BNSF DATA REQUEST NO. 3:

What is the maximum speed at which the farm equipment referenced in your response to Data Request No. 1 can and does travel on a paved roadway surface?

ANSWER TO DATA REQUEST NO. 3:

The Kubota B21 has a maximum speed of 18 km (11.2 MPH). The Ford 9N has an estimated maximum speed of 15 to 20 MPH (though it does not feel safe at those speeds).

Date prepared: 3/13/09
Preparers: Lynn Logen
Witness with knowledge about this response: Lynn Logen

Comprehensive Safety Plan

Contents

Overview

Fire Safety

Facilities Management Safety

Emergency Response

Lab Safety

Hazardous Materials

Bloodborne Pathogens

Radiological Safety

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Continuity of Operations Plans

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Lighting and Safety

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Media Releases

Ratio of Speed to Stopping Distance

§ 46.2-880. Tables of speed and stopping distances.

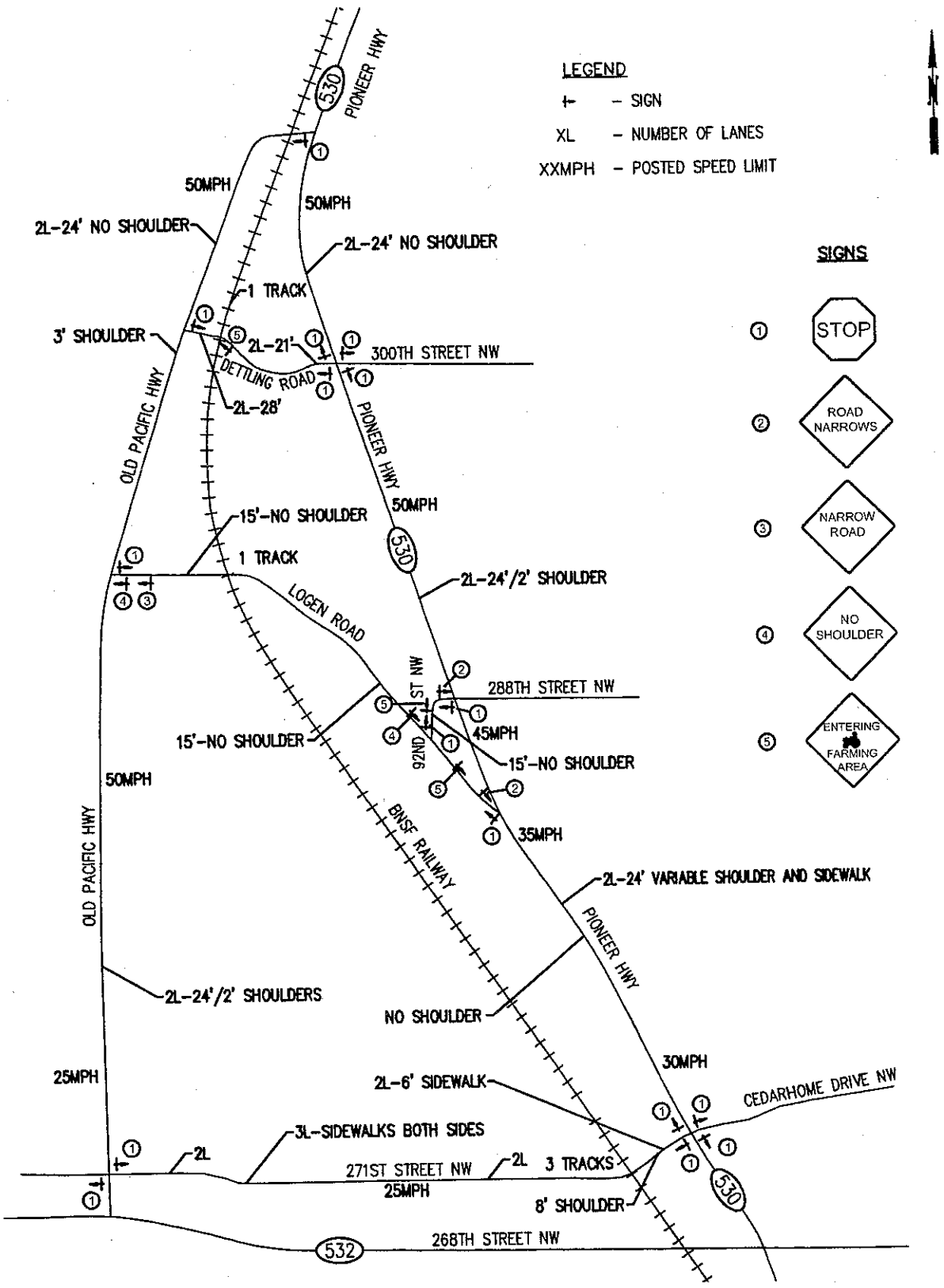
All courts shall take notice of the following tables of speed and stopping distances of motor vehicles, which shall not raise a presumption, in actions in which inquiry thereon is pertinent to the issues:

SPEED IN		AVERAGE STOPPING DISTANCES			TOTAL STOPPING DISTANCES	
Miles per Hour	Feet per Second	Automobile Brakes (In Feet)	Truck Brakes (Brakes on All Wheels) (In Feet)	Average Driver Reaction Time (3/4 seconds) (In Feet)	Automobiles (In Feet)	Trucks (In Feet)
10	14.67	5	7	11	16	18
15	22.0	12	17	16	28	33
20	29.34	21	30	22	43	52
25	36.62	32	47	27	59	74
30	44.0	47	67	33	80	100
35	51.3	63	92	38	101	130
40	58.7	82	120	44	126	164
45	66.0	104	152	50	154	202
50	73.3	128	187	55	183	242
55	80.7	155	227	61	216	288
60	88.0	185	270	66	251	336
65	95.3	217	316	71	288	387
70	102.6	252	367	77	329	444
75	109.9	289	422	82	371	504
80	117.2	328	480	88	416	568
90	132.0	425	607	99	524	706
100	146.6	514	750	109	623	859

The courts shall further take notice that such tables are the result of experiments made with motor vehicles, unloaded except for the driver, equipped with four-wheel brakes, in good condition, on dry, hard, approximately level stretches of highway free from loose material.

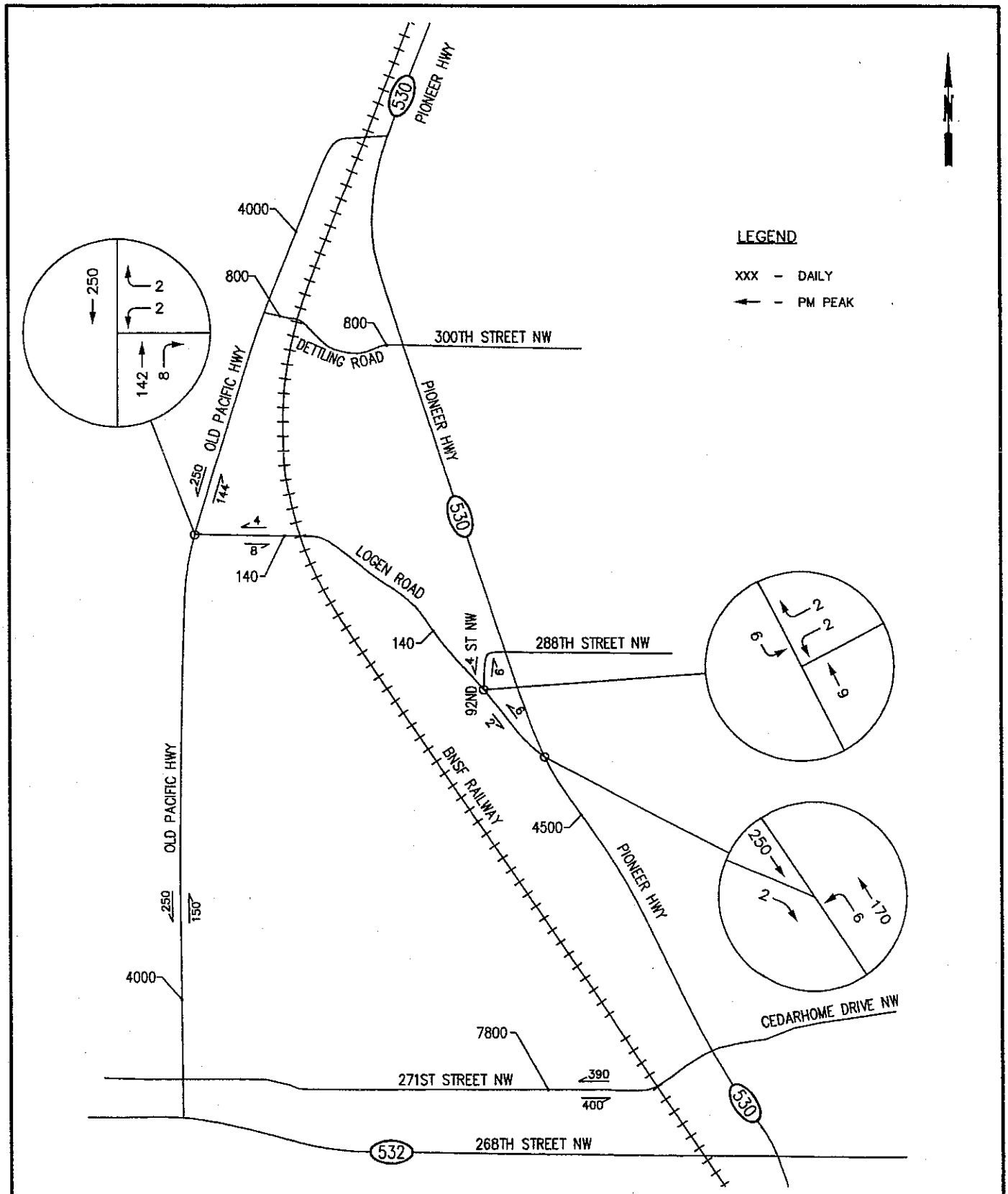
(Code 1950, § 46-212.2; 1956, c. 600; 1958, c. 541, § 46.1-195; 1989, c. 727.)

