Exhibit No. ___ (MB-1T)
Docket TR-100572
Witness: Malcolm Bowie

BEFORE THE WASHINGTON STATE
UTILITIES AND TRANSPORTATION COMMISSION

BENTON COUNTY, Petitioner, v. BNSF RAILWAY COMPANY, Respondent.	DOCKET TR-100572 **PREPARED TESTIMONY OF MALCOLM BOWIE**

Q. Please state your name and business address.

A. Malcolm Bowie, Benton County Courthouse, 620 Market Street, P.O. Box 1001, Prosser, WA 99350.

Q. What is the purpose of your testimony today?

A. I am testifying in support of the proposed at-grade railroad crossing, including safety issues, the planning and topography of the project site, the public need for the crossing, the impracticability of constructing the crossing with separated grades, and the reasons for the planned safety devices.

Q. Where do you work?

A. The Benton County Public Works Department.

Q. What is your current title?

A. I am the Benton County Engineer.

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Q. How long have you been the Benton County Engineer?

A. 14 months.

Q. Please describe your engineering work experience.

A. I have 28 years of experience in public works engineering from environmental permitting to construction. I have held a number public works positions over my career with various agencies in multiple states. Most of my public works experience has involved transportation projects in one form or another. I gained rail crossing experience as assistant construction engineer in Spokane in the 1990s and as City Engineer in Lebanon, Oregon, from 2003 to 2007.

Q. Are you a licensed engineer?

A. Yes, I am licensed in three states. My State of Washington License number 21396

Q. Please describe your training and education in engineering.

A. I have a bachelors of science degree in Civil Engineering from Washington State University and a Masters of Science in engineering management also from Washington State University.

Q. Are you familiar with the proposed crossing?

A. Yes. I have walked the ground many times, approved the crossing design, and prepared the relevant petition to the Washington Utilities and Transportation Commission.

Q. Please describe the history of the Piert road extension

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project.

A. The Piert Road extension project is the final phase of a project that was first investigated as part of a 1995 report on public needs prepared for the Benton County Commissioners. Two engineering reports were produced with multiple options considered, public hearings were held, and the County Commission adopted resolutions directing staff to move forward with the project. In 2005, Benton County secured a $1.935 million grant from the Washington State Transportation Improvement Board to go towards the Piert Road extension.

Q. Please describe the proposed crossing.

A. The petitioned crossing involves a new county collector arterial project called the Piert Road extension. The road is planned to run north to south and will cross an existing private industrial rail spur at grade. The crossing will be in a flat open area with very good geometrics and a very low exposure to accidents. Exhibit No. ___ (MB-2).

Q. Is the site of the proposed crossing suitable for an at-grade crossing?

A. Yes.

Q. Why?

A. This particular site presents an exceptionally low risk of an accident, there is an acute public need for the proposed

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crossing, and a separated grade crossing would be impracticable.

Q. Why does the site of the proposed crossing present an especially low risk?

A. The primary factors to consider when the evaluating the safety of a railway crossing are the volume of traffic along the highway and along the railway, and speeds of highway and railway traffic at the crossing point, the geometry and topography of the crossing area, and the sight distances when approaching the crossing.

The estimated vehicle volume of road traffic that will be passing over the crossing is 400 vehicles per day, which is based on the 2005 Benton Franklin Council of Governments Travel Demand Model. Actual traffic counts will be monitored annually. The Finley School District has recently confirmed that they will not be using the crossing for school bus routes. As for rail use, BNSF is presently using the rail spur approximately 1 to 2 times per week.

Vehicle and train speeds at the proposed crossing are as follows: Piert Road will have a speed limit of 35 miles per hour. The rail spur has an authorized speed of 10 miles per hour, but trains at the location of the crossing are observed to travel at an estimated 2 to 5 miles per hour.

The geometry and topography of the proposed crossing are

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very favorable. The proposed roadway alignment is located approximately 300 feet west of the industrial rail entrance for the Agrium plant, providing a buffer area for both train and truck traffic to freely move between the two facilities. It is not anticipated that any blockages would occur on the crossing as a result of railroad switching operations as any switching would occur within the industrial site or this buffer area. The sight distance for a vehicle approaching the petitioned crossing ranges from 400 feet to nearly 2000.

Utilizing Railroad Highway Grade Crossing Handbook procedures for identifying necessary sight distances at a crossing, the County has calculated the sight distance along the tracks to allow the vehicle to cross and be clear of the tracks before the train (dt) to be 237 ft. when coupled with the (dh) value of 272 ft. The procedure ensures that no obstruction is within the approach sight triangle for any vehicle approaching from any direction. The roadway is in a 2000 foot radius horizontal curve, and has been designed with a moderate vertical curve with approaching gradient is from .55% to -.1%. The rail spur has a slight horizontal curvature on an approach grade of 1.9%. Benton County performed a diagnostic regarding sight distances in accordance with The Railroad-Highway Grade Crossing Handbook, Revised Second Edition. Exhibit No. ___ (MB-3).

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All criteria was met for safe approach crossing sight distances as identified in chapter III subsection "c" of the referenced Handbook. The proposed crossing as identified in the petition and submitted in drawings conformed to pavement markings and signage as identified in Figure 8B-2 and 8B-6 of The Manual on Uniform Traffic Control Devices ("MUTCD"). Exhibit No. _____ (MB-4). Passive traffic control systems planned include signage as recommended in the MUTCD for Highway-Rail Grade Crossings (Railroad crossing sign, Advance warning sign, Do Not Stop On Tracks sign) and pavement markings (Railroad crossing marking and no passing markings) on all approaches. Again, the posted speed limit will be 35 MPH for the new road.

The combination of all these features: the modest volumes of road and rail traffic, the low speeds, the excellent topography and geography of the crossing point, and the long sight distances, make the proposed crossing especially favorable.

Q. You mentioned that there is an acute public need for the proposed crossing. What public need would this crossing serve?

A. To begin with, it would benefit public safety and the quality of life for the residents of Finley. The proposed crossing

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permits the construction of the Piert Road extension, and the Piert Road extension will provide a more direct route for trucks from the Finley industrial area to reach I-82 without having to pass through residential areas and school zones.

In addition, the road will serve over 300 acres of undeveloped industrial land. In order to see identified needs met it is necessary to construct the at grade crossing as proposed. The "Needs, Issues and Analyses Report of 1995" identified a need to provide secondary arterial access and a truck route to I-82 from the Finley industrial area. The transportation project has been planned for over 15 years, dating back to 1995 when the Benton County Commissioners held a public hearing on the needs report. In 2005 Benton County secured a $1.935 million grant from the Washington State Transportation Improvement Board. By awarding this grant the State of Washington has acknowledged the need for the Piert Road project. If the Piert Road project is not completed the Transportation Improvement Board grant will be lost and prior expenditures billed back to the county.

Q. You mentioned that a separated grade crossing would be impracticable in this case. Why would it be impracticable?

A. The complete Piert Road project is estimated to cost $3 million. Benton County consultant JUB engineers estimates that the cost of a grade separated crossing alone would be

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$3.8 million, which conforms to my expectations based on past experience. Exhibit No. (MB-5). This amount is more than the estimated complete project cost. A grade separated crossing would adversely impact the industry operations as well. The grade separated industry impact itself would likely squelch the project. The preliminary engineering shows that with a grade separation crossing, truck access to the industry would be severely unacceptably impacted. Consequently, a grade separated crossing would be impracticable.

Q. What safety protections is Benton County planning to locate at the proposed crossing?

A. The proposed crossing as identified in the petition and submitted in drawings conform to recommended pavement markings and signage as identified in Figures 8B-2 and 8B-6 of the MUTCD. The passive traffic control systems planned include the signage specified in the MUTCD for Highway-Rail Grade Crossings (Railroad crossing sign, Advance warning sign, Do Not Stop On Tracks sign) and pavement markings (Railroad crossing marking and no passing markings).

Q. Why is Benton County not proposing to install active warning devices?

A. Active warning devices are not called for given the features of the proposed crossing. Benton County has petitioned for

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passive crossings warning devices, meaning the moving train does not activate any warning devices at the crossing. All railroad crossing have certain quantifiable features represented as variables that can be used to determine the safety of that particular railroad crossing. The United States Department of Transportation has equations that these variables are used for to provide industry recognized safety ratings. These formulae are provided in the Railroad-Highway Grade Crossing Handbook Chapter III subsection "B." Exhibit No. ___ (MB-3). Variables such as number of trains and number of vehicles using the proposed crossing are as low as a diagnostic team are likely to ever find. Calculating the initial collision prediction number or a hazard index as prescribed in the referred to section of the identified Railroad-Highway Grade Crossing Handbook the numbers are very low, thus indicating that passive warning devices are the best choice.

The Federal Railroad Administration maintains railroad crossing database for all counties. From that database a predictive algorithm is utilized by which the Web Accident Predictive System ("WBAPS") can be used to generate reports identifying an accident prediction value for any particular crossing. The numbers generated in the WBAPS report identifies the probability of a collision between a train and

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a highway vehicle in a year.

The Washington Department of Transportation recommends warning device selection based on engineering judgment and coordination with effected entities. The May 2004 Washington State Department of Transportation Design Manual Figure 930-2 has historically provided a useful tool to determine what warning devices are warranted for a particular crossing. Exhibit No. ___ (MB-6). This method utilizes the "exposure factor" which is the product of the number trains per day and vehicles per day using the crossing. Utilizing this method for the proposed crossing produces an exposure factor between 200 and 800, well below the 1500 number identified in figure 930-2 indicating that a passive control devices would be the preferred alternative. The exposure factor utilized in figure 930-2 is the same variable that included in the United States Department of Transportation Accident Prediction Model, where it is referred to as the "exposure index." This model can be used to predict the likelihood of a collision occurring. This model or similar is used to rank inventory of existing crossing for accident predictions as found on the Web Accident Predictive System ("WBAPS") inventory. Exhibit No. ___ (MB-7). Since the petitioned crossing has not been constructed it is not present in the database.

The closest crossing in the Benton County WBAPS database

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both in proximity and conditions to the petitioned crossing is BNSF's Lechelt Road crossing, crossing #090045C. The existing Lechelt crossing is ranked by WBAPS as the BNSF crossing within Benton County that is least likely to have a collision. The probability of crash at the Lechelt Road crossing is 0.000687. The Lechelt crossing is at the beginning of the same privately owned rail spur that the county is proposing to cross with the Piert Road extension.

Benton County is proposing ongoing monitoring of the petitioned passive crossing. Accordingly, if at some future time conditions warrant it, a diagnostic team will meet to revisit the adequacy of the crossing.

