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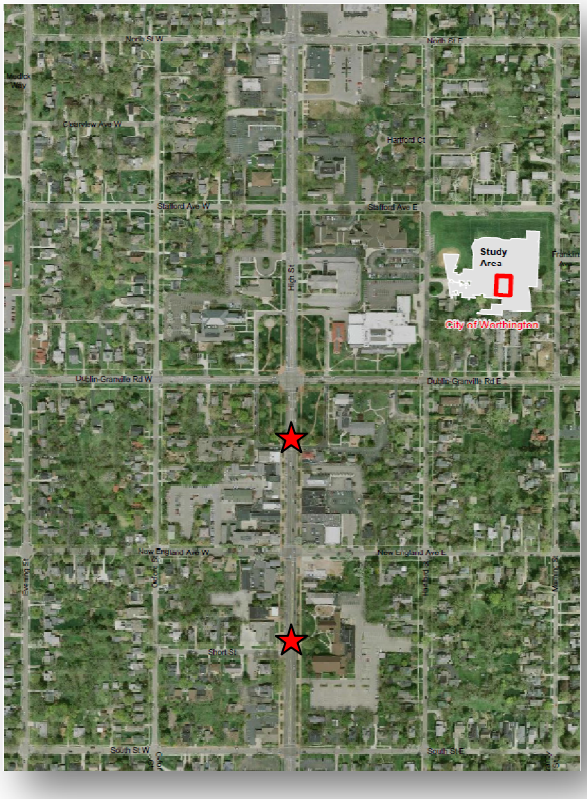
Old Worthington Mobility Study – Phase 2

High Street Pedestrian Crossings

City of Worthington, Ohio



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Executive Summary

Background

The City of Worthington, located in Franklin County Ohio, is exploring the feasibility of implementing pedestrian feature improvements in Old Worthington area (from North Street to Short Street, and between Morning Street and Evening Street, with an emphasis on the High Street (US 23) corridor), and identifying any potential degradation of traffic operations as a result of potential pedestrian improvements along High Street. ***Phase 2*** includes the pedestrian crossings adjacent to the intersections of High Street at Village Green Drive South, and High Street at Short Street.

Data Collection

DLZ utilized Miovision camera technology to perform a nine-hour turning movement count (7 AM – 9 AM, 11 AM – 1 PM, & 3 PM – 6 PM) at the intersections of High Street at Village Green South Drive, and High Street at Short Street in May 2015. Additional observations were completed by DLZ in May 2015. Thirteen (13) pedestrians crossed High Street at Short Street during the count period, and sixty-six (66) pedestrians crossed High Street at Village Green Drive South during the count period. Additional observations of the Worthington Farmer's Market were completed on July 20, 2015. At the pedestrian crossing adjacent to Short Street, sixty (60) pedestrians were observed utilizing the crossing during a thirty minute observation period. At the pedestrian crossing adjacent to Village Green South Drive, over 400 pedestrians were observed utilizing the crossing in a thirty minute observation period.

DLZ also utilized ODOT's GCAT program to check for crashes at both study locations. At the Village Green South crossing, there were fourteen (14) crashes in the study area in the six year period of 2009-2015. There were nine (9) rear end crashes and three (3) crashes involving parked vehicles. There was one crash involving a bicyclist, but no crashes involving pedestrians. There were no distinct crash patterns at this intersection.

At the Short street crossing, there were significantly more crashes with a total of twenty-nine (29) between the six year period of 2009-2015. There were eleven (11) sideswipe-passing crashes, eight (8) crashes involving parked vehicles, and seven (7) rear end crashes. There were no crashes involving bicyclists or pedestrians. The large number of sideswipe-passing crashes and crashes involving parked vehicles could be related to the on-street parking on the west side of High Street (southbound traffic) or the two northbound travel lanes merging to one lane just north of the crossing. There were no other distinct crash patterns at this intersection.

Recommendations

A number of Alternatives were considered to be implemented at the intersections of High Street at Village Green South Drive and High Street at Short Street:

I. ***Alternative 1*** – Installation of advanced pedestrian warning signs.
II. ***Alternative 2*** – Updating the existing pedestrian crossings.
III. ***Alternative 3*** - Installation of a Pedestrian Hybrid Beacon (PHB)

Numerous studies (TCRP-NCHRP 17-56, TCRP-NCHRP 562, FHWA-SA-12-012, FHWA-SA-14-014, and ITE- PHB 2012) have shown that the addition of a red beacon for vehicular traffic at a pedestrian crossing results in a higher level of motorists yielding, regardless of the street type (local road or major arterial street). The pedestrian hybrid beacon (PHB) includes this type of traffic control, providing positive guidance for drivers without implementing a typical traffic signal. PHBs are an intermediate between no traffic control and a traffic signal where the pedestrian volumes do not meet the traffic signal warrant requirements listed in the OMUTCD. In addition to the PHB having the capability to be integrated in a coordinated system without significant additional delay for High Street traffic, the alternating red signal operation allows vehicles to proceed once the pedestrian has cleared the travel lane, improving traffic flow. In accordance for uniformity with ***Phase 1*** of the Old Worthington Mobility Study, it is recommended to implement ***Alternative 3*** Pedestrian Hybrid Beacon (PHB), along with additional advanced pedestrian warning signs (***Alternative 1***).

The OMUTCD provides standards and guidance for the design and implementation of a PHB. One such stipulation listed under the "Guidance" section is that a PHB should not be installed within 100 feet of a side street. However, the National Committee on Uniform Traffic Control Devices (NCUTCD) has proposed a revision to the wording for the next MUTCD that removes the stipulation on installation of a PHB adjacent to a side street.[1] The NCUTCD assists in the development of standards, guidelines and warrants for traffic control devices and practices used to regulate, warn and guide traffic on streets and highways, and makes recommendations to the Federal Highway Administration (FHWA) and to other appropriate agencies regarding proposed revisions and interpretations to the Manual on Uniform Traffic Control Devices (MUTCD) and other accepted national standards.

