EVALUATION OF HAWK SIGNAL AT GEORGIA AVENUE AND HEMLOCK STREET, NW IN THE DISTRICT OF COLUMBIA

FINAL REPORT

August 30, 2010

Submitted to:
Mr. George Branyan
Pedestrian Program Manager
Policy, Planning and Sustainability Administration
District Department of Transportation

DISTRICT DEPARTMENT OF TRANSPORTATION

Prepared by:

Dr. Stephen Arhin, P.E., PTOE
Dr. Errol C. Noel, P.E.

HOWARD UNIVERSITY
Transportation Research Center
2366 6th Street, NW Room 130
Washington, DC 20059

Technical Report Documentation Page

1. Report No. **DDOT-PPSA-HAWK-001**	2. Report Date 08/30/2010
3. Title and Subtitle Evaluation of Hawk Signal at Georgia Avenue and Hemlock Street	4. Contract or Grant No. PO 331417
5. Author(s) Dr. Stephen Arhin, P.E., PTOE Dr. Errol C. Noel, P.E.	
6. Performing Organization Name and Address Howard University Transportation Research Center 2366 Sixth Street NW, Suite 130 Washington, DC 20059	7. Type of Report and Period Covered.
8. Sponsoring Agency Name and Address District Department of Transportation Planning, Policy and Sustainability Administration 2000 14th Street, NW Washington, DC 20009	
9. Supplementary Notes	

10. Abstract

A High-intensity Activated crossWalK (HAWK) signal was installed at the intersection of Georgia Avenue and Hemlock Street in Washington DC to reduce incidences of pedestrian-vehicle conflicts as well as overall crashes involving pedestrians. The signal was evaluated by conducting a series of field observations of pedestrian crossing and driver behaviors at the crosswalk in order to determine their compliance with the HAWK signal. The field observations were conducted in July and August of 2010, and involved obtaining the frequencies of motorists yielding or stopping for pedestrians during crossing events for at least 100 pedestrian crossing events or 4 hours of crossing events (whichever came first). The results of the analysis of the data obtained in the field showed an average of 97.1% motorist compliance with the HAWK signal. Based on the motorists' compliance rate, the use of HAWK signal as a device for improving pedestrian crossing events at selected unsignalized intersections is recommended. This device would be especially useful at intersections on high-volume major arterials with moderate-to-high pedestrian crossing events, which do not satisfy the warrants for the installation of a traffic signal.

11. Key Words Pedestrian crossing events HAWK	12. Distribution Statement

13. Security Classif.(of this report) Unclassified	14. Security Classif.(of this page) Unclassified	15. No. of Pages 18	16. Price

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

A High-intensity Activated crossWalK signal, known as HAWK, was installed at the intersection of Georgia Avenue and Hemlock Street in Washington DC to reduce incidences of pedestrian-vehicle conflicts as well as overall crashes involving pedestrians. The signal was evaluated by conducting a series of field observations of pedestrian crossing and driver behaviors at the crosswalk in order to determine their compliance with the HAWK signal.

The observations were conducted in July and August of 2010, 11 months after the HAWK signals were installed, and involved obtaining the frequencies of motorists yielding or stopping for pedestrians during crossing events for at least 100 pedestrian crossing events or 4 hours of crossing events (whichever came first). To measure the compliance rate, the measurement of effectiveness used in this evaluation was the "*Percentage of motorists yielding or stopping for pedestrians*". During the field observations, qualitative data, including driver behavior, pedestrian behavior and traffic operational issues were also noted.

The results of the analysis of the data obtained in the field showed an average of 97.1% motorist compliance with the HAWK signal. The HAWK signal treatment therefore performed well, with compliance rates above 93 percent for the three days of field observations (93.7%, 100%, and 97.6%). The effectiveness of the treatment could be due to the regulatory message of the steady red signal that requires motorists to stop for pedestrians. The HAWK signal did not appear to cause any adverse effect(s) on pedestrian crossing behaviors at the intersection during field observations. There were minimal traffic operational issues at the intersection and, in general, most drivers (97.1%) yielded for pedestrians in the crosswalk. Based on the motorist compliance rate, the use of HAWK signal as a device for improving pedestrian crossing events at selected unsignalized intersections is recommended. This device would be especially useful at intersections on high-volume major arterials with moderate-to-high pedestrian crossing events, which do not satisfy any of the warrants for signalization.

