DRAFT

Joint Transportation Committee

PRIORITIZATION OF PROMINENT ROAD-RAIL CONFLICTS IN WASHINGTON STATE

December 2016

Prepared by:

transpogroup
WHAT TRANSPORTATION CAN BE.

in partnership with:

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

BERK

www.transpogroup.com

CONTACTS

Jon Pascal, PE
Project Manager, Transpo Group USA
12131 113th Avenue NE
Suite 203
Kirkland, WA 98034
(360) 821-3665
jon.pascal@transpogroup.com

Beth Redfield
Project Manager, Joint Transportation Committee
Washington State Legislature
606 Columbia Street NW
Suite 105
PO Box 40937
Olympia, WA 98504-0937
(360) 786-7327
beth.redfield@leg.wa.gov

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

DEFINITIONS

AWC	Association of Washington Cities
DOE	Washington Department of Ecology
DOH	Department of Health
EPA	Environmental Protection Agency
FAST Act	Fixing America's Surface Transportation Act
FRA	Federal Railroad Administration
FMSIB	Freight Mobility Strategic Investment Board
HSIP	Highway Safety Improvement Program
JTC	Joint Transportation Committee
Marine Cargo Forecast	Pacific Northwest Marine Cargo Forecast and Rail Utilization Report
MPO	Metropolitan Planning Organization
PSRC	Puget Sound Regional Council
RTPO	Regional Transportation Planning Organization
UTC	Washington Utilities and Transportation Commission
WPPA	Washington Public Ports Association
WSAC	Washington State Association of Counties
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

The Legislature directed the Joint Transportation Committee to conduct a study evaluating the impacts of prominent road-rail conflicts and develop a corridor-based prioritization process for addressing the impacts on a statewide level (*Second Engrossed Substitute House Bill 1299 (2015),Section 204(3)*). At-grade railroad crossings, where roads cross railroad tracks at the same level, can typically function adequately while population and traffic levels remain low. As both rail and road traffic increases, and trains get longer, at-grade crossings become more problematic, impacting communities in a variety of ways. The phrase "road-rail conflict" is used to describe potentially problematic at-grade crossings. Examples of potential conflicts include the following:

- Long and unpredictable travel delays for both the general public and freight users
- Collisions between trains and vehicles or pedestrians
- Temporary increase of emergency response times

With the growth of the state's population and increasing road and rail traffic, communities throughout the state are concerned about the reliable and safe movement of rail and truck freight, general traffic, and emergency vehicles across more than 2,180 public, active at-grade railroad crossings.

The specific legislation calling for the study is as follows:

Second Engrossed Substitute House Bill 1299 (2015), Section 204:

3) $250,000 of the motor vehicle account—state appropriation, from the cities' statewide fuel tax distributions under RCW 46.68.110(2), is for a study to be conducted in 2016 to identify prominent road-rail conflicts, recommend a corridor-based prioritization process for addressing the impacts of projected increases in rail traffic, and identify areas of state public policy interest, such as the critical role of freight movement to the Washington economy and the state's competitiveness in world trade. The study must consider the results of the updated marine cargo forecast due to be delivered to the joint transportation committee on December 1, 2015. In conducting the study, the joint transportation committee must consult with the department of transportation, the freight mobility strategic investment board, the utilities and transportation commission, local governments, and other relevant stakeholders. The joint transportation committee must issue a report of its recommendations and findings by January 9, 2016. (Due date amended by Engrossed Substitute House Bill 2524, 2017 Supplemental Transportation Budget.)

STUDY OBJECTIVES

The following objectives guided this study.

- An understanding of the current and future mobility, community impacts, and safety problems occuring at-grade crossings in the state;
- An understanding of state, local, and private entity policy interests in improving at-grade crossings;
- Consideration of how a data-driven analysis of crossing impacts can be used in a corridor-based project prioritization process, and
- A criteria-based decision-making process for prioritizing statewide investments in at-grade crossing solutions.

This study developed a process for prioritizing at-grade crossings based on specific evaluation criteria that considered local, regional, and statewide policy interests.

Products of this study:

- *Database of at-grade crossings*
- *Online mapping tool*

STUDY APPROACH

The study developed and incorporated a data-driven approach to evaluate and prioritize crossings throughout the state. It started with collecting and reviewing available data for crossings. Data gaps and inconsistencies were identified, such as where no data existed or where data quality was in question. A prioritization framework was then prepared to analyze and test various evaluation criteria and scoring methodologies to understand the magnitude of crossing needs. To assist in the overall prioritization process, a crossing database was created along with an online mapping tool to store and display the results of the prioritization effort.

