

Calibration of the Highway Safety Manual Predictive Models for Rural Two-Lane Roads for Vermont

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Introduction / Problem Statement

The 2010 Highway Safety Manual (HSM) provides predictive equations for quantifying the safety effects of planning and designing roadway alternatives. However, these equations have been developed based on data sets from a small number of states and they must be calibrated to local conditions in order to ensure that the results are accurate for Vermont.

The purpose of this project is to develop calibration factors (CFs) for the two-lane, two-way, rural-road class predictive models and to update the safety performance functions (SPFs) used in those models. CFs are being developed separately for road segments and 3 types of intersections:

- Undivided rural two-lane roadway segments (2U)
- Signalized 4-leg intersections (4SG)
- Unsignalized intersections with minor-road stop control
 - 3-leg (3ST)
 - 4-leg (4ST)

Methodology

Calculating CFs involves first applying crash modification factors (CMFs) to the original SPFs to find the predicted number of crashes (PC) for each sample site i in Vermont (Equation 1). These CMFs are essentially a series of adjustment factors, most slightly higher or lower than 1.0, that are multiplied by the number of crashes resulting from the original SPF (N_{SPF}) to reflect the physical characteristics of the site.

The original SPFs for each site type are provided in Equations 4 – 6. The CF is calculated by comparing the predicted number of crashes at each site to the observed number of crashes (OC) at the same set of sites (Equation 2).

HSM Equations

1. $PC_i = N_{spf,i} \times (CMF_1 \times CMF_2 \times CMF_3 \times \dots)$
2. $CF_{r,i} = \frac{\sum_i OC_r}{\sum_i PC_r}$
3. $N_{spf-2U,i} = AADT_i \times L_i \times .000365 \times e^{-0.312}$
4. $N_{spf-3ST,i} = e^{[-9.86+0.79*\ln(AADT_{i,maj})+0.49*\ln(AADT_{i,min})]}$
5. $N_{spf-4ST,i} = e^{[-8.56+0.60*\ln(AADT_{i,maj})+0.61*\ln(AADT_{i,min})]}$
6. $N_{spf-4SG,i} = e^{[-5.13+0.60*\ln(AADT_{i,maj})+0.20*\ln(AADT_{i,min})]}$