A low pedestrian compliance with the HAWK signal (50-66%) was obtained in this study which could be attributed to the lack of understanding of the operation of the new device by pedestrians. Also, the existence of a sufficient number of gaps in

vehicular traffic for pedestrian crossing without activating the HAWK signal could explain poor utilization. Implementation of a public awareness campaign on the HAWK signal could help improve pedestrian understanding and compliance rate.

2.0 BACKGROUND OF HAWK SIGNAL

A High-intensity Activated crossWalK signal, known as HAWK, was installed at the intersection of Georgia Avenue and Hemlock Street in Washington DC to reduce incidences of pedestrian-vehicle conflicts as well as overall crashes involving pedestrians. The HAWK signal, originally developed by the City of Tucson in Arizona, is only activated when a pedestrian approaches the signal and presses a button, as with a traditional actuated signalized crosswalk. The HAWK remains dark for vehicular traffic on the major road unless a pedestrian activates it using the pushbutton. The signal sequence is presented in Figure 1.

Figure 1: HAWK Signal Sequence

When the pedestrian activates the signal, approaching drivers will see a FLASHING YELLOW for a number of seconds, indicating that they should reduce speed and be prepared to stop for a pedestrian in the crosswalk. The FLASHING YELLOW is followed by a SOLID YELLOW and then by a solid RED, requiring them to STOP at the stop line. During the solid RED for motorists, the pedestrian receives a WALK indication

(with an associated countdown timer, if available). In some cases, visually impaired pedestrians will hear the signal indicate that it is safe to cross. At the end of the WALK interval, the FLASHING DON'T WALK interval begins, and motorists see an ALTERNATING FLASHING RED. During the latter interval, motorists are required to STOP or remain stopped until pedestrians have finished crossing the street, and then may proceed.

3.0 SITE DESCRIPTION

Figure 1 shows an inactive HAWK signals facing the south-bound and north-bound traffic on Georgia Avenue.

Figure 2: Georgia Avenue and Hemlock Street, NW

Georgia Avenue and Hemlock Street, NW, forms a T-intersection that is located in Washington D.C, approximately four blocks south of the Washington, DC – Maryland border. Georgia Avenue is a four-lane undivided roadway oriented in the north-south direction, and Hemlock Street, the stem of the T-intersection, is a two-lane undivided

roadway with an orientation to the east of Georgia Avenue. Georgia Avenue is the major of the two roadways and provides connectivity between Silver Spring, Maryland and Washington, DC. West of the intersection is a private driveway, which serves an office and residential development. In addition to the PNC Bank, located on the north-eastern quadrant, other notable pedestrian traffic generators are the Ledo Pizza restaurant, KBC Nursing Agency and Home Health Care, and a relatively small 3-story apartment building. Bus stops are located on both approaches of Georgia Avenue. There are marked crosswalks on all approaches of the T-intersection. In addition to the HAWK signals, other regulatory signs including "*Crosswalk, STOP ON RED",* and pedestrian crossing signs mounted on the HAWK signal posts located at the corners of the intersection.

Figure 3 depicts a typical pedestrian crossing event across Georgia Avenue as a result of activating the HAWK signal.

Figure 3: Pedestrian crossing intersection after activating the HAWK signal

4.0 DATA COLLECTION AND ANALYSIS

Pedestrian crossing behaviors and motorists' compliance were obtained during 3 site visits to the study intersection. The visits were conducted on July 17, August 5th and August 6th, 2010. Using field forms developed, the following data were obtained:

- Number of pedestrians crossing events using HAWK signal
- Number of vehicles that yielded or stopped for pedestrians
- Number of vehicles that did not yield/stop for pedestrians
- Total vehicles at intersection during 4-Hour crossing period

In addition to the above, the following observations were made in order to compute a number of qualitative data at the intersection which may be attributable to the HAWK signal:

- Number of pedestrian –Vehicle Conflicts
- Number of pedestrian crossing events without HAWK signal activated and outside crosswalk
- Number of pedestrian crossing events where HAWK signal was activated but crossing aborted
- Number of pedestrian crossing events Using HAWK signal and within 10 ft of crosswalk

5.0 GENERAL FIELD OBSERVATIONS

The following general observations were made at the study intersection during the site visit:

- The majority of drivers acknowledged pedestrians using the HAWK signals.
- A number of drivers observed during the field observation period exhibited aggressive driver characteristics, such as hesitating or slowing down briefly for crossing pedestrians to clear from driver's travel path, and then proceed to drive across the intersection.
- While waiting to turn onto Georgia Avenue, motorists from Hemlock Street generally yielded to pedestrians using the crosswalk.

