Road Safety Audit Review

River Road near Sand Hill Road

Town of Underhill

July 10, 2008

Note: THIS DOCUMENT IS EXEMPT FROM DISCOVERY OR ADMISSION UNDER 23 U.S.C 409

River Road near Sand Hill Road
Road Safety Audit Review
Review Report

Definitions

A ***Road Safety Audit Review*** (RSAR) is a formal examination of an existing road in which an independent, multi-discipline team (the Audit Team) reports on potential safety issues. "Independent" means that the members of the team will not be directly involved with the location being audited.

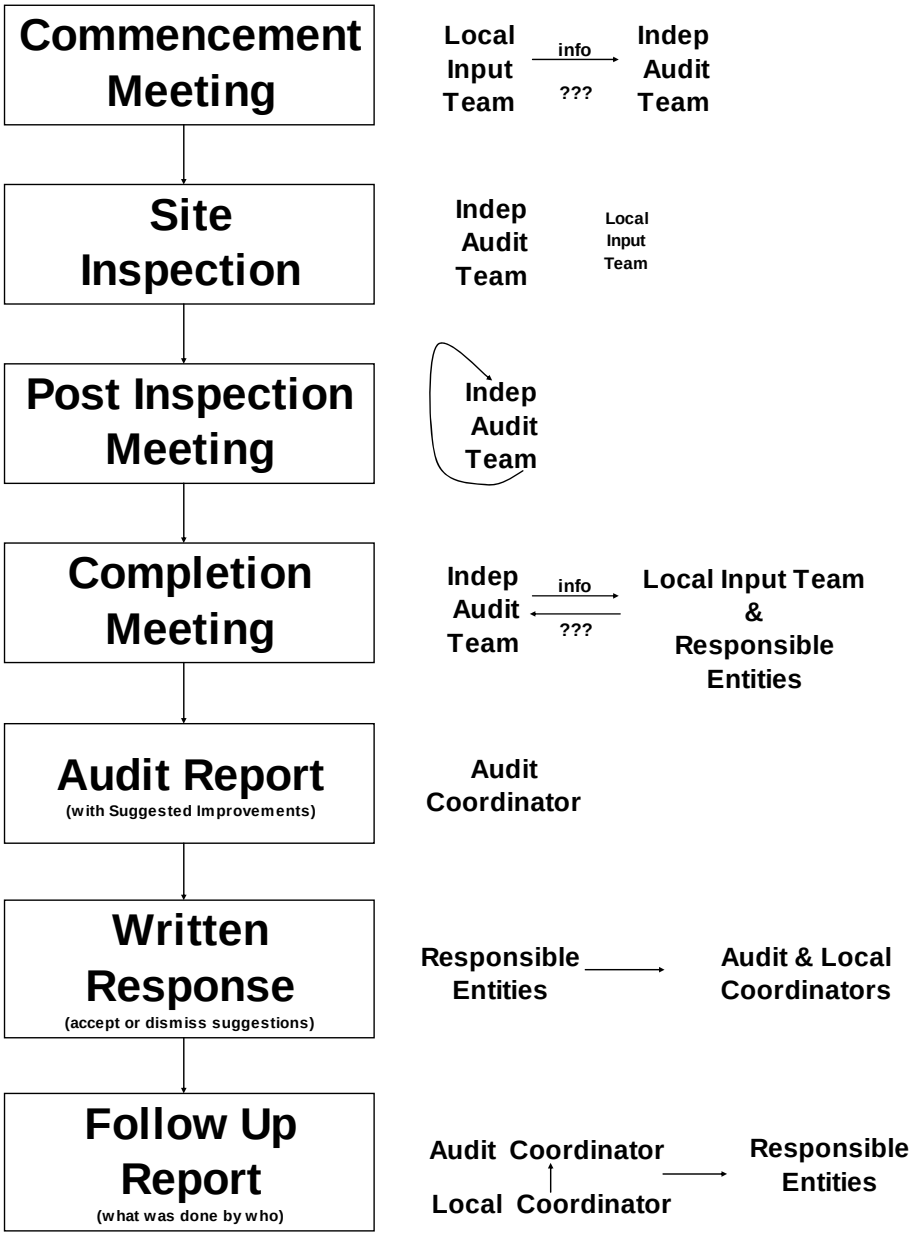
In addition to the Audit Team, a RSAR involves the following key players: Local Coordinator, Local Input Team and Responsible Entities.

The ***Local Coordinator*** is either a representative of the Town/City or the local regional planning commission. His/her role is to put a Local Input Team together, aggregate traffic and safety information, lead the commencement meeting and follow-up with local responsible entities. The role of the ***Local Input Team*** is to provide a local perspective at the commencement meeting. It is composed of representatives from the community such as Selectboard Members, Police, EMT, VAOT District, and Other Local People. The ***Audit Team*** is responsible for performing a site visit, identifying safety issues and coming to a consensus with respect to possible guidance. ***Responsible Entities*** are any groups who own a roadway feature or who are responsible for making an improvement or initiating further studies. These could include for example, the VTRANS Design Section, the Local Town, the Police or the Local RPC/MPO. The role of the Responsible Entities is to assess the viability of the suggestions provided by the Audit Team and provide a written response to the Audit Coordinator, to schedule and/or perform the improvements if deemed necessary and to follow-up with the audit or local coordinator when the project is completed. Finally, the ***Audit Coordinator*** is the person responsible for setting up the audit and other meeting dates, to put the audit team together, to facilitate the post inspection meeting and the completion meeting, and to prepare the audit report.

