CENTER FOR TRANSPORTATION RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN

Impact of Reduced Maintenance on Road Safety

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Project 0-6713

Quantitative Relationship between Crash Risks and Pavement Skid Resistance

Project Team

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Background

- In the past 5 years, over 12,000 fatalities, 48,700 incapacitating injuries, 198,300 non-incapacitating injuries, and 415,900 possible injuries have occurred on the state-maintained highway network in Texas
- TxDOT is responsible for the maintenance of over 195,000 lane miles of highways under severely constrained budget
- The goal is to evaluate the impact of pavement skid resistance on crash risk so that minimum skid resistance threshold values can be established to ensure that highway safety will not be compromised with reduced maintenance conditions

Research Scope and Objectives

- Develop a methodological procedure to determine the quantitative relationship between crash rates and pavement skid number (SN) values
- Determine guidelines for SN thresholds to assist TxDOT in making critical maintenance decisions
- Address all types of state-maintained highways in Texas
- Analyze wet weather related crashes as a separate group for comparison purposes

CRR Concept

CRR is expressed as a function:

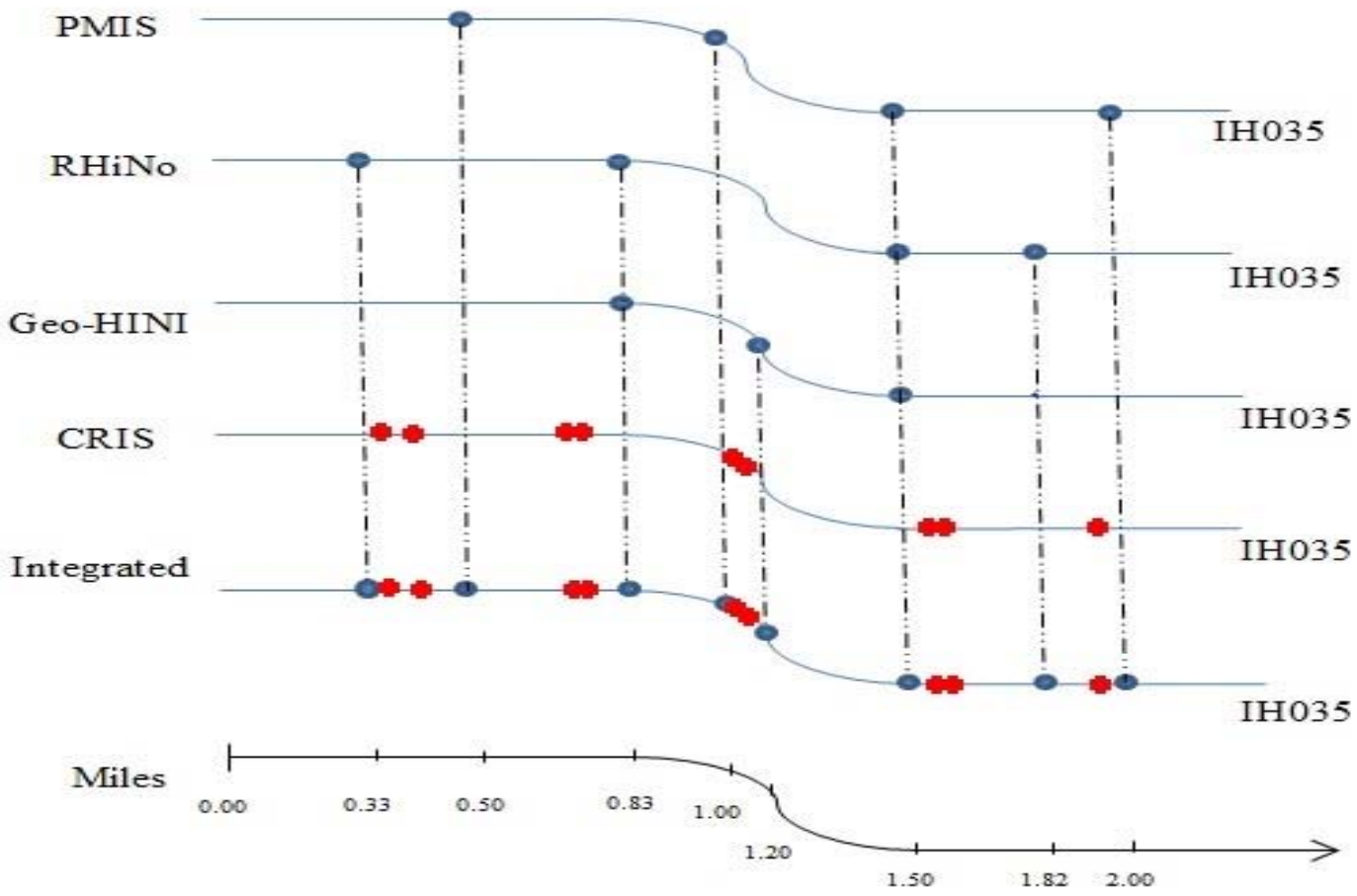
$$CRR = \frac{P_{CR}^{SN}}{P_{LM}^{SN}}$$