See ***Section VI – Conceptual Alternatives*** and ***Appendix E*** for more information.

[1] The signals Technical Committee proposed recommended changes to the MUTCD regarding the installation of a Pedestrian Hybrid Beacon, which were approved by the National Committee Council at a meeting on June 23, 2011 and forwarded to FHWA for approval; see ***Appendix F***.[1]

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I. Background

The City of Worthington, located in Franklin County Ohio, is exploring the feasibility of implementing pedestrian feature improvements in Old Worthington area (from North Street to Short Street, and between Morning Street and Evening Street, with an emphasis on the High Street (US 23) corridor), and identifying any potential degradation of traffic operations as a result of potential pedestrian improvements along High Street. ***Phase 2*** includes the pedestrian crossings adjacent to the intersections of High Street at Village Green Drive South, and High Street at Short Street; see ***Figure 1*** below and ***Figure 2*** on the following page for a map of the study intersections. The posted speed limit within the study area is 25 M.P.H.

Figure 1: Study Intersection – High Street at Village Green Drive South

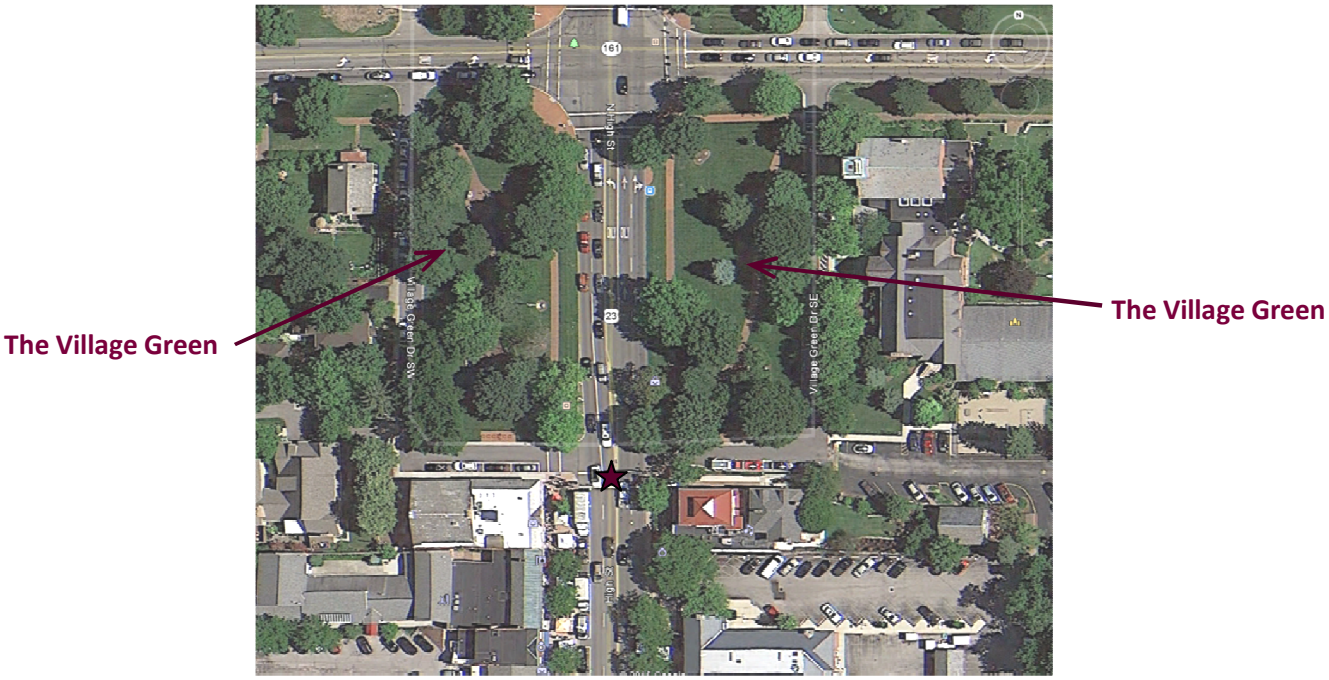
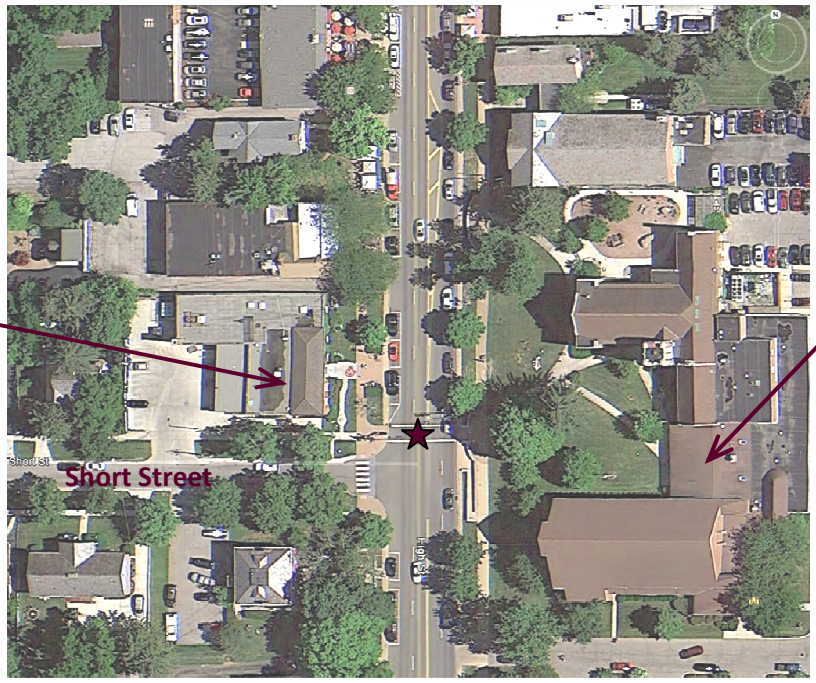