RSAR Process

The RSAR process is composed of several steps as shown in the diagram below. The process starts with a ***Commencement Meeting*** between the Local Input Team and the Audit Team. The purpose of the meeting is for the Local Input Team to present community concerns to the Audit Team. A ***Site Inspection*** is then performed by the Audit Team. Members from the Local Input Team can accompany the Audit Team to further explain concerns. The site visit involves the identification of safety deficiencies as seen in the field. The Audit Team will usually drive through the location of interest to

Figure 1. ROAD SAFETY AUDIT PROCESS



"get a feel" for the area, traveling through each approach in the case of intersections. The team is to then drive at a slower posted speed to make observations. If needed, the team will also walk the location. Following the site inspection, the Audit Team holds a ***Post Inspection Meeting.*** It is during this meeting that the team members discuss their observations and identify safety issues. The team is to reach a consensus on the importance of each safety issue mentioned. Only those issues for which a consensus is reached are included in the RSAR findings. The final RSAR report (Written Report) is finalized following the Completion Meeting during which the issues identified by the audit team are discussed with the Local Input Team and Responsible Entities. The meeting is to be constructive and

foster dialogue between the parties involved. The ***Written Report*** identifies safety concerns and proposes guidance. These issues and solutions are presented in a tabular format associated to each Responsible Entity for ease of reporting. The Responsible Entities are to provide a Written Response on every finding of the Written Report as to its implementation. The Responsible Entity is not obliged to implement the findings in the Written Report. However, the reasons for not implementing a finding should be documented (e.g. physical constraints, excessive cost, environmental constraints, etc.).

The RSAR herein covers physical features which may affect road user safety and it has sought to identify potential safety hazards. However, the audit team points out that no guarantee is made that every deficiency has been identified. Further, it should also be understood that the adoption of the guidance in this report should improve the level of safety of the facility but not necessarily remove all the risks.

Location

The location of this RSAR is the section of road on River Road from about the start of the 30 mph speed limit zone west of the Sand Hill Road intersection to the bridge east of the intersection and includes the north approach on Sand Hill Road.

Figure 2.
Location Map
Source: CCMPO

Purpose of the RSAR

This RSAR was conducted as part of the Agency of Transportation's Transportation Planning Initiative in conjunction with the High Risk Rural Roads Program (HRRR). The location was selected by the Chittenden County Metropolitan Area (CCMPO) pursuant to the prioritization process established by CCMPO with the intent of identifying hazardous locations on rural local roads.

RSAR Team

The Road Safety Audit Review Team included the following representatives from the Vermont Agency of Transportation (VAOT):

Hank Lambert,	Traffic Safety (VAOT)
Jim Cota,	Operations, District 5 (VAOT)
Patrick Gilligan,	Operations, District 5 (VAOT)

RSAR Team Coordinator

The road safety audit review coordinator was:

Mario Dupigny-Giroux,	Traffic Safety (VAOT)

Local Coordinator

The local coordinator was:

Jason Charest,	CCMPO

Local Input Team

The following individuals from the local community were present at the Commencement Meeting:

Chris Murphy,	Underhill Town Administrator
Rod Fuller,	Underhilll Road Foreman
Dan Steinbauer,	Underhill Selectboard and Traffic Committee member

Also present were Erin Parizo and Jen Wheeler, both interns with CCMPO.

Commencement Meeting

The commencement meeting was held at the Town of Underhill offices on July 10, 2008

Mario Dupigny-Giroux mentioned that this RSAR was conducted as part of the HRRR Program. Mr. Dupigny-Giroux explained that the HRRR Program included two types of locations, namely, Programmatic Corridors and High Hazard Locations and that Programmatic corridors were sections of roads of several miles in length while High Hazard Locations were isolated locations or short segments of roads of no more than 1 mile in length. Mr. Dupigny-Giroux then clarified that High Hazard Locations were reviewed with a multi-discipline road safety audit team and that a larger number of improvements were eligible for funding.

Jason Charest explained that the site had been selected based on crash data provided by VAOT for the period 2001 to 2006.

The audit team reviewed the following information presented at the commencement meeting by local members.

> The signs within the segment consist in speed limit, speed reduction, equestrian and advisory speed signs.
>
> A traffic count was performed by CCMPO a few weeks prior to this RSAR. Tubes were located just at the current transition between the 30 mph and 45 mph speed zones. Going eastbound towards the village, the 85th percentile speed (the speed at which 85% of motorists are driving at or below) was 50 mph mile per hour and the 10 mile pace (the 10 mile range with the larger number of motorists) was between 41 and 50 mph. These numbers are similar to the last count that was performed in 2001 at the same location.
>
> Five crashes were identified during the 2001 to 2006 period. Sixty percent of the crashes resulted in injuries. A review of the crash reports identified two reported rear-end crashes due to somebody waiting to make a left turn on Sand Hill Rd.
>
> The Town suggested that most crashes were due to motorists not making the curve. The direction of these crashes would most likely be towards the village.
>
> There is anecdotal evidence of only two crashes on Sand Hill Road during the winter.
>
> There is a three rod right of way.
>
> The road is used by pedestrians and bicyclists.

Following the commencement meeting, the audit team, with members of the community, performed the site review of the intersection and reconvened at the town offices to discuss their observations.

Potential Safety Concerns

This section lists the areas of safety concern identified by the audit team. The concerns are not listed in order of importance. The safety concerns are also reported on the observation tables that are specific to each entity responsible for the improvements. These tables are found at the end of the report.

- ✓ Motorists are losing control (mostly when traveling east)
- ✓ Sand Hill Road has a combination of vertical and horizontal grades
- ✓ The conspicuity of Sand Hill Road could be improved (evidence of rear-end crashes)
- ✓ This road is also used by pedestrians and bicyclists

Many of these safety concerns are illustrated in the next few pages.