Where: *CRR* = Crash Rate Ratio

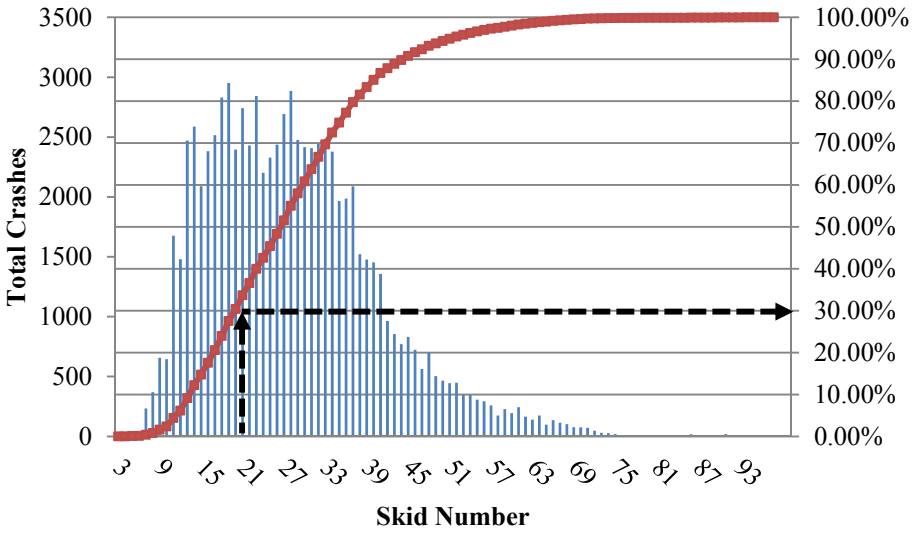
P_{CR}^{SN} = Cumulative percentage of total crashes below skid number *SN*

P_{LM}^{SN} = Cumulative percentage of total lane miles below skid number *SN*

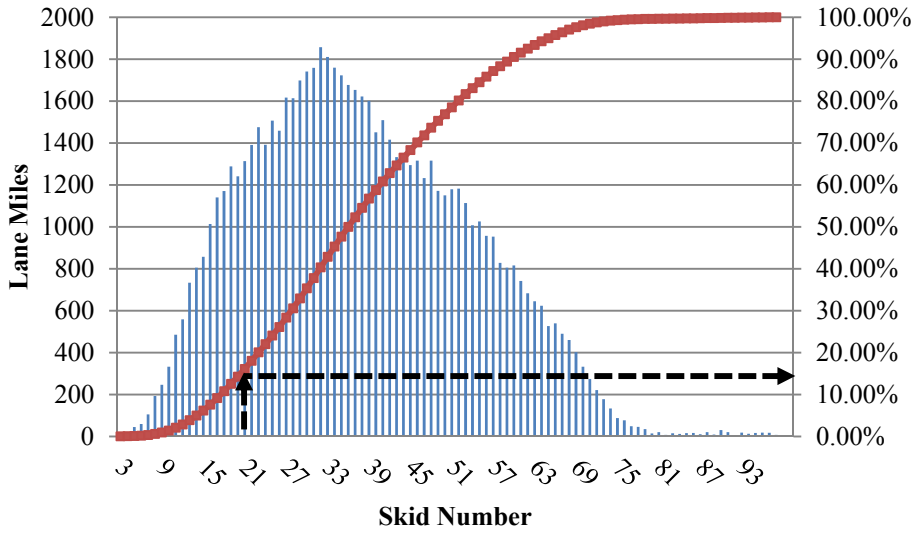
Data Integration



CRR Calculation (2011)



