CITY of NOVI CITY COUNCIL

Agenda Item D
December 22, 2014

SUBJECT: Approval to award an amendment to the engineering services agreement with Spalding DeDecker Associates for additional design engineering associated with the Beck Road Mid-Block Pedestrian Crossing project in the amount of $6,697.

SUBMITTING DEPARTMENT: Department of Public Services, Engineering Division

CITY MANAGER APPROVAL:

EXPENDITURE REQUIRED	**$ 6,697**
AMOUNT BUDGETED	**$ 40,700**
LINE ITEM NUMBER	**204-204.00-974.436**

BACKGROUND INFORMATION:

The *City of Novi Non-Motorized Master Plan 2011* identified several locations for the potential development of non-motorized crossings of major roads within the City, referred to as mid-block crossings. One of these locations was identified and funded in the FY13-14 budget on Beck Road between Cheltenham Drive and White Pines Drive. This location is also part of a future east-west regional pathway north of Nine Mile Road.

Engineering design services for this project were awarded to Spalding DeDecker Associates (SDA) on November 25, 2013. Since then, the Engineering Division has been working SDA on the preliminary engineering, which also included a traffic study to develop design recommendations. The attached Engineering Division memo dated November 5, 2014 summarizes SDA's study, as well as other details related to the proposed project.

During the initial study phase, which included some discussions with a representative of the adjacent neighborhood, it was determined that additional improvements were appropriate. The preliminary design calls for Beck Road to be widened to construct a pedestrian refuge island and corresponding center turn lane. It was determined that the pavement in this area is in poor condition and should be rehabilitated as part of the project. The additional design fee being requested is primarily attributed to the design of these road rehabilitation improvements (see attached Authorization for Additional Services #1).

The design fees for the project are based on the fixed fee schedule established in the agreement for Professional Engineering Services for Public Projects for the City's three pre-qualified engineering consultants. The revised design fees for this project are $16,277 (9.75% of the estimated construction cost of $166,939). $9,579 was originally awarded, resulting in the remaining $6,697 to be awarded at this time. The construction phase engineering fees will be awarded at the time of construction award and will be based on the contractor's bid and the fee percentage in the Agreement for Professional Engineering Services for Public Projects.

The project will be designed over the winter months, and construction of this project is expected to commence in summer 2015.

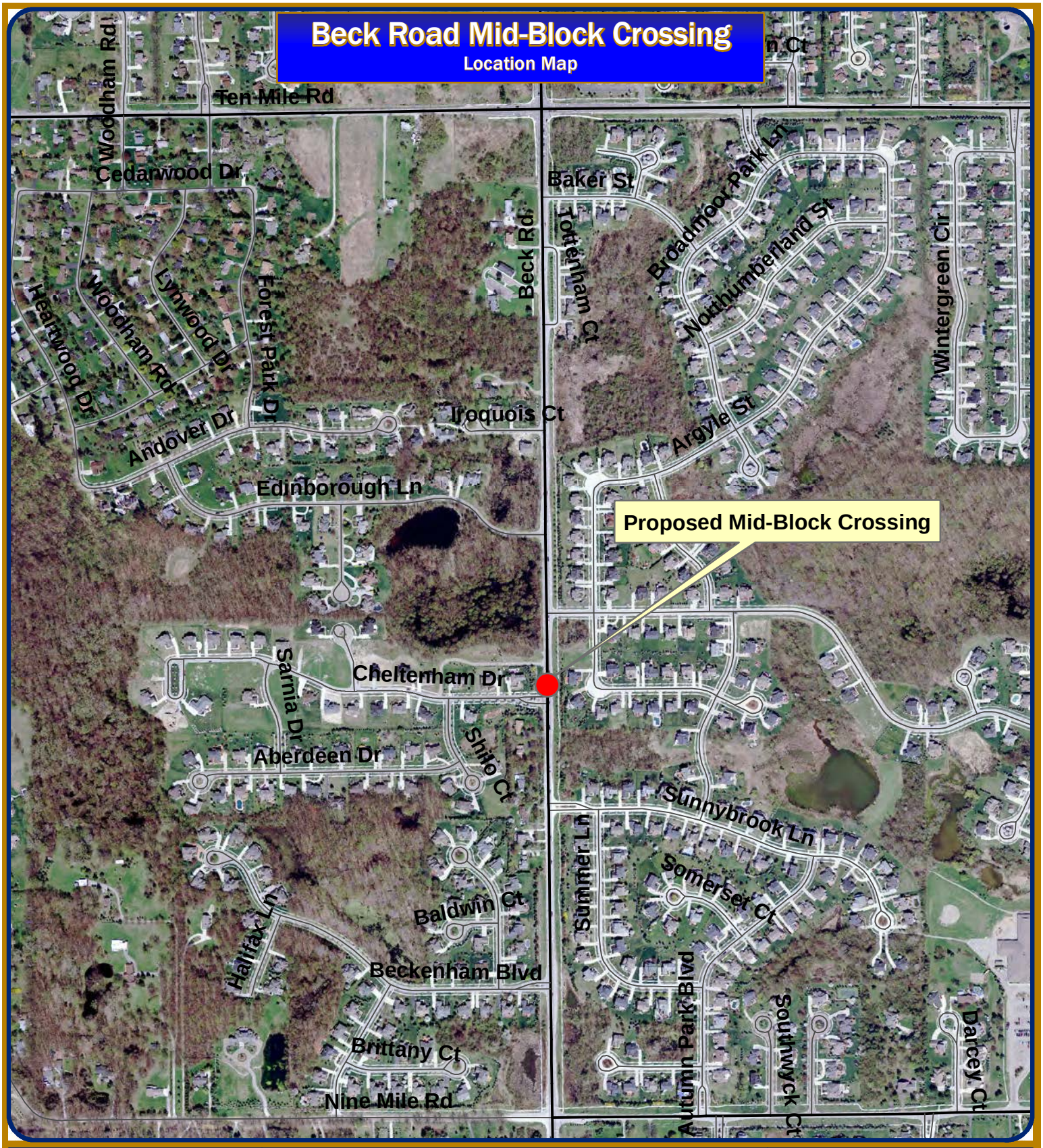
RECOMMENDED ACTION: Approval to award an amendment to the engineering services agreement with Spalding DeDecker Associates for additional design engineering associated with the Beck Road Mid-Block Pedestrian Crossing project in the amount of $6,697.

	1	2	Y	N
Mayor Gatt				
Mayor Pro Tem Staudt				
Council Member Casey				
Council Member Markham				

	1	2	Y	N
Council Member Mutch				
Council Member Poupard				
Council Member Wrobel				

Beck Road Mid-Block Crossing

Location Map



Map Author: Croy
Date: 11/14/13
Project: Beck Mid-Block Crossing
Version #: v1.0

MAP INTERPRETATION NOTICE

Map information depicted is not intended to replace or substitute for any official or primary source. This map was intended to meet National Map Accuracy Standards and use the most recent, accurate sources available to the people of the City of Novi. Boundary measurements and area calculations are approximate and should not be construed as survey measurements performed by a licensed Michigan Surveyor as defined in Michigan Public Act 132 of 1970 as amended. Please contact the City GIS Manager to confirm source and accuracy information related to this map.

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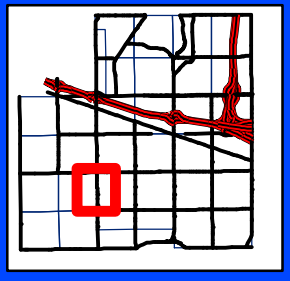
1 inch = 680 feet



City of Novi
Engineering Division
Department of Public Services
26300 Lee BeGole Drive
Novi, MI 48375
cityofnovi.org

Authorization for Additional Services #1

Project: **Engineering Services for** Date: 12/11/2014
Beck Road Pedestrian Crossing

Description of Additional Services
The proposed design of the project has been updated to include:

- Removal of the RRFB from the design
- Addition of cold milling and HMA resurfacing with 2" of HMA, 4C from the south side of White Pines Dr to the north side of Sunnybrook Ln. This is in addition to the 5" of HMA, 4C for the widening areas.

Original scope of work:
[Provide itemized list of tasks related to scope change, and provide cost associated with each task]

- Perform a topographical survey of Beck Road and adjacent sidewalks and swales / ditches from Cheltenham north through White Pines Drive to supplement existing survey information.
- Preliminary Plans – Plans will be prepared showing existing and proposed typical cross sections; plan view of the proposed work; and permanent signing and pavement marking layout.
- Plan Review – Plans will be submitted to the City at approximately 30% and again at 75% completion, for review and comments.
- Final Plan Preparation – Plans and specifications / contract documents will be finalized and prepared for advertising.
- Bidding Phase – The City will place an advertisement, and plans will be made available by SDA for potential bidders. SDA will respond to contractor inquiries and issue any required addendum.
- Bid Opening and Award – SDA will review submitted bids, prepare bid tabulations, review references, and recommend award.
- Compile contract books for execution – includes obtaining bonds, insurance information, and warranty documents.

Amount authorized for original scope: $9,580

Proposed scope of work:
[Provide itemized list of tasks related to scope change, and provide cost associated with each task]

- The project scope now includes cold milling and resurfacing the existing asphalt pavement within the project limits. The proposed budget amount is based on the Road Reconstruction fee curve and the additional award is the difference between the new design fee and the original design awarded.

Proposed budget amount for new scope: $16,277

Based on the revised scope of services, we request authorization for an increase of $6,697 to the amount authorized under the previous scope of services.

[CONSULTANT]

