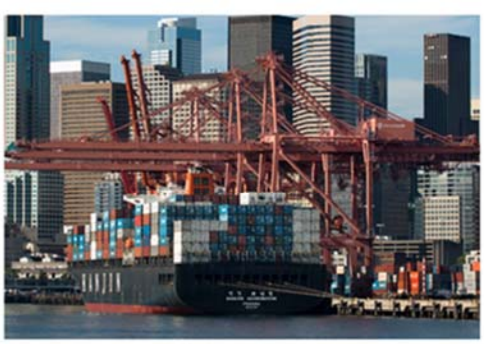
Great Northern Corridor SWOT Analysis Phase II

GREAT NORTHERN CORRIDOR COALITION



Grade Crossing Safety and Mobility Initiative

White Paper

May 23, 2016

Prepared for Great Northern Corridor Coalition

Prepared by the Olsson Associates Team

Table of Contents

Introduction

The Corridor Coalition recognizes the importance of rail transportation's role in a growing economy. The Coalition members also acknowledge the concerns of increasing rail traffic on the communities adjacent to the Corridor. These concerns include noise, lighting and air quality, and safety and congestion impacts at rail at-grade crossings. As both road and rail traffic volumes increase, it is likely public concerns regarding this traffic will also grow. The Coalition chose to investigate this initiative as one of three identified for further development in Phase II of the project. It is intended that the information gathered under this initiative will help to inform the decision making process for selecting and prioritizing potential grade crossing separation investments. This white paper examines a set of evaluation factors developed to help states, Metropolitan / Region Planning Organizations and local communities in their selection and prioritization of potential grade separation projects.

It is anticipated that future rail and vehicular traffic will result in increasing delays at local at-grade crossings and that communities along the Corridor will experience increasing levels of congestion and noise. Many local impacts can be addressed through a variety of operational measures and capital investments such as crossing closures, quiet zones, and grade separations. It needs to be recognized that grade separations are not classified as a safety improvement but rather an improvement to vehicle mobility in response to vehicle delays.

The Great Northern Corridor has over 2,300 public, at-grade railroad/street crossings. Improving safety and efficiency for cars, trucks, and trains is critical at these intersections. In Phase I, a methodology was created to assess all 2,323 crossings to identify crossing safety improvement candidates. This methodology provided a system-level view of potential crossing changes that identified candidates for closure/consolidation, candidates for signalization upgrades, and candidates for grade separation. Experience has shown that exposure, which is the product of AADT (Annual Average Daily Traffic) and the number of trains traveling that section of rail per day is a good measure to rank potential crossing improvements. The *Railroad-Highway Grade Crossing Handbook – Revised Second Edition 2007* includes a Chapter entitled "Selection of Alternatives" that provides exposure number guidelines for crossing closures and grade separations. The chapter was developed by a Technical Working Group established by the USDOT that included the representation of highway agencies, railroad companies and authorities, and governmental agencies involved in developing and implementing policies, rules, and regulations. Exposure number guidelines are a good starting point in the prioritization crossing safety candidate projects. The additional use of FRA's Web-Based Accident Prediction System (WBPAS) introduces the influence of past and predicted crossing crash statistics. Using BNSF's "Near Miss" reports provides a rail operations perspective of crossings warranting a review for possible crossing improvements. Following this methodology, Phase I produced three lists of grade crossings that are candidates for 1) closure, 2) consolidation and 3) potential grade separation.

In Phase II, the Team focused on developing evaluation criteria that can be used to develop qualitative and quantitative information to help stakeholders further identify the most suitable crossings for grade separation improvements.

The Team recognizes that it is important that the corridor-wide methodology work for both urban and rural crossings. As each size community perceives the rail traffic moving through the community as heavily affected the respective livability. The challenge remains funding potential improvements and the respective responsibilities/authority of the multiple entities involved in the decision process. It is especially important, for example, in recommending any crossing improvement that the project champions recognize the responsibility of rail crossing improvements is primarily assigned to the respective state highway departments or road authorities. The Coalition's work is intended to help each state in their respective decision processes by providing evaluation factors that can be considered. This methodology is not meant to interfere with current state responsibilities. For example, the State of Minnesota has chosen not to submit sample crossings for this evaluation due to the fact that their Department of Transportation has recently completed a crossing study which is currently under consideration in the Minnesota Legislature. MnDOT does not want their project list evaluated under this initiative over concerns that any results from this study that might appear to be in conflict with their current package.

The research presenting in this technical memo is intended as a programmatic, corridor level approach to help stakeholders identify, prioritize, and fund grade crossing improvements such as separations. The traditional approach for making grade-crossing investment decisions has been guided by the USDOT, FHWA sponsored "Railroad-Highway Grade Crossing Handbook, Revised Second Edition (August 2007) and its predecessor document. The handbook provides guidance for the consideration of grade separations for highway-rail crossings. The handbook addresses two scenarios: A) The highway-rail crossing must be grade separated or the crossing eliminated; and, B) The highway-rail crossing should be considered for grade separation. A number of recent studies, including one conducted by Coalition member Minnesota, have used additional filters beyond traditional traffic and safety factors that can assist planners in making better investment decisions for at-grade crossing separation projects, and allow for a more objective means of comparing project alternatives.