OVERSIGHT AND DIRECTION

The study was guided by an Advisory Panel that met four times throughout the study and provided policy and technical guidance on the identification of the evaluation criteria used to determine crossing priorities, development of the database and the prioritization process, and potential findings and recommendations from the study. Additional support and direction was provided by a Staff Work Group made up of legislative staff and staff of the Advisory Panel members. While these groups provided valuable input to the consultants, the findings and recommendations are those of the consultants.

Figure E-1. Overview of the Prioritization Approach

PRIORITIZATION PROCESS AND RESULTS

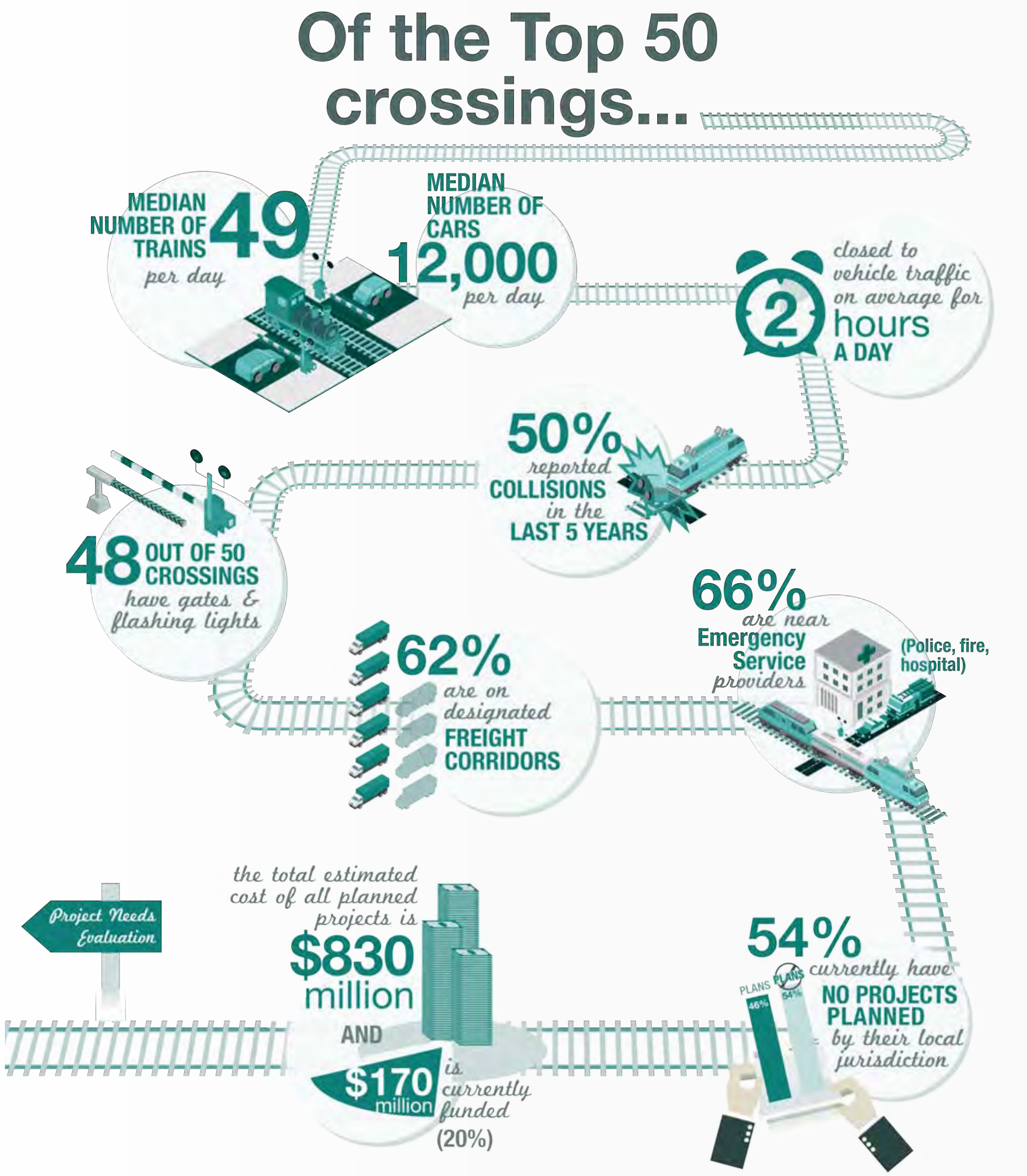
The prioritization approach included a preliminary screening process of the 4,171 total crossings statewide followed by two steps as illustrated in Figure E-1. The preliminary screening process removed crossings that were private, grade-separated, or inactive, which left 2,180 crossings. The first step was meant to "filter out" railroad crossings that did not meet defined thresholds and create a manageable number of crossings to evaluate in more detail. This filtering process left 302 prominent crossings. The second step "sorted" the remaining crossings by the evaluation criteria to create a ranked list of crossings. The two step prioritization process helped address the fact that detailed data was not available for all crossings.