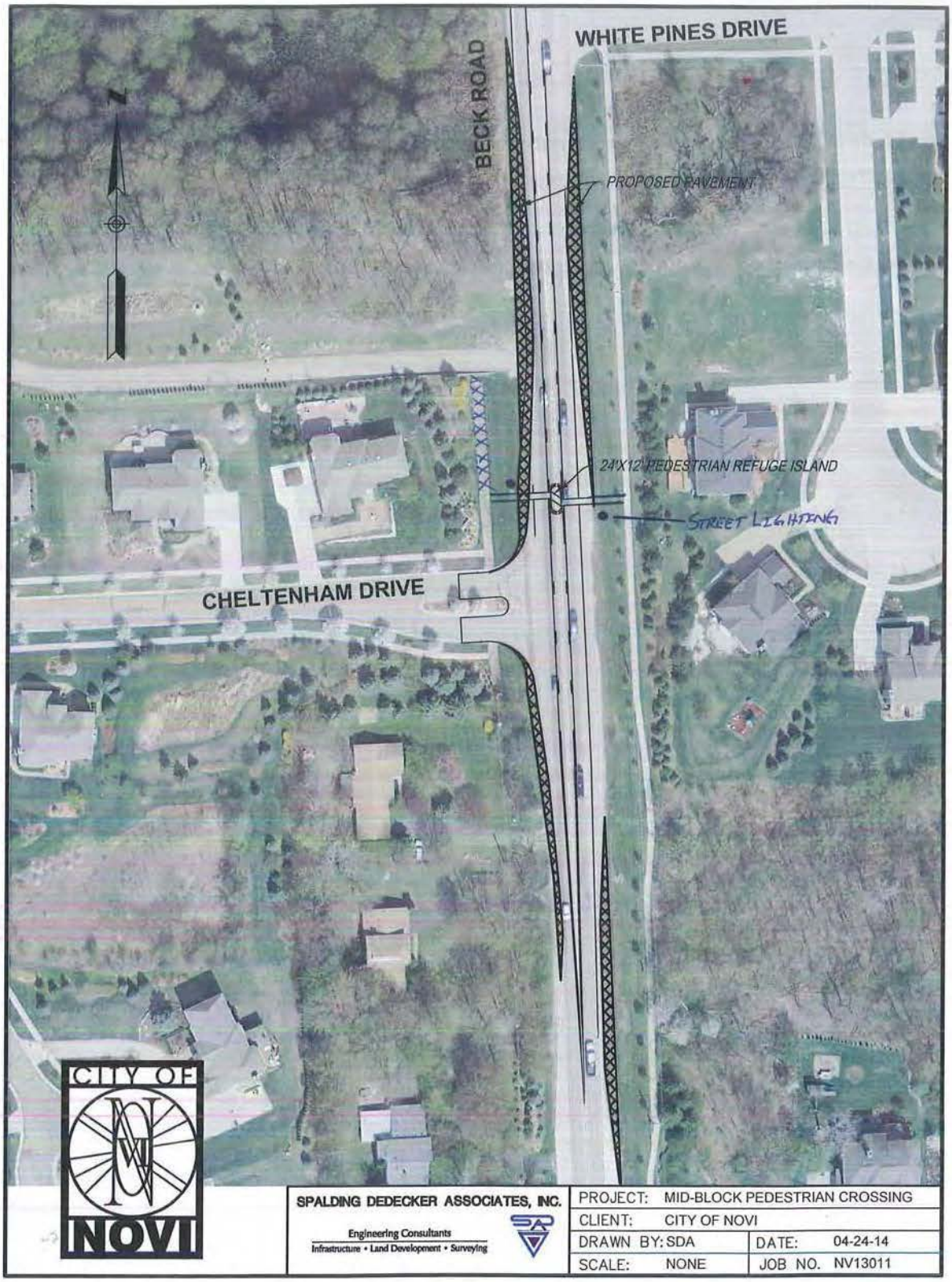
Requested by: Edward Stimpson PROJECT MANAGER Date: 12/11/2014
Name and Title

CITY OF NOVI

Reviewed by: _____ Date: 12/12/14
Brian Coburn, Engineering Manager

Approved by: _____ Date: 12/12/14
Rob Hayes, Director of Public Services

Approved by: _____ Date: _____
Sue Morianti, Purchasing Manager


WHITE PINES DRIVE
BECK ROAD
PROPOSED PAVEMENT
24'X12' PEDESTRIAN REFUGE ISLAND
STREET LIGHTING
CHELTENHAM DRIVE
CITY OF NOVI
SPALDING DEDECKER ASSOCIATES, INC.
Engineering Consultants
Infrastructure • Land Development • Surveying
PROJECT: MID-BLOCK PEDESTRIAN CROSSING
CLIENT: CITY OF NOVI
DRAWN BY: SDA
DATE: 04-24-14
SCALE: NONE
JOB NO. NV13011

SPALDING DEDECKER ASSOCIATES, INC.
905 South Boulevard East • Rochester Hills • Michigan 48307 • Tel 248 844 5400 • Fax 248 844 5404

Beck Road Pedestrian Crossing
Pre-Design Construction Cost Estimate

PROJECT: Beck Road Pedestrian Crossing
CLIENT: City of Novi
PREPARED BY: EMK
WORK: Installation of pedestrian refuge island & sign system on Beck Rd near Cheltenham Drive

PROJECT NO: PR12-005
SAD NO: N/A
DATE: 10/27/2014

	ITEM	QUANTITY	UNIT	UNIT PRICE ($)	AMOUNT ($)
	Mobilization (10% max.)	1	LS	14,360.00	14,360.00
	Pre-Construction Audio/Visual DVD Coverage	1	LS	1,500.00	1,500.00
	Soil Erosion and Sedimentation Control Measures	1	LS	2,000.00	2,000.00
	Maintaining Traffic	1	LS	5,000.00	5,000.00
	Pavement Remove	253	SYD	20.00	5,060.00
	Curb and Gutter, Rem	140	FT	20.00	2,800.00
	Excavation, Earth	271	CYD	12.00	3,252.00
	Aggregate Base, 6 inch	813	SYD	10.00	8,130.00
	Cold Milling HMA Surface	4,635	SYD	4.00	18,540.00
	HMA, 4C	798	TON	85.00	67,830.00
	Conc Pavt, Misc, 8 inch	30	SYD	75.00	2,250.00
	Curb and Gutter, Conc, Det C4	129	FT	25.00	3,225.00
	Sidewalk, Conc, 4 inch	1,500	SFT	6.00	9,000.00
	Sidewalk Ramp, Conc, 6 inch	248	SFT	14.00	3,472.00
	Detectable Warning Surface	36	FT	20.00	720.00
	Permanent Signing	1	LS	1,500.00	1,500.00
	Permanent Pavement Marking	1	LS	4,000.00	4,000.00
	Ditching	350	FT	8.00	2,800.00
	Restoration	500	SYD	5.00	2,500.00
	DTE Street Lights (2 Poles)	1	LS	9,000.00	9,000.00
OPINION OF PROBABLE CONSTRUCTION COST					**$166,939.00**

In providing opinions of probable construction cost, the Client understands that the Consultant has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's method of pricing, and that the Consultant's opinions of probable construction costs are made on the basis of the Consultant's professional judgement and experience. The Consultant makes no warranty, express or implied, that the bids or the negotiated cost of the Work will not vary from the Consultant's opinion of probable construction cost.

MEMORANDUM

TO: BRIAN COBURN, PE; ENGINEERING MANAGER

FROM: BEN CROY, PE; CIVIL ENGINEER

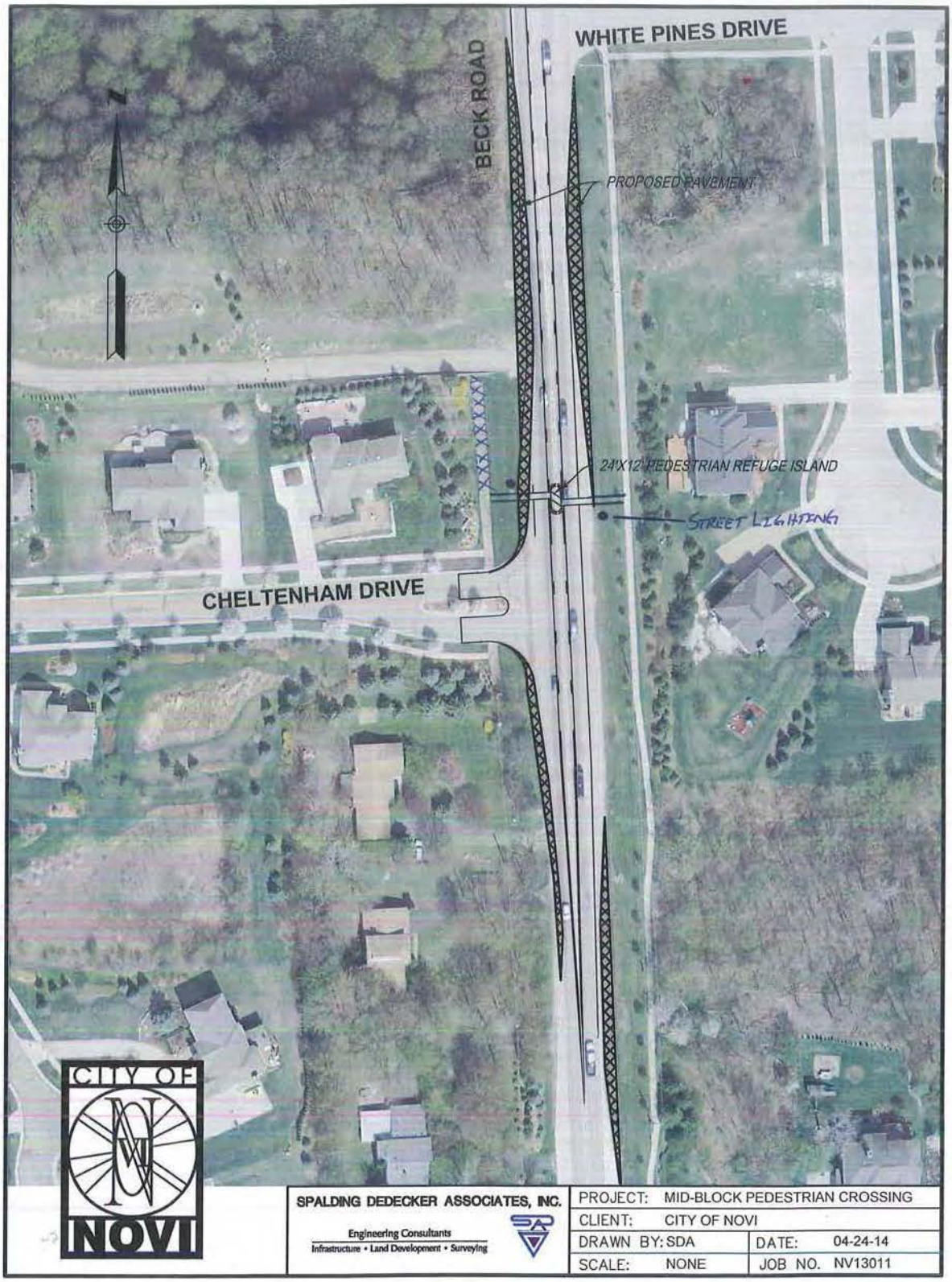
SUBJECT: BECK ROAD MID-BLOCK CROSSING

DATE: NOVEMBER 5, 2014

The *City of Novi Non-Motorized Master Plan 2011* identified several locations for the potential development of non-motorized crossings of major roads within the City, referred to as mid-block crossings. One of these locations was identified and funded in the FY13-14 budget on Beck Road between Cheltenham Drive and White Pines Drive. This location is also part of a future east-west regional pathway north of Nine Mile Road (see attached Figures 3.1I and 3.2F). Beck Road is a 2-lane road with a posted speed limit of 45 miles per hour and an average daily volume of 20,000 vehicles per day.

As the design engineer selected for this project, Spalding DeDecker Associates (SDA) assisted City staff with the evaluation of the area of Beck Road between Cheltenham Drive and White Pines Drive to determine the best location to accommodate a mid-block crossing. Since the design of mid-block crossings can be complicated, SDA consulted with the Road Commission for Oakland County (RCOC) and other sources to solicit expertise regarding some of the alternatives appropriate for mid-block crossings. A properly designed mid-block crossing can help direct pedestrians to cross in a defined location, rather than at random locations, and can help alert approaching vehicles that pedestrians may be present, making the crossing much safer.

Since this is the first mid-block crossing project under the City's jurisdiction, the initial design phase included a study to evaluate several types of treatments for the crossing such as refuge islands, illuminated pedestrian beacons, and the location of the crossing relative to adjacent streets and other obstacles. SDA performed a limited traffic study on Beck Road to evaluate the traffic patterns and help determine the appropriate design for the crossing. SDA's report, including the traffic study results, is attached. Based on SDA's recommendations, the mid-block crossing is proposed just north of Cheltenham Drive, as shown on the figure below. The crossing would include a 24' x 12' pedestrian refuge island and additional street lighting to illuminate the crossing. The island would direct pedestrians in a way that they cross only one lane of traffic at a time. The project would also include the construction of any additional pathways needed to connect the mid-block crossing to the existing pathways, and will include proper signage and pavement markings to help increase driver awareness of potential pedestrian conflicts. Additionally, portions of Beck Road will require widening to accommodate the crossing.