- On certain occasions, pedestrians did not wait for the operation of the HAWK signal before crossing the intersection after activation. They took advantage of a convenient gap in the vehicular traffic to cross the intersection.
- During instances where pedestrians attempted crossing the intersection without activating the HAWK signal, some drivers acknowledged and yielded to such pedestrians, while other drivers evaded pedestrians and continued through the intersection.
- Field observations were conducted on typical weekdays for both A.M. and P.M. periods.

6.0 RESULTS

6.1 Motorists' Compliance

Tables 1, 2 and 3 present the field data obtained from the study intersection and the associated results of the analysis for the motorists compliance with the HAWK signal.

Table 1: Analysis of Field Data Collection – 1 (July 7th, 2010)

Begin Time	No. of Ped. Crossing Events Using HAWK Signal	No. of Veh. Yielded/ Stopped for Peds.	No. of Veh. That did not Yield/Stop for Peds.	No. of Vehicles that should have Stopped
12:30 PM	3	12	-	12
12:45 PM	3	12	-	12
1:00 PM	5	18	1	19
1:15 PM	3	12	-	12
1:30 PM	4	9	-	9
1:45 PM	4	11	-	11
2:00 PM	4	14	3	17
2:15 PM	3	12	-	12
2:30 PM	3	4	-	4
BREAK	**BREAK**	**BREAK**	**BREAK**	**BREAK**
4:45 PM	7	27	5	32
5:00 PM	4	15	-	15
5:15 PM	4	16	5	21
5:30 PM	6	24	-	24
5:45 PM	3	12	2	14
6:00 PM	3	15	1	16
6:15 PM	1	4	-	4
6:30 PM	4	13	-	13
4-Hr Period	**64**	**230**	**17**	**247**

Based on the field observation data presented in Table 1, the measure of effectiveness of the HAWK signal was determined by computing the percentage of motorists yielding/ stopping for pedestrians (P), from the following equation:

$$P = \frac{\text{number of vehicles that yielded or stopped for pedestrians}}{\text{number of vehicles that should have stopped}} = \frac{230}{247} = 93.1\%$$

Table 2: Analysis of Field Data Collection – 2 (August 5th, 2010)

Begin Time	No. of Ped. Crossing Events Using HAWK Signal	No. of Veh. Yielded/ Stopped for Peds.	No. of Veh. That did not Yield/Stop for Peds.	No. of Vehicles that should have Stopped
7:00 AM	1	4	-	4
7:15 AM	3	10	-	10
7:30 AM	2	4	-	4
7:45 AM	1	4	-	4
8:00 AM	0	-	-	-
8:15 AM	1	2	-	2
8:30 AM	2	6	-	6
8:45 AM	3	9	-	9
9:00 AM	4	11	-	11
9:15 AM	2	8	-	8
9:30 AM	5	18	-	18
9:45 AM	1	4	-	4
10:00 AM	2	8	-	8
10:15 AM	1	4	-	4
10:30 AM	2	10	-	10
10:45 AM	1	4	-	4
4-Hr Period	**31**	**106**	**0**	**106**

From Table 2, the percentage of motorists yielding/ stopping for pedestrians (P) was determined to be 100% from the following computation:

$$P = \frac{\text{number of vehicles that yielded or stopped for pedestrians}}{\text{number of vehicles that should have stopped}} = \frac{106}{106} = 100\%$$

Table 3: Analysis of Field Data Collection – 3 (August 6th, 2010)

Begin Time	No. of Ped. Crossing Events Using HAWK Signal	No. of Veh. Yielded/ Stopped for Peds.	No. of Veh. That did not Yield/Stop for Peds.	No. of Vehicles that should have Stopped
2:00 PM	3	11	1	12
2:15 PM	4	12	2	14
2:30 PM	6	19	-	19
2:45 PM	3	11	-	11
3:00 PM	5	19	-	19
3:15 PM	3	9	-	9
3:30 PM	6	20	-	20
3:45 PM	7	20	-	20
4:00 PM	6	19	-	19
4:15 PM	4	17	1	18
4:30 PM	6	34	-	34
4:45 PM	3	16	-	16
5:00 PM	7	30	-	30
5:15 PM	6	23	2	25
5:30 PM	5	22	-	22
5:45 PM	1	4	1	5
4-Hr Period	**75**	**286**	**7**	**293**