Figure 2: Study Intersection – High Street at Short Street



The existing pedestrian crossing at the intersection of High Street at Village Green Drive South is on the northern edge of the downtown Worthington area, and the existing pedestrian crossing at the intersection of High Street and Short Street is on the southern edge of the downtown Worthington area. These crossings consist of two (2) overhead warning signs and beacons that light up when activated by a pedestrian pushbutton. When activated, the sign displays the message "Yield to Pedestrians Crosswalk". There are pedestrian signal heads attached to the support poles, with a "cross with caution" message displayed when the pushbutton is activated as well. There are also brightly colored flags for pedestrian use while crossing High Street readily available in a storage bag attached to the support pole. See ***Figure 3*** for a picture of the existing crossings.

Figure 3: High Street Pedestrian Crossing

II. Data Collection & Observations

DLZ utilized Miovision camera technology to perform a nine-hour turning movement count (7 AM – 9 AM, 11 AM – 1 PM, & 3 PM – 6 PM) at the intersections of High Street at Village Green South Drive, and High Street at Short Street in May 2015. Additional observations were completed by DLZ in May 2015. Thirteen (13) pedestrians crossed High Street at Short Street during the count period, and sixty-six (66) pedestrians crossed High Street at Village Green Drive South during the count period. Additional observations of the Worthington Farmer's Market were completed on July 20, 2015. At the pedestrian crossing adjacent to Short Street, sixty (60) pedestrians were observed utilizing the crossing during a thirty minute observation period. At the pedestrian crossing adjacent to Village Green South Drive, over 400 pedestrians were observed utilizing the crossing in a thirty minute observation period.

Figure 4: Malfunctioning Overhead Pedestrian Crossing Sign at Short Street

During the Farmer's Market observations, at the pedestrian crossing just north of Short Street, the northbound pedestrian light-up sign was not working correctly. However, vehicular traffic still yielded over ninety (90) percent of the time to pedestrians in the crosswalk (even when the pedestrian failed to activate the pushbutton which was often, and the yield indicator remained dark). If no pedestrians were in vehicle lane the vehicle continued thru the crosswalk. Northbound vehicles appeared to be travelling faster than the posted speed limit of twenty-five (25) MPH, but there were large gaps in traffic such that when the pedestrian crossing was activated, progression was not interrupted very often. When the pushbutton was activated, the overhead sign and the pedestrian signal head "cross with caution" indicators came on for twenty (20) seconds. Using the standard ITE (Institute of Transportation Engineers) formula for calculating pedestrian crossing time, for a pedestrian traveling at 3.5 feet per second and a crossing width of fifty (50) feet, the crossing signs should be lit for twenty-two (22) seconds (the lane configuration of High Street at Short Street is five lanes, each ten feet in width).

At the pedestrian crossing just south of the Village Green, 400 pedestrians were observed utilizing the crossing across High Street. The overhead signing was constantly on/flashing, never turning dark during the thirty (30) minute observation period. With S.R. 161 in close proximity to the north, this section of High Street is extremely congested with vehicular traffic. With the amount of pedestrians

crossing High Street, progression along High Street was non-existent. At times, vehicular queues backed up southbound into the S.R. 161 intersection, affecting turning traffic off of S.R. 161, while northbound traffic backed up to New England Avenue. Vehicles stopped in the queue a few cars back would not yield to pedestrians at times when the vehicular traffic was able to move (potential driver frustration from waiting). However, drivers still yielded consistently to pedestrians in the crosswalk, stopping unless no pedestrians were in the travel lane. The Farmer's Market booths along High Street came up to the pedestrian crossing, taking up considerable amount of sidewalk space creating small areas for pedestrians to wait at in order to cross High Street; pedestrians were standing on the Village Green South Drives waiting to cross High Street consistently. When the pushbutton was activated, the overhead sign and the pedestrian signal head "cross with caution" indicators came on for twenty-eight (28) seconds. Using the standard ITE (Institute of Transportation Engineers) formula for calculating pedestrian crossing time, for a pedestrian traveling at 3.5 feet per second and a crossing width of fifty (50) feet, the pedestrian clearance interval would be twenty-two (22) seconds.

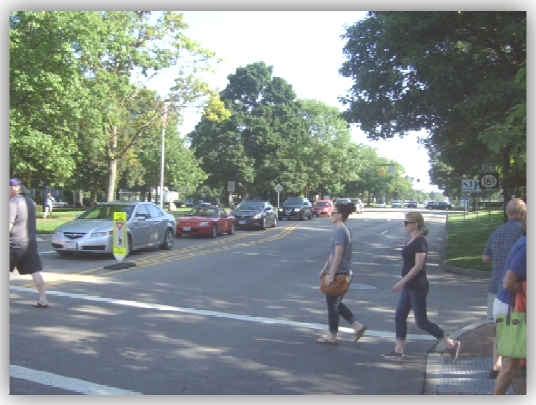


Figure 5: Village Green South Crossing Southbound Traffic Queue

III. Existing Geometry

High Street consists of a 5-lane cross section, with two travel lanes for northbound/southbound traffic and a dedicated parking lane for southbound traffic within the study area. Just north of Short Street, between Short Street and New England Avenue, the northbound travel lanes merge, with the inside northbound travel lane becoming a dedicated left-turn lane at New England Avenue (this lane becomes a northbound travel lane again north of New England Avenue). There are ADA curb ramps located on each side of both pedestrian crossings, with marked crosswalks across High Street. Pedestrian lighting is present on both sides of High Street.