Of the 302 prominent crossings identified after the first step:

- 84% have over 10 freight trains per day
- 79% do not have a nearby alternative route with a grade separated crossing
- 77% have unit trains present (long, slow trains)
- 71% are on major collectors, arterials, or state highways
- 41% have a regionally prioritized project identified
- 35% have 2 or more mainline tracks for vehicle traffic to cross
- 33% have over 8,000 daily vehicle trips
- 31% have more than 10 passenger trains per day

Figure E-2 illustrates information on the Top 50 crossings that were identified in the second step. The median number of trains and vehicles using these crossings each day is 49 trains and 12,000 vehicles, respectively, leading to substantial on-going conflicts. In addition, the Top 50 crossings are closed to vehicle traffic for an average of two hours per day. Almost two-thirds (62%) of these crossings are on a designated freight corridor and 96% of them (all but two) have gates and flashing lights, yet there was at least one collision between pedestrians and/or vehicles and trains at or nearly half the crossings in the last five years. Almost two-thirds (66%) are in close proximity to emergency providers leading to potential delays for emergency service providers.

Figure E-2. Key Findings from the Step 2 Prioritization Effort



The resulting list of crossing priorities is not a definitive list of needs, but is meant as a first step to assist policy makers, state agencies, RTPOs and local jurisdictions to understand crossing impacts, leading to the next step of project identification and evaluation of corridor-based solutions.

SCORING AND WEIGHTING

The database contains detailed characteristics, or information, about each of the 2,180 public, active, at-grade crossings in the state. A select number of the characteristics that describe each crossing are used as evaluation criteria to analyze crossings. Evaluation criteria were grouped into three categories: mobility, safety, and community. The three common categories represent shared values in the transportation industry, and have been regularly applied in other funding or prioritization processes.

The scoring of crossings is also grouped by categories: mobility scores, safety scores, and community scores. Points are allocated to the criteria used in the first and second steps. The resulting scores are then weighted to achieve an overall score for the crossing.

Three different weighting strategies were tested and evaluated, with guidance from the Advisory Panel, to understand impacts to Step 2 rankings. One strategy was to weight mobility, safety, and community equally. Another strategy was to focus exclusively on the mobility criteria and ignore the safety and community criteria. The final weighting strategy is meant to put more focus on mobility, but still incorporate the elements of safety and community. In the end, after much discussion with the Advisory Panel, the recommended final score for each crossing reflects weighting mobility at 50%, safety at 25%, and community at 25%.

CORRIDOR EVALUATION

The focus of the study was the evaluation of individual “crossings,” however “corridors” and “projects” are also discussed to understand how they could be considered in the prioritization process. Each term is distinctly different as a corridor could contain multiple crossings, and one crossing could contain multiple projects. Developing solutions to road-rail conflicts would lead to identification of a project. A corridor strategy could identify one or more projects to improve traffic flow at multiple crossings, or could result in closing one major crossing, alleviating the need to address multiple, adjacent crossings within the same corridor.

Corridor evaluation and prioritization is most useful when defining and ranking solutions which address crossing impacts, rather than identifying crossing issues. The objective of this study, the ranking of high-impact crossings, is less suited to a corridor approach. This conclusion is based on consideration of a variety of corridors, such as crossings along a rail corridor or within RTPO boundaries. A finer geographic focus on the transportation system is likely necessary to maximize the benefits of a corridor approach.

In addition, corridor-based prioritization requires more specific context about potential community needs and solutions, such as type of crossing improvement or surrounding development patterns. The database and prioritization tool would still serve as a key input into a corridor-based project prioritization, but the corridors will need to be determined by users of the database with guidance from policy makers.

DATA AND TOOL OVERVIEW

The database development focused on locations rather than projects. The assembled data described location-specific characteristics for all public, active at-grade crossings in the state, such as traffic volumes, collision history, and train counts, rather than project-specific conditions, such as type of improvement, feasibility, and cost. The database was created by assembling readily available data from a variety of sources, including the UTC, WSDOT, the Federal Railroad Administration (FRA), and the Washington Department of Ecology (DOE). A project prioritization effort, in contrast, would include more contextual information for each location and would be guided by specific objectives developed by the funding entity.

The database and prioritization tool can be used as a starting point for state, regional, and local jurisdictions to understand the magnitude of needs, and how a specific crossing would compare against other locations on a statewide or regional basis. The tool can also be used to assist in future planning efforts and serve as an indicator of the need for more detailed analysis of individual crossings. An online tool was developed as part of this study to allow agencies and the public to review and analyze the database in a user-friendly format.

TOOL SUSTAINABILITY

To remain useful in the future, the tool will need to be maintained and updated as new or improved data is available and crossing projects are completed. In addition to simply keeping the tool up and running, questions remain as to how the tool might assist with existing and future funding programs, how to ensure data consistency and ability to benchmark crossings, and others related to tool use and application.