Exhibit ____ LFL-3



DN TRAFFIC CONSULTANTS	EXISTING ROADWAY GEOMETRICS FIGURE 1	LOGEN ROAD RAILWAY CROSSING CLOSURE STUDY

Exhibit No. ____ LFL-4



DN TRAFFIC CONSULTANTS	TRAFFIC VOLUMES FIGURE 2	LOGEN ROAD RAILWAY CROSSING CLOSURE STUDY

From Snohomish Co. Exhibit Z

Exhibit ____ LFL-5

DETERMINATION OF POSSIBLE INADEQUATE ROAD CONDITION

SITE LOCATION PIONEER HWY @ OLD PACIFIC HWY - EXISTING FILE NUMBER 0611FR00R96 TSA A

CLASSIFICATION R - MAJOR COLLECTOR (7); BOTH ROADS REQUESTED BY: ANDY SMITH. TDR

SUBMITTED BY D. WISEHART DATE 08/17/06

INDICATOR	DATA VALUE		INDICATOR VALUE	WEIGHT	PARTIAL INDEX	COMMENTS
NUMBER OF ACCIDENTS	1.33	ACC/YR	27	X 0.150 =	4.05	
ACCIDENT RATE	0.42	ACC/MEV	10	X 0.150 =	1.50	
ACCIDENT SEVERITY	$7,400	$/ACC	36	X 0.100 =	3.60	
VOLUME/CAPACITY RATIO	0.33		50	X 0.100 =	5.00	
SIGHT DISTANCE RATIO	0.38		100	X 0.100 =	10.00	
PEDESTRIAN/BICYCLE FACILITIES	9		90	X 0.100 =	9.00	
TRAFFIC CONFLICT	1	CONF/HR	6	X 0.150 =	0.90	
DRIVER EXPECTANCY	2		34	X 0.150 =	5.10	

TOTALS: 1.000 * 39.15 *Do not include weights for indicators not used at this location.

TOTAL INDEX = SUM OF PARTIAL INDEXES /SUM OF APPLICABLE WEIGHTS = 39.15 / 1.000 = 39.15

RELATIVE STRENGTH OF EVALUATION = SUM OF APPLICABLE WEIGHTS X 100% = 100%

NOTE: A TOTAL INDEX GREATER THAN 40 CLASSIFIES THE LOCATION AS A POSSIBLE INADEQUATE ROAD CONDITION LOCATION AND REQUIRES A DETERMINATION BY THE INADEQUATE ROAD CONDITION REVIEW BOARD AND DIRECTOR OF PUBLIC WORKS (IF APPROPRIATE).

INTERNAL REVIEW BOARD DETERMINATION

DATE: 9/1/06

____ LOCATION **SHOULD** BE CLASSIFIED AS AN INADEQUATE ROAD CONDITION

✓ LOCATION **SHOULD NOT** BE CLASSIFIED AS AN INADEQUATE ROAD CONDITION < 40 Revised

COMMENTS: Traffic Investigator to follow up with installation of W1-6(R) turn arrow with posted 10 mph. Submit to Program Planning for prioritization: 1) Signalization of Pioneer Hwy / Old Pacific Hwy. OR 2) Closure of Old Pacific Hwy and signalization at Pioneer Hwy / Dettling Rd OR 3) Roundabout at Pioneer Hwy / Dettling Rd.

INTERNAL REVIEW BOARD MEMBERS:

JIM BLOODGOOD, P.E.
TRAFFIC ENGINEER

THEAM ONG
TADM SUPERVISOR

GORDY HYDE 9/1/06
TRAFFIC INVESTIGATION SUPERVISOR

D. WISEHART 9/1/06

From Miscellaneous section of Snohomish Co Exhibit Z

Exhibit ____ LFL-6

MEMORANDUM

November 21, 2007

TO: Brent Mattila, Traffic Programs Engineer
Program Planning

FROM: Don Wisehart, Traffic Analysis & Data Management Technician

SUBJECT: **Preferred option for signalization of Pioneer Hwy. @ Old Pacific Hwy.**
IRC's: 0611FR00R96, Pioneer Hwy. @ Old Pacific Hwy.; 0612FR98R93, Pioneer Hwy. @ Dettling Rd. / 300 St. NW

Originally, a request was made to Program Planning for prioritization of the following and three options were given:

1) Signalization of Pioneer Highway @ Old Pacific Highway or
2) Closure of Old Pacific Highway and signalization of Pioneer Highway @ Dettling Road or
3) Install Roundabout at Pioneer Highway @ Dettling Road (after closure of Old Pacific Highway).

- Old Pacific - part of freight route ∴ cannot be closed.
- Truck turning radius not avail @ old Pacific/Dettling Rd if closed.

Option Number 1 (Signalization of Pioneer Highway @ Old Pacific Highway) is now the preferred option based on our meeting today with Jim Bloodgood, County Traffic Engineer. The process required for the closure of Old Pacific Highway would be cumbersome, and Dettling Road is not currently built to handle the extra vehicular and truck traffic without significant improvements.

- Dettling Rd need to be widened and curves improved for truck traff

In attendance at the meeting with Jim Bloodgood were Theam Ong, TADM Supervisor; Brent Mattila, Traffic Programs Engineer; and Don Wisehart, TADM Tech III.

- Council approval needed to close old Pacific - along factions process

dw

Attachments

Cc: Theam Ong, TADM Supervisor
Harold Wirch, P.E., Engineer IV, Traffic Signal Operations Engineer

From Snohomish County
Response labeled Exhibit AA

Exhibit ___ LFL-7

DETERMINATION OF POSSIBLE INADEQUATE ROAD CONDITION

SITE LOCATION: PIONEER HWY @ DETTLING RD/300 ST NW- | FILE NUMBER: 0612FR98R93 | TSA: A

CLASSIFICATION: R - MAJ. COLLECTOR (7); MIN. COLLECTOR (8) | REQUESTED BY: ANDY SMITH. TDR

SUBMITTED BY: D. WISEHART | DATE: 08/17/06

INDICATOR	DATA VALUE		INDICATOR VALUE	WEIGHT	PARTIAL INDEX	COMMENTS
NUMBER OF ACCIDENTS	1.00	ACC/YR	23	X 0.150 =	3.45	
ACCIDENT RATE	0.46	ACC/MEV	11	X 0.150 =	1.65	
ACCIDENT SEVERITY	$11,233	$/ACC	43	X 0.100 =	4.30	
VOLUME/CAPACITY RATIO	0.21		39	X 0.100 =	3.90	
SIGHT DISTANCE RATIO	1.21		23	X 0.100 =	2.30	
PEDESTRIAN/BICYCLE FACILITIES	9		90	X 0.100 =	9.00	
TRAFFIC CONFLICT	0	CONF/HR	0	X 0.150 =	0.00	
DRIVER EXPECTANCY	1		17	X 0.150 =	2.55	

*Do not include weights for indicators not used at this location.

TOTALS: 1.000 * 27.15

TOTAL INDEX = SUM OF PARTIAL INDEXES /SUM OF APPLICABLE WEIGHTS = 27.15 / 1.000 = 27.15

RELATIVE STRENGTH OF EVALUATION = SUM OF APPLICABLE WEIGHTS X 100% = 100%

NOTE: A TOTAL INDEX GREATER THAN 40 CLASSIFIES THE LOCATION AS A POSSIBLE INADEQUATE ROAD CONDITION LOCATION AND REQUIRES A DETERMINATION BY THE INADEQUATE ROAD CONDITION REVIEW BOARD AND DIRECTOR OF PUBLIC WORKS (IF APPROPRIATE).

INTERNAL REVIEW BOARD DETERMINATION

DATE: 9/1/06

___ LOCATION **SHOULD** BE CLASSIFIED AS AN INADEQUATE ROAD CONDITION

V LOCATION **SHOULD NOT** BE CLASSIFIED AS AN INADEQUATE ROAD CONDITION <40

COMMENTS: See Pioneer Hwy / Pacific Hwy (0611FR00R96) comments.