WHITE PINES DRIVE
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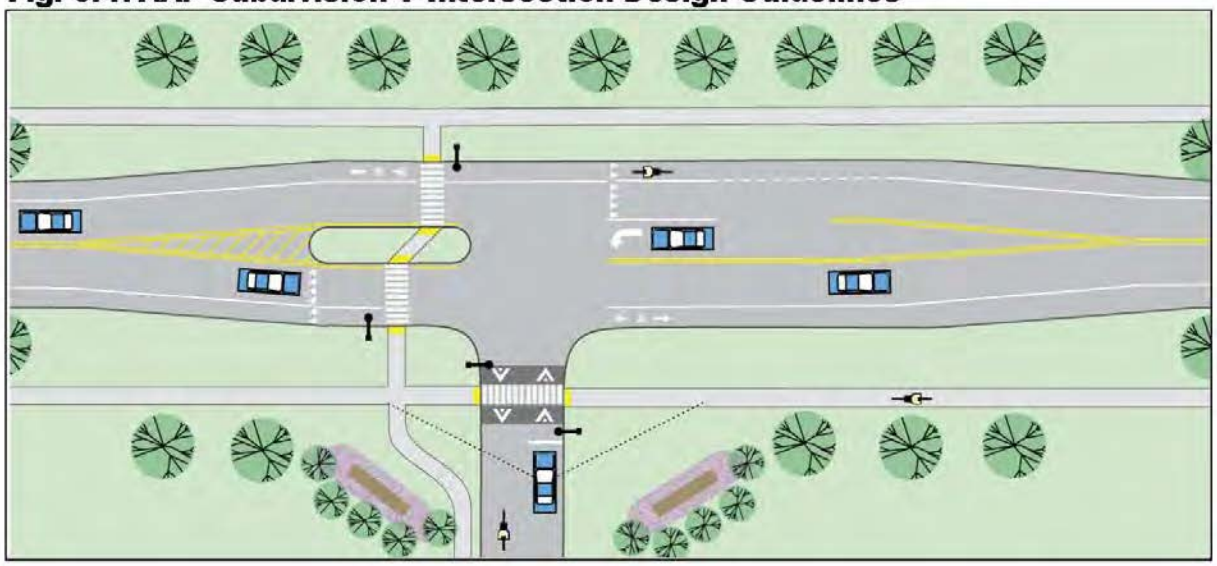
CLIENT: CITY OF NOVI
DRAWN BY: SDA
DATE: 04-24-14
SCALE: NONE
JOB NO. NV13011

The current preliminary construction estimate for this project is $166,939. This estimate includes an asphalt overlay across the limits of the project, which wasn't initially considered necessary, but is now recommended to provide the lane widening required north and south of the pedestrian refuge island. The overlay would help the appearance of the pavement, avoid issues with potentially confusing lane delineation, and avoid the need to perform maintenance on the older pavement within a short time frame following this project.

Another option that was considered, but is not currently recommended, is the use of Rectangular Rapid Flashing Beacons (RRFB). An RRFB (see photo, right) incorporates flashing lights with pedestrian crossing warning signs that will flash when activated to let motorists know a pedestrian is present. The information reviewed for RRFBs is inconclusive regarding whether the installation is appropriate for this proposed mid-block crossing. Many of the studies focus on wider 4-lane roads where a crossing would be more challenging. RCOC has indicated that driver expectancy should be considered, meaning that in areas where this type of facility isn't common, the use of the RRFB can lead to driver and pedestrian confusion, where motorists are unsure of what to do. Maintenance has also been identified as an issue with RRFBs (e.g. obtaining manufacturer's parts and service when needed, and false reports by motorists that the unit is not working properly). One primary reason that an RRFB isn't recommended is the existence of sufficient gaps in Beck Road traffic, as verified by the study, provided a pedestrian refuge island is constructed. If not installed initially with a mid-block crossing, RRFBs can be easily added afterward if desired, at a cost of approximately $15,000. Another pedestrian crossing signaling system that is available, but hasn't been considered for this crossing, is the High-intensity Activated crossWalK (HAWK) system. The HAWK (see photo, left) would be appropriate at a crossing with a higher pedestrian volume than what is expected at this crossing.

The proposed mid-block crossing would closely resemble Figure 5.47AA (below) from the non-motorized master plan.

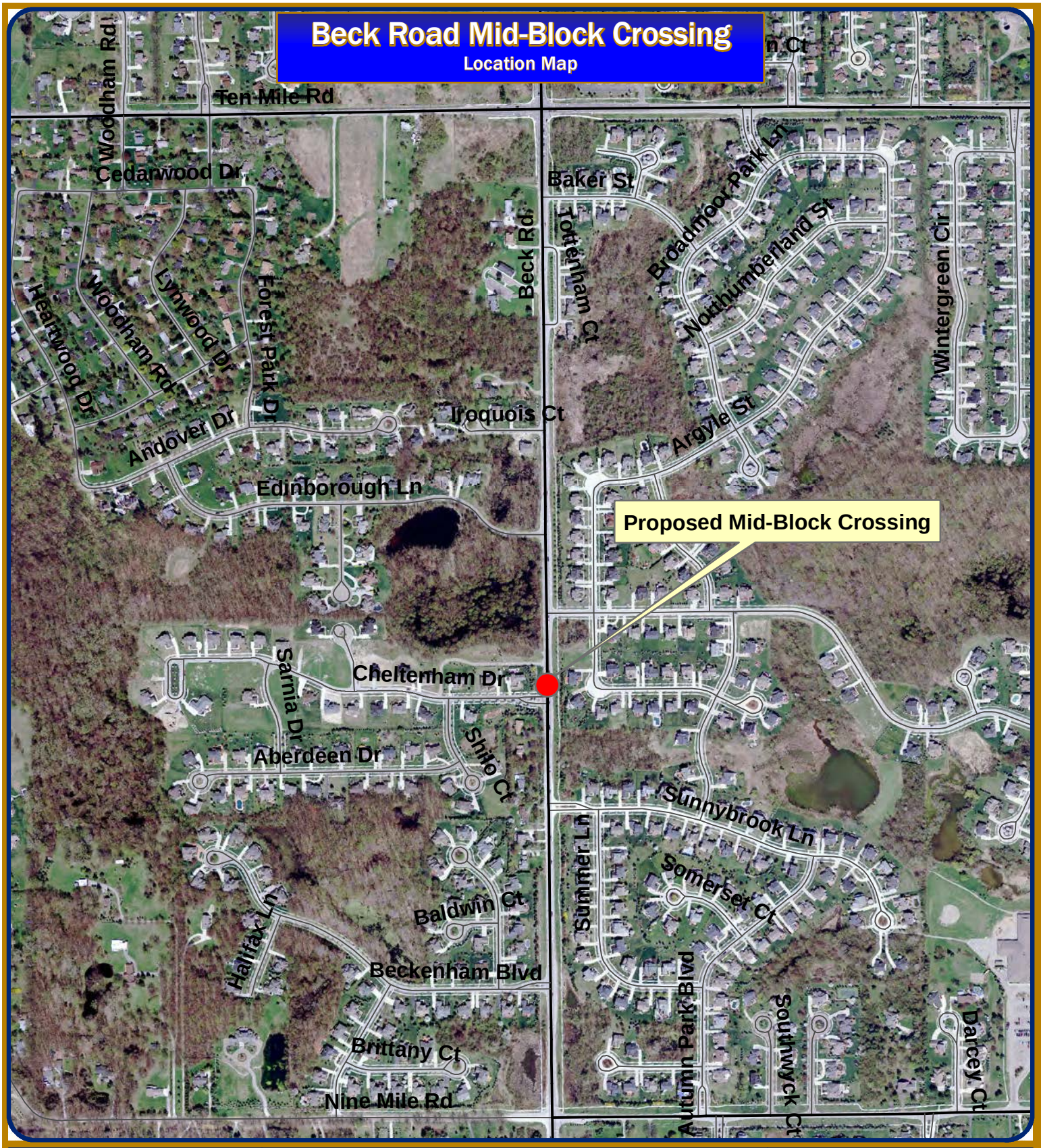
Fig. 5.47AA. Subdivision T-Intersection Design Guidelines



The final design will be completed over the winter months with construction proposed for spring and fall of 2015.

Beck Road Mid-Block Crossing

Location Map



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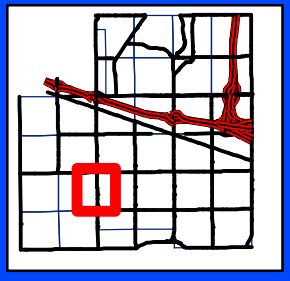