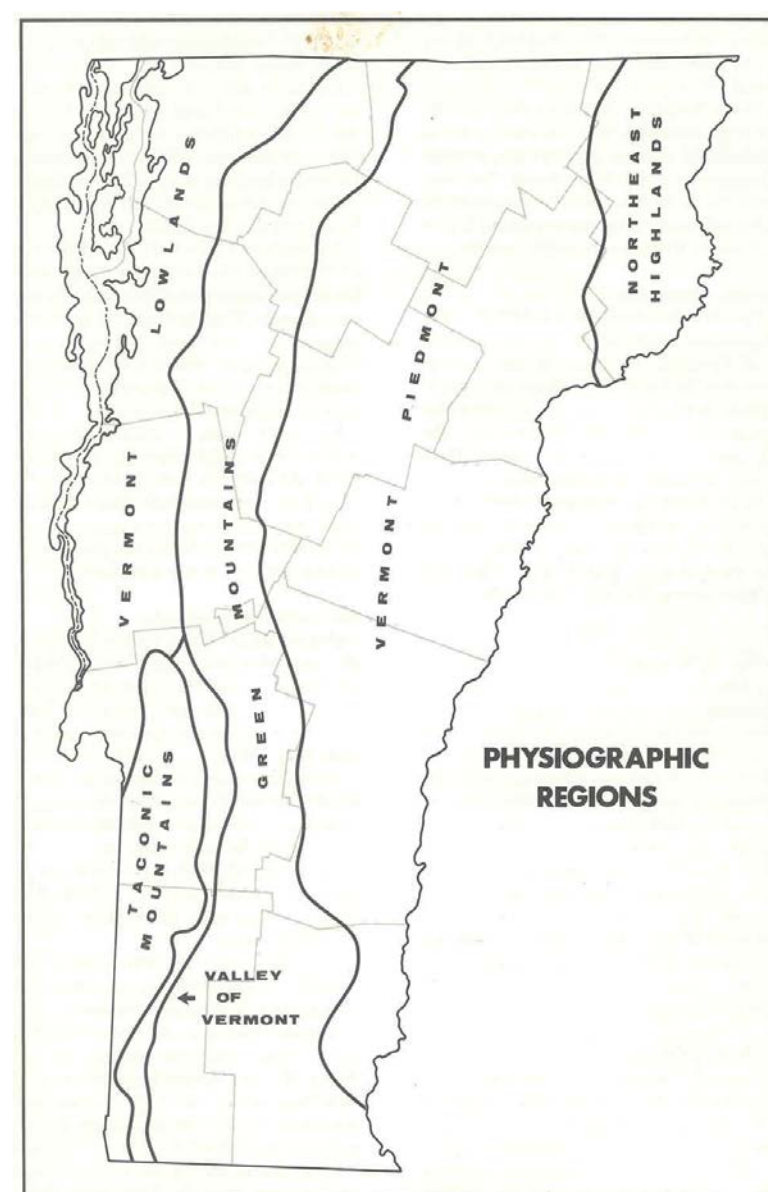
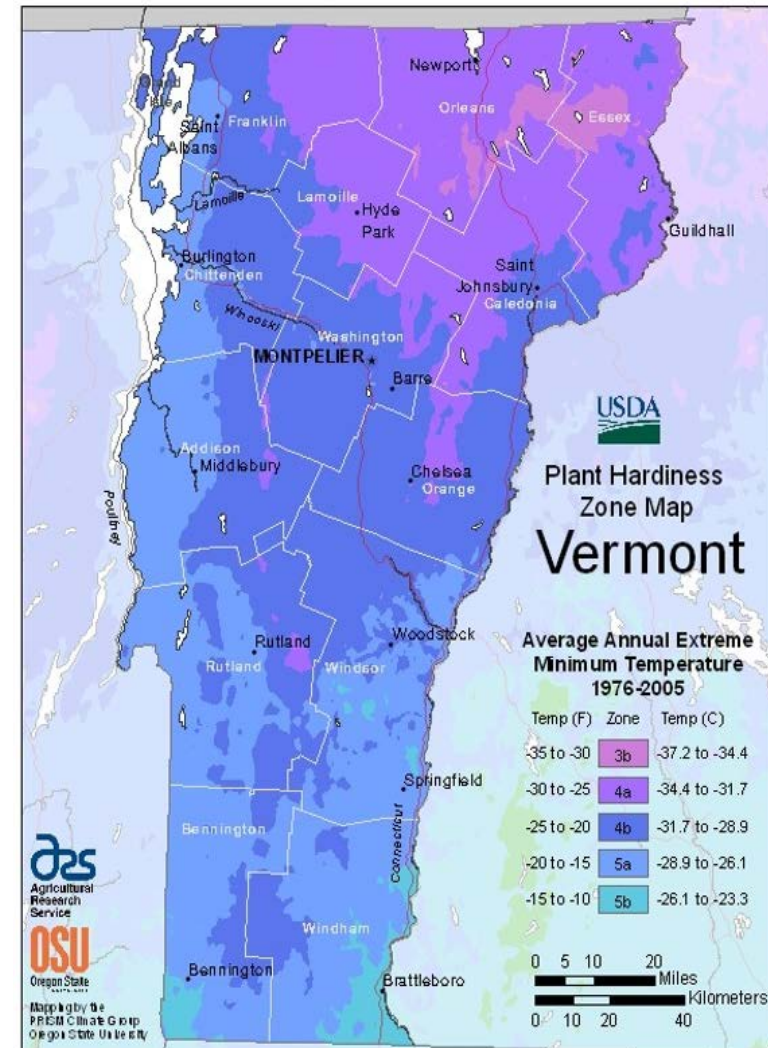
Regional Classification

Regional classifications were used in this analysis to explore how safety outcomes might vary by geographic region in Vermont. Two classifications were explored – one based on climatology and tourism, and the other based on physiography. Climatological variation is explored with a 3-region classification based on USDA north-south plant-hardiness variation (right):

- Northern (Grand Isle, Franklin, Lamoille, Orleans, Caledonia, and Essex Counties)
- Central (Addison, Chittenden, Washington, Orange, Rutland, and Windsor Counties)
- Southern (Bennington and Windham Counties)

Some researchers might also divide our state according to physiographic regions (right). Physiographic variation is explored in a second 3-region east-west classification:

- A. The Vermont Lowlands, the Valley of Vermont, and the Taconic Mountains
- B. The Vermont Piedmont and Northeast Highlands
- C. The Green Mountains



Preliminary Results (still underway)

Site Type	2U	3ST	4ST	4SG
Region	CF			
Statewide	0.293	0.448	0.448	0.568
Northern	0.306	0.432	0.322	0.456
Central	0.295	0.449	0.411	0.695
Southern	0.403	0.463	0.597	0.771
Physio A	0.194	0.375	0.616	0.277
Physio B	0.358	0.526	0.645	0.924
Physio C	0.370	0.419	0.343	0.306
Coefficient	SPF			
a	0.763	-9.835	-8.665	-16.4
b	1.388	0.936	0.759	1.452
c	-6.634	0.357	0.484	0.667

Acknowledgments

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References

Highway Safety Manual, 1st Edition, 2010. Produced by the American Association of State Highway and Transportation Officials, Washington, DC.