which the crosswalk can first be seen is such as to require an immediate response given the prevailing traffic speeds.

For an in-pavement flashing warning light system to be effective in modifying pedestrian and driver behavior, it is necessary for both pedestrians and drivers to know what is expected of them. This is particularly important while such systems are rare. To educate both pedestrians and drivers about the correct way to use and to respond to in-pavement flashing warning lights at crosswalks it is recommended that the installer of the system:

Determine the legal status of in-pavement flashing warning lights installed on crosswalks, and inform all law enforcement agencies of the same.
Develop an education program about the correct use and response to flashing in-pavement flashing warning lights at crosswalks. This education program should be aimed at both drivers and pedestrians.

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LIST OF TABLES AND FIGURES

TABLE 1 Day, Date, Status of Crosswalks and the Weather Conditions

Evaluation Number	Evaluation Day and Date	Status of Crosswalks	Weather Conditions
1	Saturday, 6/12/1999	Original*	Dry and sunny
2	Saturday, 5/13/2000	Striped**	Dry and sunny
3	Saturday, 10/23/2000	Striped and flashing***	Initially dry and overcast, rain in late afternoon
4	Saturday, 6/12/2001	Striped and flashing***	Dry and sunny
5	Thursday, 9/13/2001	Striped and flashing***	Dry and sunny

* "Before" condition with only one marginally marked crosswalk.
** Both crosswalks having high visibility crosswalk markings, ADA ramps, and advanced warning signs.
*** Both crosswalks having high visibility crosswalk markings, ADA ramps, advanced warning signs an in-pavement flashing warning lights.

TABLE 2 Mean Number of Vehicles Per Hour Between the Hours of 12:00 Noon and 6:00 pm

Evaluation Number	Direction 1	Direction 2	Direction 3	Direction 4	Directions 5 and 6
1	230	220	107	238	30
2	230	279	151	273	37
3	147	189	83	181	11
4	208	204	103	212	24
5	254	275	91	219	24

Direction 1 – West on Savage Road, straight through the intersection
Direction 2 – West on Savage Road, south onto Franklin Road
Direction 3 – North on Franklin Road, west onto Savage Road
Direction 4 – East on Savage Road, south onto Franklin Road
Direction 5 – South on Franklin Road, from Gardner Field
Direction 6 – West on Savage Road, from Gardner Field

TABLE 3 Mean Approach Speed to Crosswalk 1 with Respective Standard Deviation and Number of Observations n, From Direction 1, With and Without a Pedestrian Present, for the Hours Between 12:00 Noon and 6:00 pm

Evaluation Number	Without a pedestrian			With a pedestrian present			Difference in mean approach speed (mi/h)
	Mean approach speed (mi/h)	Std. Dev.	n	Mean approach speed (mi/h)	Std. Dev.	n	
1	29.5	1.6	50	25.0	1.1	59	4.5
2	34.1	1.2	50	24.2	1.4	71	9.9
3	27.7	2.3	50	21.6	2.3	137	6.1
4	26.0	2.6	50	23.0	1.8	82	3.0
5	28.7	3.4	50	27.5	2.2	155	1.2

TABLE 4 Number of Pedestrian Crossing Events and the Associated Mean Number of Vehicles Passing Over the Crosswalk While a Pedestrian Was Waiting, Per Event, for the Hours Between 12:00 Noon and 6:00 pm

Evaluation Number	Number of pedestrian crossing events	Mean number of vehicles passing over the crosswalk, per event
1	60	1.52
2	71	1.72
3	137	1.33
4	82	1.06
5	155	1.33

TABLE 5 Number of Pedestrian Crossing Events and the Associated Mean Number of Conflicts Per Event, for the Hours Between 12:00 Noon and 6:00 pm

Evaluation Number	Number of pedestrian crossing events	Mean number of conflicts per event
1	60	0.32
2	71	0.00
3	137	0.05
4	82	0.06
5	155	0.05