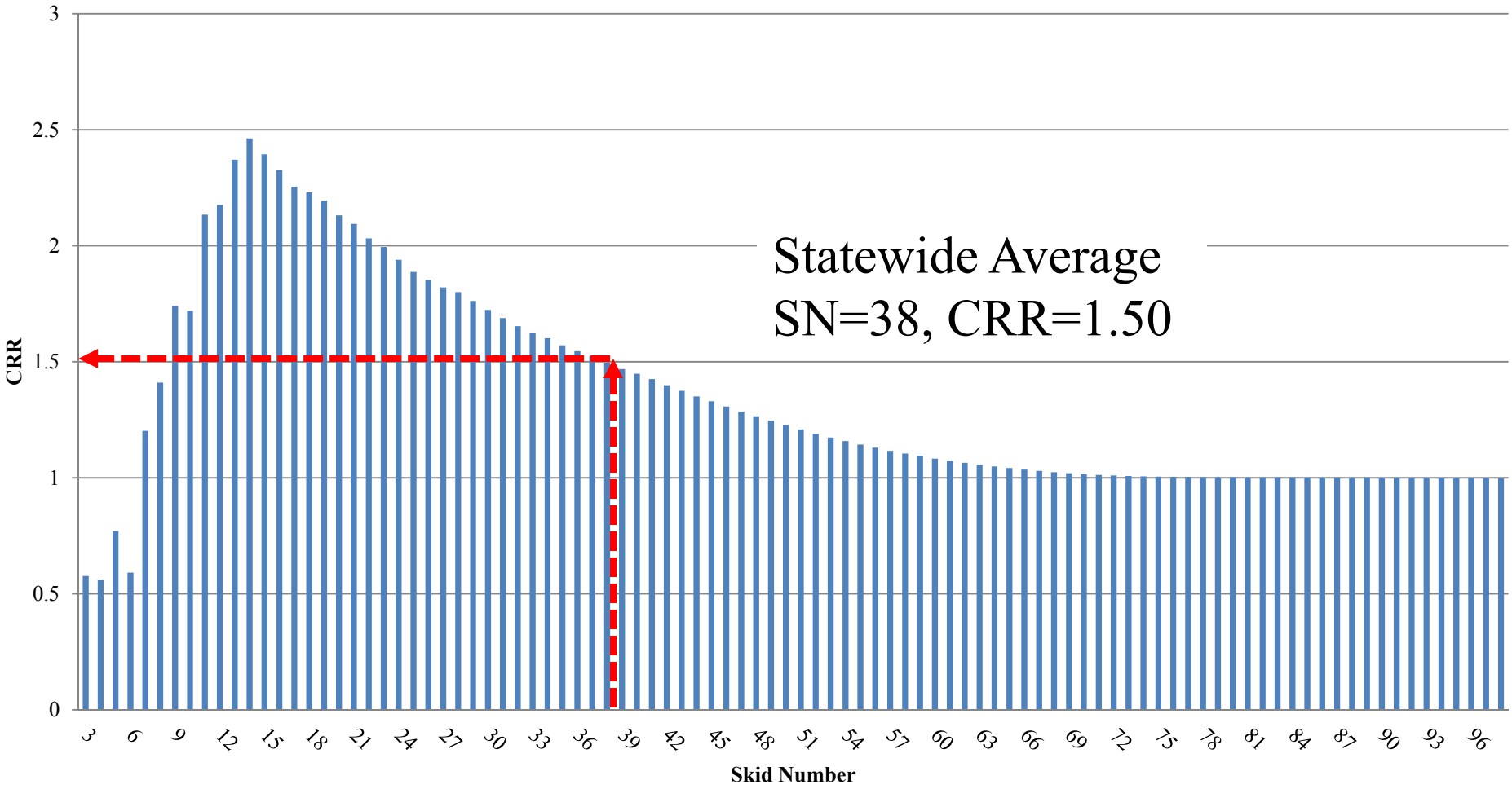
Distribution of Total Crashes by SN



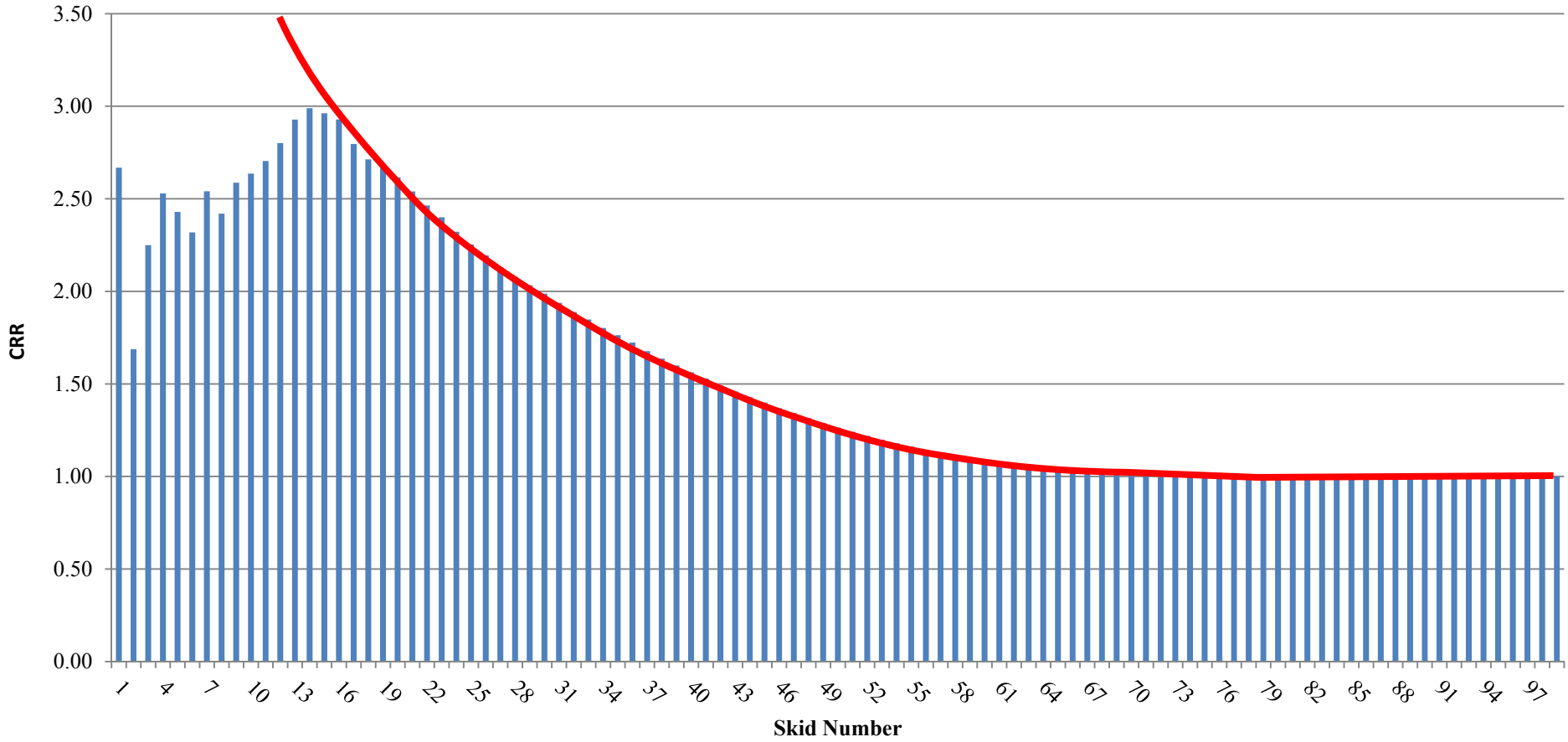
Distribution of Lane Miles by SN

Skid Number	Cumulative percentage of total crashes	Cumulative percentage of lane miles	CRR
20	30.4	14.3	2.13

CRR Calculation (2011)