The Olsson Team has explored existing relevant research, available local crossing data and proposes a broader approach/methodology framework for making strategic corridor decisions related to highway/rail at-grade crossing improvements.

Phase I provided a basis for the selection of a set of sample crossings upon which the proposed evaluation factors could be tested. The original list included 25 crossings across the corridor of over 3,200 public crossings based upon a filter using the Exposure rate and Predictive Accident Ratio. This initial selection produced a list of high priority crossing that were heavy weighted to urban centers due to the simple fact that urban crossing tends to have a much higher Average Annual Daily Traffic (AADT) level than rural crossings on the Subdivision. Thus, in Phase II, the Team reached out to each state DOT to request a list of sample crossings from their respective state for consideration under this initiative. This outreach generated a list of 19 crossings as displayed in Exhibit 1.

- Five crossings along the Seattle Subdivision between Seattle and Portland in Washington State,
- Eight crossings in North Dakota, representing five subdivisions,
- Four crossing in Montana representing three subdivisions and
- Two crossing in Wisconsin representing two subdivisions.

This sample of 19 crossing is a good mix of urban, small-city and rural crossings that may warrant consideration as a potential grade separation project by their stakeholders. Exhibit 1 displays the locations of the crossings and Exhibit 2 displays an example of available FRA data for each crossing.

Exhibit 1: Map of Sample Railroad Crossings used in the beta-testing of the Evaluation Factors