Q. Will any federal funds be used in the Piert Road Extension project?

A. No, none.

Q. Does that conclude your testimony?

A. Yes.

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DECLARATION

I, Malcolm Bowie, declare under penalty of perjury under the laws of the State of Washington that the foregoing PREPARED TESTIMONY OF MALCOLM BOWIE is true and correct to the best of my knowledge and belief.

DATED this 29th day of October, 2010.

MALCOLM BOWIE

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EXHIBIT LIST

Exhibit No. ___	(MB-2)	Site Plan
Exhibit No. ___	(MB-3)	Railroad-Highway Grade Crossing Handbook, pages iii, 54-56, 66-68
Exhibit No. ___	(MB-4)	Manual on Uniform Traffic Control Devices for Streets and Highways 2009 Edition, pages 754, 765
Exhibit No. ___	(MB-5)	BNSF/UPRR Grade Separation Evaluation Report
Exhibit No. ___	(MB-6)	Washington State Department of Transporation Design Manual, May, 2004, pages 7, 19, 930-5
Exhibit No. ___	(MB-7)	Federal Railroad Administration Web Accident Prediction System

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CERTIFICATE OF SERVICE

I certify that I served, in the manner indicated below, a true and correct copy of the foregoing document as follows:

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DATED this 29th day of October, 2010, at Kennewick, Washington.

Shannon C Slaght

SHANNON C. SLAGHT

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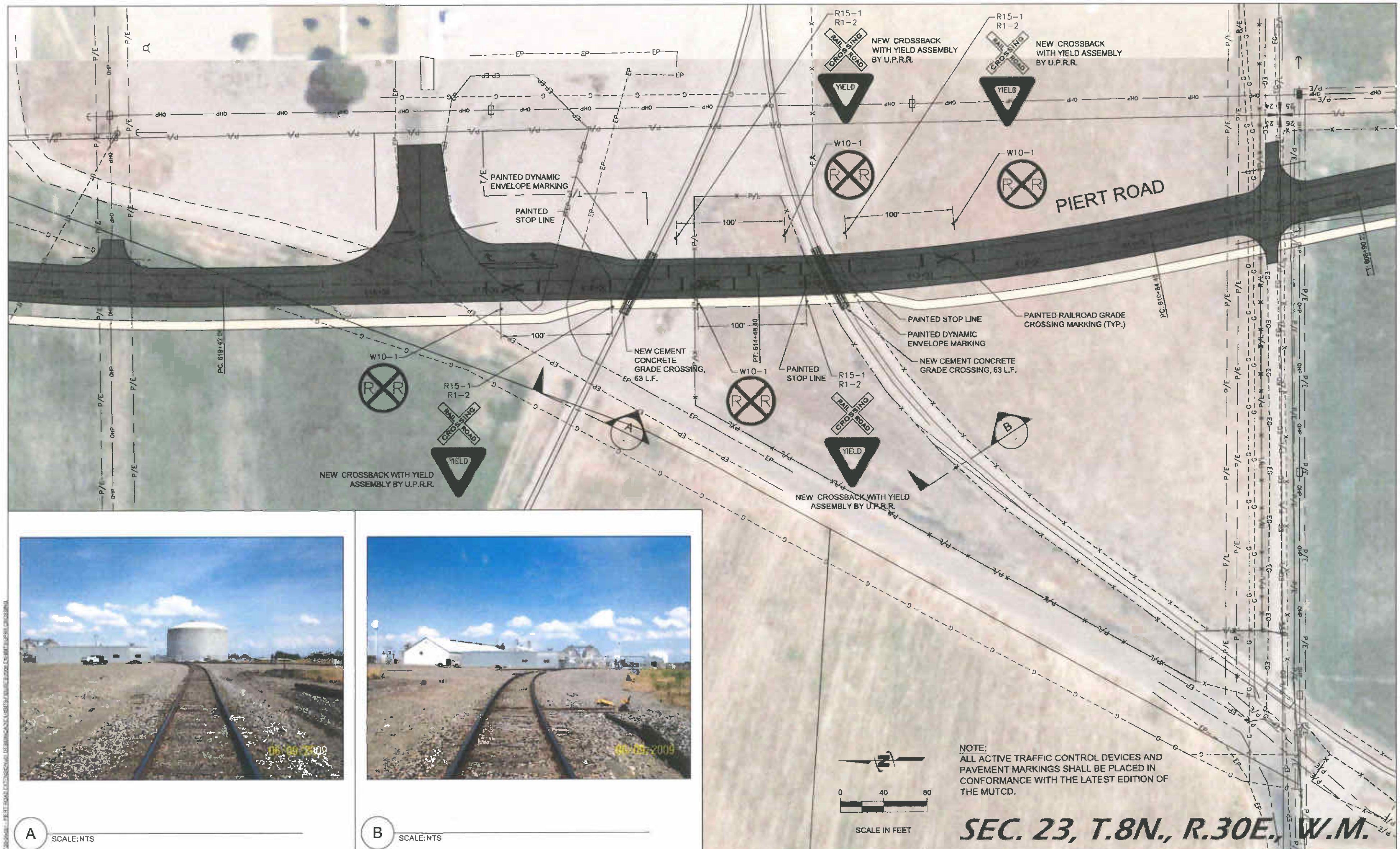

J-U-B
Engineers • Surveyors • Planners

FIGURE 1
U.P.R.R. CROSSING UPGRADE
BENTON COUNTY - PIERT ROAD EXTENSION

Exhibit No. ____ (MB-2)
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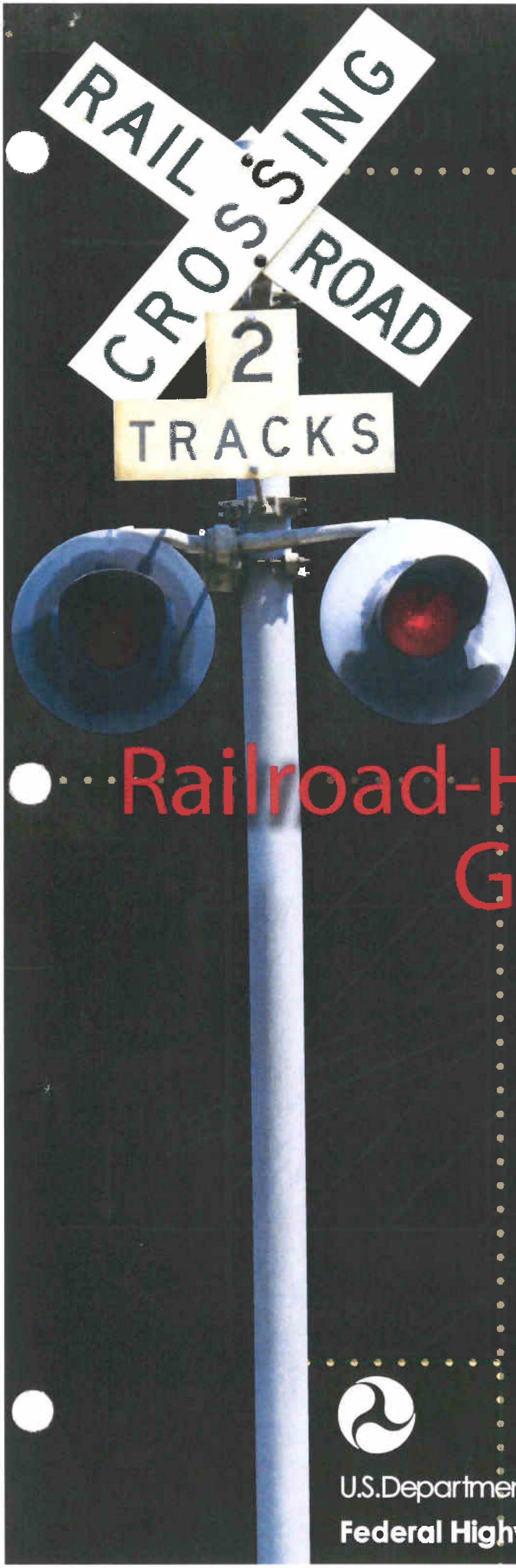
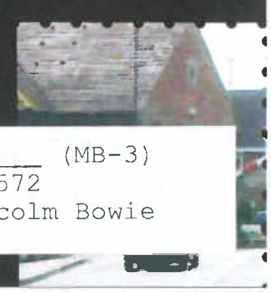


Railroad-Highway Grade Crossing Handbook

Revised Second Edition
August 2007



U.S.Department of Transportation
Federal Highway Administration

Exhibit No. ____ (MB-3)
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involving motor carriers. A recordable collision is "an occurrence involving a commercial motor vehicle operating on a highway in engaged in interstate or intrastate commerce which results in (i) a fatality; (ii) Bodily injury to a person who, as a result of the injury, immediately receives medical treatment away from the scene of the accident; or, (iii) One or more motor vehicles incurring disabling damage as a result of the accident, requiring the motor vehicle(s) to be transported away from the scene by a tow truck or other motor vehicle."[54]

In the past, FMCSA required motor carriers to report crashes directly to the agency. This is no longer the case. This information is now forwarded by states. However, motor carriers must maintain accident registers for three years after the date of each accident occurring on or after April 29, 2003 (49 CFR 390.15). (Previously, the register had to be maintained for one year.) An example of a comprehensive state crash reporting form is included in Appendix C.

Collisions involving the transport of hazardous materials are reported to the Materials Transportation Bureau (MTB) of the Research and Special Programs Administration. An immediate telephone notice is required under certain conditions, and a detailed written report is required whenever there is any unintentional release of a hazardous material during transportation or temporary storage related to transportation. Collisions are to be reported when, as a direct result of hazardous materials: a person is killed; a person receives injuries requiring hospitalization; estimated carrier or other property damage exceeds $50,000; or a situation exists such that a continuing danger to life exists at the scene of the incident. The form used for reporting these collisions to MTB is shown in Appendix D.

Significant transportation accidents are investigated by the National Transportation Safety Board (NTSB). NTSB issues a report for each accident investigated. The report presents the circumstances of the accident, the data collected, and the analysis of the data as well as conclusions, which are identified as "findings" of NTSB. In addition, NTSB issues specific recommendations to various parties for improvement of safety conditions. Appendix E provides summaries of a number of selected key grade crossing collision investigations provided by NTSB.