One of the benefits of the tool is the ability to have a statewide view of rail crossings. To ensure that this benefit continues and to provide a decision-making body for questions related to data updates or new data, a multi-stakeholder committee with similar membership to the Advisory Panel (e.g. WSAC, UTC, AWC, FMSIB, WSDOT, RTPO/MPOs) should be created. This committee could help ensure continued data integrity and facilitate tool sustainability by providing a decision-making body for data or evaluation questions and stewardship over the data. This committee could also work to address many of the questions raised by this study.

FINDINGS AND RECOMMENDATIONS

The following are the findings and recommendations from the study effort.

1 The road-rail conflicts at the Top 50 at-grade crossings are substantial and there are few funding sources to address them

Today the Top 50 crossings are closed to vehicle traffic for an estimated average of two hours per day, which will only increase in the future as train volumes increase. The median number of trains and vehicles using these crossings each day are 49 trains and 12,000 vehicles, respectively, leading to substantial on-going conflicts. Almost two-thirds (62%) of these crossings are on a designated freight corridor and 96% of them (all but two) have gates and flashing lights, yet there was at least one collision between pedestrians and/or vehicles and trains at or near half the crossings in the last five years. Almost two-thirds (66%) are in close proximity to emergency providers leading to potential delays for public safety services.

While there are existing funding programs for safety measures, such as enhanced gates and lights, they do not address the mobility issues experienced by freight and non-freight related vehicle traffic at crossings. The UTC and WSDOT were members of the Advisory Panel and reported that their crossing safety programs receive more applications than they can fund, pointing to the need for additional investments in grade crossing improvements both to address the gap in solutions for mobility impacts and to further bolster efforts to enhance safety.

2 The prioritization results point to a significant need for additional funding to address crossing improvements

Half of the Top 50 crossings have identified solutions with estimated costs of $830 million. Of the $830 million, only $170 million is funded and $100 million of that is for a single project. This leaves at least $660 million in unfunded needs just for the 25 crossings with identified projects. Assuming projects are needed for some share of the remaining 25 crossings, plus needs for crossings not making it into the Top 50, the unfunded needs amount is much higher.

While additional FMSIB and federal FAST Act freight funds will add $150 million over the next five years for all types of freight projects, it is not clear how much, if any, will be available to address the Top 50 road-rail conflicts identified in this study. Each funding program has specific eligibility criteria, and these crossings may or may not meet that criteria, or rank well when compared to other freight infrastructure investments. Further, the first call for projects has already been prioritized by WSDOT and the Freight Advisory Committee and only two projects address impacts at the Top 50 crossings.

RECOMMENDATIONS

i. Establish a dedicated funding source to address mobility impacts not covered under the current crossing safety programs.

ii. Secure additional funds for the safety programs.

iii. Further analyze Top ranked crossings to identify potential solutions individually and at the corridor level (see Finding 8).

3 The database and prioritization process provide a mechanism to compare and understand the magnitude of crossing improvement needs on a statewide basis

The database of crossings in its current form is a valuable tool for agencies throughout the state to evaluate and compare the needs of at-grade crossings. It is the only unified, statewide resource for detailed information about crossings and is a flexible tool that can be used in a variety of ways by state, regional, and local jurisdictions or other organizations. Some examples include:

- Describe the importance of a crossing (or a series of crossings) on state or federal grant applications.
- Assist in future planning efforts for local and regional jurisdictions.
- Provide a starting point for identifying locations to develop specific project proposals.

For the tool to remain useful at the statewide level, standards will need to be implemented and maintained to ensure consistency. Decisions will also need to be made on questions related to new data releases, changing the weighting of criteria, or other data to better align with a funding program, or other changes.

In order to maintain the relevance and usefulness of the tool, funding should be provided to update and maintain it and host it at an agency. This same agency could serve as the coordinator for a multi-stakeholder committee with similar membership to the Advisory Panel for this study (e.g. WSAC, AWC, FMSIB, WSDOT, UTC, RTPO/MPOs) to help with decision-making and continued data integrity. This committee could also work to address many of the questions raised by this study.

RECOMMENDATIONS

iv. Establish a multi-stakeholder committee to create database and tool standards, make decisions about future data enhancement or other changes, and address the outstanding questions raised by this study.

v. Identify an agency to maintain the database and tool and serve as the coordinator for the multi-stakeholder committee.

4 In some cases, projects prioritized locally did not rank high when evaluated on a statewide basis

Several crossing locations with planned projects did not make it into the Top 100 crossings statewide. Low ranking project locations were generally at crossings with lower train and traffic volumes, and in non-urban areas. Although proposed projects may not rank high on a statewide basis, the tool is not meant to discount legitimate congestion issues or mobility needs due to planned economic development projects or other site specific issues. There is no existing program specifically focused on mobility at rail crossings, but there are significant needs in large and small communities.