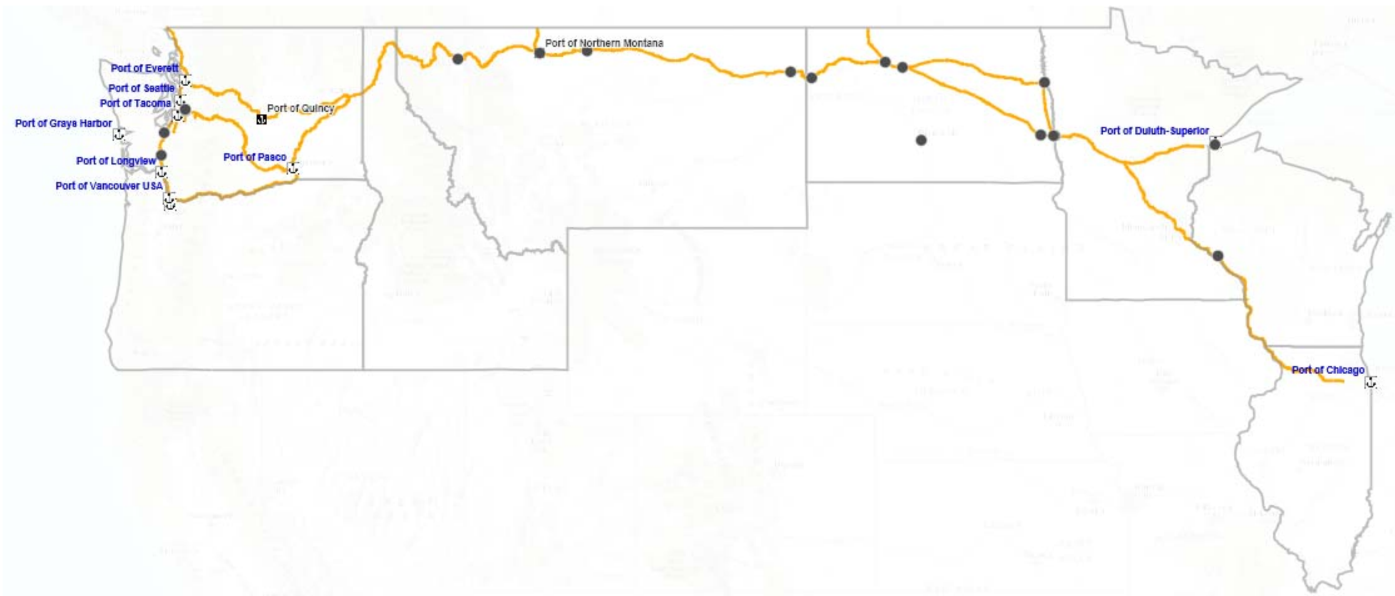


Exhibit 2: Nineteen Sample Railroad Crossings

Crossing ID	State	Subdivision	County	City	Address	Year of AADT	AADT	Trains/ Day	Urban/ Rural	Exposure	Warning Device Type	Max Train Speed	# of Tracks
059618E	MT	Glascow	Roosevelt	Culbertson	1st Ave. W	2013	543	39	City-800 pop	21,177	Flashing Lights and Gates	79 mph	1
088620J	MT	Great Falls	Toole	Shelby	Hwy 2	2013	1,534	6	Urban	9,204	Flashing Lights and Gates	20 mph	1
059334A	MT	Hi Line	Flathead	Columbia Falls	N LaSalle Rd	2013	1,070	45	Rural	48,150	Flashing Lights and Gates	70 mph	2
059770N	MT	Hi Line	Hill	Rudyard	Reed St S-255	2013	912	35	City- 275 pop	31,920	Flashing Lights and Gates	79 mph	2
071656R	ND	Crosby	Ward	Berthold	US-2	2015	7,660	2	Rural	15,320	Flashing Lights and Gates	25 mph	1
081558C	ND	Glasgow	Williams	Trenton	ND-1804	2015	4,135	35	Rural	144,725	Flashing Lights and Gates	70 mph	1
062505C	ND	Glasston	Grand Forks	Grand Forks	Hwy 2	2013	19,555	6	Urban	117,330	Flashing Lights and Gates	25 mph	1
087659J	ND	Jamestown	Burleigh	Bis/Linc	66th St SE	2014	3,890	22	Rural	85,580	Flashing Lights and Gates	60 mph	1
070809N	ND	KO	Cass	Fargo	Broadway	2015	4,675	67	Urban	313,225	Flashing Lights & 4 Quad Gates	35 mph	2
070828T	ND	KO	Cass	Fargo	27th St N	2006	1,900	67	Urban	127,300	Flashing Lights and Gates	60 mph	2
071103U	ND	KO	Cass	Casselton	Langer Av/ND	2015	3,315	52	City-2400 pop	172,380	Flashing Lights & 4 Quad Gates	60 mph	2
093077T&79G	ND	KO	Ward	Minot	27th St SE	2015	5,185	35	Urban	181,475	Flashing Lights and Gates	40 mph	5
085640K	WA	SEATTLE	King	KENT	SR516 (WILLIS ST)		20,200	46	Urban	929,200	Flashing Lights and Gates	79 mph	2
085629K	WA	SEATTLE	King	KENT	JAMES ST	2010	23,110	46	Urban	1,063,060	Flashing Lights and Gates	79 mph	2
085625H	WA	SEATTLE	King	KENT	S 212TH STREET	2010	25,300	46	Urban	1,163,800	Flashing Lights and Gates	79 mph	2
085775R	WA	SEATTLE	Thurston	OLYMPIA	RICH RD SE	2000	6,057	46	Rural	278,622	Flashing Lights and Gates	79 mph	2
092493S	WA	SEATTLE	Lewis	WINLOCK	WALNUT ST./SR 603	1995	4,500	46	Rural	207,000	Flashing Lights and Gates	67 mph	2
061459A	WI	Lakes	Douglas	Superior	N 28th	2002	3,500	22	City-27,244 pop	77,000	Flashing Lights	10 mph	4
079957N	WI	St Croix	Buffalo	Nelson	WI-25	2004	5,200	44	City- 374 pop	228,800	Flashing Lights and Gates	60 mph	2

Exhibit 2 displays the basic attributes of each of the sample rail crossing including AADT, Number of Trains per Day, Urban vs. Rural classification, Exposure Value, Type of Warning Devices, Train speed and Number of rail tracks.

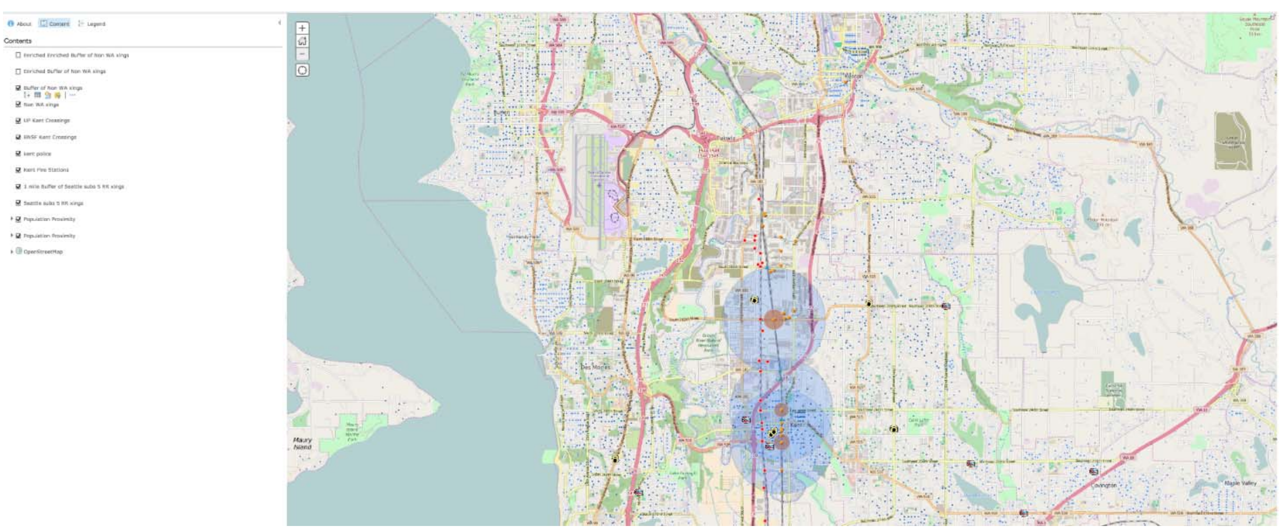
Exhibit 3: Initial Evaluation of Five High Priority Crossings on the BNSF Seattle Subdivision