Problem:

Motorists are losing control (mostly when traveling east)

Immediate Actions:

Eastbound, install a 30” x 30” right reverse curve sign (W1-4 R) that shows a side road to the left. Install by mailbox 239

Add a Sand Hill name road plaque (W16-8)

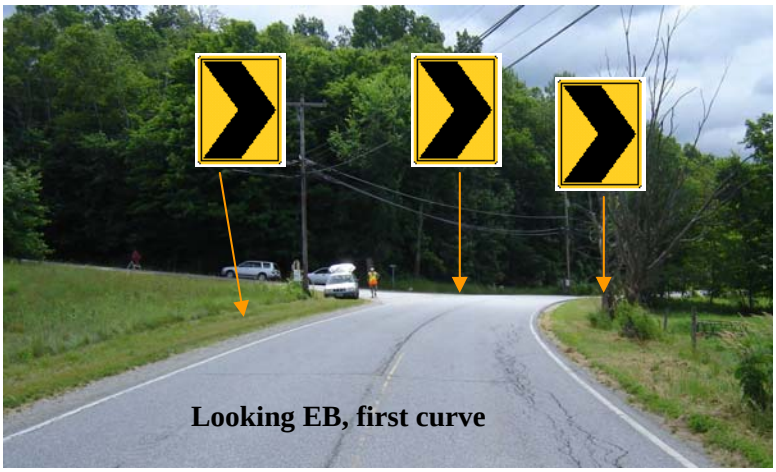
Install three 24” x 30” chevrons 120 ft apart on the Sand Hill Road side. Install them back-to-back so that chevrons are also visible from the westbound direction. Use type IX

Install two 24” x 30” chevrons 80 ft apart in the curve near the bridge. Install them back-to-back so that chevrons are also visible from the westbound direction. Use type IX

Westbound, install a 30” x 30” right reverse curve sign (W1-4 R)

Eastbound, remove the single 25 mph advisory plaque (W13-1) and post.

Determine if the equestrian sign is still needed, if not, remove the sign and the post. If it is needed, relocate



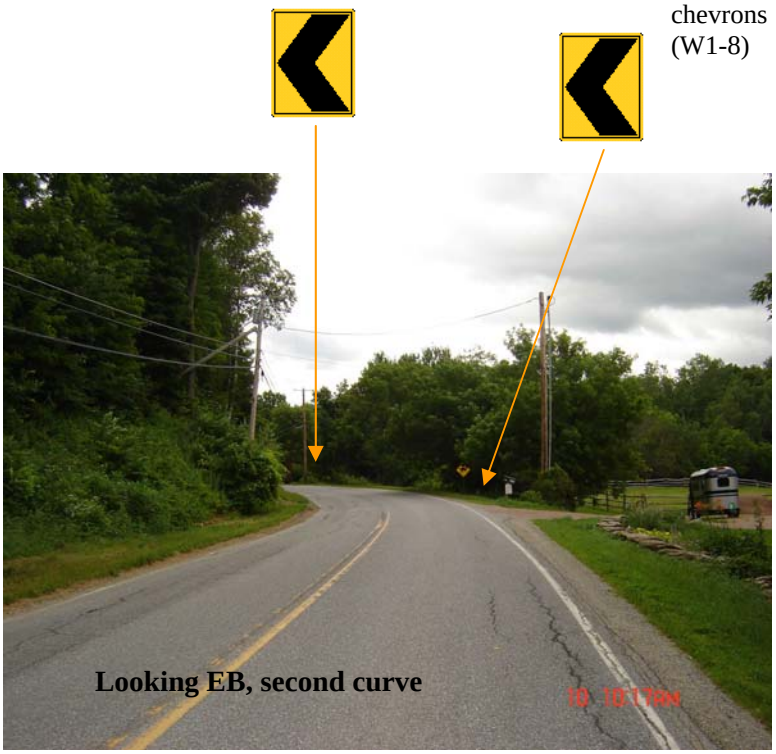
Looking EB, first curve

Add three chevrons (W1-8)

Modified W1-4 by “mailbox”

New W16-8

Add two chevrons (W1-8)



Looking EB, second curve

New W1-4 R in green space between the drives

Cut brush as needed

Verify the need, remove or relocate

Remove sole W13-1 plaque

Short To Mid Term:

Repair the rutted area in the pavement east of Sand Hill Road (eastbound lane)

Cut side slope steeper on the south side so that water would drain better

Problem:

The conspicuity of Sand Hill Road could be improved

Immediate Actions:

Replace the stop ahead sign with a new 30” x 30” stop ahead sign (W3-1) in advance of the intersection

Add a distance plaque (W16-2), 350 ft, below it

Add a 48” x 24” double arrow (W1-7) across River Road

Install a 30” x 30” left turn sign with a side road (W1-10). Add a Sand Hill name road plaque (W16-8)

Replace the street name sign with a new 9 “ blade one (6” letters, D3-1). Raise the height of the sign

New W3-1

New W16-2

New W1-10

New W16-8

Street name sign too low

New 48” x 24” W1-7

Short Term:

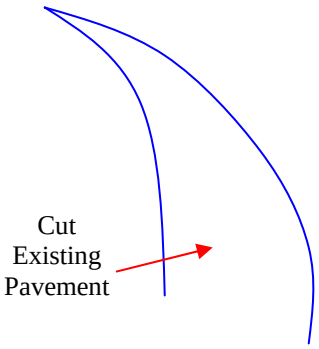
Narrow down the approach by removing some pavement on the corners and creating appropriate radii for trucks