The Village Green South crossing is a 4-leg intersection; however each side-street access is one-way away from High Street. This crossing therefore acts as a mid-block crossing, with no traffic entering High Street. The Short Street crossing is on the north leg of the T-intersection, with eastbound traffic on Short Street having a single lane to turn left or right onto High Street.

IV. Crash Data

DLZ utilized ODOT's GCAT program to check for crashes. At the Village Green South crossing, there were fourteen (14) crashes in the study area in the six year period of 2009-2015. There were nine rear end crashes and three crashes involving parked vehicles. There was one crash involving a bicyclist. One crash involved alcohol. However, there were no distinct crash patterns at this location.

At the Short Street crossing, there were twenty-nine (29) crashes in the study area in the six year period of 2009-2015. Eleven (11) crashes were sideswipe-passing crashes, eight (8) crashes involving parked vehicles, and seven (7) rear end crashes. There were no crashes involving bicyclists or pedestrians. One crash involved alcohol. Possible causes for the high number of sideswipe crashes and parked vehicle crashes include driver inattention and high speeds; the northbound travel lanes narrowing from two lanes to one lane, merging just south of New England Avenue in order to develop a dedicated left-turn lane onto New England Avenue, and the existing on-street parking along the west side of High Street in front of a U.S. Post Office. See ***Appendix C*** for crash data within the study area.

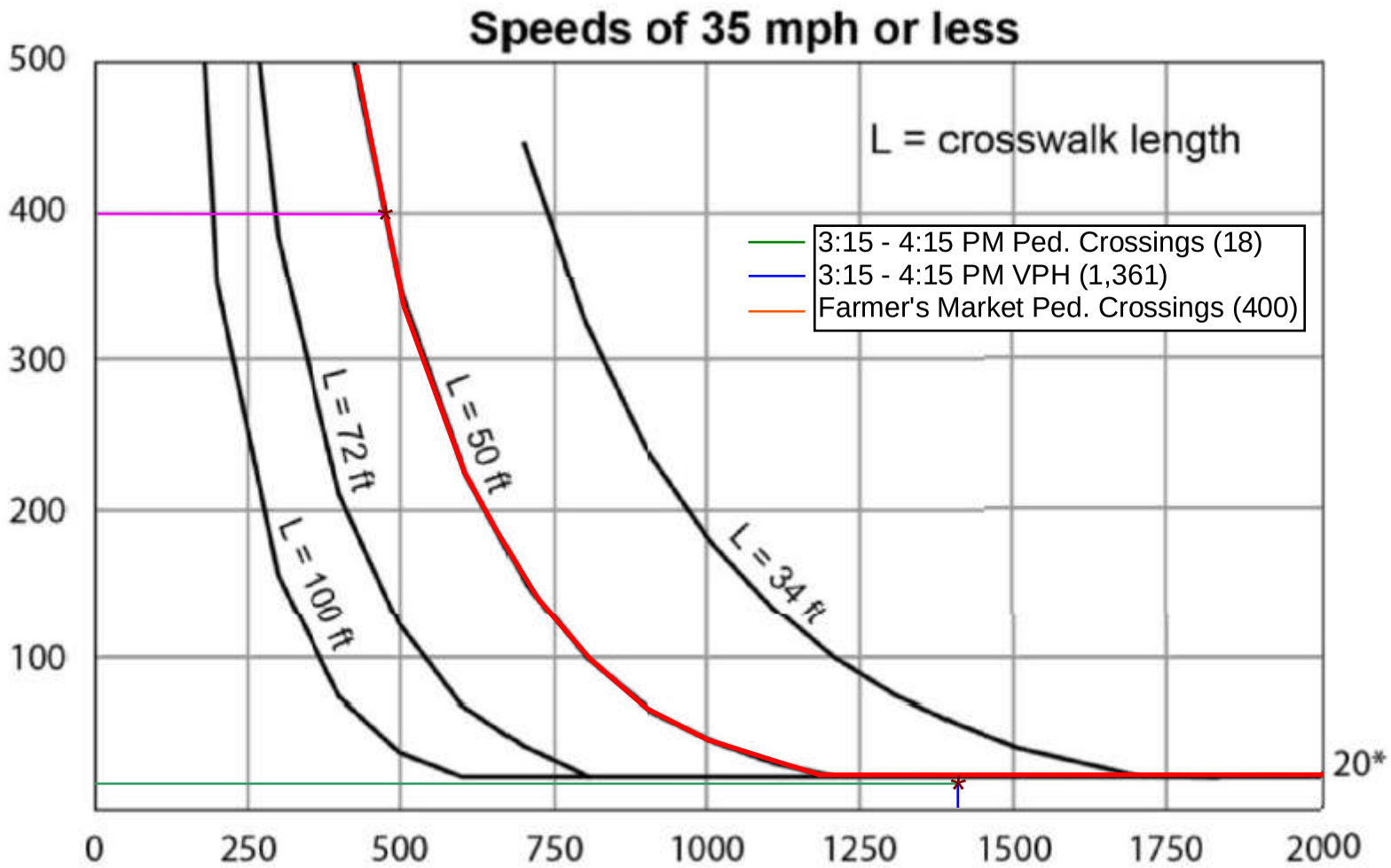
V. Traffic Control Analysis

A review of the traffic counts indicates that a traffic signal is not justified per the requirements listed in the Ohio Manual of Uniform Traffic Control Devices (OMUTCD) and the Traffic Engineering Manual (TEM) at the High Street crossings. The OMUTCD does contain guidelines for the Pedestrian Hybrid Beacon (PHB), which is intended for areas with high pedestrian traffic that do not meet traffic signal warrants. Comparing the vehicular traffic and pedestrian traffic from the weekday traffic counts reveals the guidelines are not met. However, the number of pedestrians observed crossing High Street during the Worthington Farmer's Market at both existing pedestrian crossing locations would justify installation of a PHB. ***Figure 6*** and ***Figure 7*** on the following pages show the Pedestrian Hybrid Beacon analysis at both study locations.