54 Ibid.

B. Hazard Indices and Accident Prediction Formulae

A systematic method for identifying crossings that have the most need for safety and/or operational improvements is essential to comply with requirements of the FAPG, which specifies that each state should maintain a priority schedule of crossing improvements. The priority schedule is to be based on:

- The potential reduction in the number and/or severity of collisions.
- The cost of the projects and the resources available.
- The relative hazard of public highway-rail grade crossings based on a hazard index formula.
- On-site inspections of public crossings.
- The potential danger to large numbers of people at public crossings used on a regular basis by passenger trains, school buses, transit buses, pedestrians, bicyclists, or by trains and/or motor vehicle carrying hazardous materials.
- Other criteria as appropriate in each state.

Various hazard indices and collision prediction formulae have been developed for ranking highway-rail grade crossings. These are commonly used to identify crossings to be investigated in the field. Procedures for conducting the on-site inspection are discussed in the next section. Some hazard indices incorporate collision history as a factor in the ranking formula; if not, this factor should be subjectively considered.

1. Hazard Index

A hazard index ranks crossings in relative terms (the higher the calculated index, the more hazardous the crossing), whereas the collision prediction formulae are intended to compute the actual collision occurrence frequency at the crossing. A commonly used index is the New Hampshire Hazard Index ranking methodology (presented in Appendix F).

There are several advantages of using a hazard index to rank crossings. A mathematical hazard index enhances objectivity. It can be calculated by computer, facilitating the ranking process. As crossing conditions change, a computerized database can be updated and the hazard index recalculated.

In general, crossings that rank highest on the hazard index are selected to be investigated in the field by a diagnostic team, as discussed in the next section. Other crossings may be selected for a field investigation because they are utilized by buses, passenger trains, and vehicles transporting hazardous materials. FAPG requires that the potential danger to large numbers of people at crossings used on a regular basis by passenger trains, school buses, transit buses, pedestrians, bicyclists, or by trains and/or motor vehicles carrying hazardous materials be one of the considerations in establishing a priority schedule. Some states incorporate these considerations into a hazard index, thus providing an objective means of assessing the potential danger to large numbers of people.

Some states, however, consider these factors subjectively when selecting the improvement projects among the crossings ranked highest by the hazard index. Other states utilize a point system so that crossings high on the hazard index receive a specified number of points, as do crossings with a specified number of buses, passenger trains, and vehicles transporting hazardous materials.

Other states utilize the systems approach, considering all crossings within a specified system, such as all crossings along a passenger train corridor.

Crossings may also be selected for field investigation as a result of requests or complaints from the public. State district offices, local governmental agencies, other state agencies, and railroads may also request that a crossing be investigated for improvement. A change in highway or railroad operations over a crossing may justify the consideration of that crossing for improvement. For example, a new residential or commercial development may substantially increase the volume of highway traffic over a crossing such that its hazard index would greatly increase.

2. U.S. Department of Transportation Accident Prediction Model

A prediction model is intended to predict, in absolute terms, the likelihood of a collision occurring over a given period of time given conditions at the crossing. The following discussion presents the accident prediction model developed by U.S. DOT. (Other formulae are presented in Appendix F.) Thus, an accident prediction model can also be used to either rank crossings or identify potential high-accident locations for further review.

The U.S. DOT collision prediction formula combines three independent calculations to produce a collision prediction value. The basic formula provides an initial hazard ranking based on a crossing's characteristics, similar to other formulae such as the Peabody-Dimmick formula and the New Hampshire Index. The second calculation utilizes the actual collision history at a crossing over a determined number of years to produce a collision prediction value. This procedure assumes that future collisions per year at a crossing will be the same as the average historical collision rate over the time period used in the calculation. The third equation adds a normalizing constant, which is adjusted periodically to keep the procedure matched with current collision trends.

FRA has provided a Website where highway-rail intersection safety specialists may calculate the predicted collisions for any public highway-rail intersection in the national inventory.[55]

The basic collision prediction formula can be expressed as a series of factors that, when multiplied together, yield an initial predicted number of collisions per year at a crossing. Each factor in the formula represents a characteristic of the crossing described in the national inventory. The general expression of the basic formula is shown below:

$$a = K \times EI \times MT \times DT \times HP \times MS \times HT \times HL \qquad (1)$$

where:

a = initial collision prediction, collisions per year at the crossing
K = formula constant
EI = factor for exposure index based on product of highway and train traffic
MT = factor for number of main tracks
DT = factor for number of through trains per day during daylight
HP = factor for highway paved (yes or no)
MS = factor for maximum timetable speed
HT = factor for highway type
HL = factor for number of highway lanes

Different sets of equations are used for each of the three categories of traffic control devices: passive, flashing lights, and automatic gates, as shown in Table 16.

The structure of the basic collision prediction formula makes it possible to construct tables of numerical values for each factor. To predict the collisions at a particular crossing whose characteristics are known, the values of the factors are found in the table and multiplied together. The factor values for the three

55 FRA Office of Safety Website (safetydata.fra.dot.gov/officeofsafety).

Table 16. U.S. DOT Collision Prediction Equations for Crossing Characteristic Factors

General Form of Basic Accident Prediction Formula: e = K x EI x MT x DT x HP x MS x HT x HL

Crossing Characteristic Factors

Crossing Category	Formula Constant K	Exposure Index Factor EI	Main Tracks Factor MT	Day Thru Trains Factor DT	Highway Paved Factor HP	Maximum Speed Factor MS	Highway Type Factor HT	Highway Lanes Factor HL
Passive	0.002268	$\left(\frac{c \times t + 0.2}{0.2}\right)^{0.3334}$	$e^{0.2094mt}$	$\left(\frac{d + 0.2}{0.2}\right)^{0.1336}$	$e^{-0.6160(hp-1)}$	$e^{0.0077ms}$	$e^{-0.1000(ht-1)}$	1.0
Flashing Lights	0.003646	$\left(\frac{c \times t + 0.2}{0.2}\right)^{0.2953}$	$e^{0.1088mt}$	$\left(\frac{d + 0.2}{0.2}\right)^{0.0470}$	1.0	1.0	1.0	$e^{0.1380(hl-1)}$
Gates	0.001088	$\left(\frac{c \times t + 0.2}{0.2}\right)^{0.3116}$	$e^{0.2912mt}$	1.0	1.0	1.0	1.0	$e^{0.1036(hl-1)}$

c = annual average number of highway vehicles per day (total both directions)

t = average total train movements per day

mt = number of main tracks

d = average number of thru trains per day during daylight

hp = highway paved, yes = 1.0, no = 2.0

ms = maximum timetable speed, mph

ht = highway type factor value

hl = number of highway lanes

Highway Type	Inventory Code	ht Value
Rural		
Interstate	01	I
Other principal arterial	02	2
Minor arterial	06	3
Major collector	07	4
Minor collector	08	5
Local	09	6
Urban		
Interstate	11	1
Other freeway and expressway	12	2
Other principal arterial	14	3
Minor arterial	16	4
Collector	17	5
Local	19	6

Source: Railroad-Highway Grade Crossing Handbook, Second Edition. *Washington, DC: U.S. Department of Transportation, Federal Highway Administration, 1986.*

traffic control device categories are found in Tables 17, 18, and 19, respectively.

The final collision prediction formula can be expressed as follows:

$$B = \frac{T_0}{T_0 + T}(a) + \frac{T_0}{T_0 + T}\left(\frac{N}{T}\right) \quad (2)$$

where:

B = second collision prediction, collisions per year at the crossing

a = initial collision prediction from basic formula, collisions per year at the crossing

$\frac{N}{T}$ = collision history prediction, collisions per year, where N is the number of observed collisions in T years at the crossing

Values for the second collision prediction, B; for different values of the initial prediction, a; and different prior collision rates, $\frac{N}{T}$, are tabularized in Table 20, 21, 22, 23, and 24. Each table represents results for a specific number of years for which collision history data are available. If the number of years of collision data, T, is a fraction, the second collision prediction, B, can be interpolated from the tables or determined directly from the formula.

The formula provides the most accurate results if all the collision history available is used; however, the extent of improvement is minimal if data for more than five years are used. Collision history information older than five years may be misleading because of changes that occur to crossing characteristics over time. If a significant change has occurred to a crossing during the most recent five years, such as the installation of signals, only the collision data since that change should be used.

The final collision prediction, A, is developed by applying a normalizing constant to keep the procedure matched with current collision trends. The final formula, using constants established for 2003, is shown on page 60. (As of November 2003, these new

Stop line. Cone C is placed at the stop line, which is assumed to be 4.6 meters (15 feet) from the near rail of the crossing, or 8 feet from the gate if one is present.

The questions in Section I of the questionnaire (refer to Figure 6) are concerned with the following:

- Driver awareness of the crossing.
- Visibility of the crossing.
- Effectiveness of advance warning signs and signals.
- Geometric features of the highway.

When responding to questions in this section, the crossing should be observed from the beginning of the approach zone, at traffic cone A.

The questions in Section II (refer to Figure 6) are concerned with whether the driver has sufficient information to detect an approaching train and make correct decisions about crossing safely. Observations for responding to questions in this section should be made from cone B. Factors considered by these questions include the following:

- Driver awareness of approaching trains.
- Driver dependence on crossing signals.
- Obstruction of view of train's approach.
- Roadway geometrics diverting driver attention.
- Potential location of standing railroad cars.
- Possibility of removal of sight obstructions.
- Availability of information for stop or go decision by the driver.

The questions in Section III (refer to Figure 6) apply to observations adjacent to the crossing, at cone C. Of particular concern, especially when the driver must stop, is the ability to see down the tracks for approaching trains. Intersecting streets and driveways should also be observed to determine whether intersecting traffic could affect the operation of highway vehicles over the crossing. Questions in this section relate to the following:

- Sight distance down the tracks.
- Pavement markings.
- Conditions conducive to vehicles becoming stalled or stopped on the crossing.
- Operation of vehicles required by law to stop at the crossing.
- Signs and signals as fixed object hazards.
- Opportunity for evasive action by the driver.

Corner sight distance.[61] Available sight distances help determine the safe speed at which a vehicle can approach a crossing. The following three sight distances should be considered:

- Distance ahead to the crossing.
- Distance to and along the tracks on which a train might be approaching the crossing from either direction.
- Sight distance along the tracks in either direction from a vehicle stopped at the crossing.

These sight distances are illustrated in Figure 8.

In the first case, the distance ahead to the crossing, the driver must determine whether a train is occupying the crossing or whether there is an active traffic control device indicating the approach or presence of a train. In such an event, the vehicle must be stopped short of the crossing, and the available sight distance may be a determining factor limiting the speed of an approaching vehicle.