RECOMMENDATION

vi. Identify specific policy objectives to guide investments in crossings on a statewide basis. This may necessitate a separate program targeted at smaller communities similar to the Transportation Improvement Board's Small Cities Program to ensure their needs can be addressed and that state funding programs balance investments between Puget Sound, Western Washington, and Eastern Washington communities.

5 Safety data serves as a contributor towards mobility impacts, but further analysis is needed to confirm specific safety needs

High-level safety data, where available, were incorporated into the prioritization process to assist in ranking the crossings. Safety data in the tool is related to collisions between trains and pedestrians, bicycles, or vehicles. Half of the Top 50 crossings had a reported collision at or near a crossing in the last five years. The Advisory Panel agreed that the data was not specific or detailed enough to provide a safety assessment beyond an indicator of potential problems.

In addition, there was discussion around the safety specific grant programs administered by UTC and WSDOT that focus on evaluating collisions and funding lower-cost crossing improvements. Funding sources such as the federal Railway-Highways Crossing (Section 130) Program focus on safety and evaluate crossings on a case-by-case basis given a set of uniform criteria. Evaluation of collisions requires more information than a crossing database can provide, such as site visits, predictive analysis, and review of specific causes.

The federal Section 130 Program and the UTC's Grade Crossing Protective Fund Grant Program have a finite amount of money and are unable to address all the identified needs related to crossing safety. The combined funding from both programs is approximately $5 million per year in 2016, with funding levels set to decline by 2020.

While the crossing database cannot provide an authoritative safety analysis, it can supplement safety programs by identifying indicators of safety and mobility problems. Many mobility problems have implications for safety, such as gate down times that stop emergency response vehicles moving across town and cause drivers to take risks to beat safety gates at crossings. However, solutions to address mobility problems may be ineligible for funding under the current safety programs, highlighting the need for a funding source to address mobility impacts.

RECOMMENDATIONS

vii. Coordinate efforts with the WSDOT and UTC safety programs to continue focusing on reducing collisions at crossings and ensure funding levels are adequate.

viii. Separately address mobility and safety impacts at crossings.

6 The database and prioritization tool would benefit from future enhancements

Determining how the database and online tool will be used will determine how it will be updated and maintained in the future. For example, existing or new funding programs may emphasize certain criteria, resulting in other criteria not being necessary to collect or maintain. Further, if funding is provided to address crossing improvements, local jurisdictions will have a strong incentive to improve the data and plan for projects.

Future enhancements should be considered by the multi-stakeholder committee to improve the results and usefulness of the prioritization process. For example, the screening method could be modified to remove crossings with low train and vehicle counts and additional safety data could be incorporated. The soon to be released Marine Cargo Forecast will provide projections of train traffic through 2035 and could also be incorporated into the database.

RECOMMENDATIONS

ix. Provide the agency hosting the tool with additional resources to maintain, update and enhance the database and prioritization tool.

x. Incorporate data from the Marine Cargo Forecast once it is complete.

7 Corridor evaluation and prioritization are most useful when defining projects to address crossing impacts

One of the objectives of the study was to consider a corridor-based prioritization process. A variety of corridors were considered, such as crossings along a rail corridor or within RTPO boundaries, but a finer geographic focus on the transportation system is likely necessary to maximize benefits of a corridor approach. In addition, corridor-based prioritization requires more specific context about potential community needs and solutions, such as type of crossing improvement or surrounding development patterns. The ranking of high-impact crossing locations on a statewide basis is less suited to a corridor approach. However, the database and prioritization tool would still serve as a key input and a common set of data when identifying a corridor-based project prioritization strategy.

A corridor-based strategy could help evaluate projects at a single crossing that would address multiple crossings, or evaluate a suite of projects at multiple crossings to help traffic move through a larger corridor. Corridor evaluation could be useful in identifying or evaluating specific project proposals and addressing regional or rural needs.

RECOMMENDATION

xi. Utilize a corridor-based prioritization strategy to assist in developing solutions and prioritizing investments

8 Some jurisdictions have not yet identified and prioritized needed crossing improvements

While most large jurisdictions have tried to address crossing impacts, a lack of dedicated funding sources for crossing improvements creates a disincentive for smaller jurisdictions to plan for and implement crossing improvements. Some communities may not know the range of possible solutions for crossings, or groups of crossings, and default to expensive grade-separation projects for all.

When crossing improvements compete with other local funding priorities, they often rank lower than other priorities. This is partially due to information about train activity and crossing impacts not being easily accessible (until the development of this database).

RECOMMENDATION

xii. Ensure that local jurisdictions, state agencies, and other organizations, including Regional Transportation Planning Organizations and Metropolitan Planning Organizations, are aware of the tool and the data it contains and how they might use it to assist with planning or funding decisions.