Figure 6: Guidelines for the Installation of a Pedestrian Hybrid Beacon on Low-Speed Roadways (OMUTCD Figure 4F-1)

High St @ Village Green South Dr.

TOTAL OF ALL PEDESTRIANS CROSSING THE MAJOR STREET - PEDESTRIANS PER HOUR (PPH)

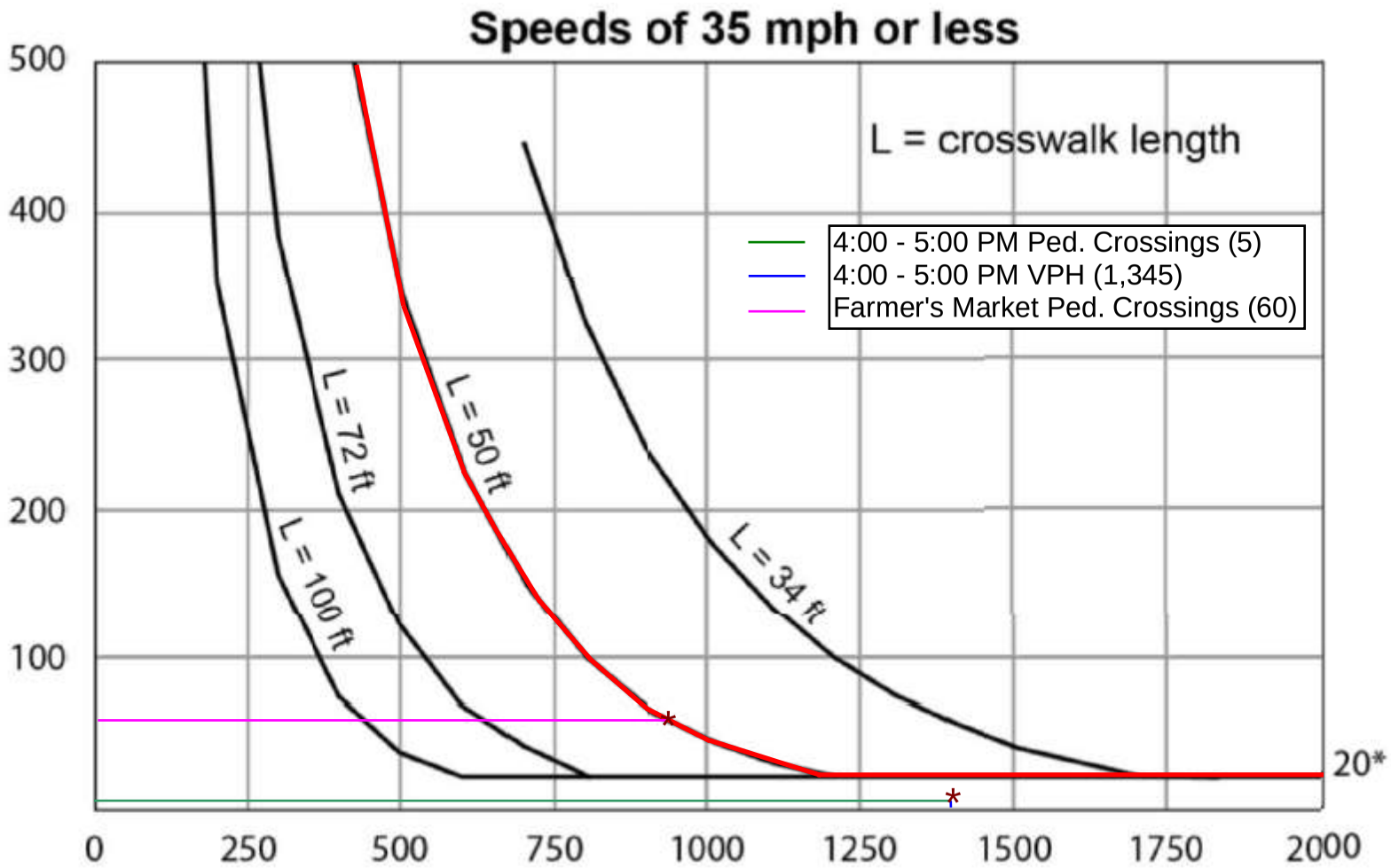


MAJOR STREET - TOTAL OF BOTH APPROACHES -VEHICLES PER HOUR (VPH)
*Note: 20 pph applies as the lower threshold volume

Figure 7: Guidelines for the Installation of a Pedestrian Hybrid Beacon on Low-Speed Roadways (OMUTCD Figure 4F-1)

High St @ Short St.