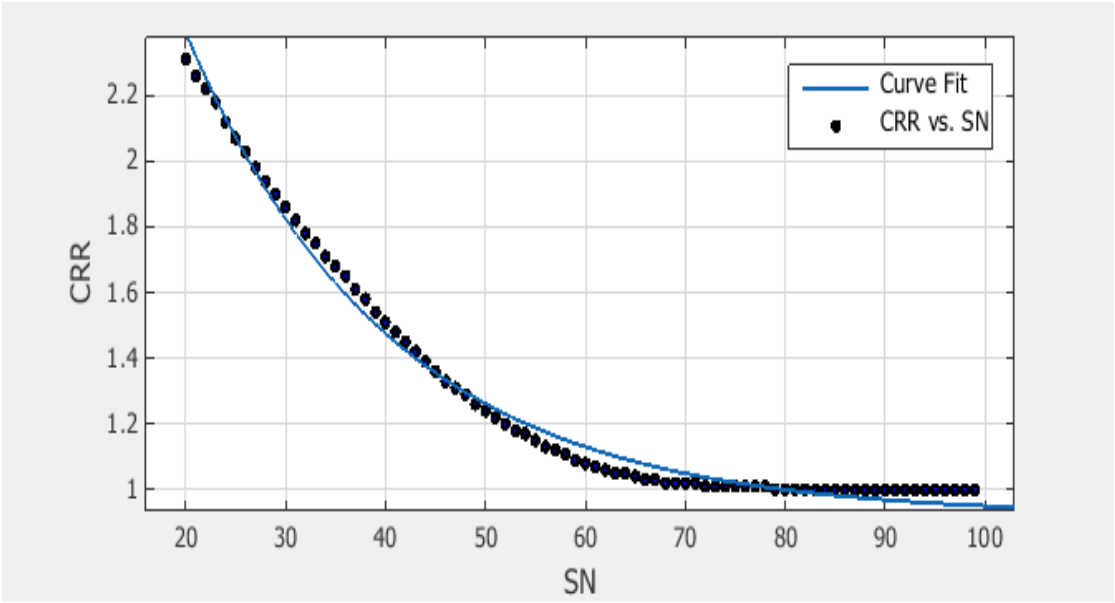
Crash Risk vs. Skid Number (08'-11')



CRR-SN Relationship (08'-11')

Exponential curve model used in analysis:

$$CRR = a \times e^{-b \cdot SN} + c$$



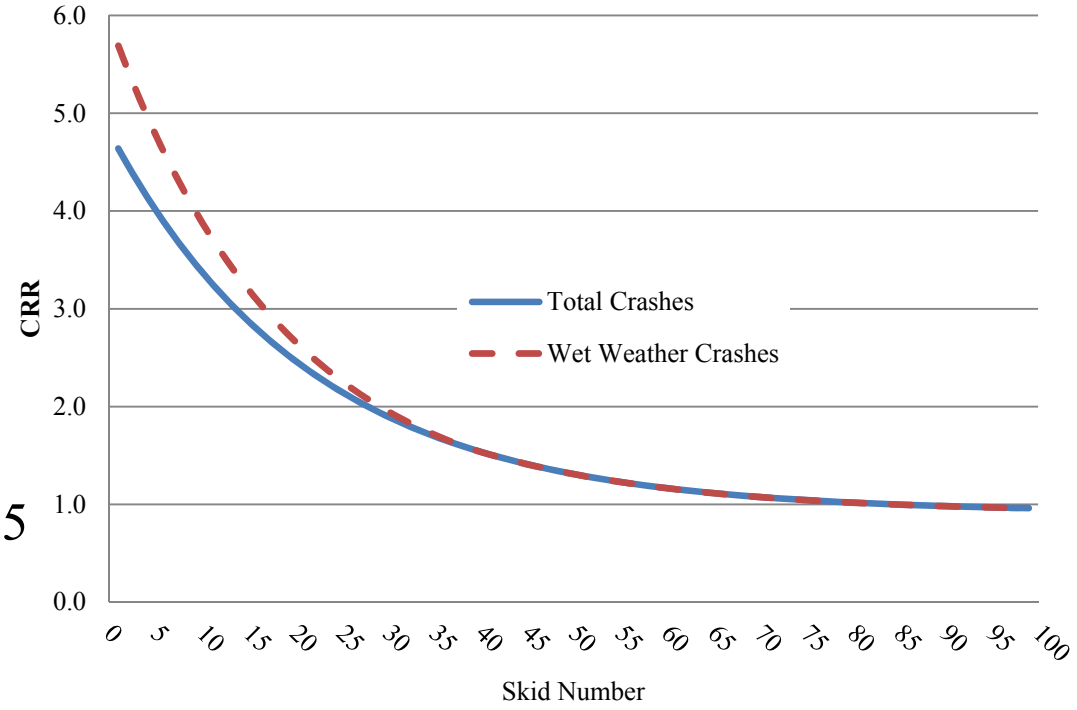
$CRR = 3.894 \times e^{-0.04605 \cdot SN} + 0.9205$ $(R^2 = 0.992)$

Statewide CRR-SN Relationship (08'-11')

Lane miles: 274,182

Total Crashes Count: 337,851

Wet Crashes Count: 36,790



CRR-SN for total crashes:

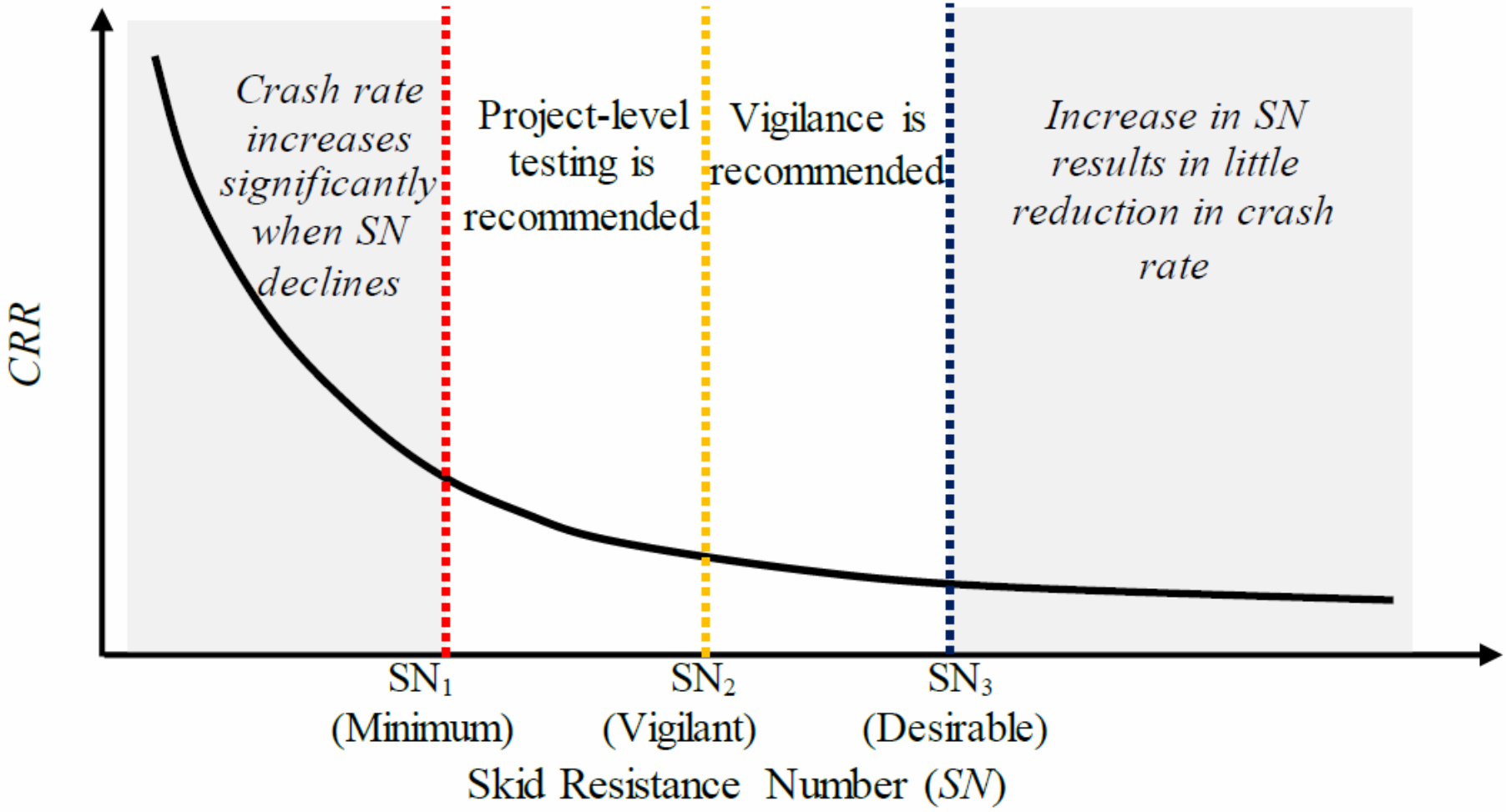
$CRR = 3.894 \times e^{-0.04605 \cdot SN} + 0.9205$

CRR-SN for wet crashes:

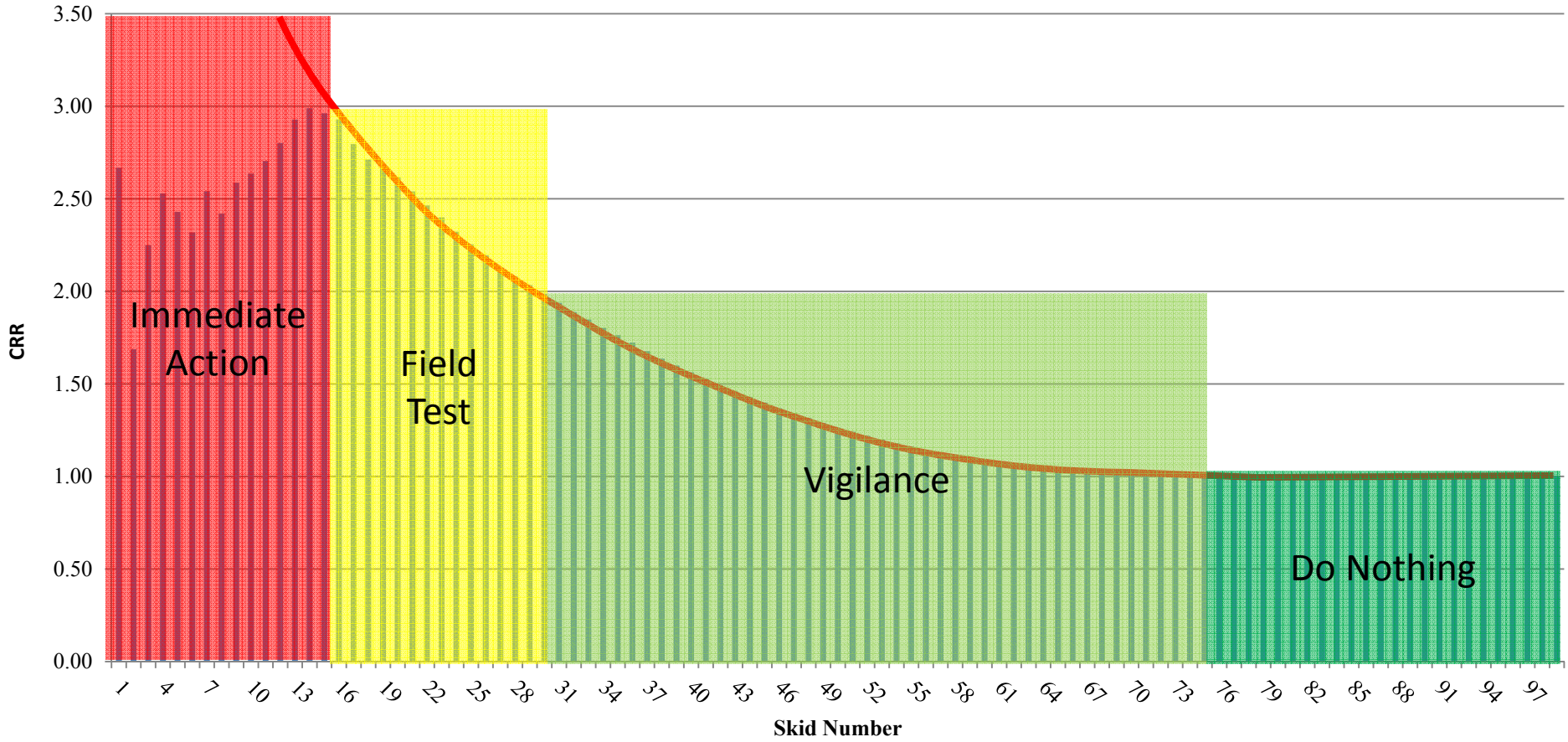
$CRR = 5.023 \times e^{-0.05292 \cdot SN} + 0.9264$ when $SN < 39$