City of Novi
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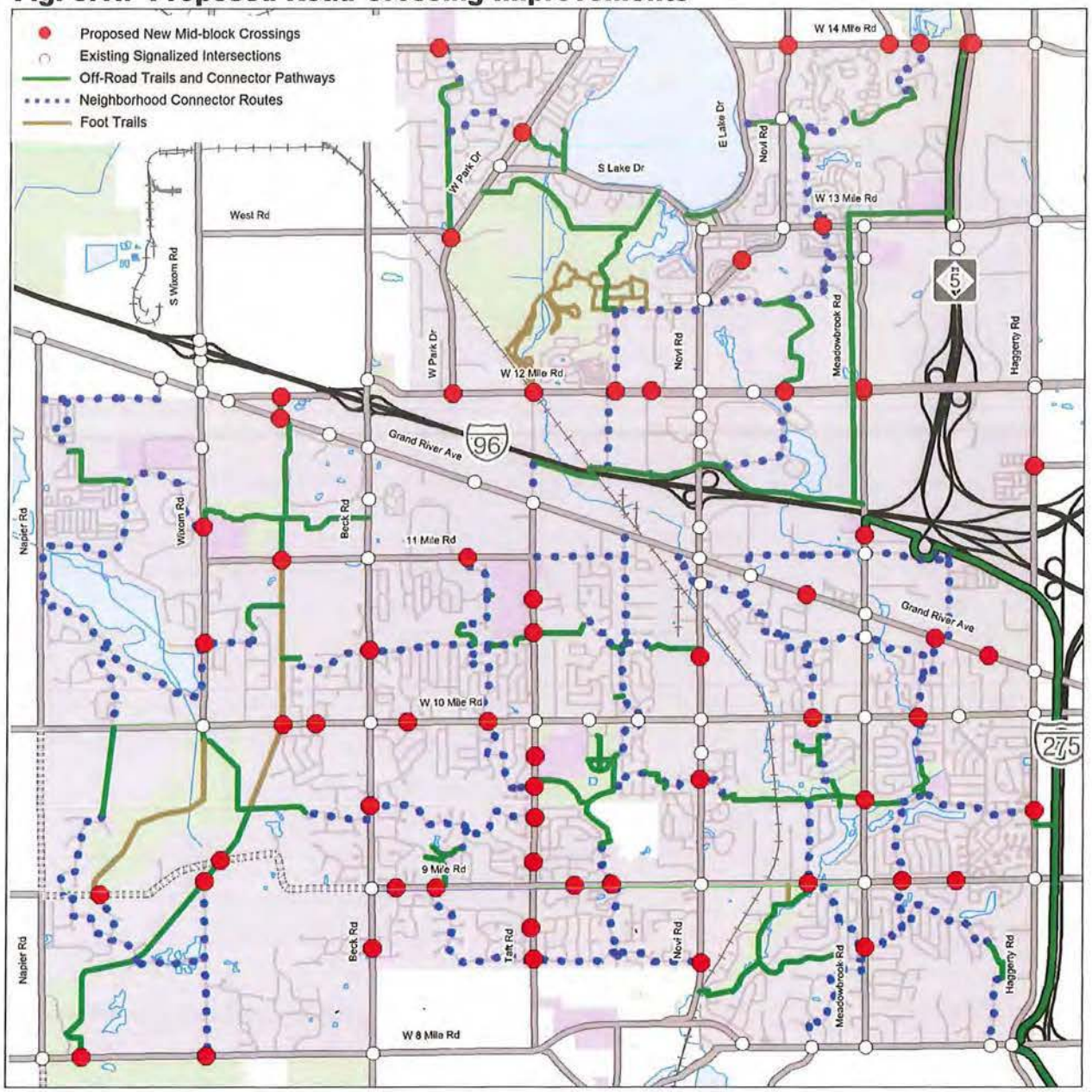
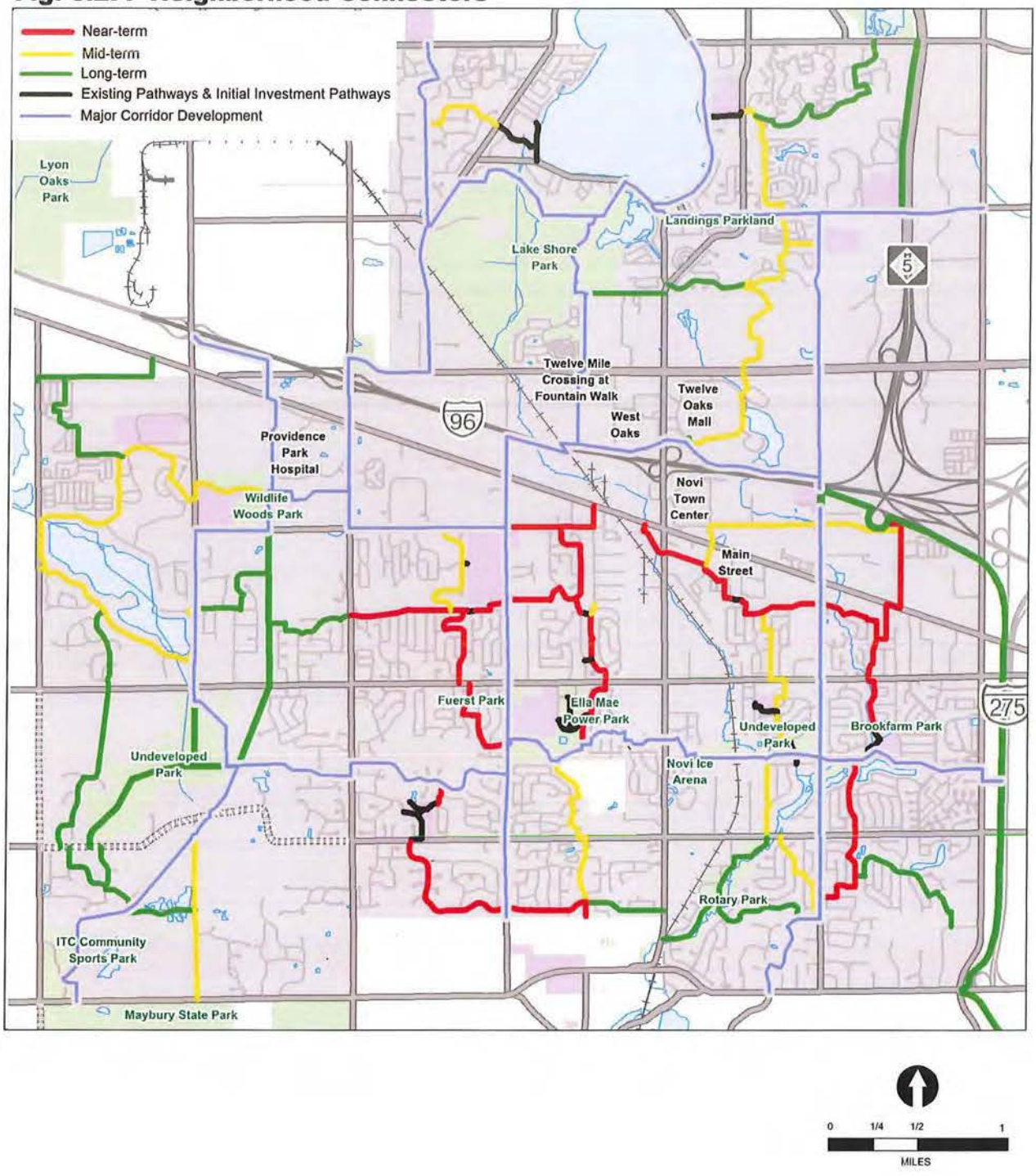
Fig. 3.11. Proposed Road Crossing Improvements



Road Crossing Improvements are needed in areas where there is a high demand to cross. These areas occur where a bike route crosses a collector or arterial road, a major bus stop or bus shelter is present, there is a long distance between crosswalks, or there is a high demand based on land use and population density.

This map illustrates where mid-block crossing improvements are needed. Many of these crossings are addressed in the implementation plan with the neighborhood connector routes and major corriodor developments. However, if demand is present they can be implemented sooner. Please note that these are initial recommendations and they need to be studied further prior to implementation.

Fig. 3.2F. Neighborhood Connectors



Beck Road Mid-Block Pedestrian Crossing

Evaluation of proposed location and supporting information

SUMMARY

The City of Novi Department of Public Works is interested in the potential construction of a mid-block pedestrian crossing of Beck Road, north of Nine Mile Road. The specific location is just north of the intersection of Cheltenham Drive and Beck Road.

Spalding DeDecker Associates, Inc. (SDA) reviewed the existing traffic patterns and evaluated "gaps" in the directional and two-way traffic to evaluate the suitability of placing a cross walk. The frequency (per hour) and duration (seconds) of gaps helps to determine if an unsignalized crossing is feasible, and also if additional safety measures should be implemented with the crossing.

The results of the gap study indicate that there are sufficient gaps available for pedestrians to cross at this location before and after school hours, provided that a pedestrian refuge island is constructed. A refuge island is a mid-point for a crossing, which allows for a pedestrian to only be concerned with the gaps in one direction of traffic at a time.

To facilitate the construction of a refuge island at this location, the northbound and southbound lanes of Beck north of Cheltenham will need to be flared around the island location via widening the pavement on the east side of Beck Road and appropriate pavement markings. A street light (or lights) should be installed on both sides of the road at a crossing. The existing light at Cheltenham should be sufficient for the west half of the crossing, but a light will need to be added on the east side of Beck Road. Signing (pedestrian crossing ahead, and pedestrian crossing location) is also required to be placed to indicate the potential for pedestrian crossing. See the attached figure on the following page for a conceptual layout of the island and pavement markings.

Additional safety measures such as a rectangular rapid-flashing beacon (RRFB) system do not appear to be needed at this location, but may be implemented immediately if desired or after the crossing is in operation and it becomes apparent there is a safety concern.


WHITE PINES DRIVE
BECK ROAD
N
PROPOSED PAVEMENT
24'X12' PEDESTRIAN REFUGE ISLAND
CHELTENHAM DRIVE
CITY OF NOVI
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CLIENT: CITY OF NOVI
DRAWN BY: SDA
DATE: 04-24-14
SCALE: NONE
JOB NO. NV13011

The following sections present some background information on the implementation of mid-block crossings, RRFB systems, and the findings of the gap study performed at the crossing in December 2013.

MID-BLOCK PEDESTRIAN CROSSINGS

General Overview and Information

Based on national crash data from the Federal Highway Administration (FHWA), about 12 percent of all traffic fatalities can be attributed to pedestrian crashes. Furthermore, over 75% of these pedestrian fatalities occur away from intersections. Many of these crashes are preventable. Mid-block pedestrian crossings should be carefully considered so as to not present a hazard to motorists nor a false sense of security to pedestrians. There are numerous treatments that can be used to highlight mid-block pedestrian crossings to alert motorist to yield such as signs, ambient lighting, and warning lights.

The addition of raised medians or pedestrian refuge islands can further protect pedestrians. A pedestrian at a mid-block crossing must make several complex decisions in order to cross the street. Pedestrians must time their crossing and speed of walking with the speed of the approaching vehicles and the gaps between vehicles. This becomes more complicated when two opposing directions of traffic must be considered at once. Raised medians allow pedestrians to cross the roadway while focusing on one direction of traffic at a time. It has been shown that providing a raised median at marked crosswalks can reduce mid-block crashes by 46 percent.

The FHWA recommends the use of raised medians for curbed multilane roadways with more than 12,000 vehicles per day, a large number of pedestrians and intermediate or high travel speeds. Beck Road traffic exceeds 20,000 vehicles per day with one lane each way, has intermediate speeds, and is not curbed. The typical number of pedestrians crossing at this location appears low, but at the time of the study the area was snow covered and the lack of a safe crossing may reduce the number of pedestrians attempting to cross.

The implementation of a curbed refuge island on Beck Road is recommended based on the traffic count and speed. Local knowledge should be utilized in deciding if the number of pedestrians will increase if a safer crossing is provided, and further safety enhancements are warranted.

Consideration should be given to the rarity of mid-block crossings in the Beck Road corridor and in the overall area. Even with a refuge island and advanced signing, if pedestrians are rarely encountered in the corridor motorists may not be attentive when they do appear. Additional measures could be taken to raise motorist awareness when a pedestrian is about to cross the road.

Rectangular Rapid Flashing Beacon (RRFB) Overview

One such treatment to raise motorist awareness is the rectangular rapid-flashing beacon (RRFB) system. The RRFB installation is a pair (or two pairs with a refuge island) of signs which are activated by pedestrians attempting to cross. Yellow rectangular LED beacons are installed under pedestrian crossing warning signs, which flash in a “stutter flash” pattern with the right side of the beacon flashing twice as fast as the left side. The flashing lights are intended to let motorists know a pedestrian is nearby, and motorists should stop to allow the crossing and proceed with caution. The RRFB installation can either be hard wired or solar powered. For a typical RRFB installation of four solar-powered units the cost including installation is about $15,000.

Numerous studies have been done to evaluate vehicle yielding rates at RRFB installations. Many of the studies were conducted on four-lane roadways. Overall, the installation of an RRFB has resulted in higher yielding rates by drivers to pedestrians. For example, a 2011 study in Portland, Oregon, evaluated two sites with four lanes and a speed limit of 45 mph. Yielding rates increased from 23-25% to 83% after the installation of the RRFB.

In locations without a pedestrian refuge island, the beacon is mounted on the right side of the road. It has been shown that yielding rates are significantly better when a second beacon is mounted in a pedestrian refuge island than just having one beacon on the

right side of the road. Multiple beacons provide greater visibility, especially at dusk or at night.