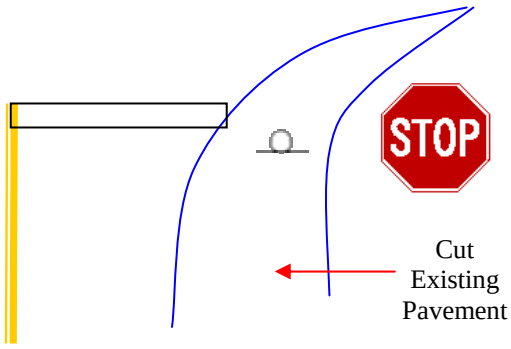
Move up the stop sign (replace with new 30” x 30” R1-1) closer to the intersection in the area where pavement was removed

Install about 30 ft of double yellow centerline

Install a stop bar four feet from the edge of River Road

Stop sign is too low





New type III 30” x 30” stop sign (R1-1). Bottom of sign to be at least 5 ft from the surface of the road

Problem:

Sand Hill Road has a combination of vertical and horizontal grades

Approaching River Road

Immediate Actions:

Add a 30” x 30” winding road sign (W1-5) in the unpaved area

Add a 30” x 30” hill sign (W7-1b) with a % grade

Add a 48” x 24” fluorescent yellow (Type IX) large arrow (W1-6) on the right side of the drive

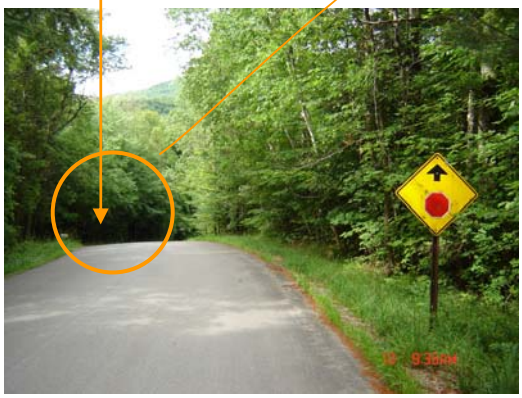
New W1-5

Short to Mid Term:

Possibly install recessed double yellow centerline markings (using polyurea) (see appendix C)

New W7-1b

New W1-6 on two posts so it can be seen before the crest



Problem:

This road is also used by pedestrians and bicyclists

Replace with new W3-5

Immediate Actions:

From Town records, determine where the 30 mph zone starts. The signs for the 30 mph zone and for the 45 mph zone should ideally line up

Adjust the location of the reduce speed ahead warning sign. Use the new (W3-5)

Replace all speed limit signs (R2-1) with new 24" x 30" type III signs (3 signs in all)

Relocate the speed limit sign just east of Sand Hill Road about 75' to 100' east of its current location

Relocate the WB speed limit sign west of the bridge for better visibility

Short to Mid Term:

Eastbound, consider dynamic striping (see appendix D). If surface could be repaved, use recessed pavement markings

Consider striping 10 foot lanes with 1 foot shoulders

Eastbound, just before the bridge, possibly could install a dynamic sign (see appendix E)

Possible location for dynamic striping

Road Safety Audit Review Observations

Instruction

The next section of the RSAR Written Report contains tables that display observations and guidance. The safety issues in the first column have been identified through this road safety audit review. For each observation, the Audit Team suggests the guidance listed in the second column as a possible remedial solution. Each Responsible Entity will receive their respective tables. Please indicate in the appropriate column if you agree to implement this measure and if not, support your decision by writing a reason in the last column. Responsible Entities are not obliged to follow the findings of this Written Report. However, the reasons for not implementing a finding should be documented (e.g. physical constraints, excessive cost, environmental constraints, etc.). A written response should be submitted to the Audit Coordinator within three weeks of receipt of the Written Report.

Written Response Town of Underhill (1 of 3)				
Issue	**Possible Solution**	**Decision Agree/Reject**	**Planned Completion Date**	**Comments**
Motorists are losing control (mostly when traveling east)	**Immediate:** Eastbound, install a 30" x 30" right reverse curve sign (W1-4 R) that shows a side road to the left. Install by mailbox 239 Add a Sand Hill name road plaque (W16-8)			
	Install three 24" x 30" chevrons 120 ft apart on the Sand Hill Road side. Install them back-to-back so that chevrons are also visible from the westbound direction. Use type IX			
	Install two 24" x 30" chevrons 80 ft apart in the curve near the bridge. Install them back-to-back so that chevrons are also visible from the westbound direction. Use type IX			
	Westbound, install a 30" x 30" right reverse curve sign (W1-4 R)			
	Eastbound, remove the single 25 mph advisory plaque (W13-1) and post			
	Determine if the equestrian sign is still needed, if not, remove the sign and the post. If it is needed, relocate			

Written Response Town of Underhill (2 of 3)				
Issue	**Possible Solution**	**Decision** Agree/Reject	**Planned Completion Date**	**Comments**
	Short to Mid Term: Repair the rutted area in the pavement east of Sand Hill Road (eastbound lane)			
	Cut side slope steeper on the south side so that water would drain better			
The conspicuity of Sand Hill Road could be improved	**Immediate:** Replace the stop ahead sign with a new 30" x 30" stop ahead sign (W3-1) in advance of the intersection			
	Add a distance plaque (W16-2), 350 ft, below it			
	Add a 48" x 24" double arrow (W1-7) across River Road			
	Install a 30" x 30" left turn sign with a side road (W1-10). Add a Sand Hill name road plaque (W16-8)			
	Replace the street name sign with a new 9 " blade one (6" letters, D3-1). Raise the height of the sign			
	Short to Mid Term: Narrow down the approach by removing some pavement on the corners and creating appropriate radii for trucks			