TOTAL OF ALL PEDESTRIANS CROSSING THE MAJOR STREET - PEDESTRIANS PER HOUR (PPH)



MAJOR STREET - TOTAL OF BOTH APPROACHES -VEHICLES PER HOUR (VPH)
*Note: 20 pph applies as the lower threshold volume

VI. Conceptual Alternatives

The analysis of the vehicular and pedestrian traffic counts and the crash data indicate there is justification for additional traffic control. While the crash data does not show a problem, there is a higher potential for a pedestrian crash in this area, especially during the Farmer's Market on Saturdays throughout the summer months. Studies (FHWA Publication HRT-04-100 "Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations", 2005) have shown that the installation of marked crosswalks at un-signalized intersections or mid-block locations without any other improvements is not as safe as unmarked crossings because pedestrians and drivers are not as alert to crossing conflicts. Therefore, the installation of marked crosswalks should have additional static or active warning signs. In accordance with ***Phase 1*** of the Old Worthington Mobility Study, the following alternatives provide ideas for enhanced pedestrian circulation.

Alternative #1 – Pedestrian Warning Signs

At a minimum, advanced pedestrian crossing signs (see ***Figure 8***) should be installed on High Street warning drivers that they are entering an area of higher than normal pedestrian activity, especially for northbound High Street, which enters the study area with two (2) travel lanes and is not coming from the downtown area. Typical costs per sign are around $150.00.

Figure 8: Source - Road Traffic Signs

Alternative #2 – Pedestrian Warning Signs

Alternative 2 involves updating the existing pedestrian crossings at the Village Green South and Short Street locations. Installation includes a new overhead sign which will be in accordance with the OMUTCD, along with flashing indicators to alert drivers of a pedestrian using the crosswalk. New pedestrian signal heads with LED indicators displaying "Proceed With Caution" will also be included. Costs would range from $1,000-$5,000.

Figure 9: Existing Pedestrian Crossing at Village Green South Drive

- Advantages
  - Improves visibility of pedestrian crossing for drivers in areas with on-street parking, landscaping, or any other visual obstruction exists.
  - Provides positive crossing guidance.
  - Can be incorporated with decorative mast arm poles.
  - Studies have shown that installation of beacons improves driver yielding up to 80% more than static signing.
- Disadvantages
  - Cannot be part of a coordinated system such as a traffic signal or PHB; pedestrians would cause more disruption of vehicular traffic flow.
  - Does not provide a red/stop condition for drivers.

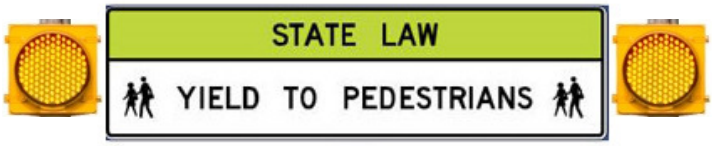


Figure 10: Overhead Pedestrian Crossing Signs

Alternative #3 –Pedestrian Hybrid Beacon (PHB)

Alternative 3 consists of installing Pedestrian Hybrid Beacon (PHB; also know as a High Intensity Activated Crosswalk or HAWK) on the south side of the intersection. The PHB is a pedestrian activated warning device located on a mastarm over a roadway. The beacons consist of two red LED lenses above a single yellow LED lens, which remain dark until activated. A pedestrian will actuate the system utilizing an ADA compliant pushbutton, which activates the beacon. The beacon flashes the yellow indicator on the major street, warning drivers to prepare to stop. Then, the yellow signal will turn solid, allowing vehicles to stop if it is safe to do so. When the all red indicators start, the vehicle stop phase begins. After a brief time period, the red beacons begin to alternate flashing, allowing drivers to proceed only if the crosswalk is clear. When the beacons turn dark, traffic is allowed to proceed. Costs for a PHB interconnected to the coordinated signals along High Street would be approximately $55,000 each to install plus regular operation and maintenance costs; however this cost could be significantly minimized if the existing support poles could be reused, with a total cost of approximately $15,000 - $20,000 each. See ***Figure 11*** at the end of this report and ***Appendix E*** for more information on PHBs. For a conceptual cost estimate, see ***Appendix G***.

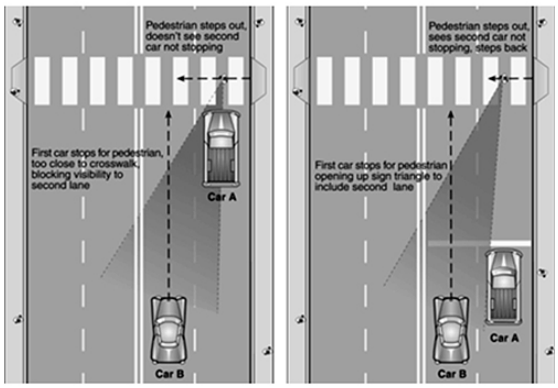


Figure 11: Sight Distance Advantage with a PHB Installation

- Advantages
  - Higher visibility of pedestrians and crossing; improves pedestrian safety.
  - Provides positive crossing guidance
  - Provides solid red indicator for drivers (positive stop control).
  - Lower costs to install and operate than a traffic signal.
  - Can be integrated into a coordinated system to minimize disruptions in traffic flow.
  - Reduction in pedestrian related crashes by 69% and total crashes by 29%.
  - Can be incorporated with decorative mast arm poles.
- Disadvantages
  - Higher cost than updating existing pedestrian crossing installations.
  - New type of device to the area will result in a learning curve (need a PR campaign)

Figure 12: Pedestrian Hybrid Beacon Installation

Various other alternatives were considered, such as in-pavement lighting, refugee islands, or installing a crosswalk only. In-pavement lighting is not considered viable due to maintenance issues ranging from damage due to snow plows and indicator lenses becoming dirty from dirt/grit requiring regular cleaning. A refugee island will not work at this location, as there is not enough space for installation. Studies have also shown that installing a crosswalk at an unsignalized intersection or mid-block location without any other improvements is less safe for pedestrians than an unmarked crossing.