As with any new traffic control device, education and enforcement are needed for success. Based on study results by the FHWA, yielding results at RRFB locations in Michigan are lower than in other states. This is likely due to a lack of familiarity with RRFB installations and a lack of understanding of Michigan law.

LOCAL RRFB INSTALLATIONS

There are numerous locations around the metro Detroit area with RRFB installations including Ann Arbor, Chelsea, Detroit, Ferndale, Oxford, South Lyon and West Bloomfield. Additional locations outside of metro Detroit include the City of Davison (near Flint) and Delhi and Delta Townships (near Lansing).

The City of Ann Arbor has five RRFB installations that were installed at existing cross walks. Four of the locations are along Plymouth Road between Murfin Avenue and Green Road. Plymouth Road is a five-lane urban principal arterial with a posted speed ranging from 35 mph to 45 mph and an average daily traffic (ADT) of 22,000 vehicles. These RRFB installations include overhead lighting, overhead signing, a pedestrian refuge island, high visibility pavement markings, ground mounted signing, overhead RRFB and ground mounted RRFB. The RRFBs are either hard wired or solar powered.

In August 2013 there was a fatality at one of the RRFB crossings along Plymouth Road. A college student was killed when the vehicle traveling in the inside lane stopped but the vehicle in the outside lane did not stop. The RRFB had been flashing for 30 seconds and the pedestrian had nearly completed the crossing before being hit. The crash investigation found the driver to be driving 10 to 15 mph over the speed limit. The investigation is continuing so fault has not yet been assigned. The RRFB at this location gets used 200 to 300 times per day.

The remaining RRFB installation in Ann Arbor is located in a residential area on 7th Street south of Washington Street. 7th Street is classified as an urban minor arterial with

a speed limit of 30 mph, on-street parking and an ADT of 10,000 vehicles. There is a middle school nearby.

City of Ann Arbor staff has observed that vehicles yielding to pedestrians has increased from previous levels. The current level of yielding at the Plymouth Road and Beal Avenue location is 84% while the average for the state of Michigan is 75%.

The RRFB in the City of Chelsea was installed in the summer of 2012 and is located on Old US-12 near Silver Maples Drive. At this location, Old US-12 is a two-lane rural minor arterial with a 45 mph speed limit and an ADT of 11,200 vehicles. This solar powered RRFB gets used significantly in warmer months, primarily by senior citizens from the nearby senior complex. There has been a request for another installation near the community center.

The City of Chelsea pays the Washtenaw County Road Commission to maintain this RRFB installation. Besides having to reset the RRFB, the City has had no maintenance issues or complaints with the installation. Educating motorists has been the biggest concern.

There are three RRFB installations in the City of Detroit along Davison Avenue. In this area, Davison Avenue is a six-lane non-freeway urban principal arterial with a speed limit of 35 mph and an ADT of 37,000 vehicles. Due to vandalism, these units no longer function correctly and were not in use long enough to gauge their usefulness.

In South Lyon Township, there is an RRFB installation for the Huron Valley Trail crossing of Lyon Center Drive which is located east of Milford Road and north of Grand River Avenue. Lyon Center Drive is a three lane roadway with one lane in each direction and center left turn lane, with a speed limit of 25 mph. The RRFB at this location does not have a pedestrian refuge island. The area immediately adjacent to the crossing is undeveloped but there is a shopping center to the west. This location utilizes in-street signing which was added after observing traffic. Yielding rates improved with the additional treatments. Baseline yielding rates were 20%, and after the RRFB was installed, yielding rates increased to 69%. With the addition of in-street signs to the

RRFB, yielding rates increased further to 80%. In-street signs have some maintenance issues where they have to be replaced when hit and since they are installed in the pavement there are issues in the winter with snow plows.

The West Bloomfield Township RRFB installations are located at all legs of the three-lane roundabout at Maple Road and Farmington Road. Outside of the roundabout, Maple Road is a two-lane or three-lane urban principal arterial with a speed limit of 45 mph and an ADT ranging from 28,500 vehicles to 29,900 vehicles. Farmington Road is classified as a two-lane urban minor arterial with a varying speed limit ranging from 35 mph north of Maple Road and 40 mph to the south. The ADT along Farmington Road ranges from 10,900 vehicles to 16,200 vehicles. This installation was placed in response to a lawsuit to facilitate blind pedestrians. Yielding rate information was not available when requested.

It should be noted that although some of the aforementioned installations are located in Oakland County, currently the Road Commission for Oakland County (RCOC) does not install, operate, or maintain RRFB installations. Any installations within Oakland County are installed, operated, and maintained by the local municipality, village, or township in which it is located. The RCOC has anecdotal evidence suggesting that there is driver and pedestrian confusion at RRFB installations, uncertain if motorists must stop or not, and on occasion, resulting in an accident. The confusion is also evident by the fact that RCOC has received phone calls from motorists or pedestrians who believe the signal is not working properly; after this is related to the owning agency and a service call is placed, it is confirmed that the signal is working as intended. Should service be necessary, RCOC is aware that local jurisdictions have experienced some difficulty in obtaining manufacturer's parts and service. A preferred pedestrian crossing signaling system that RCOC has installed is a HAWK beacon (High-intensity Activated crossWalK). Information regarding the operation of the HAWK system may be found at: http://www.rcocweb.org/Lists/Publications/Attachments/71/HAWK%20brochure2012.pdf.

BECK ROAD – GAP STUDY AT PROPOSED PEDESTRIAN CROSSING

North of Nine Mile Road, Beck Road is classified as an urban minor arterial with a posted speed of 40 mph and an ADT of 20,000 vehicles. In the vicinity of Cheltenham

Drive, Beck Road is a two-lane roadway with a northbound passing flare and a southbound right turn lane at Cheltenham Drive. There is an existing overhead street light at Cheltenham Drive. The area is primarily residential with a school, Thornton Creek Elementary, located nearby on 9 Mile Road, east of Beck Road. School starts at 8:50 AM and ends at 3:45 PM.

A gap study is typically performed in order to determine how much time a pedestrian has available to cross a roadway. A gap is defined as the measure of time, in seconds, between the rear bumper of the first vehicle and the front bumper of the second vehicle. A gap study was conducted at the project location on Thursday, December 19, 2013. Traffic data was collected during a morning period from 8:00 AM to 9:30 AM and an afternoon period from 3:15 PM to 4:15 PM which corresponds to periods before and after Thornton Creek Elementary school hours. School was in session the day the gap study was performed. Gaps were collected for northbound traffic, southbound traffic and for both directions at once. The results of the gap study are summarized in the tables below:

Gap Size	**Number of Gaps**						**Total Gaps**
(seconds)	8:00 AM to 8:15 AM	8:15 AM to 8:30 AM	8:30 AM to 8:45 AM	8:45 AM to 9:00 AM	9:00 AM to 9:15 AM	9:15 AM to 9:30 AM	
2-3	31	23	14	14	10	16	108
4-5	12	14	7	8	3	6	50
6-7	7	7	9	6	9	4	42
8-9	5	1	3	6	3	2	20
10-11	2	3	3	3	2	5	18
12-13	5	2	1	2	1	5	16
14-15	1	4	1	5	2	1	14
16-17	1	0	4	0	3	4	12
18-19	0	2	0	0	1	0	3
20-21	2	1	0	0	0	2	5
22-23	1	0	2	0	1	0	4
24-25	1	0	0	0	0	0	1
26-27	2	0	1	0	0	0	3
28-29	1	0	0	0	1	0	2
> 29	3	4	2	1	2	2	14

Table 1: AM Period Gaps for Southbound Beck Road

Gap Size	Number of Gaps						Total Gaps
(seconds)	8:00 AM to 8:15 AM	8:15 AM to 8:30 AM	8:30 AM to 8:45 AM	8:45 AM to 9:00 AM	9:00 AM to 9:15 AM	9:15 AM to 9:30 AM	
2-3	36	14	9	5	3	12	79
4-5	6	9	8	3	9	8	43
6-7	5	4	7	11	2	7	36
8-9	4	2	5	1	5	4	21
10-11	3	2	3	0	1	3	12
12-13	2	4	3	0	3	2	14
14-15	4	2	1	1	0	2	10
16-17	2	2	2	1	0	1	8
18-19	1	1	1	1	3	0	7
20-21	3	1	0	1	0	0	5
22-23	0	3	0	1	1	0	5
24-25	0	1	2	1	1	2	7
26-27	0	1	2	0	0	1	4
28-29	0	1	0	1	0	0	2
> 29	3	1	1	2	1	1	9

Table 2: AM Period Gaps for Northbound Beck Road

Gap Size	Number of Gaps						Total Gaps
(seconds)	8:00 AM to 8:15 AM	8:15 AM to 8:30 AM	8:30 AM to 8:45 AM	8:45 AM to 9:00 AM	9:00 AM to 9:15 AM	9:15 AM to 9:30 AM	
2-3	40	24	14	12	9	24	123
4-5	15	3	11	7	5	14	55
6-7	7	5	8	3	45	3	71
8-9	3	2	3	3	1	4	16
10-11	1	1	1	2	1	0	6
12-13	3	0	2	0	0	1	6
14-15	2	2	1	2	1	0	8
16-17	1	1	1	0	0	1	4
18-19	0	0	1	1	0	0	2
20-21	0	1	0	0	0	1	2
22-23	0	1	0	0	0	0	1
24-25	0	0	0	0	0	0	0
26-27	0	0	0	0	0	0	0
28-29	0	0	0	0	0	0	0
> 29	0	0	0	0	0	0	0

Table 3: AM Period Gaps for Combined Northbound & Southbound Beck Road

Gap Size	Number of Gaps				Total Gaps
(seconds)	3:15 PM to 3:30 PM	3:30 PM to 3:45 PM	3:45 PM to 4:00 PM	4:00 PM to 4:15 PM	
2-3	12	7	5	11	35
4-5	11	6	9	12	38
6-7	5	2	7	6	20
8-9	0	2	6	3	11
10-11	4	1	2	2	9
12-13	0	3	1	2	6
14-15	1	2	2	0	5
16-17	3	0	0	1	4
18-19	0	0	0	0	0
20-21	1	1	1	0	3
22-23	2	0	0	0	2
24-25	1	1	0	0	2
26-27	0	0	0	0	0
28-29	0	0	0	0	0
> 29	0	1	0	2	3

Table 4: PM Period Gaps for Southbound Beck Road

Gap Size	Number of Gaps				Total Gaps
(seconds)	3:15 PM to 3:30 PM	3:30 PM to 3:45 PM	3:45 PM to 4:00 PM	4:00 PM to 4:15 PM	
2-3	10	2	7	15	34
4-5	8	8	3	6	25
6-7	7	3	4	3	17
8-9	5	2	4	1	12
10-11	0	0	0	2	2
12-13	2	1	0	1	4
14-15	2	0	0	2	4
16-17	3	1	1	0	5
18-19	1	0	1	0	2
20-21	0	1	1	0	2
22-23	0	0	0	1	1
24-25	1	0	0	2	3
26-27	1	0	0	0	1
28-29	1	0	0	0	1
> 29	0	2	1	2	5

Table 5: PM Period Gaps for Northbound Beck Road

Gap Size	Number of Gaps				Total Gaps
(seconds)	3:15 PM to 3:30 PM	3:30 PM to 3:45 PM	3:45 PM to 4:00 PM	4:00 PM to 4:15 PM	
2-3	16	7	7	13	43
4-5	10	5	7	5	27
6-7	9	1	5	1	16
8-9	4	2	1	3	10
10-11	0	1	0	1	2
12-13	0	2	0	2	4
14-15	0	1	0	0	1
16-17	1	0	0	0	1
18-19	0	0	0	0	0
20-21	0	0	0	0	0
22-23	0	0	0	0	0
24-25	0	0	0	0	0
26-27	0	0	0	0	0
28-29	0	0	0	0	0
> 29	0	0	0	0	0

Table 6: PM Period Gaps for Combined Northbound & Southbound Beck Road

In order to evaluate the time a pedestrian has to cross a roadway, a standard walking speed of 4 feet per second was used in the analysis. The existing geometry of Beck Road is two lanes. An additional center lane is being proposed on Beck Road to allow the construction of a pedestrian refuge island at the crossing location as well as to allow northbound to westbound turning movements onto Cheltenham Drive to be made from the center turn lane. By extending the center turn lane south enough to be a benefit for northbound to westbound turning vehicles, no northbound passing flare will be necessary.