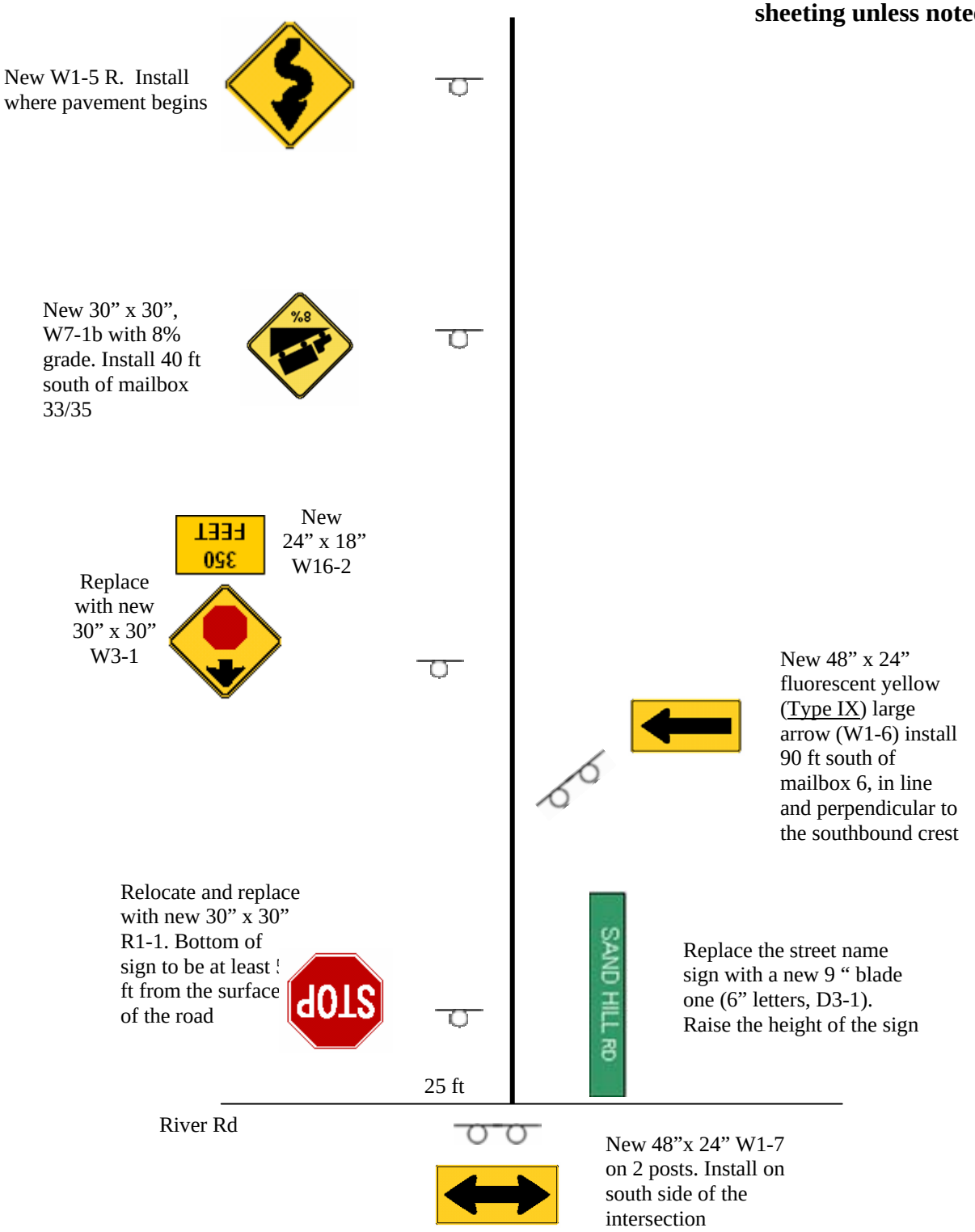
Written Response Town of Underhill (3 of 3)				
Issue	**Possible Solution**	**Decision** Agree/Reject	**Planned Completion Date**	**Comments**
	Move up the stop sign (replace with new 30" x 30" R1-1) closer to the intersection in the area where pavement was removed			
	Install a stop bar four feet from the edge of River Road			
	Install about 30 ft of double yellow centerline			
Sand Hill Road has a combination of vertical and horizontal grades	**Immediate:** Add a 30" x 30" winding road sign (W1-5) in the unpaved area			
	Add a 30" x 30" hill sign (W7-1b) with a % grade			
	Add a 48" x 24" fluorescent yellow (Type IX) large arrow (W1-6) on the right side of the drive			
	Short to Mid Term: Possibly install recessed double yellow centerline markings (using polyurea)			
This road is also used by pedestrians and bicyclists	**Immediate:** From Town records, determine where the 30 mph zone starts. The signs for the 30 mph zone and for the 45 mph zone should ideally line up			

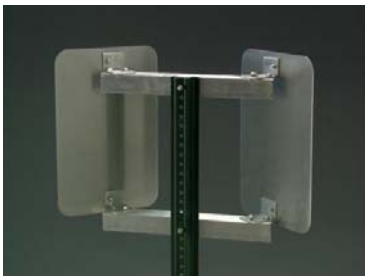
Written Response Town of Underhill (3 of 3)				
Issue	**Possible Solution**	**Decision** **Agree/Reject**	**Planned Completion Date**	**Comments**
	Adjust the location of the reduce speed ahead warning sign. Use the new (W3-5)			
	Replace all speed limit signs (R2-1) with new 24" x 30" type III signs			
	Relocate the speed limit sign just east of Sand Hill Road about 75' to 100' east of its current location			
	Relocate the WB speed limit sign west of the bridge for better visibility			
	Short to Mid Term: Eastbound, consider dynamic striping. If surface could be repaved, use recessed pavement markings			
	Consider striping 10 foot lanes with 1 foot shoulders			
	Eastbound, just before the bridge, possibly could install a dynamic sign			

