City of Burlington VT
Guidelines for Pedestrian Crossing Treatments
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Information on Rectangular Rapid Flashing Beacons (RRFBs) in the City of Burlington, VT
https://www.burlingtonvt.gov/DPW/Rectangular-Rapid-Flashing-Beacons

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Acronyms

DPW	Department of Public Works
FHWA	Federal Highway Administration
MUTCD	Manual on Uniform Traffic Control Devices
NCHRP	National Cooperative Highway Research Program
TCD	Traffic Control Device
VTrans	Vermont Agency of Transportation

Introduction

The City of Burlington, VT has adopted the NCHRP procedure, outlined in *NCHRP Report 562: Improving Pedestrian Safety at Unsignalized Intersections*. This guide is intended to be a supplemental process to the VTrans *Guidelines for Pedestrian Crossing Treatments* to evaluate where crosswalks are necessary and what types of crossing treatments are recommended to allow for safe travel. This document can be used to provide information on whether a crosswalk should be marked or unmarked and if enhancements should be added. Once it is determined that enhancements should be used at a particular crosswalk, VTrans and MUTCD standards as well as engineering judgement, should be used to choose appropriate treatment types.

Guidelines for Pedestrian Crossing Treatments

This worksheet (Figure 1) was adopted from the NCHRP 562 Report, *Improving Pedestrian Safety at Unsignalized Intersections*. It was altered to address regional concerns and employ VTrans guidelines. This worksheet is specific to roads with 35 mph or less which includes every street in the city, with the exception of Route 127 with speeds ranging from 35-50 mph.

Step 1: VTrans requirements

The VTrans specific crosswalk requirements are evaluated for the minimum distance between crosswalks of 200ft and the minimum sight distance requirement of 155ft for roadways with a 25 mph speed limit. VTrans also requires no parking within 20 feet of a crosswalk, unless the crosswalk is located mid-block with bulbouts. To meet this parking restriction, additional traffic regulations may need to be adopted by the Public Works Commission.

Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a TCD type of treatment?

A check for the minimum pedestrian volume requirement is performed. For peak-hour, the minimum is a total of 20 pedestrians per hour for both directions according to the NCHRP methodology. The input data was altered to include the VTrans standard for elementary school age and elderly pedestrians which count

as 2 pedestrians each. If this pedestrian volume is not met, then geometric improvements such as traffic calming, median refuge islands, and curb extensions are alternatives that can be considered.

Step 3: Does the crossing meet the pedestrian volume warrant for a traffic signal?

A modified check is done for the MUTCD signal warrant to determine if a traffic signal should be considered at this crossing. This slightly altered warrant analysis reflects changes that allow pedestrians crossing the major roadway from both approaches rather than only the highest approach as used in the vehicle signal warrant. The worksheet includes a regression equation that determines the minimum required number of crossing pedestrians for a given major road volume based on Figure 4C-3 and 4C-4 of the 2009 MUTCD.

Step 4: Estimate pedestrian delay.

The average approach pedestrian delay is estimated using Equations 3-5 and 3-6 from *TCRP Report 100: Transit Capacity and Quality of Service*. This report was adopted by the HCM for transit specific capacity and quality-of-service procedures, and more generally multimodal roadway analysis.

Step 5: Select treatment based upon total pedestrian delay and expected motorist compliance.

Step 5 is a selection of the proposed treatment based upon total pedestrian delay and expected motorist compliance. The treatments include:

- **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.

Final Considerations

Once these steps have been completed, VTrans recommendations should also be considered before a final treatment recommendation is made. To better reflect the traffic conditions throughout the City of Burlington, Table 1 should be referenced for information on if a crosswalk should be marked and additional treatments that may be considered. Table 1 is an adaptation of Figures 10 and 11 of VTrans Guidelines for Pedestrian Crossing Treatments. The table shows a universal speed of 30 mph or less to reflect conditions in Burlington (excluding Route 127). Engineering judgment should be used where unique circumstances make crossing unduly hazardous in the opinion of the DPW Staff.

Table 1: Adapted VTrans Pedestrian Crossing Treatment Standards

Number of Lanes	3,000 ≤ AADT < 9,000	AADT > 9,000 and ≤ 12,000	AADT > 12,000
	≤ 30 mph	≤ 30 mph	≤ 30 mph
2	In-street pedestrian crossing sign	In-street pedestrian crossing sign, RRFB	In-street pedestrian crossing sign, RRFB
3	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
4+ (with raised median)	Advanced Yield Line and required regulatory signs	RRFB, Advanced Yield Line and required regulatory signs	RRFB, Advanced Yield Line and required regulatory signs
4+ (without raised median)	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

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

Note: Table 1 adapted from Figures 10 and 11 of the VTrans Guidelines for Pedestrian Crossing Treatments.

Figure 1: Crosswalk Worksheet

Guidelines for Pedestrian Crossing Treatments
City of Burlington, VT
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Recommended Values
User input required
Optional

	Variable	Unit	Number	Input
STREET NAME:				
Step 1: VTrans requirements				
Is there another crosswalk within 200 ft?				
Minimum Stopping Sight Distance of 155 ft?				
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a TCD type of treatment?				
Peak Hour Pedestrian volume - Not at risk population	V_{nar}	ped/h	2a	
Peak Hour Pedestrian volume - At risk population (elderly and school aged)	V_{ar}	ped/h	2b	
Peak-hour pedestrian volume	V_p	ped/h	2c	
If 2c ≥ 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.				
Step 3: Does the crossing meet the pedestrian volume warrant for a traffic signal?				
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 Vmaj-s2 – 0.74072 Vmaj-s + 734.125)/0.75 OR [(0.00021 3a2 – 0.74072 3a + 734.125)/0.75]	SC		3b	
If 3b < 133, then enter 133. If 3b ≥ 133, then enter 3b.			3c	
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.			3d	
If 2c ≥ 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.				
Step 4: Estimate pedestrian delay.				
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, tc = (L/Sp) + ts 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 = Vmaj-d/3600 OR [4e/3600]	v	veh/s	4f	
Average pedestrian delay, dp = (e^(v tc) – v tc – 1) / v OR [(e4f x 4d – 4f x 4d – 1) / 4f]	d_p	s/person	4g	
Total pedestrian delay, Dp = (dp × Vp)/3,600 OR [(4g×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	
Step 5: Select treatment based upon total pedestrian delay and expected motorist compliance.				
Treatment Category			5a	
Treatment Type			5b	
VTrans Treatment Category			5c	
VTrans Treatment Type			5d	

References:

Champaign-Urbana Pedestrian Crossing Enhancement Guidelines. Champaign County Regional Planning Commission (CCRPC), Urbana, IL, September 2017. Available online at https://ccrpc.org/wp-content/uploads/2017/06/Draft-Champaign-Urbana-Pedestrian-Crossing-Enhancement-Guidelines-2017-06-22.pdf

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