INTERNAL REVIEW BOARD MEMBERS:

JIM BLOODGOOD, P.E.
TRAFFIC ENGINEER

THEAM ONG
TADM SUPERVISOR

Gordon C Hyde 9/1/06

GORDY HYDE
TRAFFIC INVESTIGATION SUPERVISOR

D. WISEHART 9/1/06

S:/TES/TRAFFIC/TAD/IRQSHTS/DATASHTLESS40 EXISTING

Exhibit ___ LFL-8

Page 1 of 8

BNSF RAILWAY COMPANY
Prepared 03/11/09 Using /data/bnsf/sf/b804216/reidet2.fex
Stanwood, WA - Snohomish County Rail Incidents Incidents

NEAREST STATION:	STANWOOD WA	MILE POST:	00057.9	TRACK NAME: MAIN
SUB DIVISION:	BELLINGHAM			
COUNTY:	SNOHOMISH			
ACCT. NO.:	PA-1194-200	DATE:	1994/11/13	TIME: 22 50
TRACK TYPE:	MAIN	TRACK NUMBER:		
TYPE INCIDENT:	HGX XING COLL			
TRACK MTCE:	BN	D-CODE:	4NL200	NON-REPORTABLE
TRACK COST:	$0	EQUIPMENT COST:	$0	
PRIMARY CAUSE:	M399	OTHER HWY/RAIL CROSSING ACCT CAUSE (PROVIDE DETAILS)		
CONTRIBUTING CAUSE:		NO CONTRIBUTING CAUSE		

CONSIST: F-L001 1-01
CONSIST TYPE: TRAIN (UNITS PULLING)
TYPE EQUIPMENT: FREIGHT TRAIN

ORIGINAL ENTRY ON 1994-11-15

FREIGHT TRAIN BN TRAIN F-L001 1-01

CREW INFO:

ROAD ENGINEER	MJ MERCERI
ROAD CONDUCTOR	HE TONY
ROAD BRAKEMAN	UNKNOWN

DESCRIPTION:

TRAIN 53626 NORTHBOUND ON MAIN TRACK STANWOOD, WA. MP 57.93 STRUCK VEHICLE STOPPED ON GRADE CROSSING. CROSSING GATES AND SIGNALS WORKING. OCCUPANT SUSTAINED FATAL INJURIES AND WAS TRANSPORTED TO HARBOR VIEW HOSPITAL SEATTLE.

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BNSF RAILWAY COMPANY
Prepared 03/11/09 Using /data/bnsf/sf/b804216/reidet2.fex
Stanwood, WA - Snohomish County Rail Incidents Incidents

NEAREST STATION:	STANWOOD WA	MILE POST:	00057.9	TRACK NAME: MAIN
SUB DIVISION:	BELLINGHAM			
COUNTY:	SNOHOMISH			
ACCT. NO.:	PA-0399-200	DATE:	1999/03/07	TIME: 02 15
TRACK TYPE:	MAIN	TRACK NUMBER:	MAIN	
TYPE INCIDENT:	HGX XING COLL			
TRACK MTCE:	BNSF	D-CODE:	93L200	NON-REPORTABLE
TRACK COST:	$3,000	EQUIPMENT COST:	$0	
PRIMARY CAUSE:	M302 HIGHWAY USER INATTENTIVENESS			
CONTRIBUTING CAUSE:	NO CONTRIBUTING CAUSE			

CONSIST: M-EVEVBC1-06
CONSIST TYPE: TRAIN (UNITS PULLING)
TYPE EQUIPMENT: FREIGHT TRAIN

ORIGINAL ENTRY ON 1999-03-08

FREIGHT TRAIN BNSF TRAIN M-EVEVBC1-06

CREW INFO:

ROAD ENGINEER SG MCARTHUR
ROAD CONDUCTOR JP OCONNOR
ROAD HEAD BRAKEM CD TAYLOR

DESCRIPTION: PER NOC REPORT: FOLLOW UP REQUIRED BY PACIFIC DIV.

M-EVEVBC1-06 REPORTS STRIKING AUTOMOBILE AT MP
57.93 BETWEEN STANWOOD AND MT VERNON.
SIGNAL DAMAGES INCLUDE REPLACING OF SIGNAL MAST, BASE,
GATE, AND LIGHTS.

BNSF RAILWAY COMPANY
Prepared 03/11/09 Using /data/bnsf/sf/b804216/reidet2.fex
Stanwood, WA - Snohomish County Rail Incidents Incidents

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Page 3 of 8

NEAREST STATION: STANWOOD WA MILE POST: 00000.0 TRACK NAME: WOLKIL LD
SUB DIVISION: BELLINGHAM
COUNTY: SNOHOMISH
ACCT. NO.: PA-1291-204 DATE: 1991/12/11 TIME: 07 28
TRACK TYPE: INDUSTRY TRACK NUMBER:
TYPE INCIDENT: HGX XING COLL
TRACK MTCE: INDUSTRY D-CODE: 1DL204 NON-REPORTABLE
TRACK COST: $0 EQUIPMENT COST: $0
PRIMARY CAUSE: M399 OTHER HWY/RAIL CROSSING ACCT CAUSE (PROVIDE DETAILS)
CONTRIBUTING CAUSE: NO CONTRIBUTING CAUSE
CONSIST: F-L001 1-01
CONSIST TYPE: TRAIN (UNITS PUSHING)
TYPE EQUIPMENT: FREIGHT TRAIN

ORIGINAL ENTRY ON 1991-12-11

FREIGHT TRAIN BN TRAIN F-L001 1-01

CREW INFO: ROAD ENGINEER JE TASCHE
ROAD CONDUCTOR AB COY

DESCRIPTION: TRAIN 01-53818-11 PUSHING CARS AT INDUSTRY OF WOLFKILL AT STANWOOD, WASHINGTON STRUCK 91 CHEVY CAPRICE DRIVEN BY R C CLEARY OF 27820 83RD NW, STANWOOD, WA AT 271ST NW CROSSING. NO INJURIES. PAGE 4 OF 15012 NOT RECEIVED SRS TILL 1-15-92.

2-25

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DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION (FRA)

HIGHWAY-RAIL GRADE CROSSING ACCIDENT/INCIDENT REPORT

OMB Approval No. 2130-0500

Name Of		Alphabetic Code	RR Accident/Incident No.
1. Reporting Railroad	Burlington Northern RR Co. [BN]	1a. BN	1b. CA0146
2. Other Railroad Involved in Train Accident/Incident		2a.	2b.
3. Railroad Responsible for Track Maintenance	Burlington Northern RR Co. [BN]	3a. BN	3b. CA0146

4. U.S. DOT-AAR Grade Crossing ID No.	5. Date of Accident/Incident	6. Time of Accident/Incident
084716K	07/05/94	01:15 AM

7. Nearest Railroad Station	8. Division	9. County	10. State Abbr. / Code	
STANWOOD		SNOHOMISH	53	WA

11. City *(if in a city)*	12. Highway Name or No.	
	102ND AVENUE 61st Pacific Hwy	☑ Public ☐ Private

Highway User Involved

13. Type — Code: A
C. Truck-trailer F. Bus J. Other Motor Vehicle
A. Auto D. Pick-up truck G. School Bus K. Pedestrian
B. Truck E. Van H. Motorcycle M. Other *(specify)*

14. Vehicle Speed *(est. mph at impact)*: 0

15. Direction *(geographical)* — Code: 1
1. North 2. South 3. East 4. West

16. Position — Code: 1
1. Stalled on crossing 3. Moving over crossing
2. Stopped on Crossing 4. Trapped

20a. Was the highway user and/or rail equipment involved in the impact transporting hazardous materials? — Code: 2
1. Highway User 2. Rail Equipment 3. Both 4. Neither

Rail Equipment Involved

17. Equipment — Code: 1
1. Train *(units pulling)* 4. Car(s) *(moving)* 8. Other *(specify)*
2. Train *(units pushing)* 5. Car(s) *(standing)* A. Train pulling- RCL
3. Train *(standing)* 6. Light loco(s) *(moving)* B. Train pushing- RCL
7. Light loco(s) *(standing)* C. Train standing- RCL

18. Position of Car Unit in Train: 1

19. Circumstance — Code: 1
1. Rail equipment struck highway user
2. Rail equipment struck by highway user

20b. Was there a hazardous materials release by — Code:
1. Highway User 2. Rail Equipment 3. Both 4. Neither

20c. State the name and quantity of the hazardous materials released, if any

21. Temperature *(specify if minus)*	22. Visibility *(single entry)* — Code	23. Weather *(single entry)* — Code
55 °F	4	2
	1. Dawn 2. Day 3. Dusk 4. Dark	1. Clear 2. Cloudy 3. Rain 4. Fog 5. Sleet 6. Snow

24. Type of Equipment Consist *(single entry)* — Code	25. Track Type Used by Rail Equipment Involved — Code	26. Track Number or Name
A. Spec. MoW 1. Freight train 4. Work train 7. Yard/Switching 2. Passenger train 5. Single car 8. Light loco(s) 3. Commuter train 6. Cut of cars 9. Main./inspect. 1	1. Main 2. Yard 3. Siding 4. Industry 1	SINGLE MAIN TRACK

27. FRA Track Class	28. Number of Locomotive Units	29. Number of Cars	30. Consist Speed *(Recorded if available)* — Code	31. Time Table Direction — Code
3	3	41	R. Recorded E. Estimated 40 mph E	1. North 2. South 3. East 4. West 1