Crossing Location (Street, city)	City	State	Existing AADT	Estimated Peak Hour Volume	Estimated Vehicles Affected by One Train [a]	2015 Number of Trains	Current Gate Downtime Per Day (Hours)	Total Delay Per Day, All Vehicles per One Train (Hours)	Total Daily Vehicle Delay, All Trains (Hours)	Maximum Queue Length [b,c] (feet)
SR516 (WILLIS ST)	Kent	WA	20,200	2020	168	63	5.25	7.0	442	4,208
JAMES ST	Kent	WA	17,900	1790	149	63	5.25	6.2	392	3,729
S 212TH STREET	Kent	WA	25,300	2530	211	63	5.25	8.8	553	5,271
RICH RD SE	Olympia	WA	6,057	606	50	51	4.25	2.1	107	1,262
WALNUT ST./SR 603	Winlock	WA	4,500	450	38	52	4.33	1.6	81	938

a. *Assumes uniform distribution of traffic during the peak hour. Calculation is based upon Peak volumes which is estimated at 10% of AADT, x 5 minutes of gate downtime divided by 60 minutes in an hour.*
b. *Includes traffic on all approaches to the crossing.*
c. *Assumes 25 feet per vehicle.*

Estimated Peak Hour Volume = 10% of AADT Estimated Vehicles Affected by One Train = Estimated Peak Hour Volume x 5 minutes/60 minutes Other Assumptions: Assumes that the average train is 7,800 long and traveling at an average of 20 mph, the average gate downtime per at-grade crossing would be approximately 5 minutes per train.

Exhibit 4: ArcGIS On-line Map of the Three Kent Crossings



This interactive map in Exhibit 4 shows the 1 mile buffer in blue around each crossing as well as the general population in the surrounding area. When expanded, the Fire Stations, Schools, and Police Stations are visible. This type of graphical presentation will help the decision makers get quickly acquainted with the location of the crossings. In addition, pop-up boxes can be added to display the Evaluation Factors for each crossing.

Literature Review

A current literature review of past practices organized evaluation factors into six main areas. Numbers in the bracket indicate the number of sub-factors identified. The notation next to the sub-factor indicates the number of studies that the sub-factor was referenced.

Safety Factors (2)

- USDOT Accident Prediction Value - 8
- Accident History - 13

Delay Factors (11)

- Road Vehicle Delay - 9
- Rail Delay - 1
- Posted HW Speed - 6
- Speed Reduction - 3
- Average Daily Vehicle Traffic (AADT) - 16
- Average Daily Train Traffic (AATT) - 15
- Train Speed - 7
- Train Length - 6
- Exposure (AADT * Average Daily Trains)- 7
- Duration of Crossing Closure - 6
- Queue Length - 1

Location and Geometry of Crossing (4)

- Geometry of the Crossing - 5
- Number of HW Lanes - 2
- Number of Rail Tracks - 2
- Adjacent Grade Separation - 1

Environmental Factors (4)

- Noise - 4
- Visual Amenity - 1
- Emission/Air Quality/Fuel Savings - 3
- Environmental Significance - 2

Community Related Factors (4)

- Population - 4
- Transit/Emergency Route/ Accessibility/Connectivity - 6
- Social Significance (local development) - 5
- Strategic Fit/Local Agent Priority/Isolated Location – 3

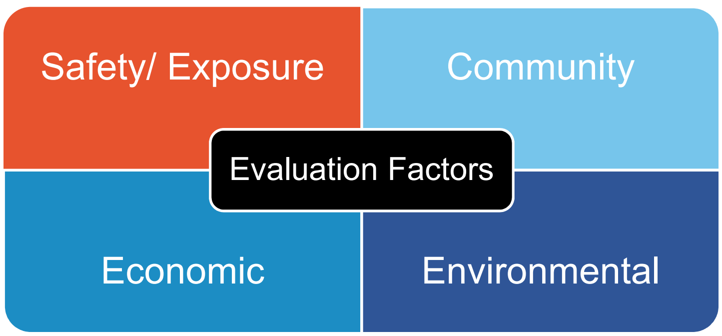
Economic Factors (4)

- Vehicle operating cost/delay and accident cost - 4
- Crossing operating cost/life cycle cost - 2
- Construction cost - 2
- Economic Losses - 1

Proposed Evaluation Factors and difficulty of gathering data

The team looked at these six areas and identified four sectors into which to group the data for this initiative.

Exhibit 5: Four Factor Sectors Identified in the Literature Review of Past Practices



For each factor, the Team assessed the availability of data as well as identified sources of data. Exhibit 6 below details the category, factor, assessment of data availability and currently identified data sources.

Exhibit 6: Rail Crossing Evaluation Factors

Evaluation Category	Level of Data Accessibility 1 = Poor/ unavailable 3= based upon a calculation of factors collected 5=Excellent/Easy	Source of Data
Safety / Exposure Factors		
1. USDOT Accident Prediction Value	5	FRA site
2. Accident History Fatalities	4	FRA site, Sum the 5 year experience
3. Road Vehicle Delay	4	Calculation
4. Rail Delay – AI suggests if blockage/ rail crossing near/ into yard, spur- Is there a rail switch .5 mile? Y/N	4	FRA site collected the nearest switches
5. Posted HW Speed	5	FRA site
6. AADT- # of daily vehicles	4, not always current	FRA site, local data
7. AATT – # of daily trains	4, not always current	FRA site
8. Hazardous Train Cars- any mixed train crude oil. Some kind of rating if on energy corridor, etc.	1	Unknown
9. Train Speed	5	FRA
10. Train Length not easily available	1	TBD could take averages based upon # freight vs # passenger
11. Exposure	5	Calculated with standard formula
12. Duration of Crossing Closure	3	Calculated using an average time per train
13. Queue Length	3	Calculate an average feet per vehicle
14. Geometry of the Crossing	5	FRA site
15. Number of HW Lanes	5	FRA site, google maps
16. Number of Rail Tracks	5	FRA site, google maps
17. Adjacent Grade Separation (within 1 mile) –Y/N	4	FRA site, google maps
Environmental Factors		
1. Noise – Quiet Zone Y/ N	5	FRA Quiet zones Y/N
2. Visual Amenity 1= low (in industrial area) 2=rural (farms low populated) 3=suburban medium residential density 4=Urban (city center, high population density) 5= High (Scenic, Park, State lands, Fed lands)	4 Data set estimates intensity of development around intersections	Looked at adjacent land use Rank 1 low-5 High
3. Emission/Air Quality/Fuel Savings	3	Calculated fuel savings / emissions see calculations below
4. Environmentally sensitive areas (wetlands, other)	3	Open source A list of criteria was developed and then a Y/N or rating system was applied