Appendix A –Proposed Signage

Note: River Road is considered an East-West route

All signs to be Type III sheeting unless noted



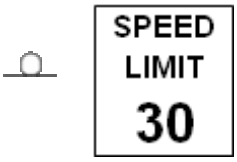


Use Chevron Brackets

24” x 30” W1-8 back-to-back Type IX

120ft

24” x 30” W1-8 back-to-back Type IX



Relocate 75 to 100 ft east and replace with new 24” x 30” R2-1

Sand Hill Rd

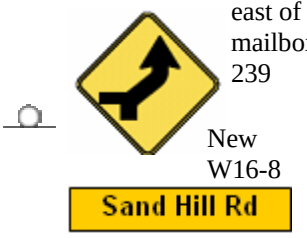
120ft

24” x 30” W1-8 back-to-back, Type IX.

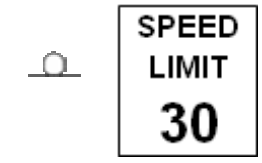
Install EB 5 ft east of telephone pole @ NW corner of intersection.

Important that first chevron in series lines up perpendicular with straight section of oncoming traffic

30” x 30” Modified W1-4 R Install 65 ft east of mailbox 239



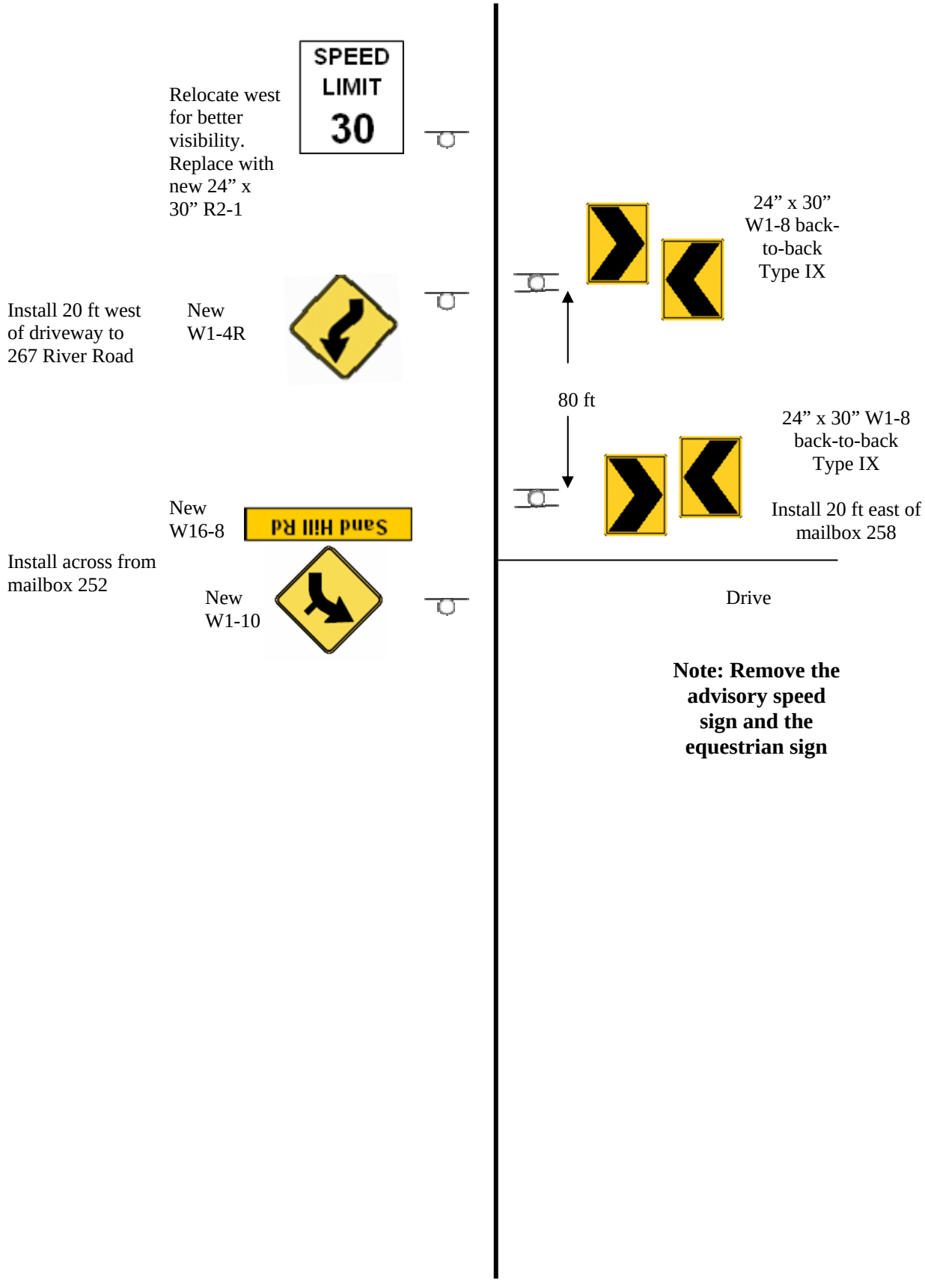
New W16-8



Replace with new 24” x 30” R2-1

Relocate east to align with 30 mph sign. Replace with new 24” x 30” R2-1

Relocate 60 feet west of existing location. Use new 36” x 36” W3-5 on 2 posts



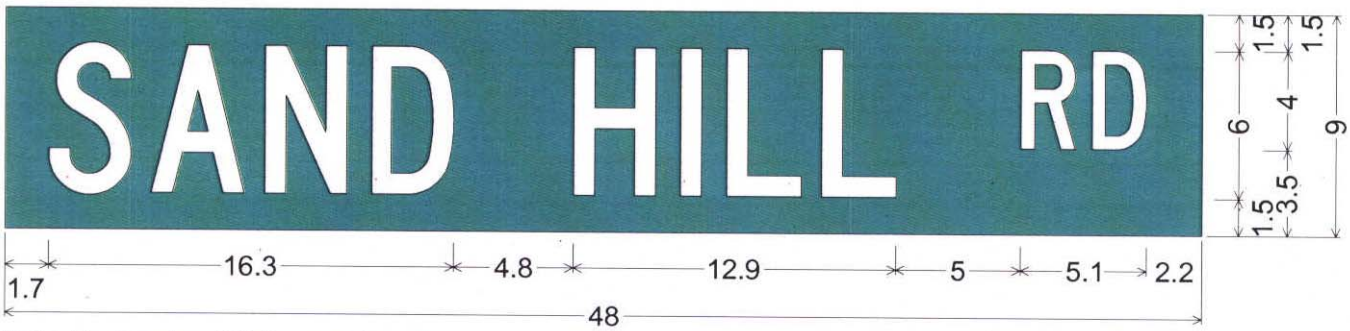
Note: Remove the advisory speed sign and the equestrian sign

Appendix B – Sign Details

21” x 21” W13-1 Advisory Speed Sign

W13-1 STD; 1.5" Radius, 0.6" Border, 0.4" Indent, Black on Yellow;
“35” E 80% spacing; “MPH” E 122% spacing;

D3-1, 9-inch Sand Hill Road Street Name Sign



D-3; No border, White on Green;
"SAND HILL" C 80% spacing; "RD" C 80% spacing;

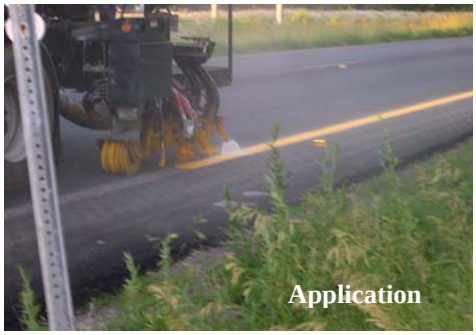
W16-8, Sand Hill Rd Supplemental Road Name plaque