TABLE 6 Means and Standard Deviations of the Sum of Ratings of Crosswalk Noticeability

Crosswalk condition	Mean rating of sum of crosswalk noticeability ratings	Standard deviation of sum of crosswalk noticeability ratings
Original - Evaluation 1	0.30	0.92
Striped - Evaluation 2	4.07	3.34
Striped plus in-pavement flashing warning light unit - Evaluation 4	6.63	3.07

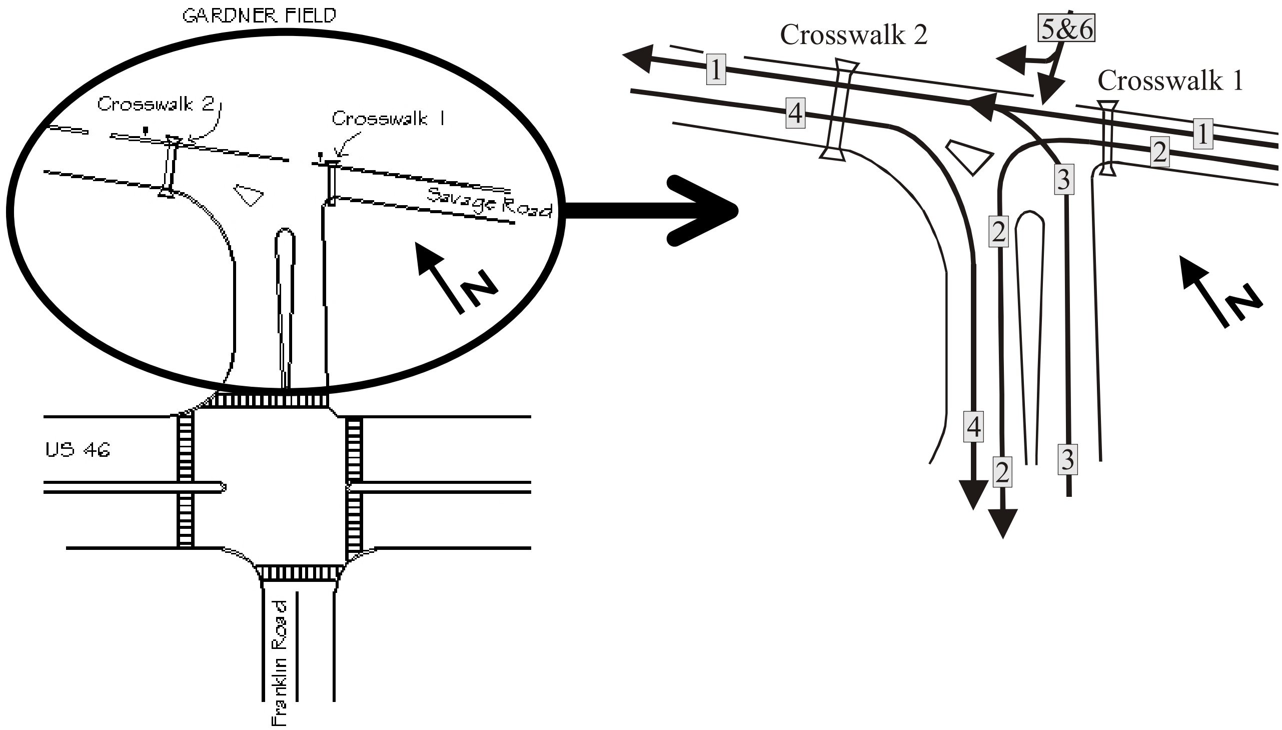

FIGURE 1 A plan of the evaluation site with close up view showing the six directions evaluated.

FIGURE 2 Crosswalk 2 at the time of the first evaluation.

FIGURE 3 Crosswalk 2 at the time of the second evaluation.

FIGURE 4 Installed in-pavement flashing warning light.

FIGURE 5 Crosswalk 1 with the in-pavement flashing warning lights installed and operating.