Exhibit 6: Rail Crossing Evaluation Factors- continued

Community Related Factors		
1. General Population (w/in 1 mile radius)	5	ArcGIS
2. Fixed populations (hospitals, nursing homes, prisons w/in mile radius)	2	Open source
3. Vulnerable populations (schools, sports facilities, city hall – w/in 1 mile radius)	3	Open source
4. Emergency services (Fire station, EMT, Police Department – w/in 1 mile radius)	2	Open source
5. Evacuation Route (Y/N) EMS route, posted routes?	1	Visual, FRA/ State Emergency Mgmt. Y/N
Economic Factors		
1. Vehicle operating cost/delay and accident cost – Passenger vehicles- EIS / BCA	2-Calculation TBD if calculation uses factors already collect then 4	Calculation –see formulas below.
2. Vehicle operating cost/delay and accident cost – Commercial vehicles –EIS/ BCA	2-Calculation TBD if calculation uses factors already collect then 4- Calculation TBD	Calculation –see formulas below.
3. Crossing operating cost/life cycle cost	TBD	Eng Estimates
4. Construction cost- more develop more expensive, rural	TBD	Eng Estimates
5. Economic Losses – positive or neg.	TBD	No formula to date

Calculations Used in the Evaluation

Exhibit 7: Detailed Calculations for Specified Factors

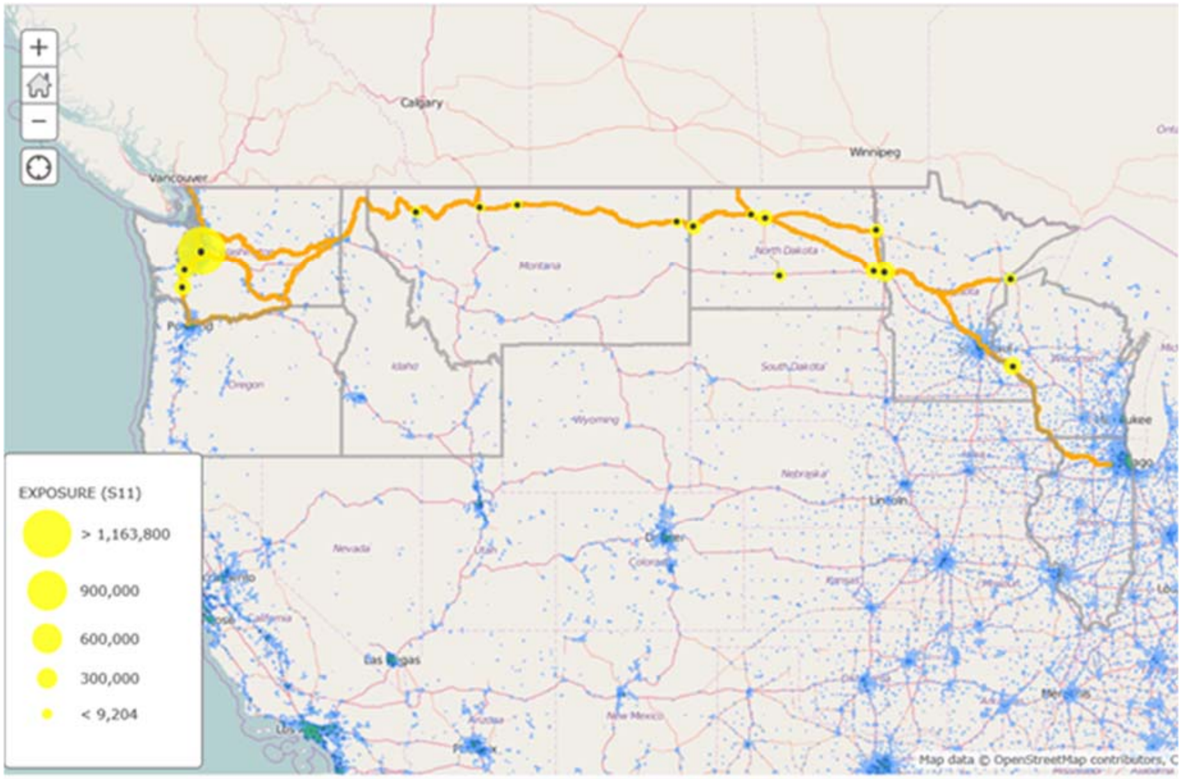
Factor	Calculation
Peak volumes	Estimated at 10% of AADT
Average Road Vehicle Delay (Hours/ day) (S3)	Average number of vehicles delayed per train *2.5 minutes/ vehicle * Number of Trains/ day a. Assumes each car averages 2.5 delay per train passing that takes an average of 5 minutes to cross the RR crossing
Exposure (S11)	AADT * Average Daily Trains
Total Duration of Crossing Closures/ Day (Hours) (S12)	(Number of Trains * 5 minutes per train)/ 60 minutes
Que Length (S13)	Estimated average volume for 1 train *25 feet per vehicle a. Includes traffic on all approaches to the crossing b. Assumes 25 feet per vehicle