32. Type of Crossing Warning	33. Signaled Crossing Warning	34. Whistle Ban — Code
1. Gates 4. Wig wags 7. Crossbucks 10. Flagged by crew 2. Cantilever FLS 5. Hwy. traffic signals 8. Stop signs 11. Other *(specify)* 3. Standard FLS 6. Audible 9. Watchman 12. None	20 sec warn min (1);	1. Yes 2. No 3. Unknown
Code(s): 01 03 06		

35. Location of Warning — Code	36. Crossing Warning with Highway Signals — Code	37. Crossing Illuminated by Street Lights or Special Lights — Code
1. Both Sides 2. Side of Vehicle Approach 3. Opposite Side of Vehicle Approach 1	1. Yes 2. No 3. Unknown 2	1. Yes 2. No 3. Unknown 1

38. Driver's Age	39. Driver's Gender — Code	40. Driver Drove Behind or in Front of Train and Struck or was Struck by Second Train — Code	41. Driver — Code
	1. Male 2. Female	1. Yes 2. No 3. Unknown 2	1. Drove around or thru the gate 4. Stopped on crossing 2. Stopped and then proceeded 5. Other *(specify)* 3. Did not stop 4

42. Driver Passed Standing Highway Vehicle — Code	43. View of Track Obscured by *(primary obstruction)* — Code
1. Yes 2. No 3. Unknown 2	1. Permanent Structure 3. Passing Train 5. Vegetation 7. Other *(specify)* 2. Standing railroad equipment 4. Topography 6. Highway Vehicles 8. Not Obstructed 8

Casualties to:	Killed	Injured
46. Highway-Rail Crossing Users	0	0
49. Railroad Employees	0	0
52. Passengers on Train	0	0

44. Driver was — Code	45. Was Driver in the Vehicle? — Code
1. Killed 2. Injured 3. Uninjured 3	1. Yes 2. No 2

47. Highway Vehicle Property Damage *(est. dollar damage)*	48. Total Number of Highway-Rail Crossing Users *(include driver)*
$5,000	0

50. Total Number of People on Train *(include passengers and crew)*	51. Is a Rail Equipment Accident / Incident Report Being Filed — Code
	1. Yes 2. No 2

53a. Special Study Block

53b. Special Study Block

54. Narrative Description

55. Typed Name and Title	56. Signature	57. Date

FORM FRA F 6180.57

* NOTE THAT ALL CASUALTIES MUST BE REPORTED ON FORM FRA F 6180.55A

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DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION (FRA)

HIGHWAY-RAIL GRADE CROSSING ACCIDENT/INCIDENT REPORT

OMB Approval No. 2130-0500

Name Of		Alphabetic Code	RR Accident/Incident No.
1. Reporting Railroad	Burlington Northern RR Co. [BN]	1a. BN	1b. PA745
2. Other Railroad Involved in Train Accident/Incident		2a.	2b.
3. Railroad Responsible for Track Maintenance		3a.	3b.

4. U.S. DOT-AAR Grade Crossing ID No.	5. Date of Accident/Incident	6. Time of Accident/Incident
084716K	06/10/76	07:50 AM

7. Nearest Railroad Station	8. Division	9. County	10. State Abbr.	Code
STANWOOD WASH		SNOHOMISH	53	WA

11. City *(if in a city)*

12. Highway Name or No. **OLD PACIFIC HIGHWAY** ☑ Public ☐ Private

Highway User Involved

13. Type — A. Auto; B. Truck; C. Truck-trailer; D. Pick-up truck; E. Van; F. Bus; G. School Bus; H. Motorcycle; J. Other Motor Vehicle; K. Pedestrian; M. Other *(specify)* — Code: **A**

14. Vehicle Speed *(est. mph at impact)*

15. Direction *(geographical)* 1. North 2. South 3. East 4. West — Code: **4**

16. Position 1. Stalled on crossing 2. Stopped on Crossing 3. Moving over crossing 4. Trapped — Code: **3**

20a. Was the highway user and/or rail equipment involved in the impact transporting hazardous materials? 1. Highway User 2. Rail Equipment 3. Both 4. Neither — Code: **4**

Rail Equipment Involved

17. Equipment — 1. Train *(units pulling)*; 2. Train *(units pushing)*; 3. Train *(standing)*; 4. Car(s) *(moving)*; 5. Car(s) *(standing)*; 6. Light loco(s) *(moving)*; 7. Light loco(s) *(standing)*; 8. Other *(specify)*; A. Train pulling- RCL; B. Train pushing- RCL; C. Train standing- RCL — Code: **8**

18. Position of Car Unit in Train: **1**

19. Circumstance 1. Rail equipment struck highway user 2. Rail equipment struck by highway user — Code: **1**

20b. Was there a hazardous materials release by 1. Highway User 2. Rail Equipment 3. Both 4. Neither — Code:

20c. State the name and quantity of the hazardous materials released, if any

21. Temperature *(specify if minus)*: **50 °F**

22. Visibility *(single entry)* 1. Dawn 2. Day 3. Dusk 4. Dark — Code: **2**

23. Weather *(single entry)* 1. Clear 2. Cloudy 3. Rain 4. Fog 5. Sleet 6. Snow — Code: **2**

24. Type of Equipment Consist *(single entry)* — A. Spec. MoW; 1. Freight train; 2. Passenger train; 3. Commuter train; 4. Work train; 5. Single car; 6. Cut of cars; 7. Yard/Switching; 8. Light loco(s); 9. Main./inspect. — Code: **8**

25. Track Type Used by Rail Equipment Involved 1. Main 2. Yard 3. Siding 4. Industry — Code: **1**

26. Track Number or Name: **SINGLE MAIN TRACK**

27. FRA Track Class	28. Number of Locomotive Units	29. Number of Cars	30. Consist Speed *(Recorded if available)*	Code	31. Time Table Direction	Code
4	0	1	R. Recorded; E. Estimated **10** mph	E	1. North 2. South 3. East 4. West	4

32. Type of Crossing Warning — 1. Gates; 2. Cantilever FLS; 3. Standard FLS; 4. Wig wags; 5. Hwy. traffic signals; 6. Audible; 7. Crossbucks; 8. Stop signs; 9. Watchman; 10. Flagged by crew; 11. Other *(specify)*; 12. None

Code(s): **03**

33. Signaled Crossing Warning: **Allgd. no warn (4);**

34. Whistle Ban 1. Yes 2. No 3. Unknown — Code:

35. Location of Warning 1. Both Sides 2. Side of Vehicle Approach 3. Opposite Side of Vehicle Approach — Code: **1**

36. Crossing Warning with Highway Signals 1. Yes 2. No 3. Unknown — Code: **3**

37. Crossing Illuminated by Street Lights or Special Lights 1. Yes 2. No 3. Unknown — Code: **2**

38. Driver's Age

39. Driver's Gender 1. Male 2. Female — Code:

40. Driver Drove Behind or in Front of Train and Struck or was Struck by Second Train 1. Yes 2. No 3. Unknown — Code: **2**

41. Driver 1. Drove around or thru the gate 2. Stopped and then proceeded 3. Did not stop 4. Stopped on crossing 5. Other *(specify)* — Code: **3**

42. Driver Passed Standing Highway Vehicle 1. Yes 2. No 3. Unknown — Code: **2**

43. View of Track Obscured by *(primary obstruction)* 1. Permanent Structure 2. Standing railroad equipment 3. Passing Train 4. Topography 5. Vegetation 6. Highway Vehicles 7. Other *(specify)* 8. Not Obstructed — Code: **8**

Casualties to:	Killed	Injured
46. Highway-Rail Crossing Users	0	0
49. Railroad Employees	0	0
52. Passengers on Train	0	0

44. Driver was 1. Killed 2. Injured 3. Uninjured — Code: **3**

45. Was Driver in the Vehicle? 1. Yes 2. No — Code: **1**

47. Highway Vehicle Property Damage *(est. dollar damage)*: **$200**

48. Total Number of Highway-Rail Crossing Users *(include driver)*: **1**

50. Total Number of People on Train *(include passengers and crew)*

51. Is a Rail Equipment Accident / Incident Report Being Filed 1. Yes 2. No — Code: **2**

53a. Special Study Block

53b. Special Study Block

54. Narrative Description

55. Typed Name and Title	56. Signature	57. Date

FORM FRA F 6180.57

* NOTE THAT ALL CASUALTIES MUST BE REPORTED ON FORM FRA F 6180.55A

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DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION (FRA)

HIGHWAY-RAIL GRADE CROSSING ACCIDENT/INCIDENT REPORT

OMB Approval No. 2130-0500

Name Of		Alphabetic Code	RR Accident/Incident No.
1. Reporting Railroad	Burlington Northern RR Co. [BN]	1a. BN	1b. CA0240
2. Other Railroad Involved in Train Accident/Incident		2a.	2b.
3. Railroad Responsible for Track Maintenance	Burlington Northern RR Co. [BN]	3a. BN	3b. CA0240

4. U.S. DOT-AAR Grade Crossing ID No.	5. Date of Accident/Incident	6. Time of Accident/Incident
084716K	11/13/94	10:50 PM

7. Nearest Railroad Station	8. Division	9. County	10. State Abbr.	Code
STANWOOD		SNOHOMISH	53	WA

11. City *(if in a city)*

12. Highway Name or No. 102ND STREET Pacific Hwy ☑ Public ☐ Private

Highway User Involved — **Rail Equipment Involved** (South)

