

# Guidelines for Pedestrian Crossing Treatments



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CITY OF BURLINGTON DPW TECHNICAL SERVICES TEAM

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# Introduction

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- 28 Crosswalk Requests in queue
- City of Burlington needs supplemental guidance to safely install crosswalks
  - Midblock crossings
  - Crosswalk enhancements

Location
N Champlain between Cedar and Poplar
Across Flynn at Foster
S Willard – midblock near Tower Terrace (by Champlain College)
Across S Willard at Buell
Barrett midblock
East Ave midblock (Bilodeau)
Battery St midblock (Monroe)
Pine St. Brewery (Zero Gravity/Queen City)
Across Pine St. at Sears Ln
Across Pine St at Howard
Across Ethan Allen Pkwy at Farrington
Across South Union at Bradley St
Across St Paul at Adams
Across Pearl at George St
Across Main at Summit St
Across Archibald at Walnut
Across Colchester at Chase
Across Flynn at Wells
62 Oak St
Across Pine at Ferguson
Across Pine at Lyman
Allen and Murray Intersection
Wells and Ferguson Intersection
Ferguson and Richardson Intersection
Across Locust St at Locust Terrace
S Prospect (at Waterman)
Shelburne St between Prospect and the Rotary
North St between Blodgett and Front St

# Burlington Crosswalk Treatment Calculator

- Calculates VTrans Treatment
  - Guidelines for Pedestrian Crossing Treatments
- Calculates NCHRP Treatment
  - Report 562: Improving Pedestrian Safety at Unsignalized Crossings
  - Referenced by NACTO
  - Sponsored by AASHTO and FHWA



**TCRP**  
REPORT 112  
SPONSORED BY THE FTA

TRANSIT  
COOPERATIVE  
RESEARCH  
PROGRAM

**IMPROVING PEDESTRIAN SAFETY  
AT UNSIGNALIZED CROSSINGS**

NATIONAL  
COOPERATIVE  
HIGHWAY RESEARCH  
PROGRAM



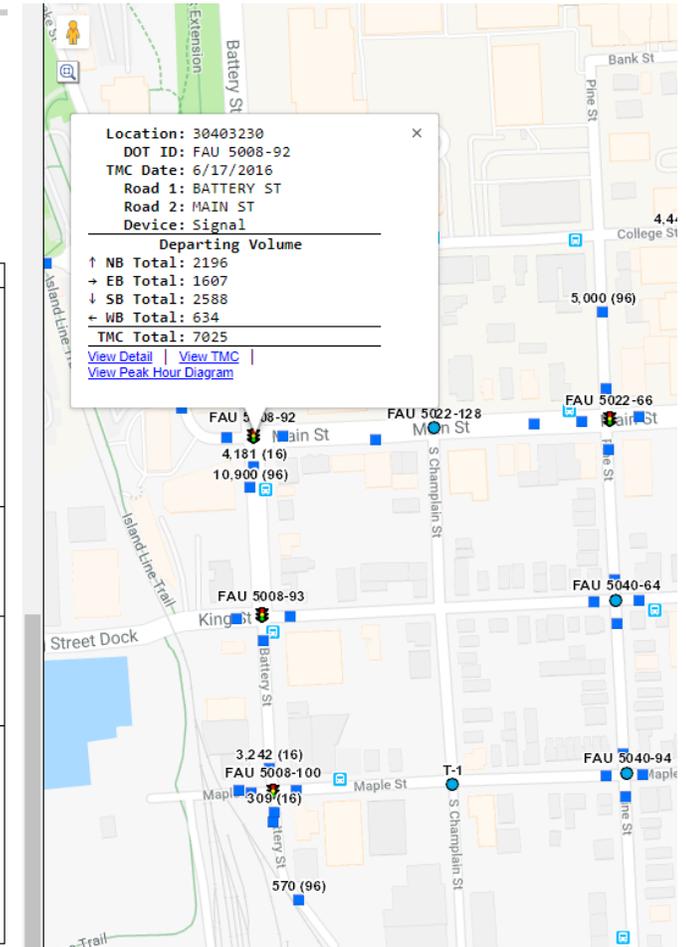
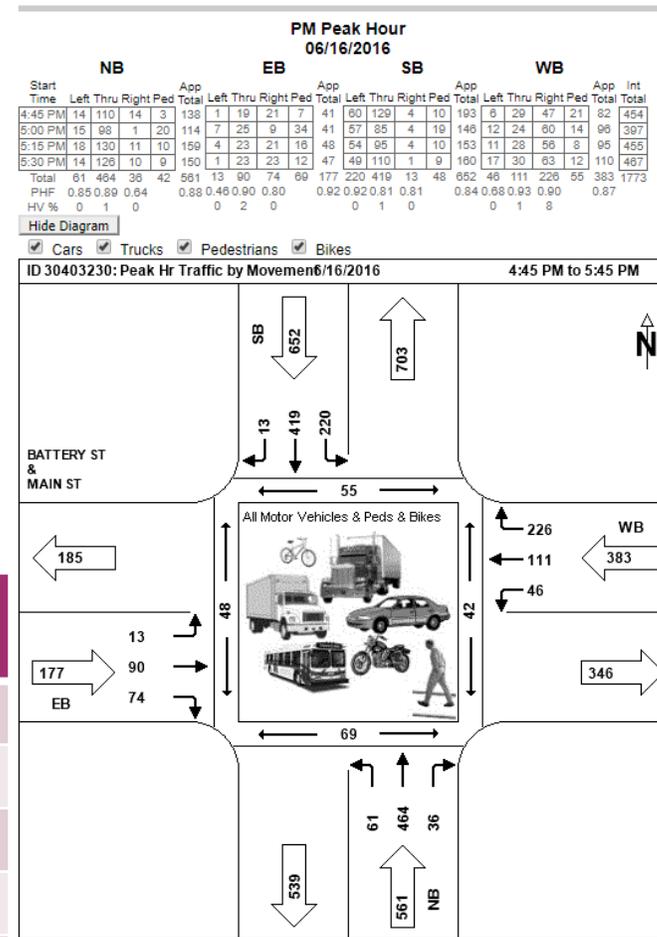
**NCHRP**  
REPORT 562