VII. Capacity Analysis

Further analysis was completed using *Synchro 9*.0 software in order to determine how the study intersection operates with the existing traffic control (stop control for Village Green South and Short Street) and if a PHB was installed. (In order to model a PHB, the intersection was analyzed as a typical traffic signal, with a pedestrian recall phase used for the side street timing.) Using the

Synchro model developed for the IR-270/US-23 construction project (which includes the existing timings and offsets in use today), these two (2) scenarios were analyzed to determine capacity, Level of Service, and Model of Effectiveness (MOE).

Capacity is the volume of traffic that can pass through a roadway facility in a given amount of time (vehicles/hour). The concept of *Level of Service* (LOS) is a qualitative measure of the operation of traffic flow. LOS considers such factors as speed, travel time, freedom to maneuver, traffic interruptions, driver inconvenience, safety, and delay. For different transportation facilities, the LOS is based on different measures of effectiveness.

Signalized and unsignalized intersections are measured for average control delay in seconds per vehicle. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final deceleration delay. The delay measurement for vehicles at a signalized intersection is a combination of driver discomfort, driver frustration, and lost travel time.

The LOS rating system as described in the 2010 Highway Capacity Manual gives a value of A through F to each type of roadway facility representing best to worst traffic conditions. When designing roadway improvements, it is desirable to accommodate peak hour volumes at a LOS C or D. ***Table 1*** below and ***Table 2*** on the following page summarize the Levels of Service for signalized and unsignalized intersections.

Table 1: LOS Criteria for Signalized Intersections

Level of Service	Average Control Delay
A	< 10 seconds per vehicle
B	> 10 sec. but not more than 20 sec. per vehicle
C	> 20 sec. but not more than 35 sec. per vehicle
D	> 35 sec. but not more than 55 sec. per vehicle
E	> 55 sec. but not more than 80 sec. per vehicle
F	> 80 seconds per vehicle

Table 2: LOS Criteria for Unsignalized Intersections

Level of Service	Average Control Delay
A	0-10 seconds per vehicle
B	10-15 seconds per vehicle
C	15-25 seconds per vehicle
D	25-35 seconds per vehicle
E	35-50 seconds per vehicle
F	> 50 seconds per vehicle

Capacity analysis was completed for the existing traffic control and if a PHB were to be installed at the intersections of High Street at Village Green South Drive and at High Street at Short Street. Since Village Green South Drive is one-way away from High Street, analysis shows this intersection operates at LOS A during all peak hours, with the worse delay of 6.2 seconds occurring during the mid-day peak hour. Analysis at Short Street shows that the existing traffic control (stop control on Short) operates at acceptable Levels of Service during the AM peak hour, Mid-Day peak hour, and PM peak hour, with the worst LOS and delay occurring during the AM peak hour with LOS D and delay of 43 seconds (LOS D is acceptable in urban conditions) on the side street (Short Street). The LOS and delays on High Street were all acceptable, with LOS A and no delay more than eight seconds.

Analysis with a PHB shows the intersection of High at Village Green South Drive operating with acceptable LOS and delay as well, with the northbound through delay of only 4.6 seconds (LOS A) during the mid-day peak hour. During the other times of the day, the northbound and southbound through average delays are all under five seconds, which is a LOS A. At the intersection of High at Short Street, analysis shows the intersection operates with acceptable LOS and delay as well, with the northbound through delay of only 6.3 seconds (LOS A) during the PM peak hour. During the other times of the day, the northbound and southbound through average delays are all under five seconds, which is a LOS A. For the PHB, the delays for vehicles on the side street (Short) will be the same as the existing condition since the traffic control on the side street will stay the same (drivers will still be under a stop controlled condition). ***Table 3*** and ***Table 4*** on the following page summarize the LOS and delay results for vehicles.

A PHB can be implemented into a coordinated signal system; therefore coordination with the existing signals along High Street was also checked with this scenario. Although Village Green South is only 300 feet south of SR-161, and Short Street is only 450 feet north of South Street, the Time Space Diagrams (see ***Appendix F***) show the intersections can be incorporated within the coordinated

system with minimal additional delay for traffic on High Street. The Measure of Effectiveness for each of the scenarios analyzed is also located in ***Appendix F***.

Analysis of delay for the pedestrians with the PHB shows the average delay for a pedestrian crossing High Street at Short Street will be 41 seconds during the AM peak hour once the pedestrian push button is pressed. Actual delay will vary between one second and 118 seconds for most of day depending on when the push button is activated during the traffic signal cycle; however, in most cases, the pedestrian would wait between 40 to 80 seconds.

Table 3: LOS & Delay Summary – Village Green South Drive

Intersection	Analysis Period	Direction	Existing Condition*		PHB	
			LOS	Delay	LOS	Delay
High & Village Green South	AM Peak Hour	Northbound	A	0.0	A	3.7
		Southbound	A	0.0	A	2.6
	Mid-Day Peak Hour	Northbound	A	0.0	A	4.6
		Southbound	A	0.0	A	4.1
	PM Peak Hour	Northbound	A	0.0	A	4.3
		Southbound	A	0.0	A	3.1

Level of Service and Delay information obtained from Synchro.
*Since traffic on High Street does not stop, there is no delay for the existing condition.

Table 4: LOS & Delay Summary – Short Street

Intersection	Analysis Period	Direction	Existing Condition*		PHB	
			LOS	Delay	LOS	Delay
High & Short	AM Peak Hour	Northbound	A	0.0	A	3.8
		Southbound	A	0.0	A	3.6
	Mid-Day Peak Hour	Northbound	A	0.0	A	3.8
		Southbound	A	0.0	A	5.7
	PM Peak Hour	Northbound	A	0.0	A	6.3
		Southbound	A	0.0	A	4.2

Level of Service and Delay information obtained from Synchro.
*Since traffic on High Street does not stop, there is no delay for the existing condition.

