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INITIAL REPORT 2006-3

DYNAMIC STRIPING IN FOUR TOWNS ALONG STATE ROUTE 30

REFERENCES:

WP-2005-R-4

INTRODUCTION:

The Windham Regional Commission (WRC) has been working with the Vermont Agency of Transportation and four towns along VT Route 30 to develop a set of traffic calming strategies aimed to slow down traffic speeds while improving safety for pedestrians and bicyclists. Local commuters, tourists and seasonal homeowners as well as commercial truck traffic contribute to an average traffic volume between 4,000 and 8,000 annual average daily drivers this area. The need for traffic calming arose from public concerns with regards to traffic speeds and recorded vehicular accidents. Traffic speeds monitored during June and July of 2001, within posted 35 mph village areas, were found to be 38 mph to 45 mph at the 85th percentile which is the speed that 85 out of 100 vehicles travel at or below. Additionally, in accordance with the VTrans' High Accident Location (HALS) database, seventy-nine crashes were recorded along the study corridor during 1994, 1996, and 1997. In general, the residents from this area feel that vehicles traveling over the speed limit within village centers results in a rise of noise, pedestrian conflicts and hazardous conditions.

The transition between rural and village areas poses a challenge for regulating traffic speeds as posted speed limits reduce from 50 mph in rural areas to 30 mph within town villages. The landscape, consisting mostly of wooded and shaded areas, and general road profile, containing blind curves and isolated straight-aways, also contribute to minimal site distance and a reduction in driver awareness. In an effort to increase awareness and decrease vehicular speeds, the four villages have developed consistent gateway treatments that would define the edges of each village. The gateway treatments consist of 30 mph speed limit signs, dynamic pavement markings, and "Welcome" signs next to the state right-of-way.

The following initial report outlines the implementation and preliminary results from the application of a series of innovative paint markings known as dynamic striping projected

to reduce average vehicle speeds at the edges of each village by increasing driver awareness and providing an illusion of increasing speed.

PROJECT LOCATION AND DESCRIPTION:

The work plan, WP-2005-R-4, specified the application of dynamic stripes at each end of four village along VT Route 30 in Newfane, Townshend, Jamaica and Bondville. Please note that the pavement marking installation locations were revised per John Perkins recommendation from Traffic Operations. Originally, the intent was to place them in close proximity to the village limits, however during the initial site visit conducted on May 24, 2005, it was determined that the striping needed to be located with a speed reduction zone. This did end up posing some problems with regards to traffic monitoring as the preconstruction data collection was conducted from May 3, 2005 through May 10, 2005, prior to the change of location of the traffic markings. This resulted in a variation of distances between the traffic calming zone and the traffic monitoring locations. Data analysis will prove to be difficult for this segment of the investigation. There is also a great variation in the distance and road profiles between the reduction sign and posted 30 mph sign at the edge of each village. Table 1, as provided below, indicates the location of the speed reduction and 30 mph signs as well as the monitoring location for each site. As a final aside, Traffic Operations requested the replacement of the preexisting speed reduction sign, specified as "R2-5" within the MUTCD, with the new speed reduction sign known as "W3-5" in Newfane and Bondville. Please refer figure 1 and 2 for a depiction of the two signs. In addition, it should be noted that there was no speed reduction sign throughout the initial phase of this project on the south side of Jamaica heading north into the village. The final analysis will include an evaluation of any recorded speed reduction in association with the two sign types.

Dynamic Striping - VT Route 30
Relationship between Various Parameters

Location:	Speed Reduction Sign (MM):	Town:	Type:	Speed Limit Sign (MM):	Town:	Distance between Reduction and Speed Limit Sign (ft):
Newfane NB	2.424	Newfane	W3-5	2.523	Newfane	523
Newfane SB	3.390	Newfane	W3-5	3.291	Newfane	523
Townshend NB	1.724	Townshend	R2-5A	1.850	Townshend	665
Townshend SB	2.330	Townshend	R2-5A	2.240	Townshend	475
Jamaica NB	-----	Jamaica	-----	3.588	Jamaica	-----
Jamaica SB	4.320	Jamaica	W3-5	4.180	Jamaica	739
Bondville NB	10.106	Jamaica	R2-5A	0.130	Windhall	760
Bondville SB	0.857	Windhall	R2-5A	0.711	Windhall	771