 Guidelines for Pedestrian Crossing Treatments City of Burlington, VT March 2019		Recommended Values		
		User input required Optional		
STREET NAME:	Variable	Unit	Number	Input
<b>Step 1: VTrans requirements</b>				
Is there another crosswalk within 200 ft?				
Minimum Stopping Sight Distance of 155 ft?				
<b>Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a TCD type of treatment?</b>				
Peak Hour Pedestrian volume - Not at risk population	$V_{nr}$	ped/h	2a	
Peak Hour Pedestrian volume - At risk population (elderly and school aged)	$V_{sr}$	ped/h	2b	
Peak-hour pedestrian volume	$V_p$	ped/h	2c	
If $2c \geq 20$ ped/h, then go to Step 3.				
If $2c < 20$ ped/h, then consider median refuge islands, curb extensions, traffic calming, etc. as feasible.				
<b>Step 3: Does the crossing meet the pedestrian volume warrant for a traffic signal?</b>				
Peak hourly count available?				
AADT		veh/d		
Peak Hourly Count		veh/h		
Major road volume, total of both approaches during peak hour	$V_{maj-s}$	veh/h	3a	
Minimum signal warrant volume for peak hour, $SC = (0.00021 V_{maj-s}^2 - 0.74072 V_{maj-s} + 734.125)/0.75$ OR $[(0.00021 3a^2 - 0.74072 3a + 734.125)/0.75]$	SC		3b	
			3c	
			3d	
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce 3c by up to 50%; otherwise enter 3c.				
If $2c \geq 3d$ , then the warrant has been met and a traffic signal should be considered if not within 300 ft (91 m) of another traffic signal. Otherwise, the warrant has not been met. Go to Step 4.				
<b>Step 4: Estimate pedestrian delay.</b>				
Pedestrian crossing distance, curb to curb (or median island refuge)	L	ft	4a	
Pedestrian walking speed	$S_p$	ft/s	4b	3.5
Pedestrian start-up time and end clearance time	$t_s$	s	4c	3
Critical gap required for crossing pedestrian, $t_c = (L/S_p) + t_s$ OR $[(4a/4b) + 4c]$	$t_c$	s	4d	
Is median island present?				
Major road volume, total both approaches or approach being crossed if median refuge island is present during peak hour	$V_{maj-d}$	veh/h	4e	
Major road flow rate, $v = V_{maj-d}/3600$ OR $[4e/3600]$	v	veh/s	4f	
Average pedestrian delay, $d_p = (e^{-(v t_c)} - v t_c - 1) / v$ OR $[(e^{4f \times 4d} - 4f \times 4d - 1) / 4f]$	$d_p$	s/person	4g	
Total pedestrian delay, $D_p = (d_p \times V_p)/3,600$ OR $[(4g \times 2c)/3600]$ (this is estimated delay for all pedestrians crossing the major roadway without a crossing treatment – assumes 0% compliance). This calculated value can be replaced with the actual total pedestrian delay measured at the site.	$D_p$	h	4h	
<b>Step 5: Select treatment based upon total pedestrian delay and expected motorist compliance.</b>				
Treatment Category			5a	
Treatment Type			5b	
VTrans Treatment Category			5c	
VTrans Treatment Type			5d	