1 INTRODUCTION

With the growth of the state's population and increasing road and rail traffic, communities throughout the state are concerned about the reliable and safe movement of rail and truck freight, general traffic, and emergency vehicles across more than 2,180 public, active at-grade railroad crossings. In response to this concern, the Washington State Legislature in 2015 appropriated funds to the Joint Transportation Committee (JTC) to evaluate the impacts of prominent road-rail conflicts and develop a corridor-based prioritization process for addressing the impacts on a statewide level.

Funding for this study was provided by Washington cities from their share of the gas tax, due to concerns about increasing congestion and safety issues resulting from road-rail conflicts.

This study developed a prioritization process for at-grade crossings based on specific evaluation criteria that considered local, regional, and statewide policy interests. It is the first study of its kind, utilizing a data-driven approach to perform a comprehensive evaluation of at-grade crossings on a statewide basis.

1.1 BACKGROUND

At-grade railroad crossings, where roads cross railroad tracks at the same level, can typically function adequately while population and traffic levels remain low. As both rail and road traffic increases, and trains get longer, these at-grade crossings become more problematic, impacting communities in a variety of ways. The phrase "road-rail conflict" is used to describe potentially problematic at-grade crossings. Examples of potential conflicts include the following:

- Long and unpredictable travel delays for both the general public and freight users
- Collisions between trains and vehicles or pedestrians
- Temporary increases of emergency response times

"Road-rail conflict" is used to describe potentially problematic at-grade crossings.

The specific legislative direction calling for this study is as follows:

Second Engrossed Substitute House Bill 1299 (2015), Section 204:
3) $250,000 of the motor vehicle account—state appropriation, from the cities' statewide fuel tax distributions under RCW 46.68.110(2), is for a study to be conducted in 2016 to identify prominent road-rail conflicts, recommend a corridor-based prioritization process for addressing the impacts of projected increases in rail traffic, and identify areas of state public policy interest, such as the critical role of freight movement to the Washington economy and the state's competitiveness in world trade. The study must consider the results of the updated marine cargo forecast due to be delivered to the joint transportation committee on December 1, 2015. In conducting the study, the joint transportation committee must consult with the department of transportation, the freight mobility strategic investment board, the utilities and transportation commission, local governments, and other relevant stakeholders. The joint transportation committee must issue a report of its recommendations and findings by January 9, 2017. (Due date amended by Engrossed Substitute House Bill 2524, 2016 Supplemental Transportation Budget.)

RAIL AND ROAD ACTIVITY EXPECTED TO GROW

The study arose partly due to concerns raised by cities related to increases in the frequency and length of freight trains, and the growth of roadway traffic volumes. Even without proposed export terminals for coal or oil, freight train traffic is expected to grow substantially. The State Rail Plan (December 2013) projects that statewide freight rail volumes will grow by 130% to 268 million tons of freight by 2035. The projected increase in rail freight volume will result in increases in freight train movements in the state. At a minimum, daily freight trains between Seattle and Spokane are projected to increase by 27 trains or 163% of current levels, and between Seattle and Portland, by 17 trains or 128% of current levels.

Roadway volumes are also expected to increase over time to serve the additional travel demand, especially in growing regions of the state, such as the Puget Sound and Spokane Metropolitan Areas. While the Washington Transportation Plan indicates vehicle miles traveled may decline per capita, vehicle volumes along many roadways are still expected to increase. Furthermore, it is expected that auto occupancy and truck freight volumes will increase due to more emphasis on buses, carpooling, and urban freight deliveries fueled from online retail sales. This means that while vehicle volumes are not expected to increase as substantially as train movements, more people will be traveling in the vehicles and more freight deliveries will be using the crossings to reach their destination.

MORE TRAINS AND VEHICLES EQUAL MORE MOBILITY IMPACTS

More and longer trains, coupled with an increase in roadway volumes, will result in additional traffic delays for people and freight at many at-grade crossings. The Puget Sound Regional Council's (PSRC) evaluation in July 2014 of the regional impacts of increased train traffic found that "gate-down" time, the time which the crossing gates are down and traffic is stopped, would more than double to about 30 minutes in some locations and nearly 3 hours in others. For some jurisdictions, crossing closures can have a ripple effect on the transportation network, causing adjoining intersections and corridors to gridlock and resulting in an extended period for the network to return to normal operations after the crossing gates have opened. These traffic delay impacts result from increasing freight and passenger train traffic, but also from increased passenger vehicle and truck freight volumes.

The Freight Mobility Strategic Investment Board (FMSIB) and the Washington Public Ports Association (WPPA) have partnered to prepare an update to the Marine Cargo Forecast. The forecast will compare the projected level of rail traffic with the capacity of the major railroad segments in the region, and identify the anticipated capacity constraints. Information from the Marine Cargo Forecast was not available to be incorporated into this study, but when available, will enhance the data utilized and help in prioritizing crossings expected to see a large increase in rail volumes.