Pedestrian crossing times vary based on the specific roadway geometry and traffic volumes. The level of comfort of the pedestrian also is a factor. In order for a pedestrian to cross two lanes of traffic of Beck Road, a minimum 6-second gap is required in northbound and southbound traffic combined. Tables 3 and 6 show the gaps for this condition during the AM and PM periods.

If there is a pedestrian refuge island, a shorter gap is needed since the pedestrian only has to cross one lane of traffic at a time. A minimum 3-second gap is needed for a pedestrian to cross one lane of either northbound or southbound traffic on Beck Road. This situation is illustrated by Tables 1, 2, 4 and 5.

Based on the results of the gap study, there are sufficient gaps available for several crossings per hour without a pedestrian island. With an island, the number of suitable gaps nearly doubles.

SPALDING DEDECKER ASSOCIATES, INC.
905 South Boulevard East • Rochester Hills • Michigan 48307 • Tel 248 844 5400 • Fax 248 844 5404

Beck Road Pedestrian Crossing
Pre-Design Construction Cost Estimate

PROJECT: Beck Road Pedestrian Crossing
CLIENT: City of Novi
PREPARED BY: EMK
WORK: Installation of pedestrian refuge island & sign system on Beck Rd near Cheltenham Drive

PROJECT NO: PR12-005
SAD NO: N/A
DATE: 10/27/2014

	ITEM	QUANTITY	UNIT	UNIT PRICE ($)	AMOUNT ($)
	Mobilization (10% max.)	1	LS	14,360.00	14,360.00
	Pre-Construction Audio/Visual DVD Coverage	1	LS	1,500.00	1,500.00
	Soil Erosion and Sedimentation Control Measures	1	LS	2,000.00	2,000.00
	Maintaining Traffic	1	LS	5,000.00	5,000.00
	Pavement Remove	253	SYD	20.00	5,060.00
	Curb and Gutter, Rem	140	FT	20.00	2,800.00
	Excavation, Earth	271	CYD	12.00	3,252.00
	Aggregate Base, 6 inch	813	SYD	10.00	8,130.00
	Cold Milling HMA Surface	4,635	SYD	4.00	18,540.00
	HMA, 4C	798	TON	85.00	67,830.00
	Conc Pavt, Misc, 8 inch	30	SYD	75.00	2,250.00
	Curb and Gutter, Conc, Det C4	129	FT	25.00	3,225.00
	Sidewalk, Conc, 4 inch	1,500	SFT	6.00	9,000.00
	Sidewalk Ramp, Conc, 6 inch	248	SFT	14.00	3,472.00
	Detectable Warning Surface	36	FT	20.00	720.00
	Permanent Signing	1	LS	1,500.00	1,500.00
	Permanent Pavement Marking	1	LS	4,000.00	4,000.00
	Ditching	350	FT	8.00	2,800.00
	Restoration	500	SYD	5.00	2,500.00
	DTE Street Lights (2 Poles)	1	LS	9,000.00	9,000.00
OPINION OF PROBABLE CONSTRUCTION COST					**$166,939.00**

In providing opinions of probable construction cost, the Client understands that the Consultant has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's method of pricing, and that the Consultant's opinions of probable construction costs are made on the basis of the Consultant's professional judgement and experience. The Consultant makes no warranty, express or implied, that the bids or the negotiated cost of the Work will not vary from the Consultant's opinion of probable construction cost.

Guidance for Installation of Pedestrian Crosswalks on Michigan State Trunkline Highways

Michigan Department of Transportation

July 7, 2014

Background

The Michigan Department of Transportation's (MDOT) overall mission includes the provision of safe and efficient transportation facilities for all road users. Determining when and where to provide appropriate treatments such as marked crosswalks and pedestrian signing is often complicated. Elements that can affect decisions on whether to install crossing treatments and what type include:

- Posted speed limit of the roadway
- Volumes of vehicular and pedestrian traffic
- Number of travel lanes and geometry of the roadway at the crossing location
- Profile of pedestrian traffic (proportion of crosswalk used by elderly or children)
- Type of roadway
- Setting (urban or rural)

All of the elements listed above can influence decision making on whether a crosswalk should be installed at a given location and if additional treatments should be considered. Not providing a uniform approach to pedestrian crossing treatments can create confusion for both motorists and pedestrians, resulting in a potential to lessen the effectiveness of pedestrian crossings.

The objective of this guidance document is to establish a step-by-step procedure to evaluate the use of various pedestrian crossing treatments. This guidance is expected to provide crosswalk treatments that meet both motorist and pedestrian expectations and consistency on trunkline routes. Recent pedestrian research studies, existing crosswalk guidelines used by other governmental agencies, manuals on traffic control devices, and state statute were reviewed in order to establish this guidance document.

Crosswalk Location Evaluation Procedures

Evaluation of a proposed crosswalk location for potential crossing treatments on state trunkline routes should include the following four basic steps:

1) Identification and Description of the Crossing Location
2) Physical Data Collection
3) Traffic Data Collection and Operational Observations
4) Application of Data to Determine Appropriate Treatments

Step 1: Identification and Description of the Proposed Crossing Location

a) Identify the pedestrian crossing location including the major street and the specific location of the crossing
b) Determine if the crossing location connects both ends of a shared-use path.
c) Note the posted speed along the major street at the crossing location.
d) Identify the existing traffic control, if any, and any existing crossing treatments (signs, markings or physical treatments), street lighting and curb ramps.
e) Identify lane use (setting) on either side of crossing.

Step 2: Physical Data Collection

a) Determine the existing roadway configuration including the number of lanes and the presence of raised medians or refuge islands at the crossing location.
b) Identify the nearest marked or protected crossing and measure the distance to this proposed crossing.
c) Measure the stopping sight distance (SSD) on all vehicular approaches to the proposed crossing. If the SSD is less than eight times the posted speed limit, determine if improvements (such as removal of obstructions) are feasible means to mitigate the inadequate SSD. Consider traffic calming treatments that would encourage lower driving speeds.

Step 3: Traffic Data Collection and Operational Observations

a) Gather or collect pedestrian crossing volumes during the peak hours of use. This will typically involve AM, midday, and PM peaks hours. Locations near schools may only require two hours of data collection, corresponding to school opening and closing times. Pedestrian volumes should include and differentiate between pedestrians and bicyclists, the number of young, elderly and/or disabled pedestrians. For locations where school crossing traffic is anticipated, the volume of student pedestrians (school age pedestrians on their way to/from school) should also be noted separately. Whenever possible, pedestrian and bicycle volumes should be collected during weather months and conditions that represent peak crossing activity. Consider gathering data before, during and after special events or near venues that generate large pedestrian volumes such as stadiums, conventions centers, theaters, etc.
b) Collect hourly and average daily traffic (ADT) volumes for vehicle traffic along the roadway at the crossing location, including truck volumes and turning movements simultaneously with pedestrian data.

Step 4: Application of Data to Determine Appropriate Treatments

a) Using the available data, utilize the following to determine appropriate treatment(s) for signalized, stop-controlled or uncontrolled locations :
    - Figure 1 (see page 8) – Pedestrian Crossing Treatment Flow Chart at Controlled Crossings,
    - Figure 2 (see page 9) – Pedestrian Crossing Treatment Flow Chart at Uncontrolled Crossings and
    - Table 1 (see page 10) – Criteria for Types of Crossing Treatments at Uncontrolled Locations (if applicable)
b) Consider and incorporate the following additional evaluation considerations as appropriate in:
    - Figure 3a (see page 11) – Installation of Pedestrian Hybrid Beacon or Rectangular Rapid Flashing Beacon Signs on Low Speed Roadways (≤ 35 mph)

If an electronic device is being considered, submit Form 1597 to MDOT Signal

Operations to request a study for any electronic pedestrian device.

Types of Crossing Treatments at Uncontrolled Locations

Four primary types of uncontrolled crossing treatments are discussed below. These treatments consider the physical roadway conditions, vehicle volumes, pedestrian volumes and posted speed limit at the potential crossing location. Table 1 should be used to determine which crossing type should be applied. All crossing types shall include ADA compliant sidewalk ramps. An uncontrolled location includes mid-block and unsignalized intersections where mainline of the state trunkline does not stop.

Crossing Type A:

- Marked special emphasis crosswalk (See MDOT PAVE 945 series)
- Standard pedestrian warning signs (W11-2) (See MDOT Traffic Sign Design, Placement and Application Guide). Evaluate need for advanced signing.
- If the location is a designated school crossing then standard school crossing signs (S1-1) should be used.

Crossing Type B:

- Marked special emphasis crosswalk (See MDOT PAVE 945 series)
- Standard pedestrian warning signs (MDOT Traffic Sign Design, Placement and Application Guide). Evaluate need for advanced warning signs.
- Geometric improvements (such as median nose extensions, curb extensions, pork chop island, tighter curb radius or median refuge islands) or consider pedestrian activated Rectangular Rapid Flashing Beacons (RRFB) if criteria are met in Figure 3a or 3b (see page 11). Submit form 1597 to MDOT Signal Operations to request a study for any electronic pedestrian device.
- Consider use of in-street yield to pedestrian crossing sign (R1-6) in low speed urban setting if the local unit of government has adopted the Michigan Uniform Traffic Code for Cities Townships and Villages.
- Additional pavement markings may be required such as double yellow centerline

or cross hatching in advance of a median refuge island.

- If the location is a designated school crossing then standard school crossing signs (S1-1) should be used.
- Consider curb extensions if on-street parking is present and storm drainage structures can be accommodated.
- If pedestrian volume falls above the RRFB limit line on Figure 3a or 3b, go to Crossing Type D.