Another analysis was also completed with the PHB operating at a half cycle. The PHB would operate on a 60-second cycle during the AM and midday hours and a 65-second cycle during the PM peak hours, which would result in less delay for a pedestrian crossing High Street. With the PHB operating on a half-cycle at High and Village Green South, the LOS and delay for northbound and southbound vehicular traffic would be a LOS A with an average delay of 7.5 seconds in the AM peak hour. In the

Mid-Day peak, northbound traffic operates with LOS B and delay of 11.4 seconds, while southbound traffic has LOS A with delay of 6.7 seconds. During the PM peak hour, northbound traffic has LOS A with a delay of 7.8 seconds and southbound traffic has a LOS A with 5.3 seconds of delay.

With the PHB operating on a half-cycle at High and Short, the LOS and delay for northbound and southbound vehicular traffic would be a LOS A with an average delay of six seconds in the AM peak hour. In the Mid-Day peak, northbound traffic operates with LOS B and delay of 10.5 seconds, while southbound traffic has LOS A with delay of 7.6 seconds. During the PM peak hour, northbound traffic has LOS B with a delay of 12.9 seconds and southbound traffic has a LOS A with 6.7 seconds of delay. ***Table 5*** and ***Table 6*** summarize the LOS and delay results for vehicles.

Table 5: LOS & Delay Summary – Village Green South Drive

Intersection	Analysis Period	Direction	Existing Condition*		PHB	
			LOS	Delay	LOS	Delay
High & Village Green South	AM Peak Hour	Northbound	A	0.0	A	9.9
		Southbound	A	0.0	A	5.0
	Mid-Day Peak Hour	Northbound	A	0.0	B	11.4
		Southbound	A	0.0	A	6.7
	PM Peak Hour	Northbound	A	0.0	A	7.8
		Southbound	A	0.0	A	5.3

Level of Service and Delay information obtained from Synchro.
*Since traffic on High Street does not stop, there is no delay for the existing condition.

Table 6: LOS & Delay Summary – Short Street

Intersection	Analysis Period	Direction	Existing Condition*		PHB	
			LOS	Delay	LOS	Delay
High & Short	AM Peak Hour	Northbound	A	0.0	A	7.8
		Southbound	A	0.0	A	3.8
	Mid-Day Peak Hour	Northbound	A	0.0	B	10.5
		Southbound	A	0.0	A	7.6
	PM Peak Hour	Northbound	A	0.0	B	12.9
		Southbound	A	0.0	A	6.7

Level of Service and Delay information obtained from Synchro.
*Since traffic on High Street does not stop, there is no delay for the existing condition.

VIII. Recommendations

Numerous studies (TCRP-NCHRP 17-56, TCRP-NCHRP 562, FHWA-SA-12-012, FHWA-SA-14-014, and ITE- PHB 2012) have shown that the addition of a red beacon for vehicular traffic at a pedestrian crossing results in a higher level of motorists yielding, regardless of the street type (local road or major arterial street). The pedestrian hybrid beacon (PHB) includes this type of traffic control, providing positive guidance for drivers without implementing a typical traffic signal. PHBs are an intermediate between no traffic control and a traffic signal where the pedestrian volumes do not meet the traffic signal warrant requirements listed in the OMUTCD. In addition to the PHB having the capability to be integrated in a coordinated system without significant additional delay for High Street traffic, the alternating red signal operation allows vehicles to proceed once the pedestrian has cleared the travel lane, improving traffic flow. In accordance for uniformity with ***Phase 1*** of the Old Worthington Mobility Study, it is recommended to implement ***Alternative 3*** Pedestrian Hybrid Beacon (PHB), along with additional advanced pedestrian warning signs (***Alternative 1***). The PHBs at both the Village Green South and Short Street can run on half cycles (half of the traffic signal cycle as compared to the other intersections along High Street) in order to minimize the delay for pedestrians.

The OMUTCD provides standards and guidance for the design and implementation of a PHB. One such stipulation listed under the "Guidance" section is that a PHB should not be installed within 100 feet of a side street. However, the National Committee on Uniform Traffic Control Devices (NCUTCD) has proposed a revision to the wording for the next MUTCD that removes the stipulation on installation of a PHB adjacent to a side street.[2] The NCUTCD assists in the development of standards, guidelines and warrants for traffic control devices and practices used to regulate, warn and guide traffic on streets and highways, and makes recommendations to the Federal Highway Administration (FHWA) and to other appropriate agencies regarding proposed revisions and interpretations to the Manual on Uniform Traffic Control Devices (MUTCD) and other accepted national standards.

The signals Technical Committee proposed recommended changes to the MUTCD regarding the installation of a Pedestrian Hybrid Beacon, which were approved by the National Committee Council at a meeting on June 23, 2011 and forwarded to FHWA for approval; see ***Appendix F***.[2]

	DRIVERS		PEDESTRIANS	
	Will See...	Will Do...	Will See...	Will Do...
1		Proceed with caution.		Push the button to activate the system.
2	FLASHING	Slow down, prepare to stop. A pedestrian has activated the system.		Wait.
3		Stop if it is safe to do so.		Continue to wait.
4		STOP. A pedestrian is in the crosswalk.		Start crossing when all vehicles are stopped.
5	FLASHING	STOP. Proceed with caution if the crosswalk is clear.		Continue crossing; the signal will count down.
6		Proceed with caution.		Push the button to activate the system.

Figure 13: PHB Operation Guide