The relationship between vehicle speed and this sight distance is set forth in the following formula:

$$d_H = AV_v t + \frac{BV_v^2}{a} + D + d_e \qquad (5)$$

where:

d_H = sight distance measured along the highway from the nearest rail to the driver of a vehicle, which allows the vehicle to be safely stopped without encroachment of the crossing area, feet

A = constant = 1.47

B = constant = 1.075

V_v = velocity of the vehicle, miles per hour (mph)

t = perception-reaction time, seconds, assumed to be 2.5 seconds

a = driver deceleration, assumed to be 11.2 feet per second^2

D = distance from the stop line or front of vehicle to the near rail, assumed to be 15 feet

d_e = distance from the driver to the front of the vehicle, assumed to be 8 feet

61 Ibid.

This formula is also expressed in SI Metric terms, as follows:

$$d_H = AV_v t + \frac{BV_v^2}{a} + D + d_e \qquad (6)$$

where:

d_H = sight distance measured along the highway from the nearest rail to the driver of a vehicle, which allows the vehicle to be safely stopped without encroachment of the crossing area, feet

A = constant = 0.278

B = constant = 0.039

V_v = velocity of the vehicle, kilometers per hour (km/hr.)

t = perception-reaction time, seconds, assumed to be 2.5 seconds

a = driver deceleration, assumed to be 3.4 meters per second^2

D = distance from the stop line or front of vehicle to the near rail, assumed to be 4.5 meters

d_e = distance from the driver to the front of the vehicle, assumed to be 2.4 meters

The minimum safe sight distances, d_H, along the highway for selected vehicle speeds are shown in the bottom line of Tables 31 and 32. As noted, these distances were calculated for certain assumed conditions and should be increased for less favorable conditions.

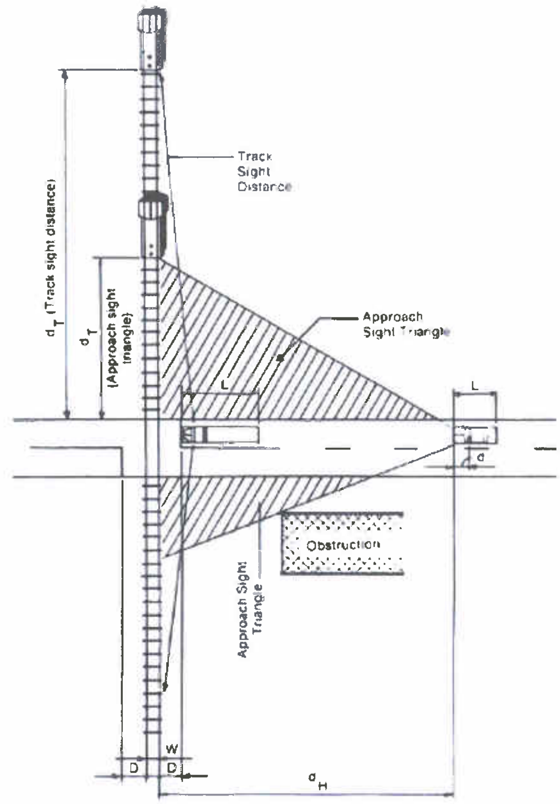
The second sight distance utilizes a so-called "sight triangle" in the quadrants on the vehicle approach side of the track. This triangle is formed by:

- The distance (d_H) of the vehicle driver from the track.
- The distance (d_t) of the train from the crossing.
- The unobstructed sight line from the driver to the front of the train.

This sight triangle is depicted in Figure 8. The relationships between vehicle speed, maximum timetable train speed, distance along the highway (d_H), and distance along the railroad are set forth in the following formula:

$$d_T = \frac{V_T}{V_v}(A)V_v t + \frac{BV_v^2}{a} + 2D + L + W \qquad (7)$$

Figure 8. Crossing Sight Distances



Source: Railroad-Highway Grade Crossing Handbook, Second Edition. *Washington, DC: U.S. Department of Transportation, Federal Highway Administration, 1986.*

where:

d_T = sight distance along the railroad tracks to permit the vehicle to cross and be clear of the crossing upon arrival of the train

A = constant = 1.47

B = constant = 1.075

V_v = velocity of the vehicle, mph

t = perception-reaction time, seconds, assumed to be 2.5 seconds

a = driver deceleration, assumed to be 11.2 feet per second^2

D = distance from the stop line or front of vehicle to the near rail, assumed to be 15 feet

L = length of vehicle, assumed to be 65 feet

W = distance between outer rails (for a single track, this value is 5 feet)

In SI Metric values, this formula becomes:

$$d_T = \frac{V_T}{V_v}(A)V_v t + \frac{BV_v^{\ 2}}{a} + 2D + L + W \qquad (8)$$

where:

- d_T = sight distance along the railroad tracks to permit the vehicle to cross and be clear of the crossing upon arrival of the train
- A = constant = 0.278
- B = constant = 0.039
- V_v = velocity of the vehicle, km/hr.
- t = perception-reaction time, seconds, assumed to be 2.5 seconds
- a = driver deceleration, assumed to be 3.4 meters per second^2
- D = distance from the stop line or front of vehicle to the near rail, assumed to be 4.5 meters
- L = length of vehicle, assumed to be 20 meters
- W = distance between outer rails (for a single track, this value is 1.5 meters)

Distances d_h and d_T are shown in Tables 31 and 32 for several selected highway speeds and train speeds.

Clearing sight distance. In the case of a vehicle stopped at a crossing, the driver needs to see both ways along the track to determine whether a train is approaching and to estimate its speed. The driver needs to have a sight distance along the tracks that will permit sufficient time to accelerate and clear the crossing prior to the arrival of a train, even though the train might come into view as the vehicle is beginning its departure process.

Figure 9 illustrates the maneuver. These sight distances, for a range of train speeds, are given in the column for a vehicle speed of zero in Tables 31 and 32. These values are obtained from the following formula:

$$d_T = 1.47V_T\left(\frac{V_G}{a_1} + \frac{L + 2D + W - d}{V_G} + J\right) \qquad (9)$$

where:

- V_G = maximum speed of vehicle in selected starting gear, assumed to be 8.8 feet per second
- a_1 = acceleration of vehicle in starting gear, assumed to be 1.47 feet per second per second
- J = sum of the perception time and the time required to activate the clutch or an automatic shift, assumed to be 2 seconds
- d_a = distance the vehicle travels while accelerating to maximum speed in first gear, or

$$d_a = \frac{V_G^{\ 2}}{2a_1} \quad \text{or} \quad \frac{8.8^2}{(2)(1.47)} = 26.4 \text{ feet} \qquad (10)$$

d_T, V_T, L, D, and W are defined as above.

Expressing the formula again in SI Metric terms:

$$d_T = 0.28V_T\left(\frac{V_G}{a_1} + \frac{L + 2D + W - d_a}{V_G} + J\right) \qquad (11)$$

where:

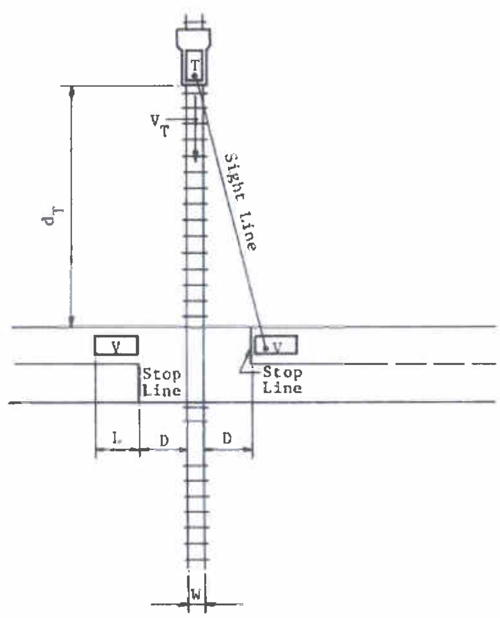
- V_G = maximum speed of vehicle in selected starting gear, assumed to be 2.7 meters per second
- a_1 = acceleration of vehicle in starting gear, assumed to be 0.45 meter per second per second
- J = sum of the perception time and the time required to activate the clutch or an automatic shift, assumed to be 2 seconds
- d_a = distance the vehicle travels while accelerating to maximum speed in first gear, or

$$d_a = \frac{V_G^{\ 2}}{2a_1}$$

$$\frac{2.7^2}{(2)(0.45)} = 8.1 \text{ meters}$$

d_T, V_T, L, D, and W are defined as above.[62]

Figure 9. Sight Distance for a Vehicle Stopped at Crossing



Source: Railroad-Highway Grade Crossing Handbook, Second Edition. *Washington, DC: U.S. Department of Transportation, Federal Highway Administration, 1986.*

Manual on Uniform Traffic Control Devices

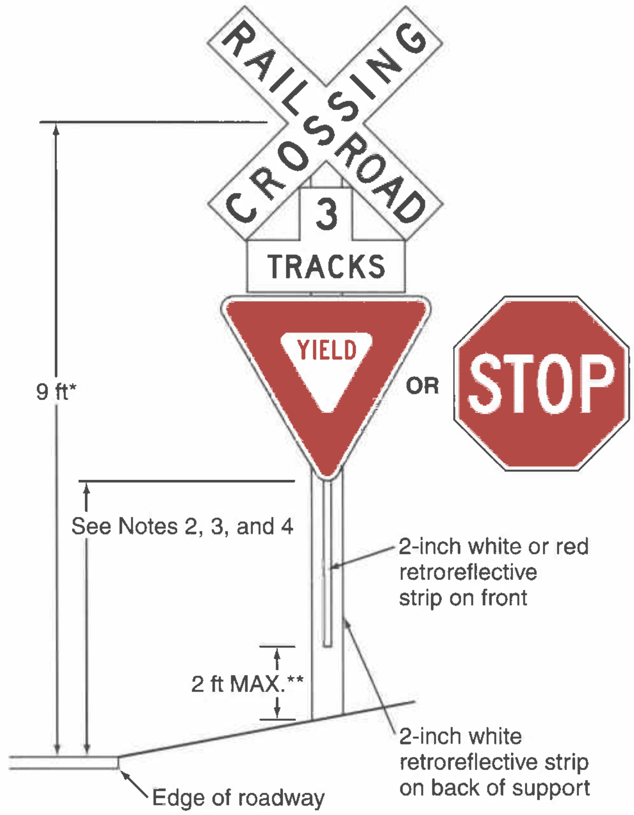
for Streets and Highways

2009 Edition

U.S. Department of Transportation
Federal Highway Administration

Exhibit No. ____ (MB-4)
Docket TR-100572
Witness: Malcolm Bowie

Figure 8B-2. Crossbuck Assembly with a YIELD or STOP Sign on the Crossbuck Sign Support



* Height may be varied as required by local conditions and may be increased to accommodate signs mounted below the Crossbuck sign

** Measured to the ground level at the base of the support

Notes:

1. YIELD or STOP signs are used only at passive crossings. A STOP sign is used only if an engineering study determines that it is appropriate for that particular approach.
2. Mounting height shall be at least 4 feet for installations of YIELD or STOP signs on existing Crossbuck sign supports.
3. Mounting height shall be at least 7 feet for new installations in areas with pedestrian movements or parking.