Crossing Type C:

- Where the posted speed is greater than or equal to 45 mph, determine if modifications can be made to the geometrics of the roadway or signal timing adjusted to calm traffic to reduce travel speeds (85th) thus allowing the road to have a lower the posted speed limit and a raised median and/or pork chop island can be installed. A lower posted limit must be supported by a speed study. If so, go to Crossing Type B
- If not possible or if pedestrian volumes fall above the Rectangular Rapid Flashing Beacon (RRFB) limit line on Figure 3a or 3b, go to Crossing Type D

Crossing Type D:

- Crossing has the following configurations:
  - 4 Lanes with speed greater than or equal to 45 mph and ADT greater than or equal to 12,000 vpd
  - 5 Lanes with refuge island or 4 lane with raise median with speed greater than or equal to 45 mph and ADT greater than or equal to 15,000 vpd
  - 5 Lanes with speed greater than or equal to 45 mph and ADT greater than or equal to 12,000 vpd
  - 6 Lanes with speed greater than or equal to 40 mph and ADT between 1,500 and 12,000 vpd or ADT greater than 12,000 vpd for all posted speeds.
- 3 or more through lanes in a given direction and posted speed 40 mph or greater.
- Consider the Pedestrian Hybrid Beacon (PHB), pedestrian traffic signal or grade separated pedestrian crossing. Submit form 1597 to MDOT Signal Operations to request a study for any electronic pedestrian device.

- Must consider corridor signal progression, grades, physical constraints and other engineering factors.

Table 1 lists the number of lanes crossed to reach refuge and the number of multiple threat lanes per crossing. This information does not directly play into the use of Table 1, but does provide important context to help distinguish the crossing types and support the difference in recommended crossing treatments.

Additional crossing treatments for consideration can be found in Best Design Practices for Walking and Bicycling in Michigan. http://www.michigan.gov/documents/mdot/MDOT_Research_Report_RC1572_Part6_387521_7.pdf

Minimum Vehicle Volume for Treatments

Crossing treatments should generally not be installed at locations where the ADT is lower than 1,500 vehicles per day. Exceptions may be made at school crossing locations where the peak hour vehicle traffic exceeds 10% of the ADT. School crossings are defined as locations where 10 or more student pedestrians are crossing in any given hour and the crossing is a designated school walking route. Treatments for roadways with greater than 1,500 vehicles per day should be installed based on the criteria in Figure 1, Table 1 and the information in Figure 3 (a or b depending on posted speed limit).

Minimum Pedestrian Volume for Treatment at Uncontrolled Crossing Locations

The base threshold for consideration of an enhanced crossing treatment at an uncontrolled location is 20 pedestrians per hour. This threshold is consistent with national guidance and policies adopted by other states and cities.

The Minimum Pedestrian Volume Thresholds are as follows:

- 20 pedestrians per hour* in any one hour, or
- 18 pedestrians per hour* in any two hours, or
- 15 pedestrians per hour* in any three hours, or
- 10 school age (grades K-12) pedestrians traveling to or from school in any one hour and the crossing is a designated school walking route

*Young, elderly, and disabled pedestrians count two times towards volume thresholds

Definition of a Pedestrian Median Refuge and Minimum Median Refuge Width

A pedestrian median refuge island is defined as a location in the middle of a pedestrian crossing where a pedestrian can take refuge, separating the crossing into two segments, across each direction of approaching traffic. A painted center median or a painted turn lane does not

constitute a pedestrian refuge. A pedestrian refuge must include some type of raised median as described below:

- A raised median nose at an intersection (next to a left turn bay for example) can only be considered a pedestrian refuge for the adjacent crosswalk if the median is at least four feet wide and the left turn volume is less than 20 vehicles per hour. This low left turn volume means that during most pedestrian crossings there will not be a vehicle in the left turn lane as they cross the street.
- A raised median at a mid-block pedestrian crossing must be at least six feet wide (preferably 8 feet wide) and includes curb ramps or a walkway at grade through the median. For shared-use path crossing locations, a 10 foot median refuge width is desirable to accommodate bicycles with child trailers, recumbent bicycles and tandem bicycles.

Distance to Nearest Marked or Protected Crossing

The Pedestrian Crossing Treatment Flow Chart in Figure 2 includes consideration of spacing criteria for an uncontrolled crossing to the nearest marked or signalized crossing. The flowchart requires that a new uncontrolled mid-block crossing be at least 300 feet from the nearest crossing. However, this spacing criterion can be waived if the proposed crossing serves a shared-use path or the pedestrian crossing volume exceeds twice the minimum threshold. This criterion is subject to engineering judgment. In urban conditions, where a typical block length is 400 feet, the engineer may want to consider allowing a minimum of 200 feet, provided that the pedestrian crossing:

- Does not cross any left or right turn lanes or their transitions, where it is anticipated that vehicles will be changing lanes
- Is not near an intersection area where it will create undue restriction to vehicular traffic operations.

Pedestrian Crossing Treatments at Higher Speed Roadways with Rural Character

There may be conditions that necessitate the installation of pedestrian crossings where speeds are higher and special consideration is warranted. Engineering judgment should be applied and consideration given to providing an uncontrolled crosswalk. Engineering judgment should also be used in rural scenarios at shared use path crossings. Pedestrian warning signs may be adequate in some situations.