13. Type	Code
A. Auto B. Truck C. Truck-trailer D. Pick-up truck E. Van F. Bus G. School Bus H. Motorcycle J. Other Motor Vehicle K. Pedestrian M. Other *(specify)*	A

17. Equipment	Code
1. Train *(units pulling)* 2. Train *(units pushing)* 3. Train *(standing)* 4. Car(s) *(moving)* 5. Car(s) *(standing)* 6. Light loco(s) *(moving)* 7. Light loco(s) *(standing)* 8. Other *(specify)* A. Train pulling- RCL B. Train pushing- RCL C. Train standing- RCL	1

14. Vehicle Speed *(est. mph at impact)*	15. Direction *(geographical)* 1. North 2. South 3. East 4. West	Code	18. Position of Car Unit in Train
0		3	1

16. Position	Code	19. Circumstance	Code
1. Stalled on crossing 2. Stopped on Crossing 3. Moving over crossing 4. Trapped	2	1. Rail equipment struck highway user 2. Rail equipment struck by highway user	1

20a. Was the highway user and/or rail equipment involved in the impact transporting hazardous materials? 1. Highway User 2. Rail Equipment 3. Both 4. Neither	Code	20b. Was there a hazardous materials release by 1. Highway User 2. Rail Equipment 3. Both 4. Neither	Code
	4		

20c. State the name and quantity of the hazardous materials released, if any

21. Temperature *(specify if minus)*	22. Visibility *(single entry)* 1. Dawn 2. Day 3. Dusk 4. Dark	Code	23. Weather *(single entry)* 1. Clear 2. Cloudy 3. Rain 4. Fog 5. Sleet 6. Snow	Code
50 °F		4		1

24. Type of Equipment Consist *(single entry)* A. Spec. MoW 1. Freight train 2. Passenger train 3. Commuter train 4. Work train 5. Single car 6. Cut of cars 7. Yard/Switching 8. Light loco(s) 9. Main./inspect.	Code	25. Track Type Used by Rail Equipment Involved 1. Main 2. Yard 3. Siding 4. Industry	Code	26. Track Number or Name
	1		1	SINGLE MAIN TRACK

27. FRA Track Class	28. Number of Locomotive Units	29. Number of Cars	30. Consist Speed *(Recorded if available)* R. Recorded E. Estimated	Code	31. Time Table Direction 1. North 2. South 3. East 4. West	Code
4	3	73	48 mph	E		1

32. Type of Crossing Warning	33. Signaled Crossing Warning	34. Whistle Ban 1. Yes 2. No 3. Unknown	Code
1. Gates 2. Cantilever FLS 3. Standard FLS 4. Wig wags 5. Hwy. traffic signals 6. Audible 7. Crossbucks 8. Stop signs 9. Watchman 10. Flagged by crew 11. Other *(specify)* 12. None	20 sec warn min (1);		

Code(s)							
	01	03	06				

35. Location of Warning 1. Both Sides 2. Side of Vehicle Approach 3. Opposite Side of Vehicle Approach	Code	36. Crossing Warning with Highway Signals 1. Yes 2. No 3. Unknown	Code	37. Crossing Illuminated by Street Lights or Special Lights 1. Yes 2. No 3. Unknown	Code
	1		2		2

38. Driver's Age	39. Driver's Gender 1. Male 2. Female	Code	40. Driver Drove Behind or in Front of Train and Struck or was Struck by Second Train 1. Yes 2. No 3. Unknown	Code	41. Driver 1. Drove around or thru the gate 2. Stopped and then proceeded 3. Did not stop 4. Stopped on crossing 5. Other *(specify)*	Code
				2		4

42. Driver Passed Standing Highway Vehicle 1. Yes 2. No 3. Unknown	Code	43. View of Track Obscured by *(primary obstruction)* 1. Permanent Structure 2. Standing railroad equipment 3. Passing Train 4. Topography 5. Vegetation 6. Highway Vehicles 7. Other *(specify)* 8. Not Obstructed	Code
	2		8

Casualties to:	Killed	Injured	44. Driver was 1. Killed 2. Injured 3. Uninjured	Code	45. Was Driver in the Vehicle? 1. Yes 2. No	Code
				1		2
46. Highway-Rail Crossing Users	1	0	47. Highway Vehicle Property Damage *(est. dollar damage)*	$3,000	48. Total Number of Highway-Rail Crossing Users *(include driver)*	1
49. Railroad Employees	0	0	50. Total Number of People on Train *(include passengers and crew)*		51. Is a Rail Equipment Accident / Incident Report Being Filed 1. Yes 2. No	Code
52. Passengers on Train	0	0				2

53a. Special Study Block

53b. Special Study Block

54. Narrative Description

55. Typed Name and Title	56. Signature	57. Date

FORM FRA F 6180.57

* NOTE THAT ALL CASUALTIES MUST BE REPORTED ON FORM FRA F 6180.55A

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DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION (FRA)

HIGHWAY-RAIL GRADE CROSSING ACCIDENT/INCIDENT REPORT

OMB Approval No. 2130-0500

Name Of		Alphabetic Code	RR Accident/Incident No.
1. Reporting Railroad	Chicago, Milwaukee, St. Paul & Pacific RR [MILW]	1a. MILW	1b. 916401
2. Other Railroad Involved in Train Accident/Incident		2a.	2b.
3. Railroad Responsible for Track Maintenance	Burlington Northern RR Co. [BN]	3a. BN	3b. XXX

4. U.S. DOT-AAR Grade Crossing ID No.	5. Date of Accident/Incident	6. Time of Accident/Incident
084714W	07/13/78	05:57 AM

7. Nearest Railroad Station	8. Division	9. County	10. State Abbr.	Code
STANWOOD		SNOHOMISH	53	WA

11. City *(if in a city)*	12. Highway Name or No.	
STANWOOD	DETTLING ROAD	☑ Public ☐ Private

Highway User Involved

13. Type — Code: B
C. Truck-trailer F. Bus J. Other Motor Vehicle
A. Auto D. Pick-up truck G. School Bus K. Pedestrian
B. Truck E. Van H. Motorcycle M. Other *(specify)*

14. Vehicle Speed *(est. mph at impact)*: 20

15. Direction *(geographical)* — Code: 4
1. North 2. South 3. East 4. West

16. Position — Code: 3
1. Stalled on crossing 3. Moving over crossing
2. Stopped on Crossing 4. Trapped

20a. Was the highway user and/or rail equipment involved in the impact transporting hazardous materials? — Code: 3
1. Highway User 2. Rail Equipment 3. Both 4. Neither

Rail Equipment Involved

17. Equipment — Code: 1
1. Train *(units pulling)* 4. Car(s) *(moving)* 8. Other *(specify)*
2. Train *(units pushing)* 5. Car(s) *(standing)* A. Train pulling- RCL
3. Train *(standing)* 6. Light loco(s) *(moving)* B. Train pushing- RCL
7. Light loco(s) *(standing)* C. Train standing- RCL

18. Position of Car Unit in Train: 1

19. Circumstance — Code: 2
1. Rail equipment struck highway user
2. Rail equipment struck by highway user

20b. Was there a hazardous materials release by — Code:
1. Highway User 2. Rail Equipment 3. Both 4. Neither

20c. State the name and quantity of the hazardous materials released, if any

21. Temperature *(specify if minus)*	22. Visibility *(single entry)*	Code	23. Weather *(single entry)*	Code
55 °F	1. Dawn 2. Day 3. Dusk 4. Dark	1	1. Clear 2. Cloudy 3. Rain 4. Fog 5. Sleet 6. Snow	1

24. Type of Equipment Consist *(single entry)*	Code	25. Track Type Used by Rail Equipment Involved	Code	26. Track Number or Name
A. Spec. MoW 1. Freight train 4. Work train 7. Yard/Switching 2. Passenger train 5. Single car 8. Light loco(s) 3. Commuter train 6. Cut of cars 9. Main./inspect.	1	1. Main 2. Yard 3. Siding 4. Industry	1	SINGLE MAIN LINE

27. FRA Track Class	28. Number of Locomotive Units	29. Number of Cars	30. Consist Speed *(Recorded if available)*	Code	31. Time Table Direction	Code
4	2	27	R. Recorded E. Estimated 50 mph	E	1. North 2. South 3. East 4. West	4

32. Type of Crossing Warning	33. Signaled Crossing Warning	34. Whistle Ban	Code
1. Gates 4. Wig wags 7. Crossbucks 10. Flagged by crew 2. Cantilever FLS 5. Hwy. traffic signals 8. Stop signs 11. Other *(specify)* 3. Standard FLS 6. Audible 9. Watchman 12. None		1. Yes 2. No 3. Unknown	

Code(s): 07 | 11

35. Location of Warning	Code	36. Crossing Warning with Highway Signals	Code	37. Crossing Illuminated by Street Lights or Special Lights	Code
1. Both Sides 2. Side of Vehicle Approach 3. Opposite Side of Vehicle Approach	1	1. Yes 2. No 3. Unknown	2	1. Yes 2. No 3. Unknown	3

38. Driver's Age	39. Driver's Gender	Code	40. Driver Drove Behind or in Front of Train and Struck or was Struck by Second Train	Code	41. Driver	Code
	1. Male 2. Female		1. Yes 2. No 3. Unknown	2	1. Drove around or thru the gate 4. Stopped on crossing 2. Stopped and then proceeded 5. Other *(specify)* 3. Did not stop	3