1.500" Radius, 0.375" Border, 0.375" Indent, Black on Yellow;
"SAND HILL RD" B;

Appendix C – Recessed Pavement Markings

Recessed Pavement Markings

Involved milling the pavement with specialized equipment and applying application of marking materials. Markings are more visible and last longer.



Source: AOT Materials and Research

General Information from VAOT 2006 Standard Specifications for Construction

646.09 OTHER RELATED MARKINGS.
(a) Pavement Marking Recess. Recessed pavement markings shall be installed as specified for permanent markings. The recess shall be a uniform depth across the width of the marking. The recess shall be controlled such that the depth provided is 125% of the marking material thickness. The recess shall be clean and dry at the time of marking placement.

From 646.07 Durable Pavement Markings, subsection 2.

(d) Polyurea Paint. Approved polyurea marking materials shall be one of the markings listed on the Approved Products List on file with the Agency's Materials and Research Section under Subsection 708.08(a). Glass beads shall be AASHTO M247 Type I incorporated at 30% mass of the combined material, unless otherwise specified.

Possible contractor

L & D Safety Markings from Berlin (800-698-6154).

Appendix D – Dynamic Striping

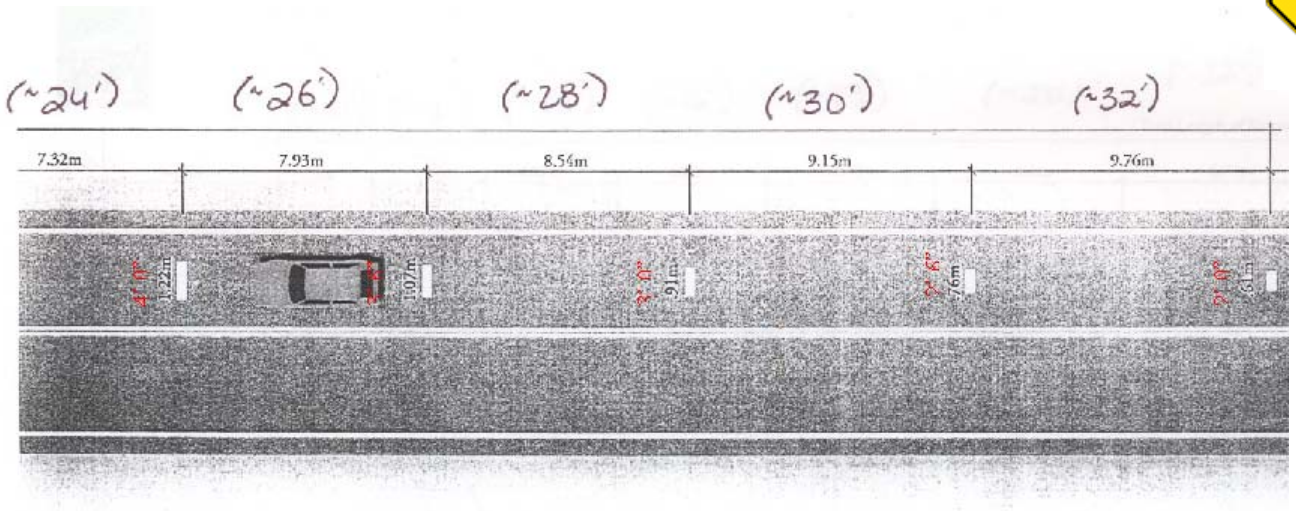
The Agency of Transportation evaluated the application of dynamic striping markings through Work Plan, WP-2005-R-4.