Exhibit 7: Detailed Calculations for Specified Factors-continued

Factor	Calculation
Emission/ Air Quality/ Fuel Savings (E3)	Total reduction in Daily idling in hours: A. Av. Delay in minutes/60 minutes per hour *AADT B. Total Gallons save by the reduction of idling = Hours of daily idling (A) *1.5 gals/ hr ** 60 sec of idling uses .025 gallons of gas or 60 minutes of idling use= 1.5 gals, every gallon of gas produces 20 lbs. of CO2, calculate gallons saved at current gas prices C. Fuel Savings = (B)* $x.xx per gallon*** ($2.342) as of 5/2/16 US- all gasoline grades (note this can be divided by POV and commercial if desired (Diesel- all types US-$2.266 5/2/16) For ease US average was used in fuel prices. ***Source: http://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_r50_w.htm Co2 Savings: Total Gallons of Fuel saved (C) /20 lbs. per gallon Co2 in MT = Co2 Savings/ 2240 lbs. per MT Total Social Cost of Carbon = Co2 in MT* Carbon Cost $/ MT**** **** Tiger FY16 estimated 2016 Carbon Cost to be $43/MT Other Emission can also be calculated on a MT basis see TIGER Grant BCA Guidelines for more information.
Vehicle operating cost/ delay and accident cost- Commercial vehicles (EC2)	1. Vehicle delay cost in travel time savings: #Commercial Vehicles (AADT * % of trucks) *(av. delay (2.5 min) /60 minutes per hour)* average hourly all-purpose local travel ($26.68/ hr for truck drivers in Tiger FY 2016 guidance) 2. Operating cost defined as Idling fuel costs: • Fuel savings due to Reduction of idling time in minutes * AADT/60 minutes per hour to convert to total hours of idling per day. • Total gallons saved by reduction of idling= hours of idling *1.5 gallons per hour • Total fuel savings =Total gallons saved * average cost of fuel per gallon
Suggest breaking out Annual Accident Costs from (EC1) and (EC2)	1. Annual Accident costs can be calculated by reduction of deaths based upon closing the crossing. • Predictive Accident rate * the social value of a Life ($9.6 million per fatality ($2015) given in TIGER FY16 guidance.
Economic Losses- Positive or negative (EC5)	A methodology has yet to be developed for this factor

The graphic in Exhibit 8 below displays the Exposure Value for each of the 19 rail crossings. The three Kent crossing have the highest exposure values compared to the other crossings due to their higher average annual daily traffic and higher average daily train traffic.

Exhibit 8: Exposure Value of the 19 Sample Rail Crossings



Base Assumptions:

- Estimated Peak Hour Volume = 10% of AADT
- Assumes uniform distribution of traffic during the peak hour. Calculation is based upon Peak volumes which is estimated at 10% of AADT, * 5 minutes of gate downtime divided by 60 minutes in an hour
- Estimated Peak Vehicles Affected by One Train = Estimated Peak Hour Volume * 5 minutes/60 minutes
- Estimated Av. Vehicles Affected by One Train = Estimated av. Hourly volume * 5 minutes per train / 60 minutes

Other Assumptions

- Assumes that the average train is 7,800 long and traveling at an average of 20 mph, the average gate downtime per at-grade crossing would be approximately 5 minutes per train. This is based upon a 4:26 train crossing time (i.e. 7800 feet long train traveling at 20 mph, or 1760 feet per minute) plus 0:30 to lower the gate plus 0:12 to raise the gate = 5:08 minutes.
- For an individual motorist who is approaching the crossing when the gate begins to come down, 1 train would result in a gate downtime of just over 5 minutes. However,

because drivers would arrive at different times during the gate closure and reopening process, the average gate downtime for each driver is estimated to be 2:30 (Analysis Group, Inc. 2014)

These calculations were taken from the Tesoro Savage Vancouver Energy Distribution *Terminal Facility Draft Environmental Impact Statement November 2015* pg. 3.14-25

Additional Elements in Rating Factors

Methodology used when rating the different environmental items

Environmentally Sensitive Areas: we assessed each crossing for potential environmentally sensitive areas based on a set of 9 environmental resources we identified in a previous GNC phase. Each crossing was assigned a 5-mile buffer and we determined if one of the environmental resources intersected that buffer which triggered a “yes” for that resource column. For each crossing, the number of environmental resources with a yes were totaled, and an overall ranking as assigned for the “Environmental Sensitive Area” for the crossing. Based on 9 environmental resources assessed, 0-1 resources affected was given a 1 (low) ranking; 2-3 resources affected was given a 2 ranking; 4 resources affected was given a 3 (medium ranking); 5 resources affected given a 4 ranking; 5 resources and above was given a 5 (high) ranking).