Table 1

Dynamic Striping - VT Route 30 Relationship between Various Parameters					
Location:	Speed Limit Sign (MM):	Town:	Traffic Counter (MM):	Town:	Distance Between Speed Limit Sign and Traffic Counter (ft):
Newfane NB	2.523	Newfane	2.600	Newfane	407
Newfane SB	3.291	Newfane	3.195	Newfane	507
Townshend NB	1.850	Townshend	1.910	Townshend	317
Townshend SB	2.240	Townshend	2.156	Townshend	444
Jamaica NB	3.588	Jamaica	3.607	Jamaica	100
Jamaica SB	4.180	Jamaica	4.146	Jamaica	180
Bondville NB	0.130	Windhall	0.320	Windhall	1003
Bondville SB	0.711	Windhall	0.573	Windhall	729

Table 1 Continued

Figure 1: R2-5A

Figure 2: W3-5

STRIPING DETAIL AND INSTALLATION:

The striping layout, intended to create a deliberate distortion of the environment and an illusion of an increasing speed, is similar to that detailed in Section 3B.27, "Advance Speed Hump Markings", and as shown on Figure 3B-31 of the MUTCD published in 2003. The design differs from this figure in that hump and hump markings are absent and the distance between the pavement markings progressively decreases from 32 feet to 10 feet, for a total dynamic striping zone length of 252 feet. Please refer to Appendix A for a diagram of the striping detail.

The eight dynamic striping zones were applied on June 30, 2005 by an independent contractor. The stripes were applied in accordance with the work plan which specified the application of standard white paint and drop on glass beads in order to provide for nighttime visibility. The markings at each location began with the application of the first marking consisting of 2 feet in length positioned 252 feet downstation from the posted 30 mph speed sign and continued to the last marking consisting of 8 feet in length located immediately downstation of the speed sign. The paint markings were installed through the use of hand cart with spray nozzle. While the paint was wet, glass beads were hand broadcast. Traffic control was utilized throughout the project and allowed for proper dry time prior to the onset of traffic. Figure 1 below depicts the construction of the dynamic markings.

Figure 1: Installation – Bondville headed southbound

It should be known that this particular contractor provided a considerably lower bid to the Agency than all other companies. According to personnel within the Research Unit, the contractor appeared hurried which resulted in a poor performance. The lines were not always centered in the lane and some were not applied to the correct measurements. Additionally, the hand cart with spray nozzle was unable to create a distinct edge. This will be an important parameter to consider during final analysis and upon reflection of residential feedback as the stripes are intended to increase driver awareness which may demonstrate to be essential for the overall effectiveness and effect.

SURVEILLANCE AND TESTING:

As the diversity of each village's land uses and roadway configuration, this investigation provides a valuable opportunity to learn how different traffic calming features work in a rural village along a state road. During the design phase of the project, it was determined that monitoring traffic speeds and public perceptions of the project at regular intervals following installation will be useful for determine possible future application on VTrans projects.

SPEED DATA

Traffic speeds were monitored periodically throughout the investigation period. Traffic speed data was collected using pneumatic traffic count tubes in 15- minute increments over a consecutive 7 day period. Each site was monitored once prior to application and twice following application for the following dates: May 3rd through May 10th, July 20th through July 27th and October 24th through October 31st. All speed data was collected by the recorder and automatically binned in 5 mph ranges, except the low end (less than 15 mph) and high end (greater than 75 mph). Please note that some traffic counters malfunctioned during the referenced monitoring periods for various reasons including winter maintenance practices. Therefore, this data will not be able to be analyzed.

The final analysis will include data mining and subsequent analysis. The collected speed data will be examined to determine the impact and effectiveness of the traffic calming feature. Parameters of evaluation is to include peak period and average daily volumes, median and 85th percentile speeds with reference to a speed spot analysis (prior to and following application of the paint markings in order to evaluate of the change) and other measures such as the 10 mile-per-hour pace (defined as the 10 mph window during which the highest number of vehicle travel).

RETROREFLECTIVITY

Retroreflectivity, or luminance, values were gathered following application, in order to document nighttime visibility. Retroreflectivity readings were collected twice, on July 13th, 2005 and once approximately 4 months after installation on November 11, 2005. The readings were collected with a handheld device, known as the LTL 3000, which employs the preferred 30 meter geometry, in accordance with the ASTM (American Society for Testing Materials) specification D913-03. Care was taken to collect all subsequent readings from the same location as the previous data collection in July and gathered from the center of the first marking, or stripe 1, and on each ensuing third marking as follows: stripe 4, 7, 10 and final marking, or stripe 13. Retroreflectivity readings were also collected from the right wheel path (RWP) and left wheel path (LWP) on the final marking.