42. Driver Passed Standing Highway Vehicle 1. Yes 2. No 3. Unknown	Code	43. View of Track Obscured by *(primary obstruction)*	Code
	2	1. Permanent Structure 3. Passing Train 5. Vegetation 7. Other *(specify)* 2. Standing railroad equipment 4. Topography 6. Highway Vehicles 8. Not Obstructed	8

Casualties to:	Killed	Injured
46. Highway-Rail Crossing Users	0	1
49. Railroad Employees	0	0
52. Passengers on Train	0	0

44. Driver was 1. Killed 2. Injured 3. Uninjured	Code: 2	45. Was Driver in the Vehicle? 1. Yes 2. No	Code: 1
47. Highway Vehicle Property Damage *(est. dollar damage)*	$2,500	48. Total Number of Highway-Rail Crossing Users *(include driver)*	1
50. Total Number of People on Train *(include passengers and crew)*		51. Is a Rail Equipment Accident / Incident Report Being Filed 1. Yes 2. No	Code: 2

53a. Special Study Block

53b. Special Study Block

54. Narrative Description

55. Typed Name and Title	56. Signature	57. Date

FORM FRA F 6180.57

* NOTE THAT ALL CASUALTIES MUST BE REPORTED ON FORM FRA F 6180.55A

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DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION (FRA)

HIGHWAY-RAIL GRADE CROSSING ACCIDENT/INCIDENT REPORT

LFL-8 Page 8 of 8

OMB Approval No. 2130-0500

Name Of		Alphabetic Code	RR Accident/Incident No.
1. Reporting Railroad	Burlington Northern RR Co. [BN]	1a. BN	1b. PA1550
2. Other Railroad Involved in Train Accident/Incident		2a.	2b.
3. Railroad Responsible for Track Maintenance	Burlington Northern RR Co. [BN]	3a. BN	3b. PA1550

4. U.S. DOT-AAR Grade Crossing ID No.	5. Date of Accident/Incident	6. Time of Accident/Incident
084714W	11/03/80	12:10 PM

7. Nearest Railroad Station	8. Division	9. County	10. State Abbr.	Code
STANWOOD		SNOHOMISH	53	WA

11. City *(if in a city)*

12. Highway Name or No. BETTLING RD ☑ Public ☐ Private

Highway User Involved

13. Type — A. Auto, B. Truck, C. Truck-trailer, D. Pick-up truck, E. Van, F. Bus, G. School Bus, H. Motorcycle, J. Other Motor Vehicle, K. Pedestrian, M. Other *(specify)* — Code: B

14. Vehicle Speed *(est. mph at impact)*: 8

15. Direction *(geographical)* — 1. North 2. South 3. East 4. West — Code: 4

16. Position — 1. Stalled on crossing, 2. Stopped on Crossing, 3. Moving over crossing, 4. Trapped — Code: 3

20a. Was the highway user and/or rail equipment involved in the impact transporting hazardous materials? — 1. Highway User 2. Rail Equipment 3. Both 4. Neither — Code: 4

Rail Equipment Involved

17. Equipment — 1. Train *(units pulling)*, 2. Train *(units pushing)*, 3. Train *(standing)*, 4. Car(s) *(moving)*, 5. Car(s) *(standing)*, 6. Light loco(s) *(moving)*, 7. Light loco(s) *(standing)*, 8. Other *(specify)* — A. Train pulling- RCL, B. Train pushing- RCL, C. Train standing- RCL — Code: 1

18. Position of Car Unit in Train: 1

19. Circumstance — 1. Rail equipment struck highway user, 2. Rail equipment struck by highway user — Code: 1

20b. Was there a hazardous materials release by — 1. Highway User 2. Rail Equipment 3. Both 4. Neither — Code:

20c. State the name and quantity of the hazardous materials released, if any

21. Temperature *(specify if minus)*: 55 °F

22. Visibility *(single entry)* — 1. Dawn 2. Day 3. Dusk 4. Dark — Code: 2

23. Weather *(single entry)* — 1. Clear 2. Cloudy 3. Rain 4. Fog 5. Sleet 6. Snow — Code: 2

24. Type of Equipment Consist *(single entry)* — A. Spec. MoW, 1. Freight train, 2. Passenger train, 3. Commuter train, 4. Work train, 5. Single car, 6. Cut of cars, 7. Yard/Switching, 8. Light loco(s), 9. Main./inspect. — Code: 4

25. Track Type Used by Rail Equipment Involved — 1. Main 2. Yard 3. Siding 4. Industry — Code: 1

26. Track Number or Name: SINGLE MAIN TRACK

27. FRA Track Class: 4

28. Number of Locomotive Units: 2

29. Number of Cars: 13

30. Consist Speed *(Recorded if available)* — R. Recorded, E. Estimated: 32 mph — Code: E

31. Time Table Direction — 1. North 2. South 3. East 4. West — Code: 3

32. Type of Crossing Warning — 1. Gates, 2. Cantilever FLS, 3. Standard FLS, 4. Wig wags, 5. Hwy. traffic signals, 6. Audible, 7. Crossbucks, 8. Stop signs, 9. Watchman, 10. Flagged by crew, 11. Other *(specify)*, 12. None — Code(s): 07

33. Signaled Crossing Warning

34. Whistle Ban — 1. Yes 2. No 3. Unknown — Code:

35. Location of Warning — 1. Both Sides, 2. Side of Vehicle Approach, 3. Opposite Side of Vehicle Approach — Code: 1

36. Crossing Warning with Highway Signals — 1. Yes 2. No 3. Unknown — Code: 3

37. Crossing Illuminated by Street Lights or Special Lights — 1. Yes 2. No 3. Unknown — Code: 3

38. Driver's Age

39. Driver's Gender — 1. Male, 2. Female — Code:

40. Driver Drove Behind or in Front of Train and Struck or was Struck by Second Train — 1. Yes 2. No 3. Unknown — Code: 2

41. Driver — 1. Drove around or thru the gate, 2. Stopped and then proceeded, 3. Did not stop, 4. Stopped on crossing, 5. Other *(specify)* — Code: 3

42. Driver Passed Standing Highway Vehicle — 1. Yes 2. No 3. Unknown — Code: 2

43. View of Track Obscured by *(primary obstruction)* — 1. Permanent Structure, 2. Standing railroad equipment, 3. Passing Train, 4. Topography, 5. Vegetation, 6. Highway Vehicles, 7. Other *(specify)*, 8. Not Obstructed — Code: 8

Casualties to:	Killed	Injured
46. Highway-Rail Crossing Users	0	1
49. Railroad Employees	0	0
52. Passengers on Train	0	0

44. Driver was — 1. Killed 2. Injured 3. Uninjured — Code: 2

45. Was Driver in the Vehicle? — 1. Yes 2. No — Code: 1

47. Highway Vehicle Property Damage *(est. dollar damage)*: $1,500

48. Total Number of Highway-Rail Crossing Users *(include driver)*: 2

50. Total Number of People on Train *(include passengers and crew)*

51. Is a Rail Equipment Accident / Incident Report Being Filed — 1. Yes 2. No — Code: 2

53a. Special Study Block

53b. Special Study Block

54. Narrative Description

55. Typed Name and Title	56. Signature	57. Date

FORM FRA F 6180.57

* NOTE THAT ALL CASUALTIES MUST BE REPORTED ON FORM FRA F 6180.55A

Exhibit ____ LFL-9

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U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

HIGHWAY/RAIL GRADE CROSSING TECHNICAL WORKING GROUP (TWG)

NOVEMBER 2002

GUIDANCE ON TRAFFIC CONTROL DEVICES AT HIGHWAY-RAIL GRADE CROSSINGS

EXECUTIVE SUMMARY

The Technical Working Group (TWG) established by the U.S. Department of Transportation, is led by representatives from the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), Federal Transit Administration (FTA), and the National Highway Traffic Safety Administration (NHTSA). The cooperation among the various representatives of the TWG represents a landmark effort to enhance communication between highway agencies, railroad companies and authorities, and governmental agencies involved with developing and implementing policies, rules and regulations.

The report is intended to provide guidance to assist engineers in selection of traffic control devices or other measures at highway-rail grade crossings. It is not to be interpreted as policy or standards. Any requirements that may be noted in this guidance are taken from the Manual on Uniform Traffic Control Devices (MUTCD) or other document identified by footnotes. These authorities should be followed. This guide merely tries to incorporate some of the requirements found in those documents. A number of measures are included which may not have been supported by quantitative research, but are being used by States and local agencies. These are included to inform practitioners of an array of tools used or being explored.

The goal is to provide a guidance document for users who understand general engineering and operational concepts of highway-rail grade crossings. The Guide serves as a reference to aid in decisions to install traffic control devices or otherwise improve such crossings. Additional references are provided as resource for further information.