This methodology of using the 5-mile buffer is a conservative approach which we thought was appropriate at this level of analysis – upon closer/crossing by crossing specific analysis, the environmental resource intersected within the 5-mile buffer may not actually be affected by the change in crossing grade.

Exhibit 9 below demonstrates the technique as described that the Team used to determine the Environmental Sensitivity ranking for each crossing.

Exhibit 9: Environmentally Sensitive Ratings

			Environmentally Sensitve Areas										
#	Crossing ID	State	Air Non-attainment areas	Critical habitat for federally listed species	Coastal Management Zone	Federal and State lands	Military Installations	Native American Tribal lands	Wild and Scenic Rivers	Superfund Sites	Ramsar Wetlands	Total Yes	Environmentally Sensitive Area Ranking 1(Low) - 5(High)
5	092493S	WA	No	No	No	Yes	No	No	No	No	No	1	1
6	088620J	MT	No	No	No	Yes	No	No	No	No	No	1	1
10	059770N	MT	No	No	No	Yes	No	No	No	No	No	1	1
12	070828T	ND	No	No	No	No	No	No	No	No	No	0	1
13	071103U	ND	No	No	No	No	No	No	No	No	No	0	1
14	079957N	WI	No	No	No	Yes	No	No	No	No	No	1	1
16	087659J	ND	No	No	No	Yes	No	No	No	No	No	1	1
17	071656R	ND	No	No	No	No	No	No	No	No	No	0	1
19	093077T&79G	ND	No	No	No	No	No	No	No	No	No	0	1
7	062505C	ND	No	No	No	Yes	Yes	No	No	No	No	2	2
8	059334A	MT	No	Yes	No	Yes	No	No	No	No	No	2	2
9	059618E	MT	No	No	No	Yes	No	Yes	No	No	No	2	2
15	061459A	WI	No	Yes	Yes	Yes	No	No	No	No	No	3	2
18	081558C	ND	No	No	No	Yes	No	Yes	No	No	No	2	2
1	085640K	WA	No	Yes	Yes	Yes	No	No	No	Yes	No	4	3
2	085629K	WA	No	Yes	Yes	Yes	No	No	No	Yes	No	4	3
3	085625H	WA	No	Yes	Yes	Yes	No	No	No	Yes	No	4	3
4	085775R	WA	No	Yes	Yes	Yes	Yes	No	No	Yes	No	5	4

Visual Amenities – A ranking was assigned based upon the assessment of the land use cover data (2011) directly at the crossing, as well as the overriding land use within a 1-mile buffer around the crossing. This data was then confirmed via aerial image (2014 – 2015) whether it looked like industrial, rural, residential, etc. Exhibit 10 below demonstrates the results of this methodology to rank the 19 individual crossings.

Exhibit 10: Visual Amenities Ratings

			Visual Amenities			
#	Crossing ID	State	Land use (at Crossing Point)	1-mile buffer of Land Use	Confirmed by Aerial	Visual Impact Ranking 1= low (in industrial area) 2=rural (farms low populated) 3=suburban medium residential density 4=Urban (city center, high population density) 5= High
3	085625H	WA	Developed, High Intensity	Developed, High Intensity	Industrial	1
4	085775R	WA	Developed, Low Intensity	Mixed Forest	Rural	2
5	092493S	WA	Developed, High Intensity	Hay/Pasture	Rural/Residential	2
6	088620J	MT	Developed, Medium Intensity	Herbaceuous	Residential/Open Space	2
7	062505C	ND	Developed, High Intensity	Developed, Medium Intensity	Residential	2
8	059334A	MT	Developed, Open Space	Hay/Pasture	Rural	2
9	059618E	MT	Developed, Low Intensity	Herbaceuous	Rural	2
10	059770N	MT	Developed, Open Space	Cultivated Crops	Industrial/Residential	2
13	071103U	ND	Developed, High Intensity	Cultivated Crops	Residential/Rural	2
14	079957N	WI	Developed, Medium Intensity	Deciduous Forest	Rural/Woodland	2
16	087659J	ND	Developed, Open Space	Herbaceuous	Rural	2
17	071656R	ND	Developed, Low Intensity	Cultivated Crops	Rural	2
18	081558C	ND	Developed, Medium Intensity	Cultivated Crops	Rural	2
1	085640K	WA	Developed, Medium Intensity	Developed, Medium Intensity	Industrial/Residential	3
2	085629K	WA	Developed, High Intensity	Developed, Medium Intensity	Industrial/Residential	3
15	061459A	WI	Developed, Medium Intensity	Developed, Low Intensity	Industrial/Residential	3
19	093077T&79G	ND	Developed, Medium Intensity	Developed, Low Intensity	Industrial/Rural	3
12	070828T	ND	Developed, High Intensity	Developed, Medium Intensity	Industrial/Residential	4

Methodology used when rating the Community Related Factors

Community Related Factors were developed using the USGS National Map (http://viewer.nationalmap.gov/basic/) under National Structures Dataset. This dataset breaks down facilities by state for a variety entities. Each state needs to be downloaded and queried.