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10 *Where unusual conditions make variations in location and lateral offset appropriate, engineering judgment should be used to provide the best practical combination of view and safety clearances.*

Section 8B.04 Crossbuck Assemblies with YIELD or STOP Signs at Passive Grade Crossings

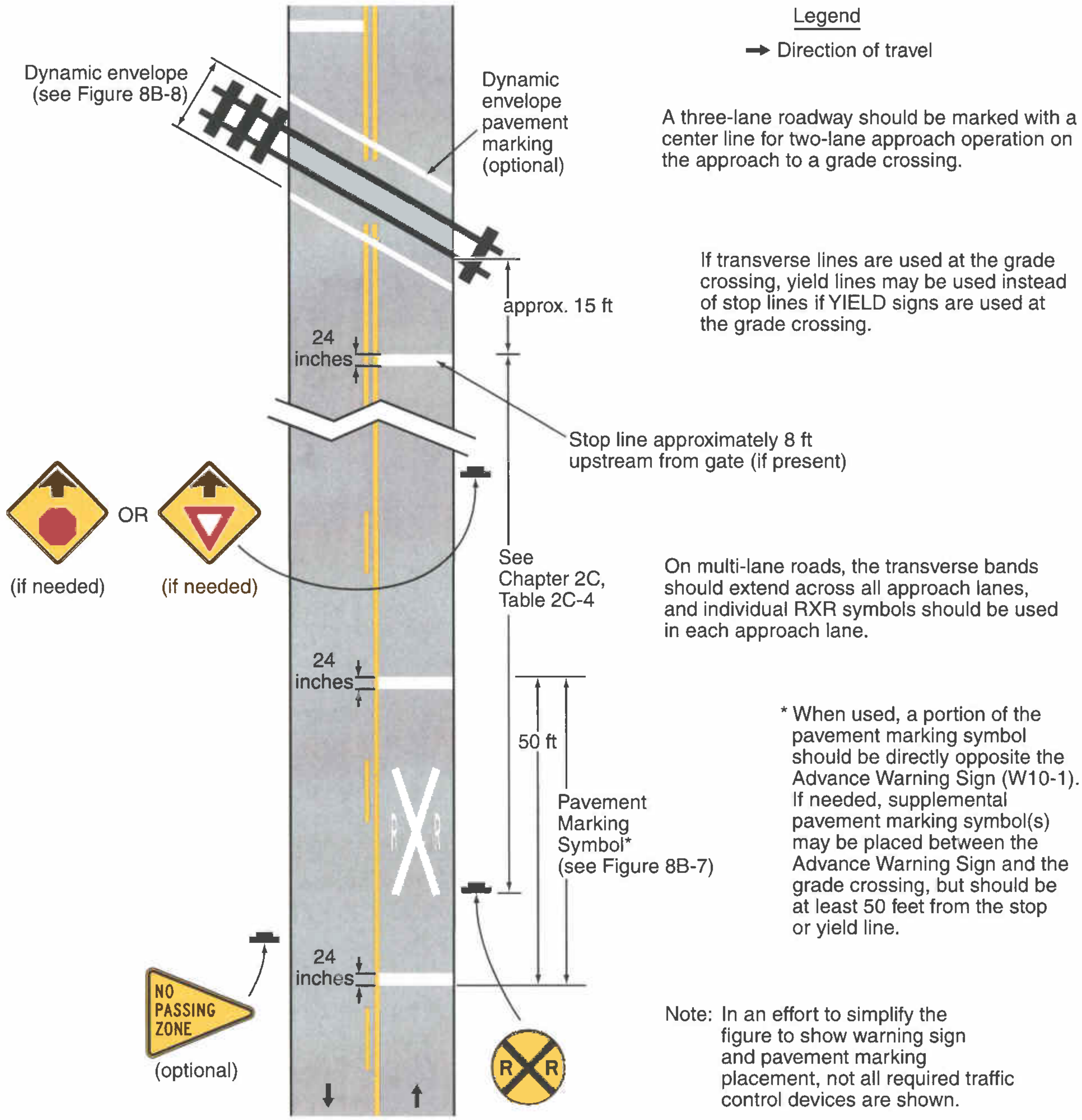
Standard:

01 **A grade crossing Crossbuck Assembly shall consist of a Crossbuck (R15-1) sign, and a Number of Tracks (R15-2P) plaque if two or more tracks are present, that complies with the provisions of Section 8B.03, and either a YIELD (R1-2) or STOP (R1-1) sign installed on the same support, except as provided in Paragraph 8. If used at a passive grade crossing, a YIELD or STOP sign shall be installed in compliance with the provisions of Part 2, Section 2B.10, and Figures 8B-2 and 8B-3.**

02 **At all public highway-rail grade crossings that are not equipped with the active traffic control systems that are described in Chapter 8C, except crossings where road users are directed by an authorized person on the ground to not enter the crossing at all times that an approaching train is about to occupy the crossing, a Crossbuck Assembly shall be installed on the right-hand side of the highway on each approach to the highway-rail grade crossing.**

03 **If a Crossbuck sign is used on a highway approach to a public highway-LRT grade crossing that is not equipped with the active traffic control systems that are described in Chapter 8C, a Crossbuck Assembly shall be installed on the right-hand side of the highway on each approach to the highway-LRT grade crossing.**

Figure 8B-6. Example of Placement of Warning Signs and Pavement Markings at Grade Crossings



warning and control. Pavement markings shall not be required at grade crossings in urban areas if an engineering study indicates that other installed devices provide suitable warning and control.

Guidance:

05 *When pavement markings are used, a portion of the X symbol should be directly opposite the Grade Crossing Advance Warning sign. The X symbol and letters should be elongated to allow for the low angle at which they will be viewed.*

Option:

06 When justified by engineering judgment, supplemental pavement marking symbol(s) may be placed between the Grade Crossing Advance Warning sign and the grade crossing.

BNSF/UPRR Grade Separation Evaluation Report

Piert Road Extension
SR-397 to Bowles Road
Benton County, Washington

October 26, 2010

Prepared for:

Benton County
Prosser, WA 99350

Prepared by:

J·U·B

J-U-B ENGINEERS, Inc.
Kennewick, Washington 99336

Exhibit No. ____ (MB-5)
Docket TR-100572
Witness: Malcolm Bowie

Grade Separation Evaluation Report

As requested by the Washington Utilities and Trade Commission, J-U-B ENGINEERS, Inc. has evaluated the costs of constructing a grade separated crossing for the Piert Road Extension project. The intersection being evaluated is a proposed crossing of the extension of Piert Road with a private industrial rail line served by Burlington Northern Santa Fe Railway (BNSF), located in the Southeast ¼ of Section 23, T. 8 N., R. 30 E., Willamette Meridian. This document provides a preliminary layout of the overcrossing structure and costs associated with the structure and approaches.

Overcrossing Location

Piert Road Extension, a project which extends Piert Road from SR 397 (Chemical Drive) northerly to Bowles Road, is currently in preliminary design. The geometric layout of the grade separation is based on the permanent clearances provided in Section 5.2 of the BNSF Railway - Union Pacific Railroad Guidelines for Railroad Grade Separation Projects, Dated January 24, 2007. These clearances are noted on Exhibit 1.

Given the proximity of the BNSF industry track to the Union Pacific Railroad (UPRR) industry track, both serving the south Agrium chemical plant, two separate structures will be required for the overcrossing. The required length for the grade separation structures is approximately 35 feet for both the BNSF and UPRR crossings. The width of both structures will be approximately 50 feet to accommodate the two travel lanes, shoulders, concrete sidewalk on the west side, and concrete barriers.

As shown on the exhibit, it will be necessary to construct earthen embankment approaches to a height of approximately 26 feet above the existing industrial tracks. This is required to meet the minimum 23'4" vertical clearance under the concrete bridge structures. To remain outside of the minimum railroad clearance envelope, retaining walls will be required for the entire width of the grade separation embankment. 2:1 embankment slopes can be utilized to reduce costs in other areas without retaining walls.

The grade separation poses numerous problems for vehicle operations around the Agrium plant. The main entrance to the plant, which also provided access to the guard house and truck scale, will be eliminated due to the height of the proposed roadway above the existing ground. At this location, Piert Road would be over 15 feet higher than the existing entrance, making a new connection to the plant impractical. Any connection east into the plant would require a descent of at least 10% in order to keep the scale in operation. Major modifications would need to be made to Agrium's infrastructure, including relocating the main entrance and truck scale, along with reconfiguring the roadway network within the site.

Much of the property surrounding the Agrium plant is leased to local farmers for agricultural production. One of the primary access roads for these farms is located just south of the plant. On the attached exhibit it's noted that this access road will require extensive reconstruction. Piert Road would be approximately 16 feet above the existing gravel road. In order to provide access for large, wide farming equipment across the now elevated roadway would require nearly 500 feet of additional embankment and gravel road construction on each side of Piert Road. This would supply the local farmers with an access road with 4% grades on the approaches, providing adequate sight distances for crossing maneuvers.

Opinion of Probable Costs

A preliminary opinion of probable costs (see attached), was compiled based on historical unit bid prices obtained from WSDOT, Benton County, and other local project bid results. Construction for the grade separated crossing is expected to cost an estimated $3,800,000.