$CRR = 3.894 \times e^{-0.04605 \cdot SN} + 0.9205$ when $SN \geq 39$

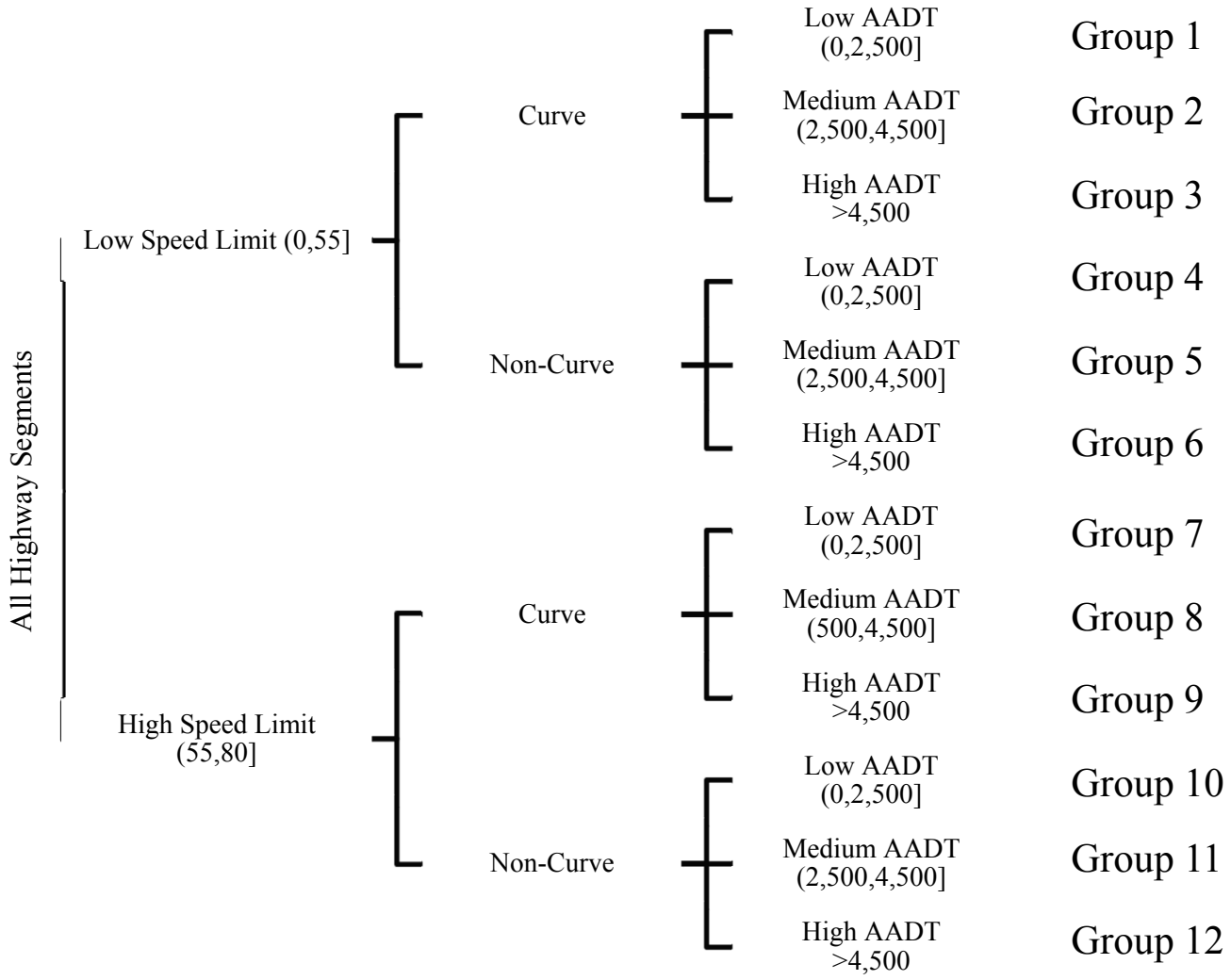
Threshold Values for SN



Statewide Threshold Values for SN



Stratified Groups



Recommended Thresholds

		Total Crashes			Wet Weather Crashes		
		SN_1	SN_2	SN_3	SN_1	SN_2	SN_3
Statewide		18	24	73	18	29	73
Highway Group ID	1	17	31	52	20	34	75
	2	-	-	42	-	-	52
	3	-	-	43	-	10	43
	4	11	26	48	18	31	72
	5	-	-	42	-	-	48
	6	-	-	44	-	-	44
	7	14	26	34	23	35	73
	8	-	10	32	14	20	47
	9	-	-	43	23	34	73
	10	-	16	63	-	30	68
	11	-	-	28	-	14	50
	12	-	-	42	-	10	42

Conclusions

- Compared to traditional regression models that are developed to describe the relationship between pavement skid resistance and crash risks, CRR-SN curve is specifically designed to support management of skid resistance at the network level
- The development of CRR-SN curves provides both researchers and engineers an easy way to quantify and understand the overall relationship between skid resistance and crash risks
- By choosing the break points of CRR according to the safety goals and objectives of the transportation agencies, the critical threshold values of SN can be directly determined

QUESTIONS?