Some of the retroreflectivity measurements collected immediately following installation were found to be surprisingly low, well below the FHWA's (Federal Highway Administration's) recommended minimum retroreflectivity of 250 mcdl for white roadway safety markings as was the case for both sites on either end of Bondville village. It was noted during installation, that the paint in these locations was allowed to dry prior to the application of beads. While this means that the nighttime visibility in these locations is low, it will allow for a nighttime analysis of the effectiveness of the markings with reference to the speed spot study. Appendix B contains all of the retroreflectivity results.

PUBLIC PERCEPTION

In accordance with the work plan, local residents were surveyed for perceived effectiveness and visual appeal. The Windham Regional Commission distributed a total of 45 surveys to each of the four villages. Out of the 45 surveys, 19 were received by the WRC. In general, the comments indicates the stripes were effective in alerting the driver to slow down while a few surveys agreed that stripes had no effect on the driver's perception or driving behavior. Additionally, the WRC received a number of phone calls and discussed the stripes visual effectiveness within other transportation discussions. One resounding point relayed through these discussions was that the dynamic markings act more as a signal that driver is entering a village and, due to the consistency of the stripes within the four village, the stripes are viewed as a "village approaching" indicator.

COST:

Six contractors were solicited for a cost estimate for the application of the lines as recommended by VTrans. Two bids of $6000 and one bid of $2000 were received from the contractors, and included the maintenance of traffic, as well as all of the materials, equipment and manpower needed. VTrans awarded the contract with Frank's Line Striping from Newport Center, Vermont for $2000. Expenditures from all traffic monitoring events were paid for by both VTrans and WRC.

The only cost that required SPR funds was for the surveillance and testing of the paint marking, as indicated in line item number two under the surveillance and testing section. In addition, the fund was used to analyses data collected fro the Windham Regional Commission and VTrans as well as provided assistance with corresponding report. The cost estimate for the SPR funds was $2,573 for a project duration of two years, and $3150 for a project duration of three years for the above mentioned tasks.

SUMMARY:

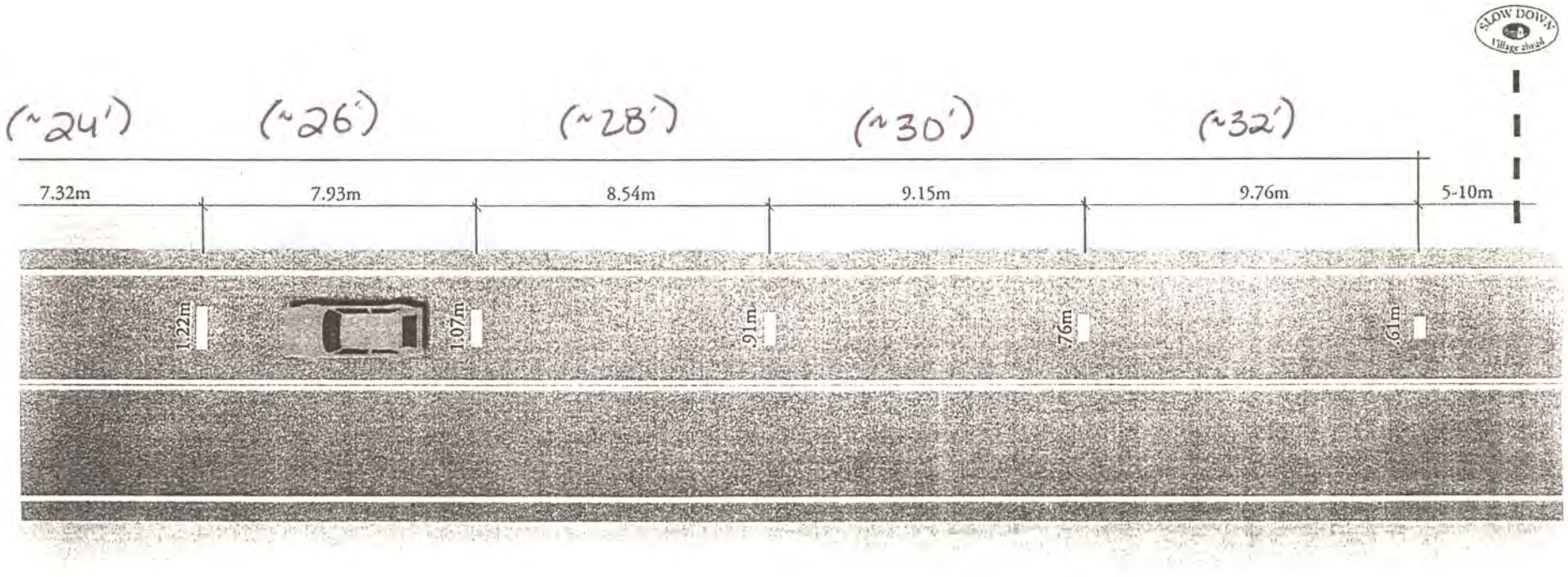
Traffic calming techniques are becoming more popular and readily used within the United States as communities and towns are seeking various alternatives to oppose increased traffic and associated speeding. In an area full of historic villages, scattered rural homes, several mixed-use ski resort developments as well as many public lands and recreational areas, the residents are seeking a traffic calming technique that is effective in reducing traffic speeds while maintaining the draw to Vermont. In an effort to evaluate an experimental series of pavement markings known as "Dynamic Striping", VTrans, the Windham Regional Commission and four towns along VT Route 30 applied the referenced roadway treatment within speed reduction zones located at the entrance of each of the villages during the summer of 2005 with associated monitoring including: the collection of both pre and post installation traffic speeds, retroreflectivity (or luminance) readings and local public perceptions. The final analysis will evaluate the effectiveness of the markings through a comparison of pre and post-installation speed measures with consideration to nighttime visibility.