ENGINEER'S OPINION OF PROBABLE COST

J·U·B

PROJECT: BENTON COUNTY PIERT ROAD EXTENSION — **DATE:** 10/26/2010
PRELIMINARY OVERCROSSING COST ESTIMATE

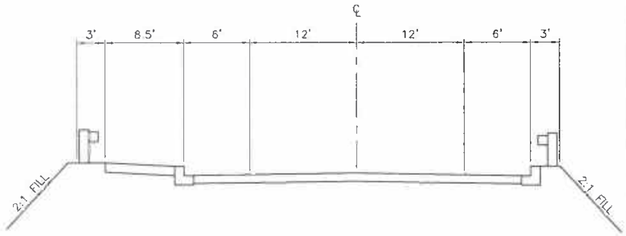
PROJECT DESCRIPTION: SR 397 TO BOWLES ROAD
BURLINGTON NORTHER SANTA FE RAILWAY INDUSTRIAL SPUR OVERCROSSING

CLIENT: Benton County

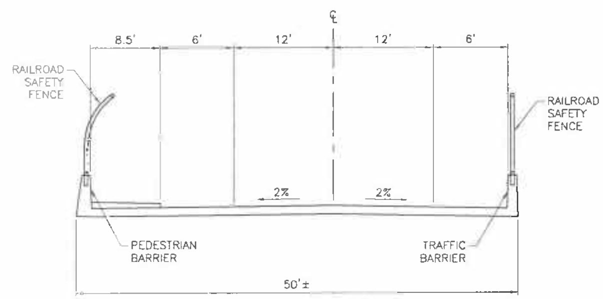
PRELIM

CLIENT PROJ. NO. CRP 1619 — J-U-B PROJ. NO.: 30-04-051

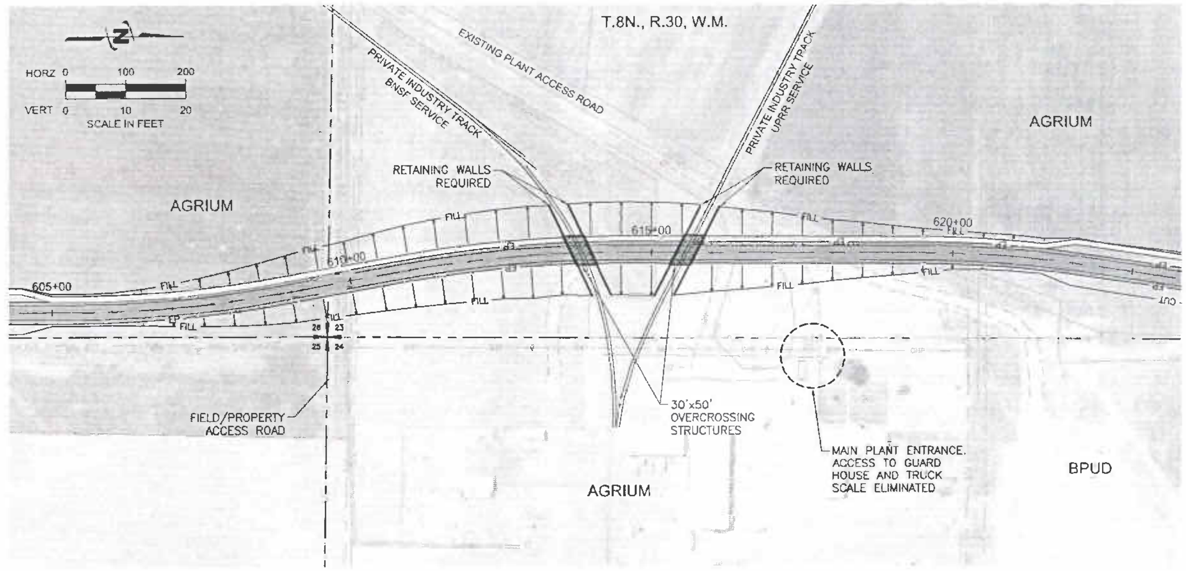
ITEM NO.	DESCRIPTION	SCHEDULE OF VALUES QUANTITY	UNIT	UNIT PRICE	TOTAL COST
	GRADING				
1	ROADWAY EXCAVATION INCL. HAUL	0	C.Y.	$3.50	$0
2	EMBANKMENT COMPACTION	86,250	C.Y.	$2.50	$215,625
3	COMMON BORROW INCL. HAUL	112,100	C.Y.	$6.00	$672,600
	DRAINAGE				
4	SCHEDULE A STORM SEWER PIPE 10 IN. DIAM	290	L.F.	$18.00	$5,220
5	SCHEDULE A STORM SEWER PIPE 12 IN. DIAM	1815	L.F.	$21.00	$38,115
6	SHORING-TRENCH SAFETY SYSTEMS	2105	L.F.	$1.25	$2,631
7	MANHOLE 48 IN. DIAM. TYPE 1	8	EA.	$2,800.00	$22,400
8	CATCH BASIN TYPE 1	16	EA.	$850.00	$13,600
9	RETENTION PONDS	1	L.S.	$10,000.00	$10,000
	STRUCTURES				
10	STRUCTURE EXCAVATION CLASS A INCL. HAUL	400	C.Y.	$15.00	$6,000
11	STRUCTURAL EARTH WALL	12,775	S.F.	$35.00	$447,125
12	BACKFILL FOR STRUCTURAL EARTH WALL INCL. HAUL	2,839	C.Y.	$17.00	$48,261
13	FURNISHING AND DRIVING STEEL TEST PILE	4	EACH	$3,500.00	$14,000
14	DRIVING STEEL PILE	28	EACH	$2,500.00	$70,000
15	FURNISHING STEEL PILE HP 10X57	980	L.F.	$55.00	$53,900
16	FURNISHING STEEL TIP	32	EACH	$250.00	$8,000
17	SUPERSTRUCTURE RR OVERPASS	3,500	S.F.	$200.00	$700,000
18	ST. REINFORCING BAR	7,525	LB	$2.20	$16,555
19	TRAFFIC BARRIER	70	L.F.	$85.00	$5,950
20	TRAFFIC PEDESTRIAN BARRIER	70	L.F.	$135.00	$9,450
21	RAILROAD SAFETY FENCE	140	L.F.	$30.00	$4,200
22	CONC. CLASS 4000 FOR BRIDGE	330	C.Y.	$600.00	$198,000
	CEMENT CONCRETE PAVEMENT				
23	BRIDGE APPROACH SLAB	556	S.Y.	$295.00	$163,889
	TRAFFIC				
24	BEAM GUARDRAIL TYPE 1	3,160	L.F.	$22.00	$69,520
25	BEAM GUARDRAIL ANCHOR TYPE 1	4	EA.	$750.00	$3,000
26	BEAM GUARD RAIL TRANSITION SECTION TYPE 4	8	EA.	$1,100.00	$8,800
27	CEMENT CONC. SIDEWALK	1,492	S.Y.	$20.00	$29,844
28	SIDEWALK RAMP TYPE 1	2	EA.	$1,800.00	$3,600
29	CEMENT CONC. TRAFFIC CURB AND GUTTER	3,160	L.F.	$8.50	$26,860
	OTHER ITEMS				
30	WATER	5,000	M GAL.	$12.00	$60,000
	CONSTRUCTION SUBTOTAL				**$2,927,146**
			CONTINGENCY	30%	$878,144
			CONSTRUCTION TOTAL		**$3,805,289**

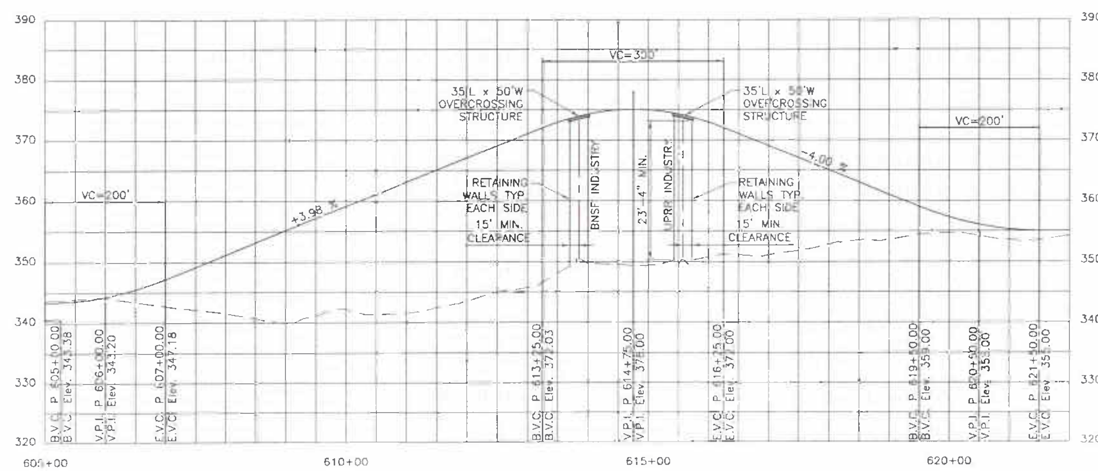


1 TYPICAL ROADWAY SECTION AT OVERCROSSING APPROACHES
SCALE:NTS



2 TYPICAL ROADWAY SECTION AT OVERCROSSING
SCALE:NTS





J-U-B
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EXHIBIT 1
BNSF/UPRR GRADE SEPARATION
PIERT ROAD EXTENSION PROJECT
BENTON COUNTY, WA

Design Manual

M 22-01

English

Washington State Department of Transportation
Environmental and Engineering Service Center
Design Office

Exhibit No. _____ (MB-6)
Docket TR-100572
Witness: Malcolm Bowie

			Date
	910.07	Channelization	
	910.08	Roundabouts	
	910.09	U-Turns	
	910.10	Sight Distance at Intersections	
	910.11	Traffic Control at Intersections	
	910.12	Interchange Ramp Terminals	
	910.13	Procedures	
	910.14	Documentation	
Chapter 915	Roundabouts		May 2004
	915.01	General	
	915.02	References	
	915.03	Definitions	
	915.04	Roundabout Categories	
	915.05	Capacity Analysis	
	915.06	Geometric Design	
	915.07	Pedestrians	
	915.08	Bicycles	
	915.09	Signing and Pavement Marking	
	915.10	Illumination	
	915.11	Access, Parking, and Transit Facilities	
	915.12	Procedures	
	915.13	Documentation	
Chapter 920	Road Approaches		December 2003
	920.01	General	
	920.02	References	
	920.03	Definitions	
	920.04	Design Considerations	
	920.05	Road Approach Design Template	
	920.06	Sight Distance	
	920.07	Road Approach Location	
	920.08	Drainage Requirements	
	920.09	Procedures	
	920.10	Documentation	
Chapter 930	Railroad Grade Crossings		June 1989
	930.01	General	(930-4, 6 through 12 March 1994)
	930.02	References	
	930.03	Plans	
	930.04	Traffic Control Systems	
	930.05	Stopping Lanes	
	930.06	Types of Crossing Surfaces	
	930.07	Crossing Closure	
	930.08	Traffic Controls During Construction and Maintenance	
	930.09	Railroad Grade Crossing Orders	
	930.10	Longitudinal Easements From Railroad	
Chapter 940	Traffic Interchanges		September 2002
	940.01	General	
	940.02	References	
	940.03	Definitions	
	940.04	Interchange Design	