From Table 3, the percentage of motorists yielding/ stopping for pedestrians (P) was obtained to be 97.6% from the following equation:

$$P = \frac{\text{number of vehicles that yielded or stopped for pedestrians}}{\text{number of vehicles that should have stopped}} = \frac{286}{293} = 97.6\%$$

6.2 Qualitative Data Analysis

Table 4: Qualitative Analysis of Pedestrian Crossing Events

Begin Time	No. of Ped. Crossing Events Using HAWK Signal and within 10 ft of Crosswalk	No. of Ped. Crossing Events without activated HAWK Signal and Outside Crosswalk	No. of Ped. Crossing Events where HAWK Signal was Activated but Aborted	No. of Pedestrian –Vehicle Conflicts
7:00 AM	1	-	-	1
7:15 AM	3	2	-	-
7:30 AM	2	1	-	-
7:45 AM	1	2	-	-
8:00 AM	0	1	-	-
8:15 AM	1	-	1	-
8:30 AM	2	2	-	-
8:45 AM	3	2	-	-
9:00 AM	4	3	-	1
9:15 AM	2	1	-	-
9:30 AM	5	3	-	-
9:45 AM	1	3	-	1
10:00 AM	2	3	-	2
10:15 AM	1	3	-	3
10:30 AM	2	1	-	1
10:45 AM	1	2	-	-
AM TOTALS	**31**	**29**	**1**	**9**
2:00 PM	3	2	-	1
2:15 PM	4	1	-	1
2:30 PM	6	2	1	-
2:45 PM	3	4	-	-
3:00 PM	5	-	-	-
3:15 PM	3	3	-	-
3:30 PM	6	4	1	-
3:45 PM	7	5	-	-
4:00 PM	6	5	-	1
4:15 PM	4	1	-	-
4:30 PM	6	3	-	4
4:45 PM	3	3	-	2
5:00 PM	7	1	-	-
5:15 PM	6	1	-	-
5:30 PM	5	1	-	1
5:45 PM	1	1	-	-
PM TOTALS	**75**	**37**	**2**	**10**

Below are the results (Table 5) of the analyses of surrogate measurements, based on the field observations, conducted during 4-hour crossing events in the A.M. and P.M. periods on August 5th and 6th, 2010, respectively:

Table 5: Results of Pedestrian Compliance and Pedestrian –Vehicle Conflicts

TIME OF DAY	Percentage of Crossing Events where Pedestrians used the HAWK Signal	Percentage of Crossing Events without Activating HAWK Signal and Outside of Crosswalk	Percentage of Crossing Events with Pedestrian – Vehicle Conflicts
A.M.	50.8%	47.5%	14.7%
P.M.	65.8%	35.6%	8.7%

The results show that in about 51% and 66% of the pedestrians crossing events the HAWK signal was used in the A.M. and P.M. periods, respectively. The percentage of crossing events without activating the HAWK and involving pedestrians crossing outside of the crosswalk were 48% and 36% for the A.M. and P.M. periods, respectively. There were more instances of pedestrian-vehicle conflicts in the A.M. period than in the P.M. period.

The number of pedestrian-vehicle conflicts observed with and without the HAWK signal being activated is presented in Table 6. A total of 9 and 10 pedestrian-vehicle conflicts were observed in the morning and evening periods respectively. Approximately 11% (1 out of 9) of the total number of pedestrian-vehicle conflicts occurred while the HAWK signal was activated during the morning observation. During the evening observations, 40% (4 out of 10) of the total number of pedestrian-vehicle conflicts occurred while the HAWK signal was activated.

Table 6: Qualitative Analysis of Pedestrian – Vehicle Conflicts

BEGIN TIME	PEDESTRIAN – VEHICLE CONFLICTS		
	No. of Conflicts upon Activating HAWK Signal	No. of Conflicts Without Activating HAWK Signal	Total No. of Pedestrian – Vehicle Conflicts
7:00 AM	1	-	1
7:15 AM	-	-	-
7:30 AM	-	-	-
7:45 AM	-	-	-
8:00 AM	-	-	-
8:15 AM	-	-	-
8:30 AM	-	-	-
8:45 AM	-	-	-
9:00 AM	-	1	1
9:15 AM	-	-	-
9:30 AM	-	-	-
9:45 AM	-	1	1
10:00 AM	-	2	2
10:15 AM	-	3	3
10:30 AM	-	1	1
10:45 AM	-	-	-
AM TOTALS	**1**	**8**	**9**
2:00 PM	1	-	1
2:15 PM	1	-	1
2:30 PM	-	-	-
2:45 PM	-	-	-
3:00 PM	-	-	-
3:15 PM	-	-	-
3:30 PM	-	-	-
3:45 PM	-	-	-
4:00 PM	-	1	1
4:15 PM	-	-	-
4:30 PM	1	3	4
4:45 PM	-	2	2
5:00 PM	-	-	-
5:15 PM	-	-	-
5:30 PM	1	-	1
5:45 PM	-	-	-
PM TOTALS	**4**	**6**	**10**