GRADE SEPARATION PROJECTS ARE NOT ALWAYS FEASIBLE

There is a perception that grade separation projects are the only solution to road-rail conflicts. An average grade separation project can cost a minimum of $20 to $30 million, with a few projects costing more than $100 million. The City of Seattle is currently moving forward with an approximately $140 million grade separation project on Lander Street. Given that many local jurisdictions have multiple crossings within their boundaries, and a backlog of other infrastructure needs, this cost is often more than a jurisdiction can finance on its own. Furthermore, the cost of making all of these improvements statewide would be prohibitive.

A grade separation project may not be the only or best solution for every corridor with road-rail conflicts. Alternative at-grade crossing investments could be considered that improve network traffic flow, such as inter-connected signal equipment, or additional signing and lighting at the crossing resulting in improved operations and safety. Other technology could be considered that would provide dynamic traffic signage, predictive crossing closure times, or real-time data on mobile devices so motorists can find alternative routes. In cities or regions with multiple crossings, a combination of complementary investments may make the most sense given the need and financial capabilities of local jurisdictions, and the unpredictable nature of future train activity.

For situations where a grade crossing improvement is selected, an evaluation should be completed to determine if the project removes the need to invest in one or more adjacent at-grade crossings.

EXISTING FUNDING FOR CROSSING IMPROVEMENTS IS FOCUSED ON SAFETY

Washington State has two funding programs exclusively focused on improving safety at crossings. Because grade crossing improvements do not generally compete well against other transportation improvements, these programs ensure funding for grade crossing projects because these projects only need to compete against each other. However, the funding for these programs is limited to small scale improvements.

The Washington Utilities and Transportation Commission (UTC) operates the Grade Crossing Protection program for which funding has been limited to $500,000 per biennium. Typical projects are focused on installation of protective devices such as gates and warning signals. In the 2016 Supplemental Transportation Budget, the program was increased by an additional $1.1 million to address safety issues at crossings with high volumes of oil train traffic.

WSDOT administers the federal Highway Safety Improvement Program (HSIP) funded as part of the Fixing America's Surface Transportation (FAST) Act, which includes the Railway-Highways Crossing (Section 130) Program that funds projects at public at-grade crossings. The funds are apportioned to each state, with Washington receiving approximately $4.2 million per year through 2020.

Of the $16 billion Connecting Washington spending plan, as much as $245 million will be spent on projects which include improvements to at-grade crossings.

PLANNING FOR CROSSING IMPROVEMENTS

Crossing improvements are not always included in the normal Metropolitan Planning Organization (MPO) or Regional Transportation Planning Organization (RTPO) planning process. Many jurisdictions overlook crossing improvements due to potential project costs, few outside funding sources, and lack of understanding of other lower-cost solutions. As part of this study, JTC staff surveyed RTPOs asking about at-grade crossing projects, but only eight of 14 RTPOs responded with information. Of those eight, some often addressed at-grade crossings as part of larger highway projects or as part of a focus on a single corridor. Some agencies, such as WSDOT and PSRC, are focusing on corridor improvement strategies, recognizing that one or multiple improvements in a corridor can improve mobility for the overall transportation system. Crossing improvements can be part of the strategies that are considered when identifying corridor solutions to improve traffic flow.

1.2 POLICY INTERESTS

A key objective of the study is to identify the local, regional, and statewide policy interests of road-rail conflicts. The jurisdictions and stakeholders with an interest in addressing the impacts of road-rail conflicts include:

- The federal government, with the most recent Surface Transportation Act reauthorization including new funding for freight mobility;
- Washington State, as represented by WSDOT, UTC, and FMSIB;
- Local jurisdictions, as represented by cities, counties, ports, and MPOs and RTPOs;
- Railroads, represented by BNSF, UP and short lines; and
- The trucking industry.

The federal and state governments are primarily interested in high level goals of congestion relief and safety for both general and freight traffic, and freight mobility as an important contributor to economic vitality. National and state funding programs tend to prioritize improvements to the national and state highway systems over funding local road systems.

Local governments and the local road system experience the most immediate impacts of road-rail conflicts, including but not limited to traffic back-ups, collisions at crossings, unreliable access to emergency services, and unsafe connections for pedestrians and bicycles. Air quality, noise, and general quality of life impacts are also of concern to some communities.

Ports experience the immediate impacts of constrained freight mobility. Terminal and inland rail connections can be a major constraint to their ability to efficiently handle marine cargo and landside rail traffic. Grade crossings are only one piece of the freight system, however, last-mile connections to ports frequently include road-rail intersections.

Railroads also seek to eliminate constraints to cargo through-put. In some rail segments, grade separation projects in a corridor only improve speed and volumes if accompanied by closures of nearby crossings.