Figure Number	Title	Page	Last Date
910-12	Right-Turn Lane Guidelines	910-28	May 2001
910-13	Right-Turn Pocket and Right-Turn Taper	910-29	February 2002
910-14	Right-Turn Lane	910-30	February 2002
910-15	Acceleration Lane	910-31	May 2001
910-16a	Traffic Island Designs	910-32	May 2001
910-16b	Traffic Island Designs (Compound Curve)	910-33	May 2001
910-16c	Traffic Island Designs	910-34	May 2001
910-17	U-Turn Locations	910-35	May 2001
910-18a	Sight Distance for Grade Intersection With Stop Control	910-36	May 2001
910-18b	Sight Distance at Intersections	910-37	May 2001
910-19	Interchange Ramp Details	910-38	May 2001
915-1	Roundabout Elements	915-3	May 2004
915-2	Entry Angle	915-4	May 2004
915-3	Turning Radius (R)	915-5	May 2004
915-4	Approach Leg Alignment	915-8	May 2004
915-9	Deflection	915-9	May 2004
915-6	Stopping Sight Distance for Roundabouts	915-11	May 2004
915-7	Roundabout Categories Design Characteristics	915-17	May 2004
915-8	Approximate Entry Capacity	915-18	May 2004
915-9a	Deflection Path	915-19	May 2004
915-9b	Deflection Path	915-20	May 2004
915-10	Deflection Path Radius	915-21	May 2004
915-11	Entry and Exit	915-22	May 2004
915-12	Path Overlap	915-23	May 2004
915-13	Roundabout Intersection Sight Distance	915-24	May 2004
915-14	Central Island	915-25	May 2004
915-15	Splitter Island	915-26	May 2004
915-16	Shared Use Sidewalk	915-27	May 2004
915-17	Roundabout Signing	915-28	May 2004
915-18	Roundabout Illumination	915-29	May 2004
920-1	Road Approach Design Templates	920-2	December 2003
920-2	Road Approach Access Category	920-2	December 2003
920-3	Road Approach Design Template A1	920-5	December 2003
920-4	Road Approach Design Templates B1 and C1	920-6	December 2003
920-5	Road Approach Design Template D1	920-7	December 2003
920-6	Road Approach Sight Distance	920-8	December 2003
930-1 M	Sight Distance at Railroad Crossing	930-4	March 1994
930-2	Guidelines for Railroad Crossing Protection	930-5	June 1989
930-3 M	Typical Pullout Lane at Railroad Crossing	930-6	March 1994
930-4 M	Railroad Crossing Plan for Washington Utilities and Transportation Commission	930-7	March 1994
930-5 M	Longitudinal Easement Cross Sections	930-8	March 1994
930-1	Sight Distance at Railroad Crossing	930-9	March 1994
930-3	Typical Pullout Lane at Railroad Crossing	930-10	March 1994
930-4	Railroad Crossing Plan for Washington Utilities and Transportation Commission	930-11	March 1994
930-5	Longitudinal Easement Cross Sections	930-12	March 1994
940-1	Ramp Design Speed	940-5	September 2002

All conditions not covered in this chart, or marginal situations, are to be referred to headquarters, Project Development Office with the district's recommendation and support data.

TYPE OF HIGHWAY	EXPOSURE FACTOR x	TYPE OF RAILROAD FACILITY		
		NONMAIN LINE	SINGLE MAIN LINE (UNDER 60 MPH)	DOUBLE TRACK OR HIGH SPEED SINGLE MAIN LINE
Two Lane	Under 1,500	Reflectorized Signs	Flashing Lights	Flashing Lights
	1,500 - 5,000	Flashing Lights	Flashing Lights	Flashing Lights
	5,000 - 50,000	Auto. Gates x x	Auto. Gates x x	Auto. Gates x x
	Over 50,000	Separation	Separation	Separation
Multi-Lane	Under 50,000	Auto. Gates	Auto. Gates	Auto. Gates
	Over 50,000	Separation	Separation	Separation
All Fully Controlled Access	In All Cases	Separation	Separation	Separation

x Exposure Factor = Trains per day x vehicle ADT.
x x Automatic Gates to be used in urban areas and flashing lights in rural areas, unless conditions warrant otherwise.

GUIDELINES FOR RAILROAD CROSSING PROTECTION
Figure 930-2

Federal Railroad Administration
Office of Safety Analysis

FRA Web Accident Prediction System (WBAPS)

Welcome to the newly redesigned FRA Office of Safety Accident/Prediction Web Site. This site was established for the purpose of making railroad safety information readily available to a broad constituency which includes FRA personnel, railroad companies, research and planning organizations and the public, in general.

Visitors have access to railroad safety information including accidents and incidents and highway-rail crossing data. From this site users can run dynamic queries and view current statistical information on railroad safety.

Search by : ⦿ Location ○ Crossing

Select Location(s) and/or Railroad(s), and Choose 'Select'

State: Washington ☐ Entire State

County/City*: BENTON CHELAN CLALLAM ⦿ County ○ City [Select]

*Select more than one County/City in the list by holding down your PC's ctrl key while you click.

Railroad: Union Pacific RR Co. [UP] [Select]

Click here for a complete listing of Railroads

Location selected:

WA BENTON

[Remove]

Railroad selected:

BNSF
UP

[Remove]

How many Records?

○ 30 ○ 50 ⦿ 100 ○ All

Reports

☑ Cover Sheet
☑ Disclaimer/Abbreviation Key
☑ Prediction Report
☐ Sorted By Crossing Number
☐ Crossing Profile
☑ Accident History
☐ Contact Sheet

⦿ View Report ○ Download Report

⦿ Annual Report ○ Cyclic Report

Exhibit No. _____ (MB-7)
Docket TR-100572
Witness: Malcolm Bowie

Annual WBAPS 2010

WEB ACCIDENT PREDICTION SYSTEM

Accident Prediction Report for
Public at-Grade Highway-Rail Crossings

Including:

Disclaimer/Abbreviation Key
Accident Prediction List
Collision History

Provided by:

Federal Railroad Administration
Office of Safety Analysis
Highway-Rail Crossing Safety & Trespass Prevention

Data Contained in this Report:

STATE: WA
COUNTY: BENTON
RAILROAD: BNSF,UP

Date Prepared: 8/27/2010

*PUBLIC HIGHWAY-RAIL CROSSINGS RANKED BY PREDICTED ACCIDENTS PER YEAR AS OF 12/31/2009**

*Num of Collisions: Most recent year is partial year (data is not for the complete calendar year) unless Accidents per Year is 'AS OF DECEMBER 31'

RANK	PRED COLLS	CROSSING	RR	STATE	COUNTY	CITY	ROAD	NUM OF COLLISIONS 09*	08	07	06	05	DATE CHG	WD	TOT TRN	TOT TRK	TTBL SPD	HWY PVD	HWY LNS	AADT
1	0.071478	090038S	BNSF	WA	BENTON	KENNEWICK	BOWLES RD.9713	0	0	1	0	0		GT	37	1	79	YES	2	1,515
2	0.058803	104544M	BNSF	WA	BENTON	PROSSER	RICHARDS ROAD	0	0	0	0	1		XB	8	1	49	YES	2	100
3	0.049297	090051F	BNSF	WA	BENTON	KENNEWICK	EVANS RD.	0	0	0	0	1		XB	36	1	79	NO	2	10
4	0.034378	090031U	BNSF	WA	BENTON	KENNEWICK	3RD AVE E.	0	0	0	0	0		FL	37	2	35	YES	2	1,735
5	0.032685	919073D	BNSF	WA	BENTON	KENNEWICK	KELLOGG STREET	0	0	0	0	0		GT	14	1	49	YES	4	12,000
6	0.032327	808955P	UP	WA	BENTON	KENNEWICK	SR-397 M.P. 6.	0	0	0	0	0		XB	6	1	8	YES	2	10,000
7	0.031041	808925X	UP	WA	BENTON	KENNEWICK	SR-397 M.P. 6.	0	0	0	0	0		XB	4	2	8	YES	4	13,000
8	0.027827	090040T	BNSF	WA	BENTON	KENNEWICK	FINLEY RD.9721	0	0	0	0	0		GT	37	1	79	YES	2	1,943
9	0.026547	808911P	UP	WA	BENTON	KENNEWICK	R.R. AVE. & WA	0	0	0	0	0		XB	4	1	8	YES	4	7,600
10	0.022112	808960L	UP	WA	BENTON	KENNEWICK	BENTON ST	0	0	0	0	0		FL	6	2	8	YES	4	3,300
11	0.021549	104552E	BNSF	WA	BENTON	PROSSER	LOOP CTY (LEE	0	0	0	0	0		NO	8	1	60	YES	2	150
12	0.021549	104553L	BNSF	WA	BENTON	PROSSER	LEE RD.	0	0	0	0	0		XB	8	1	60	YES	2	150
13	0.021510	104572R	BNSF	WA	BENTON	KENNEWICK	N. FRUITLAND S	0	0	0	0	0		GT	6	3	35	YES	4	4,500
14	0.020568	808908G	UP	WA	BENTON	KENNEWICK	BENTON ST.	0	0	0	0	0		XB	4	1	8	YES	2	3,300
15	0.020067	090035W	BNSF	WA	BENTON	KENNEWICK	E. 25TH AVE.	0	0	0	0	0		GT	37	1	79	YES	2	487
16	0.019911	104547H	BNSF	WA	BENTON	PROSSER	SIXTH ST	0	0	0	0	0	06/06	GT	8	2	45	YES	4	4,000
17	0.019726	808904E	UP	WA	BENTON	KENNEWICK	RR AVE & DAYTON	0	0	0	0	0		XB	4	2	8	YES	2	2,890
18	0.019598	808232B	UP	WA	BENTON	KENNEWICK	N. FRUITLAND	0	0	0	0	0		FL	4	1	8	YES	4	5,400
19	0.019588	104574E	BNSF	WA	BENTON	KENNEWICK	N. WASHINGTON	0	0	0	0	0	06/06	GT	6	5	35	YES	4	5,500
20	0.019572	090036D	BNSF	WA	BENTON	KENNEWICK	PERKINS RD.7572	0	0	0	0	0		GT	37	1	79	YES	2	440
21	0.018493	090037K	BNSF	WA	BENTON	KENNEWICK	HANEY RD.7640	0	0	0	0	0		GT	37	1	79	YES	2	350
22	0.017703	808950F	UP	WA	BENTON	KENNEWICK	PERKINS RD.	0	0	0	0	0		SS	6	2	40	YES	4	705
23	0.016144	808959S	UP	WA	BENTON	KENNEWICK	N. WASHINGTON	0	0	0	0	0		GT	6	2	8	YES	4	7,600
24	0.014789	808966C	UP	WA	BENTON	KENNEWICK	NO. FRUITLAND	0	0	0	0	0		GT	6	1	8	YES	4	5,400
25	0.014460	808957D	UP	WA	BENTON	KENNEWICK	1ST AVE.	0	0	0	0	0		GT	6	2	8	YES	4	4,950
26	0.013989	104573X	BNSF	WA	BENTON	KENNEWICK	N. BENTON ST	0	0	0	0	0	06/06	GT	6	4	35	YES	4	2,250
27	0.013952	808976H	UP	WA	BENTON	BENTON CITY	SR-275 M.P. 1.	0	0	0	0	0		HS	2	1	40	YES	2	6,000
28	0.013673	808954H	UP	WA	BENTON	KENNEWICK	E. 10TH AVE.	0	0	0	0	0		FL	6	1	8	YES	3	1,210
29	0.013652	104567U	BNSF	WA	BENTON	KENNEWICK	COLUMBIA CTR.	0	0	0	0	0		GT	12	2	60	YES	2	550
30	0.013111	808956W	UP	WA	BENTON	KENNEWICK	SO. GUM ST	0	0	0	0	0		GT	6	3	8	YES	4	3,400
31	0.012779	104562K	BNSF	WA	BENTON	KIONA	BADGER CANYON	0	0	0	0	0		HS	12	4	60	YES	2	280
32	0.012763	104548P	BNSF	WA	BENTON	PROSSER	SEVENTH STREET	0	0	0	0	0	06/06	GT	8	1	45	YES	2	3,000
33	0.012401	104568B	BNSF	WA	BENTON	KENNEWICK	N. EDISON ST.	0	0	0	0	0	06/06	GT	6	1	49	YES	2	4,000