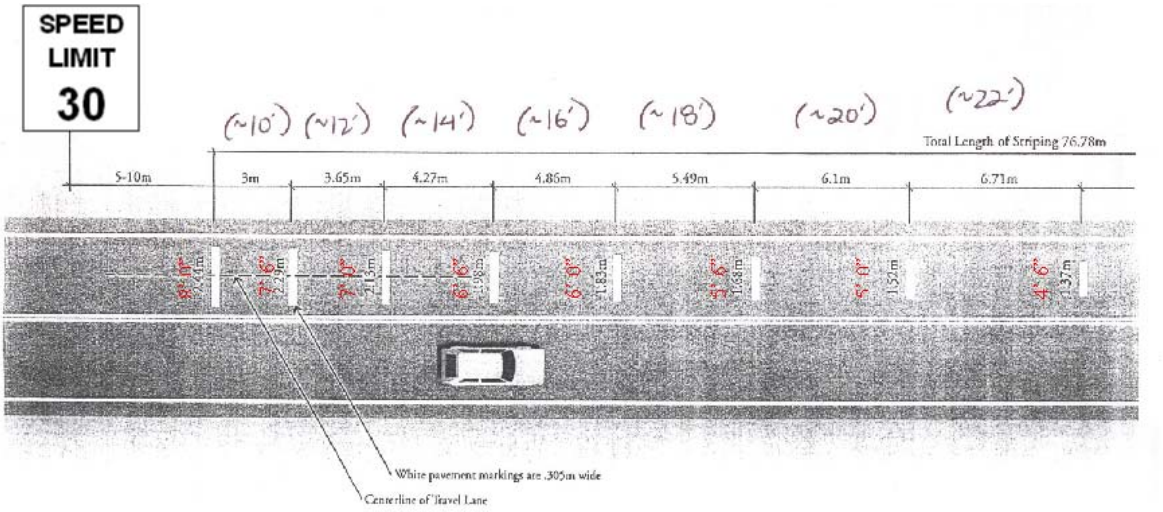
The striping layout, intended to create a deliberate distortion of the environment and an illusion of an increasing speed, is similar to that detailed in Section 3B.27, “Advance Speed Hump Markings”, and as shown on Figure 3B-31 of the MUTCD published in 2003. The design differs from this figure in that 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.

The experimental markings were associated with the beginning of a speed reduction zone as shown in exhibit 2.

From this analysis, the immediate effect of the dynamic stripes in reducing traffic speeds, one week following application, was an average decrease in speed of 0.1 mph. This effectiveness appears to increase over time with an average decrease in speed of 1.0 mph four months following application. Furtherer evidence suggests that the experimental markings had a larger impact on drivers that were exposed on a daily basis.

Exhibit 2


(~24')
(~26')
(~28')
(~30')
(~32')
7.32m
7.93m
8.56m
9.15m
9.76m


SPEED LIMIT 30
(~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
White pavement markings are .305m wide
Centerline of Travel Lane

Appendix E – Example of an Activated Speed Limit Sign

DORMAN VARITEXT

Posted Speed Limit - VATCS

SOLAR or AC POWERED

ADVISORY CATEGORY OF SIGN FOR **EDUCATION** OF DRIVER TOWARDS IMPROVED POSTED SPEED LIMIT ADHERANCE

VAMP TIMER **AUTO ADJUST FOR DAYLIGHT SAVINGS**

PIXELATED LED DISPLAY COMPLIANT AND INCLUDING MOST **MUTCD SIGN DIAGRAMS.**

BLUETOOTH WIRELESS DATA-LOGGING SPEED ANALYSIS

FCC COMPLIANT SI-3 INTEGRATED RADAR TECHNOLOGY

ALUMINIUM LIGHTWEIGHT ROBUST ENCLOSURES

MODULAR DESIGN FOR EASY INSTALL, SET UP/SERVICE

HIGH INTENSITY LED DISPLAY **VISIBLE IN ALL AMBIENT LIGHT CONDITIONS** WITH AUTO LUMINOSITY CONTROL

SIGN DESIGN SPECIFICATION (Generic)

Model Ref.	**VATCS**/*Sign Ref, Speed/SD slow down/L lanterns/ DL data logging*
Display Technology	High intensity LED. Auto luminosity control to suit ambient light conditions.
Display format	24" R2-1/ (60 x 75cm)RB-1 MUTCD diagrams available as standard. Visible at 480'. Display colours are inverted from the MUTCD regulatory sign diagrams . 5" 125mm beacons are located in each corner , flashing in horizontal pairs to attract drivers attention.
Vehicle Detection	FCC compliant K Band SI-3 technology , configurable trigger speeds between 5MPH/8KPH to 120MPH/192KPH, 12^0 beam with adjustable range from 350 to 1200 feet. Standard 600'.

Models	***Model No.***	***Approx Dimensions Inches/mm***		
		Height	***Width***	***Depth***
	VATCS/R2-1,XX/SD/L/DL (US) (24")	59/1510	34/875	4/90
	VATCS/RB-1,XX/SD/L/DL (CAN) (60 x 75)	59/1510	34/875	4/90
	Smaller scaled down versions and larger size formats of sign are available on request. Dual speed versions available for rotating between speed zones and other hazard specific warning signs in accordance with MUTCD with or without slow down and lanterns. Posted speed and size to be quoted when ordering.			
Weight	45Kg 90lbs			

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