7.0 CONCLUSIONS

The average motorists' compliance rate obtained in this study (97.1%) is consistent with studies reviewed on the HAWK signal in the United States. Most the of the studies also considered other pedestrian crossing treatments at intersections and found that the HAWK was effective since the red signal (or beacon) prompted high levels of motorist compliance on high-volume, high-speed streets.

The results of the analysis of the data obtained in the field showed an average of approximately 97.1% compliance of motorist (for the three days of field observations: 93.7%, 100%, and 97.6%) with the HAWK signal. The HAWK signal treatment was effective in getting motorist to stop for pedestrians. This favorable result could be due to the strong regulatory message that the solid red signal sends to motorists. The HAWK signal did not appear to cause any adverse effect(s) on pedestrian crossing behaviors at the intersection during the field observations. There were minimal traffic operational issues at the intersection and, in general, most drivers (97.1%) yielded for pedestrians in the crosswalk.

A low pedestrian compliance with the HAWK signal (50-66%) was found in this study which could be attributed to the lack of understanding of the operation of the HAWK signal. Also, the existence of a sufficient number of gaps in vehicular traffic for pedestrian crossing without activating the HAWK signal could explain poor utilization. Implementation of a public awareness campaign on the HAWK signal would help improve pedestrian understanding and thereby improving their compliance rate.

Based on the motorists' compliance rate, the use of HAWK signal as a device for improving pedestrian crossing events at selected unsignalized intersections is recommended. This device would be especially useful at intersections on high-volume major arterials with moderate-to-high pedestrian crossing events, which do not satisfy any of the warrants for signalization.

8.0 BIBLIOGRAPHY

1. The HAWK Signal. City of Alexandrian. http://alexandriava.gov/HAWK; assessed on August 4, 2010.
2. Manual on Uniform Traffic Control Devices for Streets and Highways. U.S. DOT, FHWA, Washington, DC, 2003. Available online at http://mutcd.fhwa.dot.gov/, accessed August 4, 2005.
3. Guide for the Planning, Design, and Operation of Pedestrian Facilities. Draft Report, AASHTO,Washington, DC, August 2001.
4. *1995 Nationwide Personal Transportation Survey*.U.S.DOT,Bureau of Transportation Statistics, Washington, DC, 1995. Available online at http://npts.ornl.gov/npts/1995/doc/NPTS_Booklet.pdf.
5. Pedestrian Facilities Guidebook: Incorporating Pedestrians into Washington's Transportation System. Prepared by Otak for Washington State DOT, Olympia,WA, September 1997.
6. Florida Pedestrian Safety Plan. Florida DOT, Tallahassee, FL, February 1992.
7. Florida Pedestrian Planning and Design Handbook. Florida DOT, Tallahassee, FL, April 1999. Available online at http://www11.myflorida.com/safety/ped_bike/ped_bike_standards.htm#Florida%20Ped%20Handbook, accessed April 14, 2003.
8. Zegeer, C. *Design and Safety of Pedestrian Facilities*. Institute of Transportation Engineers,Washington, DC,March 1998.
9. Dewar, R.*Human Factors in Traffic Safety*,"Chapter 18: Pedestrians and Bicyclists." Lawyers and Judges Publishing Company, Tucson, AZ, 2002.
10. Bennett, S., A. Felton, and R. Akçelik."Pedestrian Movement Characteristics at Signalized Intersections." *23rd Conference of Australian Institutes of Transportation Research*, Monash University, Melbourne, Australia, December 10-12, 2001.
11. Staplin, L., K. Lococo, S. Byington, and D. Harkey. Guidelines and Recommendations to Accommodate Older Drivers and Pedestrians. Report No.FHWA-RD-01-051,FHWA,McLean,VA, October 2001.

12. Dahlstedt, S. *Walking Speeds and Walking Habits of Elderly People.* National Swedish Road and Traffic Research Institute, Stockholm, Sweden, undated.
13. Transportation Research Board, NCHRP Report 562/TCRP Report 112, Improving Pedestrian Safety at Unsignalized intersections, March 2006.