Community Related Factors:

Open Sources data bases which can also be helpful in gathering data for the Community Related Factors include:

- General Population (C1) - can be populated from ARCGIS Business Analyst Online (BAO)
- Fixed Populations (C2) - (hospitals, nursing home, prisons within 1 mile)-
  - Hospitals can usually be observed off of the Open Streets base map in ARCGIS.
  - Nursing homes are more difficult, can be research in the local phone directory,
  - Prisons locations can be gathered from the local police website
- Vulnerable populations (schools, sports facilities, city hall within 1 mile
  - School locations can be gathered from school district websites
  - Sports facilities can usually be located by visual inspection off the ARCGIS Open Streets base map
  - City Hall can usually be location by visual inspection off the ARCGIS Open Streets base map or the address can be gathered off the city's website
- Emergency Services (Fire Stations, EMT, Police Stations) within 1 mile
  - Fire Station locations can be gathered from the Fire District's website
  - EMT is more difficult, sometimes part of the Fire Department and sometimes stand-alone Ambulance Company. Googling "Ambulance Services" for a specific location usually gives a listing of available ambulance locations near the crossing.
- Evacuation routes
  - These are more difficult as in many cases there is no specific emergency route, as the route is determined on an incident by incident basis.

Exhibit 11 below illustrates the data collected for the Community Factors for each of the 19 rail crossings under evaluation.

Exhibit 11: Community Factors for Effected Populations

Crossing ID	State	Subdivision	County	City	Address	BufferDist	IDN	Prisons	Schools	Fire Station/ EMT	Police Stations	Hospitals	Total EMS	Total Fixed Pop
059618E	MT	Glascow	Roosevelt	Culbertson	1st Ave. W	1 mile	9	0	4	1	2	1	3	1
088620J	MT	Great Falls	Toole	Shelby	Hwy 2	1 mile	6	1	5	2	2	2	4	3
059334A	MT	Hi Line	Flathead	Columbia Falls	N LaSalle Rd	1 mile	8	0	0	0	0	0	0	0
059770N	MT	Hi Line	Hill	Rudyard	Reed St S-255	1 mile	10	0	0	0	0	0	0	0
071656R	ND	Crosby	Ward	Berthold	US-2	1 mile	17	0	0	0	0	0	0	0
081558C	ND	Glasgow	Williams	Trenton	ND-1804	1 mile	18	0	0	0	0	0	0	0
062505C	ND	Glasston	Grand Forks	Grand Forks	Hwy 2	1 mile	7	0	3	1	1	0	2	0
087659J	ND	Jamestown	Burleigh	Bis/Linc	66th St SE	1 mile	16	0	0	0	0	0	0	0
070809N	ND	KO	Cass	Fargo	Broadway	1 mile	11	0	11	1	1	4	2	4
070828T	ND	KO	Cass	Fargo	27th St N	1 mile	12	0	3	1	0	0	1	0
071103U	ND	KO	Cass	Casselton	Langer Av/ND	1 mile	13	0	3	1	0	0	1	0
093077T&79G	ND	KO	Ward	Minot	27th St SE	1 mile	19	0	0	0	0	0	0	0
085640K	WA	SEATTLE	King	KENT	SR516 (WILLIS	1 mile	1	0	3	1	1	5	2	5
085629K	WA	SEATTLE	King	KENT	JAMES ST	1 mile	2	0	3	1	1	4	2	4
085625H	WA	SEATTLE	King	KENT	S 212TH STREE	1 mile	3	0	0	1	0	0	1	0
085775R	WA	SEATTLE	Thurston	OLYMPIA	RICH RD SE	1 mile	4	0	0	1	0	0	1	0
092493S	WA	SEATTLE	Lewis	WINLOCK	WALNUT ST./S	1 mile	5	0	1	1	0	2	1	2
061459A	WI	Lakes	Douglas	Superior	N 28th	1 mile	15	0	2	1	0	1	1	1
079957N	WI	St Croix	Buffalo	Nelson	WI-25	1 mile	14	0	0	1	0	0	1	0

Methodology used when rating the Economic Factors

Economic Factors:

The five factors identified as Economic include:

1. Vehicle operating cost/delay and accident cost – Passenger vehicles
2. Vehicle operating cost/delay and accident cost – Commercial vehicles
3. Crossing operating cost/life cycle cost
4. Construction cost
5. Economic Losses – positive or neg.

These factors can be broken into those that can be calculated using directions given by USDOT in their TIGER and FASTLANE Benefit Cost Analysis Guidance and those factors that need more development such as Economic Loss. In recent USDOT guidance in their *TIGER and FASTLANE BCA Resource Guide*, standard values are given for numerous public benefits related to long term outcomes from the investment. These standard factors include:

- Value of Statistical Life
- Value of Injuries
- Value of Property Damage Only Crashes
- Value of Travel Time
- Value of Emissions
- Social Cost of Carbon

It is recommended that a set of standard monetized values be selected as default values. The default values can be selected when no better local information is available as inputs into the calculations. This method will provide a basis upon which the competing projects can be evaluated.

Conclusion

This analysis provides a good basis for further RR crossing evaluations. As other studies are completed such as the *Washington State Joint Transportation Commission Study of Road-Rail Conflicts in Cities (2016)*, the factors and calculations under this initiative should be reviewed and updated as appropriate. Second, this initial evaluation methodology does not include a weighting scheme to add weight to each individual sub-factors nor any of the evaluation categories as a whole. In the future, evaluators may want to add a weight factor scheme to the methodology in order to give certain factors more importance during the evaluation process.