The Guide discusses a number of existing laws, regulations and policies of the FHWA and FRA concerning highway-rail grade crossings and railroad operations, driver needs concerning various sight distance, and highway and rail system operational requirements and functional classification. There is an extensive description of passive and active traffic control devices, including supplemental devices used in conjunction with active controls. Traffic control devices in the 2000 edition of the MUTCD are listed, together with a few experimental devices. An appendix provides limited discussion on the complex topic of interconnection and preemption of traffic signals near highway-rail grade crossings. There is also discussion concerning closure, grade separation and consideration for installing new grade crossings. A glossary defines a few less familiar and technical terms. (Please note that the term grade crossings is synonymous with both the terms "highway-rail grade crossings" and "highway-rail intersections" in this document.)

A traffic control device selection procedure and extensive list of quantitative guidance are the specific products of this document. However, due to the unique characteristics of each individual crossing, these procedures and practices should not be considered as warrants or standards. Therefore, selection decisions must be made based on engineering studies.

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safety.fhwa.dot.gov/media/ftwgreport.htm

FOUR-QUADRANT TRAFFIC GATE SYSTEMS

Four-quadrant gate systems consist of a series of automatic flashing-light signals and gates where the gates extend across both the approach and departure side of roadway lanes. Unlike two-quadrant gate systems, four-quadrant gates provide additional visual constraint and inhibit nearly all traffic movements over the crossing after the gates have been lowered. At this time, only a small number of four-quadrant gate systems have been installed in the U.S., and incorporate different types of designs to prevent vehicles from being trapped between the gates.

Table 2, prepared by members of the TWG, relates the typical minimal clearing sight distances for various train speeds and vehicle types. (It should be noted the column for 65 foot double trucks generally corresponds to the distances listed in table 36 on page 133 of the *RHGCH*, under the column for vehicle speed of "0 MPH." Vehicle acceleration data has been interpreted from the *Traffic Engineering Handbook*.[6]) The person or agency evaluating the crossing should determine the specific design vehicle, pedestrian, bicyclist, or other non-motorized conveyance and compute clearing sight distance if it is not represented in the table. Also note the table values are for a level, 90-degree crossing of a single track. If other circumstances are encountered, the values **must** be **re-computed**.

TABLE 2
CLEARING SIGHT DISTANCE (in feet) *

Train Speed	Car	Single Unit-Truck	Bus	WB-50 Semi-Truck	65-ft Double Truck	Pedestrian **
10	105	185	200	225	240	180
20	205	365	400	450	485	355
25	255	455	500	560	605	440
30	310	550	600	675	725	530
40	410	730	795	895	965	705
50	515	910	995	1,120	1,205	880
60	615	1,095	1,195	1,345	1,445	1,060
70	715	1,275	1,395	1,570	1,680	1,235
80	820	1,460	1,590	1,790	1,925	1,410
90	920	1,640	1,790	2,015	2,165	1,585

Lesson 38: Four-Quadrant Gated Crossing

September 13, 2000

1. Executive Summary

On September 29, 1997, the Massachusetts Bay Transportation Authority (MBTA) successfully completed the rehabilitation of the Old Colony Railroad Rehabilitation (OCRR) Lines. This commuter line restored rail service to 32 South Shore communities between Braintree and Plymouth/Middleborough areas. The OCRR services an area covering nearly 450 square miles and is comprised of approximately 70 miles of track, 44 signalized grade crossings and 15 stations. Today, the local roads, which accommodate more automobiles, have trains traveling at speeds up to 70 miles per hour passing through the highway-rail grade crossings nearly every hour throughout the day.

Aware of concerns for public safety, the Commonwealth of Massachusetts passed legislation in 1996 in an effort to attain a higher level of safety at the newly activated crossings along the OCRR. Prior to instituting the changes called for in the legislature, the MBTA applied for and received a grant from the Federal Transit Administration (FTA). The grant was awarded to demonstrate four-quadrant gate operations on the OCRR and then evaluate its effect on on or enhancements to sysystem safety. The MBTA commissioned a private consulting firm (SYSTRA) to establish, implement and evaluate design methods for four-quadrant gated grade crossings with Vehicle Intrusion Detection System (VDS).

2. Background

The project involved participation from various Federal and State agencies including: the FTA, Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), MBTA, Department of Energy and Telecommunications (DTE), and the American Association of Railroads (AAR) as well as Amtrak and the Town of Abington. Early involvement by all the referenced parties resulted in the successful implementation of this demonstration project.

In order to develop a safety optimizing four-quadrant gate design that optimizes the safety offor a highway-rail grade crossing, the operating characteristics of both modes of transportation were thoroughly studied. MBTA's design consultant conducted a detailed corridor analysis of each of the newly constructed 44 signalized highway-rail grade crossings along the OCRR before installing the four-quadrant gate system. This analysis focused on enhancing warning systems at each crossing. The existing arrangement of the warning devices were documented and evaluated specifically for this investigation. This systematic approach ultimately helped to determine where the four-quadrant gates could be installed for the greatest public benefit.

The final design step was to select one of the existing highway-rail grade crossings on the OCRR for the demonstration project. Wales Street in Abington met all the parameters of the design methodology. Additionally, baselines of motorists' behavior could be established, as well as the associated costs for the four-quadrant gate system could be estimated for other applications of highway-rail crossings in the Commonwealth of Massachusetts.

Prior to the construction of the four-quadrant gate system at Abington, cameras were installed at the Wales Street crossing to observe its current operation and driver behavior patterns. The camera recorded each event until the warning system was no longer activated. The MBTA reviewed the recorded videotapes every few days and any incidents or right-of-way violations were identified and logged. For purposes of this study an "incident" was defined as any automotive vehicle, pedestrian, or bicyclist that violated the existing warning devices and proceeded through the crossing after the initial bells, flashers and gate arms were activated. The base line survey was conducted for an eight-week observation period

from May 26, 1998 to July 15, 1998. During this time period the MBTA documented thirteen incidents.

Following the baseline observation period the MBTA proceeded with the installation of the four-quadrant gate design elements. The design elements were comprised of the following components:

1. Raised Concrete Median Islands
2. Gate Offsets
3. Emergency Exit Zones
4. Signage and Striping
5. Exit Gates
6. Vehicle Intrusion Detection System (VDS)
7. In-service testing
8. Public Awareness

The concrete median islands (7 inches in height) provided channelized traffic control for vehicles entering and exiting the crossing area. With a target distance of 25 feet from the gage of the rail, this offset gate allowed the motorist who managed to pass the entrance gate just before it descended to leave the crossing area. The off set gates provided strong visibility relative to the no crossing zone once the system was activated. Emergency exit zones were created to provide for an emergency pull off area should the motorist panic during the system activation process and become restrained between the entrance gate and the off set gate once the system responded to a train approach. Signage and striping was implemented to warn both pedestrians and motorists of the different types of railroad crossings. The exit gates themselves provided the basis of the four-quadrant gate system to prevent motorist from intentionally circumventing the standard gate warning devices. The Vehicle Intrusion Detection System was designed and installed as a non-vital element of the railroad grade crossing signal system and was to have minimal interface with the vital signal system. The VDS was outlined in each vehicular travel lane and designated as the Zone of Detection (ZOD). The ZOD was effectively located between the entrance and exit gate for each lane of traffic and was comprised of fluxgate magnetic sensor (magnetometers) elements placed strategically within the designated ZOD and connected to the exit gates via electronic signals. The magnetometers measured a change in the magnetic field of the earth detected by the presence of a vehicle located within the ZOD. The VDS was designed to not be ignored or shut off by the vital circuits controlling the exit gates signal system as the train passed through the crossing. Once the system was installed and tested an in-service observation period was conducted for approximately 26 weeks from June 18, 1999 to December 18, 1999 and then extended to mid March 2000 to provide further evaluation during inclement winter weather conditions.

During the entire process public awareness and "Operation Lifesaver" played a crucial role in the overall effectiveness and success of the program. The MBTA extended the "Operation Lifesaver" program to local schools and heightened public awareness about the four-quad gate program. Through educating and communicating with the public officials in the Town of Abington, the MBTA was able to develop a strong partnership that provided support for the demonstration project. In addition, the MBTA worked with a local television station and developed two special video programs regarding the four-quadrant gate system for educating the public.

3. Lessons Learned

During the demonstration project there were two events recorded that indicated a problem with the operation of the crossing. Both of these events were minor in scope and required only slight adjustments to the elements of the four-quadrant gate system. Based on the evolution of the project the following lessons were learned for possible future applications.

1. Exit gates that require to be powered down and remain under power to stay down will require a dedicated 12VDC vital battery source. Future applications should investigate gate manufactures prior to design for requirements regarding the power down and stay option of the gates once the system would be activated.
2. The location of the magnetic sensors is critical to the overall performance and reliability of the

VDS. It is recommended that a detailed site survey at any future crossings be performed in order to establish a thorough understanding of the normal magnetic field that exists when a train is passing through the crossing.