34	0.012361	090039Y	BNSF	WA	BENTON	KENNEWICK	COCHRAN RD	0	0	0	0	0		GT	37	1	79	YES	2	73
35	0.011908	808951M	UP	WA	BENTON	KENNEWICK	BRYSON-BROWN R	0	0	0	0	0		XB	6	1	40	YES	2	212
36	0.011592	090062T	BNSF	WA	BENTON	PATERSON	PUBLIC XING	0	0	0	0	0		XB	36	2	70	NO	2	10
37	0.010808	808963G	UP	WA	BENTON	KENNEWICK	CASCADE ST.	0	0	0	0	0		XB	6	3	8	YES	2	310
38	0.010198	808978W	UP	WA	BENTON	BENTON CITY	KENDALL RD.	0	0	0	0	0		XB	2	1	40	YES	2	403
39	0.009996	090061L	BNSF	WA	BENTON	PATERSON	WHITCOMB ISLND	0	0	0	0	0		GT	36	1	70	YES	2	35
40	0.009950	808952U	UP	WA	BENTON	KENNEWICK	HANEY ROAD	0	0	0	0	0		XB	6	1	40	YES	2	125
41	0.009913	104566M	BNSF	WA	BENTON	KENNEWICK	KEENE RD	0	0	0	0	0	02/08	FL	12	1	60	YES	2	270
42	0.009665	104549W	BNSF	WA	BENTON	PROSSER	EIGHTH ST	0	0	0	0	0		XB	8	2	45	NO	2	90
43	0.009581	808990D	UP	WA	BENTON	PROSSER	GAP RD.	0	0	0	0	0		XB	4	1	40	YES	2	168
44	0.009472	104557N	BNSF	WA	BENTON	KIONA	HANSEN RD.	0	0	0	0	0		XB	12	2	60	NO	2	30
45	0.009459	808958K	UP	WA	BENTON	KENNEWICK	SO. ALDER STRE	0	0	0	0	0		XB	6	3	8	YES	2	210
46	0.009443	808992S	UP	WA	BENTON	PROSSER	MISSEMER RD.	0	0	0	0	0		XB	4	1	40	YES	2	161
47	0.009054	808977P	UP	WA	BENTON	BENTON CITY	WEST D ST.	0	0	0	0	0		XB	2	1	40	YES	2	285
48	0.007936	090042G	BNSF	WA	BENTON	KENNEWICK	EVANS ROAD	0	0	0	0	0		GT	36	1	79	NO	2	15
49	0.007559	808915S	UP	WA	BENTON	KENNEWICK	BRUNEAU & BEECH	0	0	0	0	0		XB	4	1	8	YES	2	165
50	0.007408	808975B	UP	WA	BENTON	BENTON CITY	DEMOSS RD	0	0	0	0	0		XB	2	1	40	YES	2	160
51	0.007258	808988C	UP	WA	BENTON	PROSSER	HINZERLING RD.	0	0	0	0	0		FL	4	1	40	YES	2	500
52	0.007192	808983T	UP	WA	BENTON	PROSSER	ROTH ROCK RD.	0	0	0	0	0		FL	4	1	40	YES	2	488
53	0.007096	090056P	BNSF	WA	BENTON	PLYMOUTH	CHRISTY RD	0	0	0	0	0		GT	36	1	79	YES	2	10
54	0.006641	808986N	UP	WA	BENTON	PROSSER	BUNN RD.	0	0	0	0	0		XB	4	1	35	YES	2	65
55	0.006541	808968R	UP	WA	BENTON	KENNEWICK	NO. EDISON ST.	0	0	0	0	0		GT	4	1	40	YES	2	1,030
56	0.006341	808918M	UP	WA	BENTON	KENNEWICK	N. DATE ST.	0	0	0	0	0		XB	4	1	8	YES	2	100
57	0.006281	808984A	UP	WA	BENTON	PROSSER	PIONEER RD	0	0	0	0	0		XB	4	1	40	YES	2	50
58	0.006048	090046J	BNSF	WA	BENTON	KENNEWICK	CHEMICAL RD.97	0	0	0	0	0		GT	2	1	79	YES	2	2,600
59	0.005860	104564Y	BNSF	WA	BENTON	KENNEWICK	GOOSE GAP RD	0	0	0	0	0		OS	6	1	49	NO	2	30
60	0.005852	090057W	BNSF	WA	BENTON	PATERSON	PATERSON RD.11	0	0	0	0	0		GT	36	1	79	YES	2	5
61	0.005216	090034P	BNSF	WA	BENTON	KENNEWICK	BERNATH RD 7610	0	0	0	0	0	12/06	GT	37	2	79	NO	2	100
62	0.004960	808917F	UP	WA	BENTON	KENNEWICK	CEDAR & BRUNEAU	0	0	0	0	0		SS	4	1	8	YES	2	50
63	0.004960	808905L	UP	WA	BENTON	KENNEWICK	RR AVE	0	0	0	0	0		XB	4	1	8	YES	2	50
64	0.004835	101905E	BNSF	WA	BENTON	PROSSER	LEE ROAD	0	0	0	0	0	06/06	GT	8	1	49	YES	2	290
65	0.004739	808970S	UP	WA	BENTON	RICHLAND	LESLIE RD.	0	0	0	0	0		GT	2	1	40	YES	3	403
66	0.004319	808981E	UP	WA	BENTON	PROSSER	CASE RD.	0	0	0	0	0		FL	2	1	40	YES	2	260
67	0.003794	090044V	BNSF	WA	BENTON	KENNEWICK	CHEMICAL RD.97	0	0	0	0	0		FL	2	1	79	YES	2	298
68	0.003724	808974U	UP	WA	BENTON	BENTON CITY	RUPPERT RD.	0	0	0	0	0		SS	2	1	40	YES	2	23
69	0.003665	808982L	UP	WA	BENTON	PROSSER	BEER'S RD	0	0	0	0	0		XB	2	1	40	YES	2	22
70	0.003201	808991K	UP	WA	BENTON	PROSSER	ALBRO RD.	0	0	0	0	0		XB	4	1	40	NO	2	38

71	0.002938	808987V	UP	WA	BENTON	PROSSER	HECK RD.	0	0	0	0	0		XB	4	2	40	NO	2	30
72	0.002830	808985G	UP	WA	BENTON	PROSSER	MCDOMALD RD.	0	0	0	0	0		XB	4	1	35	NO	2	30
73	0.002784	808913D	UP	WA	BENTON	KENNEWICK	ALDER & BRUNEAU	0	0	0	0	0		NO	4	1	8	YES	2	10
74	0.002784	808927L	UP	WA	BENTON	KENNEWICK	BRUNEAU AVE	0	0	0	0	0		XB	4	1	8	YES	2	10
75	0.002784	808937S	UP	WA	BENTON	KENNEWICK	COLUMBIA DR	0	0	0	0	0		XB	4	2	8	YES	2	10
76	0.002784	808930U	UP	WA	BENTON	KENNEWICK	ALLEY & BRUNEAU	0	0	0	0	0		NO	4	1	8	YES	2	10
77	0.002394	090047R	BNSF	WA	BENTON	KENNEWICK	GAME FARM RD 7	0	0	0	0	0		GT	2	1	79	YES	2	100
78	0.002394	090048X	BNSF	WA	BENTON	KENNEWICK	COCHRAN RD	0	0	0	0	0		GT	2	1	79	YES	2	100
79	0.002394	090050Y	BNSF	WA	BENTON	KENNEWICK	BOWLES RD	0	0	0	0	0		GT	2	1	79	YES	2	100
80	0.002229	808989J	UP	WA	BENTON	PROSSER	WAMBA RD.	0	0	0	0	0		NO	4	1	40	NO	2	14
81	0.002172	090043N	BNSF	WA	BENTON	KENNEWICK	CHEMICAL RD. 9	0	0	0	0	0	06/06	GT	2	1	79	YES	2	298
82	0.002170	808973M	UP	WA	BENTON	BENTON CITY	RUPPERT RD.	0	0	0	0	0		XB	2	1	40	NO	2	26
83	0.000687	090045C	BNSF	WA	BENTON	KENNEWICK	LECHELT RD	0	0	0	0	0		XB	0	1	79	YES	2	50
84	0.000399	808965V	UP	WA	BENTON	KENNEWICK	CANAL DRIVE	0	0	0	0	0		NO	0	1	8	YES	2	2,250
TTL:	1.084611							0	0	1	0	2								