# Data Sources

- Vehicle Speed
  - o Posted Speed, CCRPC
- Peak Hour Vehicle Volume
  - o CCRPC, VTrans
- Peak Hour Pedestrian Volume
  - o CCRPC, VTrans
- Pedestrian Crossing Distance

	VTrans Guidelines	Burlington Guidelines
Vehicle Speed	✓	✓
AADT (veh/day)	✓	
Peak Hour Vehicle Volume (veh/hr)		✓
Peak Hour Pedestrian Volume (ped/hr)		✓
Number of Lanes	✓	
Crossing Distance		✓



# Step 1: VTrans Requirements

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Consideration of applicable VTrans specific requirements:

- Proximity to another crosswalk
  - Greater than 200 ft
- Minimum Stopping Sight Distance
  - Greater than 155 ft

**VERMONT AGENCY OF TRANSPORTATION  
GUIDELINES FOR PEDESTRIAN CROSSING  
TREATMENTS**

January 2015 Update



# Step 2: Minimum Pedestrian Volumes

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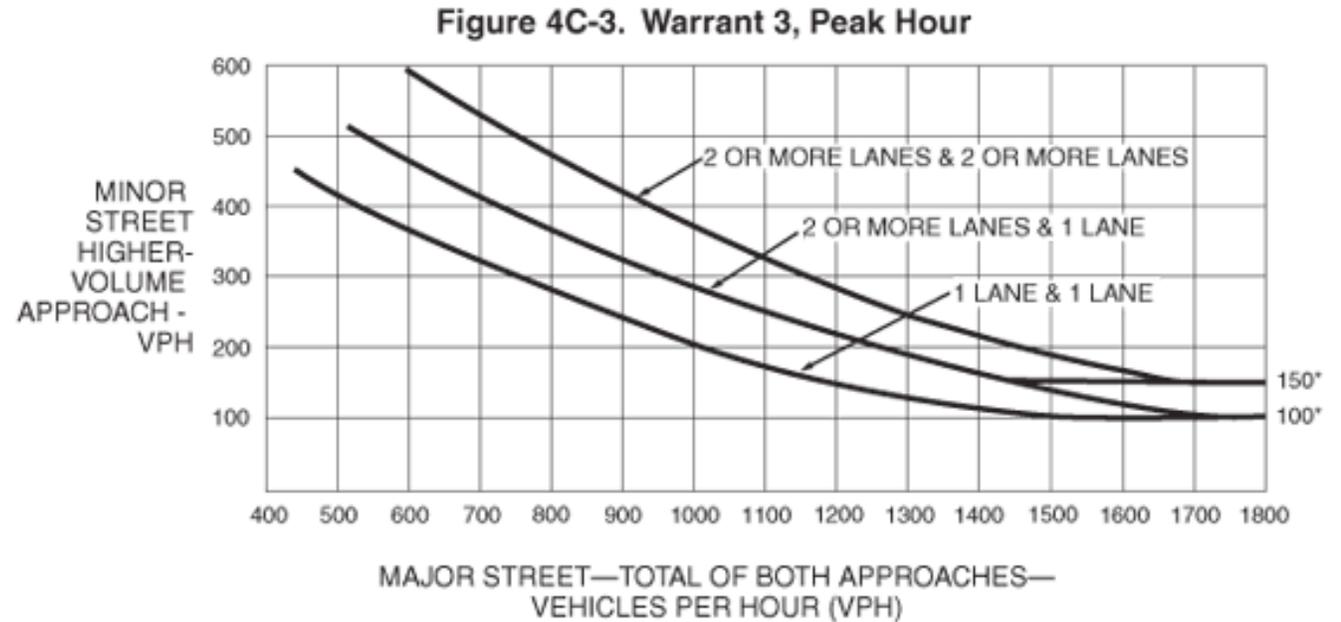
- Peak Pedestrian Volume

- Minimum of 20 pedestrians during the peak hour
  - Special consideration for elderly and school aged children per VTrans requirements

- Peak Hour Traffic Volume considered

# Step 3: Warrant for a Traffic Signal

- MUTCD Section 4.C.05 Warrant 4, Pedestrian Volume

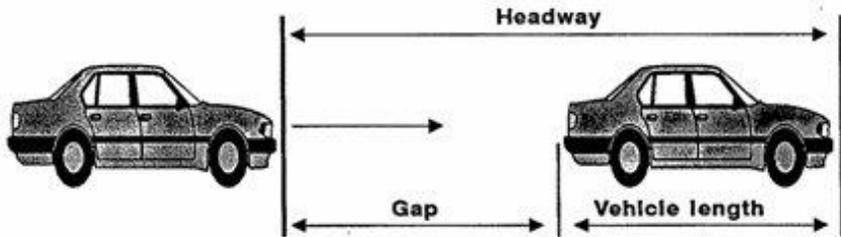


\*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

# Step 4: Estimate Pedestrian Delay

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Equations from 2010 Highway Capacity Manual used to estimate pedestrian delay:



- Crossing Distance,  $L$
- Walking Speed,  $S_p$
- Start up time and end clearance time,  $t_s$
- Critical gap,  $t_c = L/S_p$
- Consideration of median island
- Road volume of approach being crossed,  $v$
- Average pedestrian delay,  $d_p = \frac{e^{vt_c} - vt_c - 1}{v}$
- Total pedestrian delay,  $D_p = \frac{d_p - v_p}{3600}$

# Step 5: Treatment Selection

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**Crosswalk:** This category encompasses standard crosswalk markings and pedestrian crossing signs, as opposed to unmarked crossings.

**Enhanced:** This category includes those devices that enhance the visibility of the crossing location and pedestrians waiting to cross. Warning signs, markings, or beacons in this category are present or active at the crossing location at all times.

**Active:** Also called “active when present,” this category includes those devices designed to display a warning only when pedestrians are present or crossing the street.

**Red:** This category includes those devices that display a circular red indication (signal or beacon) to motorists at the pedestrian location.

**Signal:** This category pertains to traffic control signals.

# VTrans Comparison

VTrans Requirements		
	Unit	User Field
STREET NAME:		
Is there another crosswalk within 200 ft?		Yes/No
Minimum Stopping Sight Distance of 155 ft?		Yes/No
AADT	veh/d	
Number of Lanes		
Treatment Category		
Treatment Type to consider		

	Marked Crosswalk alone may be appropriate
	Additional enhancements should be included
	Additional crosswalk enhancements must be included, a marked crosswalk alone is not appropriate

Roadway configuration	$3,000 \leq \text{vpd} < 9000 \text{ vpd}$	$9,000 \leq \text{vpd} < 12,000$	$\text{vpd} \geq 12,000 \text{ vpd}$
	$\leq 30 \text{ mph}$	$\leq 30 \text{ mph}$	$\leq 30 \text{ mph}$
<b>2</b>	In-street pedestrian crossing sign	In-street pedestrian crossing sign, RRFB	In-street pedestrian crossing sign, RRFB
<b>3</b>	Pedestrian refuge island	Pedestrian refuge island, RRFB, Advanced Yield Line and required regulatory signs	Pedestrian refuge island, RRFB, Advanced Yield Line and required regulatory signs
<b>4+ (with raised median)</b>	Advanced Yield Line and required regulatory signs	RRFB, Advanced Yield Line and required regulatory signs	RRFB, Advanced Yield Line and required regulatory signs
<b>4+ (without raised median)</b>	Pedestrian Refuge Island, Advanced Yield Line and required regulatory signs	Pedestrian Refuge Island, Advanced Yield Line and required regulatory signs, RRFB	Advanced Yield Line and required regulatory signs, RRFB

Derived from Figures 10 and 11 of VTrans Guidelines for Pedestrian Crossing Treatments

# Conclusion

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Using both NCHRP and VTrans guidance, the City can install safe crosswalks and crosswalk treatments based on readily available data.

# Links

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VTrans Guidelines:

[https://vtrans.vermont.gov/sites/aot/files/highway/documents/ltf/Crossing%20Treatment%20Guidelines%20January\\_2015.pdf](https://vtrans.vermont.gov/sites/aot/files/highway/documents/ltf/Crossing%20Treatment%20Guidelines%20January_2015.pdf)

VTrans Transportation Data Management System:

<https://vtrans.ms2soft.com/tcds/tsearch.asp?loc=Vtrans&mod=>

NCHRP Report:

<https://nacto.org/wp-content/uploads/2010/08/NCHRP-562-Improving-Pedestrian-Safety-at-Unsignalized-Crossings.pdf>

MUTCD Warrant:

<https://mutcd.fhwa.dot.gov/htm/2009/part4/part4c.htm>

# Crosswalk

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This category encompasses standard crosswalk markings and pedestrian crossing signs, as opposed to unmarked crossings.



# Enhanced

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This category includes those devices that enhance the visibility of the crossing location and pedestrians waiting to cross. Warning signs, markings, or beacons in this category are present or active at the crossing location at all times.



# Active

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Also called “active when present,” this category includes those devices designed to display a warning only when pedestrians are present or crossing the street.



# Red

This category includes those devices that display a circular red indication (signal or beacon) to motorists at the pedestrian location.



# Signal

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This category pertains to traffic control signals.