3. During the preliminary testing, it was determined that two sensors should be installed in the track bed approximately fifteen feet outside of the crossing area. This would greatly reduce the complexity of the algorithms the controller would have to analyze, especially with slow moving trains or equipment movements through the crossing.
4. It is recommended that if an emergency exit zone is provided, an additional sensor should be located at approximately eight feet back from the existing sensor located in the street. The purpose of this is to provide positive directional identification of a vehicle that enters the area, either as an escape route during a train event or as an unauthorized entry.
5. Sensor cables should be constructed flush and plumb with the track bed in accordance with the installation drawings for maximum effectiveness and reliability.
6. Sensor cables should never be spliced in wet weather or unsuitable soil conditions as this may result in system failure and erratic behavior. Also, sensor cabling should be comprised of double-jacketed railroad burial grade, as it is far more durable and effective for use in the critical nature of grade crossings.
7. Should four-quadrant grade crossings be installed and placed into extended service, a maintenance plan and schedule needs to be developed and implemented consistent with current AREMA standards and CFR 49 requirements.
8. Large induced currents, such as those caused by the Sperry Track Inspection Car, used to test weld integrity in the track, caused a residual magnetic effect in the reinforcing bars of the concrete ties. This dramatic change to the magnetic ambient conditions along the track will necessitate a need to re-baseline the sensor array to compensate for such an altered condition.
9. A four Quadrant Gate system cannot be applied or "forced" at all crossing locations. Each location has its own merits and concerns and a detailed systematic review is required to determine the best way to address the crossing.

4. Applicability

The four-quadrant gate system demonstrated that new technology combined with traditional grade crossing applications and enhanced feature elements could be effective and reliable to control motorist movement at an activated highway-rail intersection. However, this project demonstrated that a four-quadrant gate system cannot be applied or "forced" at all crossing locations. Each highway-rail grade crossing under consideration for a four-quadrant gate system must be thoroughly evaluated by a team of experts who can assess the unique site characteristics and specific configuration of the proposed crossing and highway geometry. This demonstration has shown that a four-quadrant gate system can be added to an existing operating system. Further, this project has demonstrated the need for additional testing of the new VDS technology utilizing magnetometers as well as industry evaluation. Other viable alternatives, such as the extension of gate arms and the use of roadway medians should be considered during the preliminary engineering phase of the project.

5. Contact

Mr. Howard Haywood
Chief of Design and Construction
Massachusetts Bay Transportation Authority
10 Park Plaza
Boston, MA
Telephone: 617-222-3118
Fax: 617-222-1557
Email: hhaywood@mbta.com

6. Resources

- Four-quadrant Gate Demonstration Project on the Old Colony Railroad

- (Draft final report Rev. 1 June 2000) Design Methodology Report
- Corridor Analysis Report- April 1998
- Manual for Uniform Traffic Control Devices (MUTCD)
- Operation Lifesaver
- Specialized Pamphlets for Public Education "Operation Lifesaver
- Video Programs Developed for Televised Education in the Local Community

Exhibit ____ LFL-11

Title: **FIELD EVALUATION OF A FOUR-QUADRANT GATE SYSTEM FOR USE AT RAILROAD-HIGHWAY GRADE CROSSINGS**

Accession Number: 00495482

Record Type: Component

Abstract: As part of research to identify and evaluate innovative active warning devices with the potential for improving safety at railroad-highway grade crossings, candidate devices were identified and developed, and the most promising devices were evaluated in detailed laboratory studies. Based on the results of the laboratory evaluation, three devices were evaluated in the field at actual crossings. One of the innovative active warning devices evaluated in the field was a four-quadrant gate and flashing light signal system with skirts. A before-and-after study approach was used to evaluate the four-quadrant gate system. Data were collected on measures of effectiveness (MOEs) at the existing crossing with the standard two-quadrant gate system and then again at the same crossing after the four-quadrant gate system had been installed to allow a direct comparison of the impact on the MOEs. With the installation of the four-quadrant gate system, MOEs such as speeds, perception-brake reaction times, and deceleration levels did not indicate a change in driver behavior. There were no measurable safety disadvantages to the four-quadrant gate system as measured by these MOEs. The four-quadrant gate system had no effect on the level of service at the crossing but had a positive effect on driver behavior at the crossing by eliminating risky and illegal behavior as well as violations at the crossing, thus producing superb improvements in safety MOEs. Such benefits are especially important at crossings with limited sight distance, high-speed trains, and multiple tracks.

Supplemental Notes: This paper appears in Transportation Research Record No. 1244, Traffic and Grade Crossing Control Devices.

TRIS Files: HRIS; RRIS

Pagination: p. 39-51

Authors: Heathington, K W; Fambro, D B; Richards, S H

Features: Figures (2); Photos (4); References (17); Tables (8)

Monograph Info: See related components

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Index Terms: Before and after studies; Behavior; Benefits; Drivers; Field tests; Hazards; Laboratory tests; Level of service; Measures of effectiveness; Railroad grade crossings; Risk assessment; Safety; Technological innovations; Traffic violations; Warning devices; Four-quadrant gate system

Subject Areas:
Highways
Operations and Traffic Management
Railroads
Safety and Human Factors
Security and Emergencies
I73: Traffic Control

Cancel Change Scenario: LOGEN ROAD_28433 **Continue**

Create New Zone
Manage Existing Zones
Log Off

Crossing	Street	Traffic	Warning Device	Pre-SSM	SSM	Risk	
084713P	**292ND ST NW**	**60**	**Gates**	0	4	1,478.50	MODIFY

* Only Public At Grade Crossings are listed.

ALERT: Quiet Zone qualifies because SSM has been applied in each crossing.

Click for Supplementary Safety Measures [SSM]

Click for ASM spreadsheet: **ASM**

* Note:The use of ASMs requires an application to and approval from the FRA.

Summary	
Proposed Quiet Zone:	Logen Road III
Type:	New 24-hour QZ
Scenario:	LOGEN ROAD_28433
Estimated Total Cost:	$100,000.00
Nationwide Significant Risk Threshold:	17610 .00
Risk Index with Horns:	4924.4
Quiet Zone Risk Index:	**1478.5**

Select

Step by Step Instructions:

Step 1: To specify New Warning Device (For Pre-Rule Quiet Zone Only) and/or SSM, click the MODIFY Button

Step 2: Select proposed warning device or SSM. Then click the UPDATE button.To generate a spreadsheet of the values on this page, click on ASM button—This spreadsheet can then be used for ASM calculations.

Step 3: Repeat Step (2) until the SELECT button is shown at the bottom right side of this page. Note that the SELECT button is shown ONLY when the Quiet Zone Risk Index falls below the NSRT or the Risk Index with Horn.

Step 4: To save the scenario and continue, click the SELECT button

Exhibit LFL-13

Print This Page

Home | Help | Contact | logoff lynn.logen@pse.com

Cancel Change Scenario: Logen Road_28434 **Continue**

Create New Zone
Manage Existing Zones
Log Off

Crossing	Street	Traffic	Warning Device	Pre-SSM	SSM	Risk	
084713P	**292ND ST NW**	**60**	**Gates**	0	12	2,141.40	MODIFY

* Only Public At Grade Crossings are listed.

ALERT: Quiet Zone qualifies because SSM has been applied in each crossing.

Click for Supplementary Safety Measures [SSM]

Click for ASM spreadsheet: **ASM**

* Note:The use of ASMs requires an application to and approval from the FRA.

Summary	
Proposed Quiet Zone:	Logen Road II
Type:	New 24-hour QZ
Scenario:	Logen Road_28434
Estimated Total Cost:	$13,000.00
Nationwide Significant Risk Threshold:	17610 .00
Risk Index with Horns:	5135.24
Quiet Zone Risk Index:	**2141.4**

Select

Step by Step Instructions:

Step 1: To specify New Warning Device (For Pre-Rule Quiet Zone Only) and/or SSM, click the MODIFY Button

Step 2: Select proposed warning device or SSM. Then click the UPDATE button.To generate a spreadsheet of the values on this page, click on ASM button—This spreadsheet can then be used for ASM calculations.

Step 3: Repeat Step (2) until the SELECT button is shown at the bottom right side of this page. Note that the SELECT button is shown ONLY when the Quiet Zone Risk Index falls below the NSRT or the Risk Index with Horn.

Step 4: To save the scenario and continue, click the SELECT button

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Cancel Change Scenario: Logen Road_28434 **Continue**

Create New Zone
Manage Existing Zones
Log Off

Crossing	Street	Traffic	Warning Device	Pre-SSM	SSM	Risk	
084713P	**292ND ST NW**	**60**	**Gates**	0	13	1,713.12	MODIFY

* Only Public At Grade Crossings are listed.

ALERT: Quiet Zone qualifies because SSM has been applied in each crossing.

Click for Supplementary Safety Measures [SSM]

Click for ASM spreadsheet: **ASM**

* Note:The use of ASMs requires an application to and approval from the FRA.

Summary	
Proposed Quiet Zone:	Logen Road II
Type:	New 24-hour QZ
Scenario:	Logen Road_28434
Estimated Total Cost:	$15,000.00
Nationwide Significant Risk Threshold:	17610 .00
Risk Index with Horns:	5135.24
Quiet Zone Risk Index:	**1713.12**

Select

Step by Step Instructions:

Step 1: To specify New Warning Device (For Pre-Rule Quiet Zone Only) and/or SSM, click the MODIFY Button

Step 2: Select proposed warning device or SSM. Then click the UPDATE button.To generate a spreadsheet of the values on this page, click on ASM button—This spreadsheet can then be used for ASM calculations.

Step 3: Repeat Step (2) until the SELECT button is shown at the bottom right side of this page. Note that the SELECT button is shown ONLY when the Quiet Zone Risk Index falls below the NSRT or the Risk Index with Horn.

Step 4: To save the scenario and continue, click the SELECT button

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