Figure 1
Pedestrian Crossing Treatment Flow Chart for Controlled Crossing

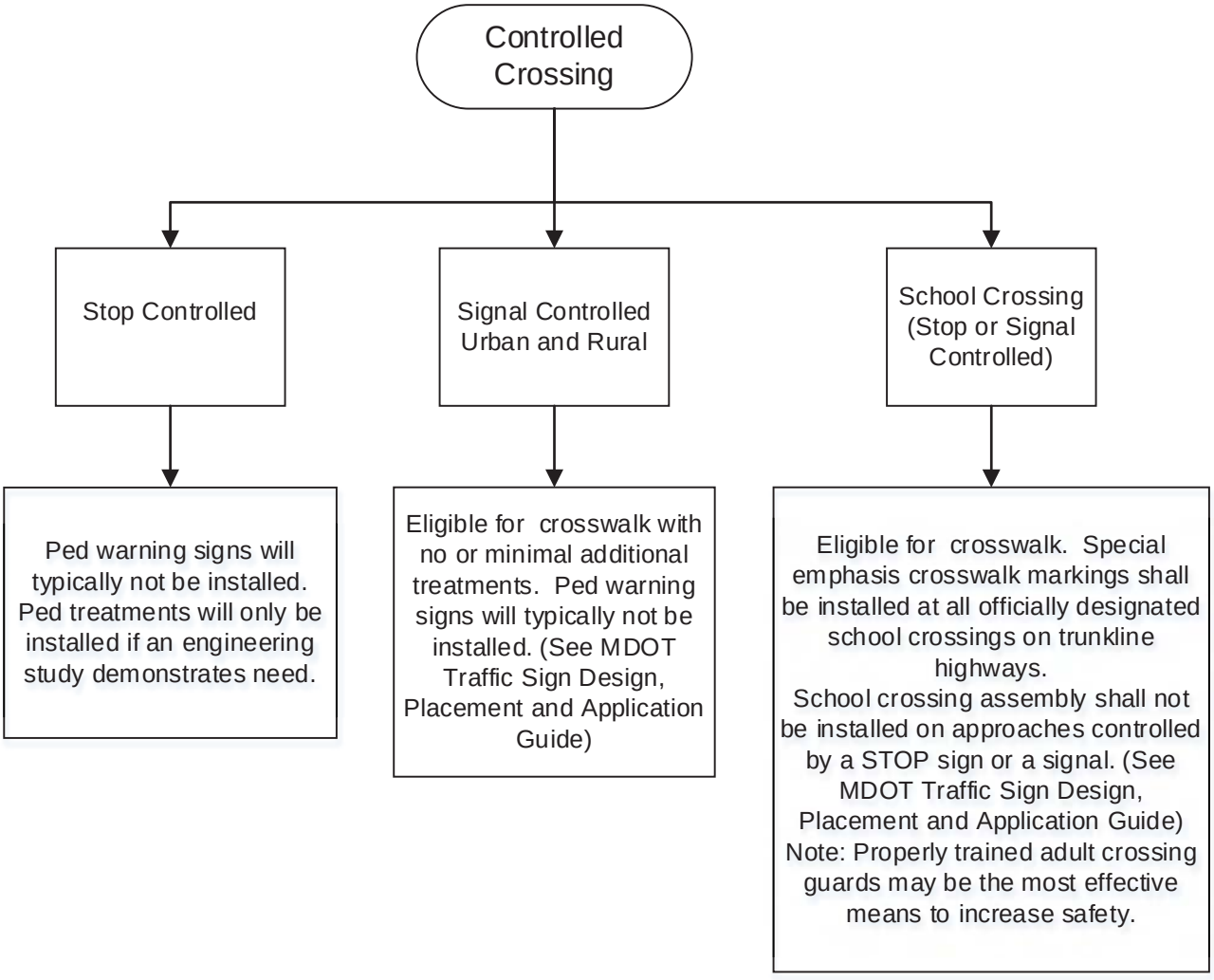


Figure 2
Pedestrian Crossing Treatment Flow Chart for Uncontrolled Crossing

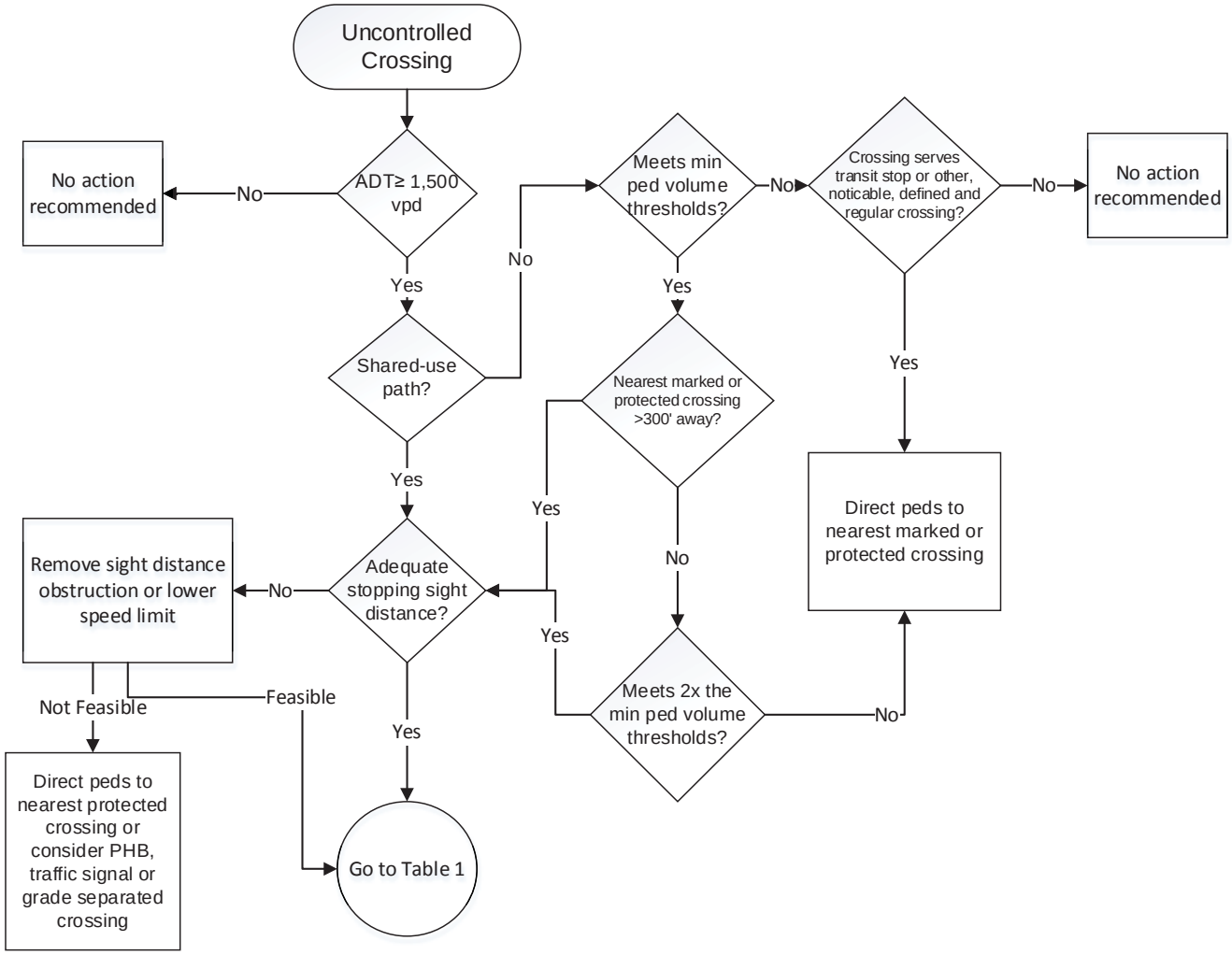


Table 1
Criteria for Types of Crossing Treatments at Uncontrolled Locations

Roadway configuration	# of lanes crossed to reach a refuge	# of multiple threat lanes* per crossing	Roadway ADT and Posted Speed															
			1,500 - 9,000 vpd				9,000 - 12,000 vpd				12,000 - 15,000 vpd				>15,000 vpd			
			≤ 30 mph	35 mph	40 mph	≥ 45 mph	≤ 30 mph	35 mph	40 mph	≥ 45 mph	≤ 30 mph	35 mph	40 mph	≥ 45 mph	≤ 30 mph	35 mph	40 mph	≥ 45 mph
2 Lanes (one way street)	2	1	A	A	A	B	A	A	B	B	A	A	B	B	A	A	B	B
2 Lanes (two way street with no median)	2	0	A	A	A	B	A	A	B	B	A	A	B	B	A	A	B	B
3 Lanes w/refuge island or 2 Lanes w/raised median	1	0	A	A	A	B	A	A	B	B	A	A	B	B	A	B	B	B
3 Lanes (center turn lane)	3	1	A	A	B	B	A	B	B	B	A	B	B	B	A	B	B	B
4 Lanes (two way street with no median)	4	2	A	B	B	C	A	B	C	C	A	B	C	D	B	B	C	D
5 Lanes w/ refuge island or 4 lanes w/raised median	2	2	A	A	B	B	A	B	B	C	A	B	C	C	B	B	C	D
5 Lanes (center turn lane)	5	2	A	B	C	C	B	B	C	C	C	C	C	D	C	C	C	D
6 lanes (two way street with or without median)	3 to 6	4	A	B	D	D	B	B	D	D	D	D	D	D	D	D	D	D

* Minimum pedestrian volumes (page 6) must be met before consideration of uncontrolled crossing treatments.

See page 4 and 5 for detailed description of treatments for Crossing Type A, B, C and D.

Figure 3a
Installation of Pedestrian Hybrid Beacon or Rectangular Rapid Flashing Beacon Signs on Low Speed Roadways (≤ 35 mph)

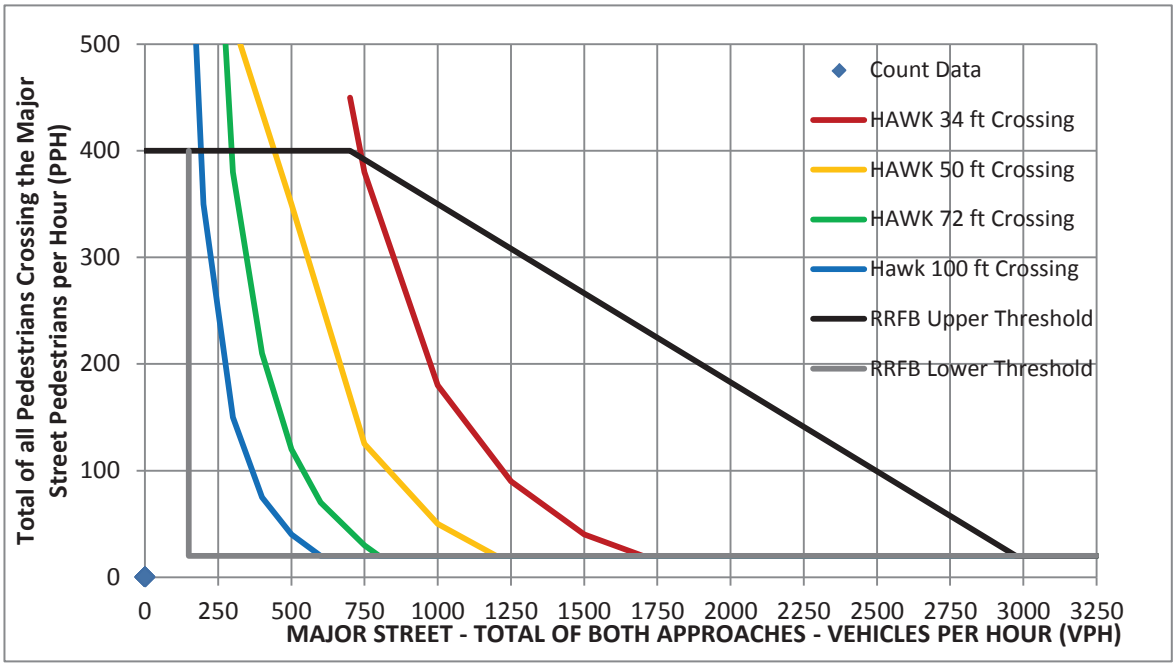
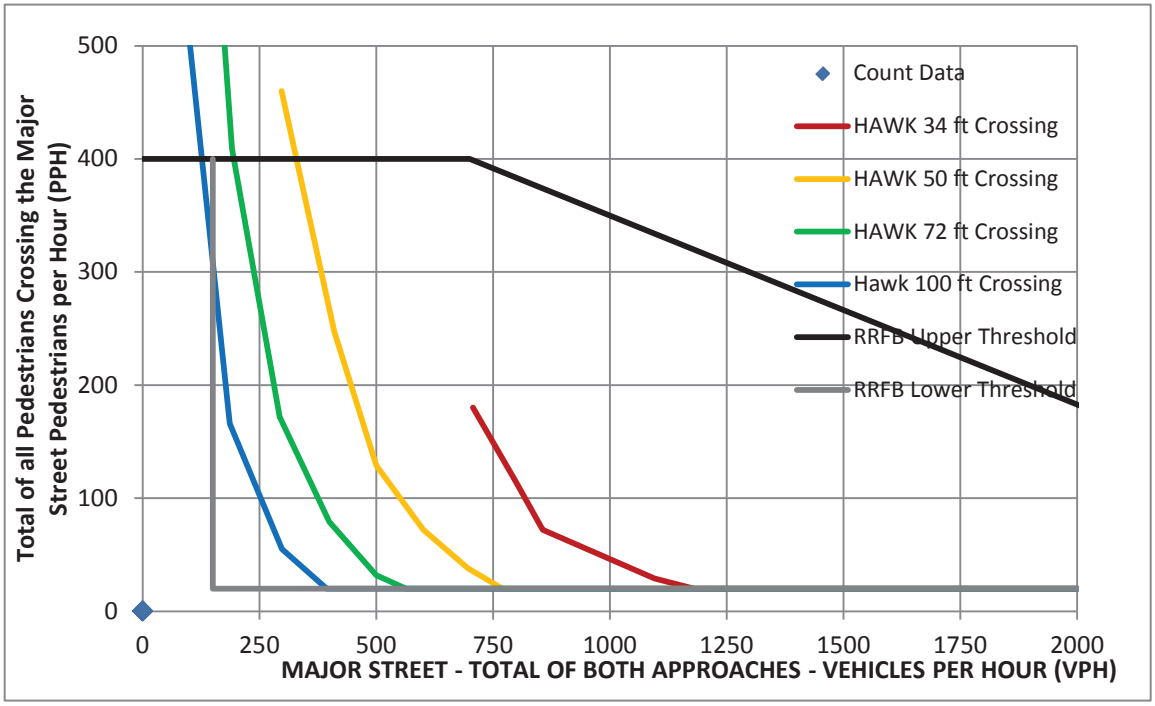


Figure 3b
Installation of Pedestrian Hybrid Beacon or Rectangular Rapid Flashing Beacons Signs on High Speed Roadways > 35 mph)



*See MMUTCD for pedestrian signal warrant graphs. Submit form 1597 to MDOT Signal Operations to request a study for any electronic pedestrian device.

Traffic Control Device Guidance

Crosswalk Pavement Marking Guidance

Crosswalk markings at an intersection shall be two 6 inch transverse markings as specified in the Pavement Marking Standard for Intersection, Stop Bar and Crosswalk Markings.
http://mdotcf.state.mi.us/public/tands/Details_Web/mdot_pave-945-b.pdf

Crosswalk markings for established school crossings and mid-block locations shall be Special Emphasis 12" longitudinal markings as specified in the Pavement Marking Standard for Intersection, Stop Bar and Crosswalk Markings.
http://mdotcf.state.mi.us/public/tands/Details_Web/mdot_pave-945-b.pdf

Pavement marking materials shall be placed as specified in the Pavement Marking Materials Usage Guidelines.
http://mdotcf.state.mi.us/public/tands/Details_Web/mdot_pavemark_material-guide.pdf

Crosswalk Signing Guidance

Guidance for signing can be found in the MDOT Traffic Sign Design, Placement and Application Guidelines.
http://mdotcf.state.mi.us/public/tands/Details_Web/mdot_signing_design_placement_application_guidelines.pdf

Traffic Signal Guidance

Guidance for the installation of traffic signals can be found in the MDOT document Traffic Signals A Guide for Their Proper Use.
http://mdotcf.state.mi.us/public/tands/Details_Web/mdot_signal_guideforuse.pdf

References

1) Michigan Manual on Uniform Traffic Control Devices, 2011.
2) Safety Effects of Marked vs Unmarked Crosswalks at Uncontrolled Locations: Final Report and Recommended Guidelines, Zeeger, C.V. and others, U.S. Department of Transportation, Federal Highway Administration, September 2005.
3) City of Boulder Pedestrian Crossing Treatment Installation Guide, November 2001.
4) Improving Pedestrian Safety at Unsignalized Crossings, Kay Fitzpatrick and others, Transit Cooperative Research Program Report 112 and National Cooperative Highway Research Program Report 562, 2006.
5) The Effects of Advance Stop Lines and Sign Prompts on Pedestrian Safety in a Crosswalk on a Multilane Highway, Van Houten, R., Journal of Appiled Behavior Analysis, Number 3, pages 245-251, Fall 1988.
6) Pedestrian Facilities Users Guide – Providing Safety and Mobility, Zegeer, C.V. and others, Federal Highway Administration publication number FHWA-RD-01-102, March 2002.
7) Safety Analysis of Marked Versus Unmarked Crosswalks in 30 Cities, Zeeger, C.V. and others, ITE Journal, January 2004.