While a full analysis of the data will be carried out for the first year of application, there are several parameters that will generate variability within the data sets resulting in a low confidence level of all associated results. Due to the change of the proposed locations for the installation of the markings following the pre-installation monitoring, the distance between the zone and monitoring location vary greatly, from a minimum of 317 feet to a maximum of 1890 feet. Ideally, this distance would have been constant as each site; however efforts will be made to assess the distance of effectiveness. Additionally, the lines were not painted to the provided specifications and looked "sloppy" according to residential feedback. As the markings are to provide a visually illusion, this may reduce the overall success in reducing vehicle speeds. As a final aside, the application of glass beads was not consistent and the initial retroreflectivity of the pavement markings at two out of eight sites was below the FHWA's recommended minimum retroreflectivity for white roadway safety markings. This is anticipated that this will reduce the likelihood of reducing speeds at night in these locations.

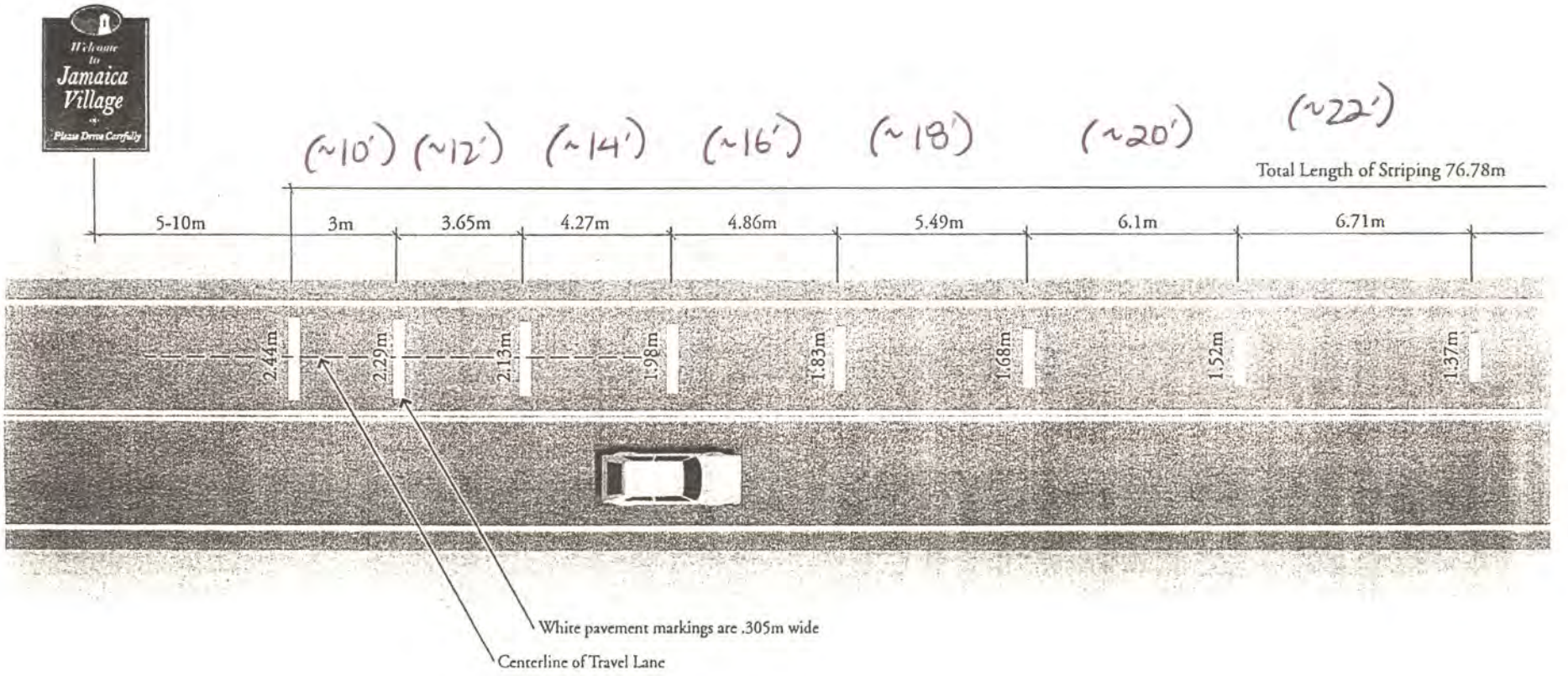
FUTURE RECOMMENDATIONS:

Given the expected variability of the data sets with reference to the monitoring locations, retroreflectivity and application, a second installation of “dynamic striping” is recommended at each of the eight sites. It is further recommended that a stencil is utilized to paint the markings in order to provide a clean and uniform look. All markings are to be centered in the lane and glass beads hand broadcast immediately following paint application. All traffic monitoring locations will be placed immediately upstation of the experimental markings. Surveillance and testing should be performed as specified within the associated work plan. A final analysis is to be preformed following the completion of data collection for the second application of the markings.

APPENDIX A – STRIPING DETAIL



Dynamic Striping & Gateway Signs


Welcome to Jamaica Village
Please Drive Carefully
(~10') (~12') (~14') (~16') (~18') (~20') (~22')
Total Length of Striping 76.78m
5-10m
3m
3.65m
4.27m
4.86m
5.49m
6.1m
6.71m
2.44m
2.29m
2.13m
1.98m
1.83m
1.68m
1.52m
1.37m
White pavement markings are .305m wide
Centerline of Travel Lane

APPENDIX B – RETROFLECTIVITY RESULTS

Dynamic Striping Retro Readings

			Town along VT Route 30:							
			Newfane NB	Newfane SB	Townshend NB	Townshend SB	Jamaica NB	Jamaica SB	Bondville NB	Bondville SB
	Distance From White Edge Line:		RWP 2'	RWP 2'	RWP 2.5'	RWP 2'	RWP 2'	RWP 2.5'	RWP 2.5'	RWP 2.5'
	Distance From White Edge Line:		LWP 7'	LWP 7'	LWP 7.5'	LWP 7'	LWP 7'	LWP 7.5'	LWP 7.5'	LWP 7.5'
	Distance From Speed Reduction Sign:		271'	271'	413'	223'	-----	487'	508'	519'
Test Date:	Test Site ID:	Test Location:	Retroreflectivity Readings (mcdl):							
07/13/2005	Stripe 1	center of marking	326	300	269	283	228	29	5	215
07/13/2005	Stripe 4	center of marking	326	282	250	241	152	62	11	143
07/13/2005	Stripe 7	center of marking	319	244	241	292	104	136	11	70
07/13/2005	Stripe 10	center of marking	335	288	215	194	82	140	12	12
07/13/2005	Stripe 13	center of marking	268	277	198	134	63	135	12	23
07/13/2005	Stripe 13 RWP	as indicated above	168	149	173	192	53	179	10	56
07/13/2005	Stripe 13 LWP	as indicated above	157	192	171	46	54	40	8	15
		average center reading:	314.8	278.2	234.6	228.8	125.8	100.4	10.2	92.6
		average wheel path reading:	162.5	170.5	172	119	53.5	109.5	9	35.5
11/04/2005	Stripe 1	center of marking	276	126	282	293	266	34	22	222
11/04/2005	Stripe 4	center of marking	261	200	246	238	261	68	33	149
11/04/2005	Stripe 7	center of marking	267	145	287	220	161	198	36	73
11/04/2005	Stripe 10	center of marking	299	187	281	151	119	218	88	31
11/04/2005	Stripe 13	center of marking	261	204	155	168	118	177	44	40
11/04/2005	Stripe 13 RWP	as indicated above	51	100	86	180	50	198	29	31
11/04/2005	Stripe 13 LWP	as indicated above	139	95	102	37	86	39	33	51
		average center reading:	272.8	151.0	205.6	183.9	151.6	133.1	40.7	85.3
		average wheel path reading:	95.0	97.5	94.0	108.5	68.0	118.5	31.0	41.0

Indicates a lower retroreflectivity reading than recommended 250 mcdl for white pavement markings by FHWA.