A significant amount of freight is moved by trucks on state and local roads. The trucking industry experiences all aspects of road-rail conflicts, from traffic back-ups, reduced access to first- and last-mile connections, and exposure to safety risks.

1.3 RECENT STUDIES

A number of recent studies analyzed road-rail conflicts in Washington State and identified impact mitigation opportunities. These studies were reviewed to understand items to consider when evaluating road-rail conflicts on a statewide basis. Each of the studies prioritized crossings or crossing improvement projects in order to identify funding needs.

WASHINGTON STATE FREIGHT ADVISORY COMMITTEE, "WASHINGTON STATE FREIGHT TRENDS & POLICY RECOMMENDATIONS"

In 2013, FMSIB convened the Washington State Freight Advisory Committee (WSFAC) made up of public and private freight stakeholders. The WSFAC's report discusses trends, challenges, and recommendations for each freight sector. In addition, the WSFAC compiled an inventory of grade separation projects, which improve "first priority" and "emerging" at-grade rail crossings. The inventoried projects were submitted by MPOs and RTPOs based on their regional prioritization processes. Only crossings of mainline railroads within city limits and on streets identified as part of the Freight and Goods Transportation System were considered.

The prioritized projects submitted by MPOs and RTPOs were grouped into two categories. The "first priority" crossing category included only projects addressing crossings of heavily-used roadways and were limited to near-term projects with at least some funding. The "emerging" at-grade rail crossing inventory included crossings with expected growth in truck traffic and projects in earlier stages of development (likely to proceed after 2020).

The inventory included $1.1 billion in projects prioritized by MPOs and RTPOs, with many projects not yet costed out. A few of these projects were funded by the 2015 Connecting Washington Act. This study is notable for its linkage of projects and crossings and the overwhelming cost of inventoried projects, demonstrating the need for a prioritized approach to funding.

In 2016, the WSFAC reconvened, staffed by WSDOT in collaboration with FMSIB to prioritize freight projects. For this process, the two agencies initiated a call for projects from cities, counties, ports, and tribes. The projects were screened and prioritized based on regional support, funding eligibility, remaining funding gap, and scheduled year for project start. Of the $6.3 billion in eligible projects submitted, only ten projects included elements addressing road-rail conflicts.

PSRC GATEWAY PACIFIC TERMINAL STUDY

Grade crossings have received increased attention in the last few years due to proposals for oil and coal terminals served by rail. In 2014, the PSRC commissioned a study of the impacts of the increased train traffic serving a proposed SSA Marine coal terminal at Cherry Point in Whatcom County. The study found that the 18 new trains per day passing through the four county region would have both benefits and costs. Benefits would include upgrades in rail capacity that would help the Port of Seattle and provide additional in jobs. Costs would result from increased traffic delays and declines in property value.

The PSRC study focused on 70 crossings of the BNSF mainline which would serve Cherry Point. The two-step process first conducted a city-by-city analysis and narrowed the list to 34 crossings, or “mitigation opportunities,” based on two criteria: traffic delay due to crossing gate-down time and the impact of increased freight traffic on property values.

The second step collected data on the 34 crossings based on a broader set of criteria (truck volumes, rail freight class/volumes, impacts to emergency services, annual accidents, impacts to environmental justice, and pedestrian activity). Most of these 34 crossings receive a high priority ranking using at least one criteria.

This study is notable for demonstrating the importance of choosing a limited set of criteria to narrow a list of potential investments, the analysis of individual cities, and measurement of traffic delay by calculating gate-down time.

SKAGIT COUNCIL OF GOVERNMENTS RAIL CROSSING STUDY

In January 2016, the Skagit Council of Governments released the Rail Crossing Study, which evaluated all 56 at-grade crossings in the county. The study evaluated the impacts to local roads from increased future train traffic at all at-grade crossings. It included data on existing and future train and traffic volumes, the crossings, vehicle queueing, impacts to emergency services, and safety. A list of priority projects was developed based on impacts to traffic delay, freight delay, and safety, among other concerns.

Similar to this study, the Rail Crossing Study assembled data from various sources for each at-grade crossing to identify potential impacts from existing and future train traffic. The study provided potential solutions to address those impacts, including localized solutions for each crossing as well as more network-based mitigation measures, such as Intelligent Transportation Systems (ITS).

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, AT-RISK CROSSINGS, OIL BY RAIL LEGISLATIVE STUDY

In 2014, theUTC undertook a study of public railroad-highway grade crossings along oil routes. The 2015 summary of the study describes a process which narrowed a list of 347 crossings on oil routes to 14 crossings that are under-protected and would benefit from additional investments in protections, separation or closure. This study is notable for the UTC's on-site, in-depth analysis of safety issues at individual grade crossings.

FMSIB AND WPPA, 2016 UPDATE TO THE MARINE CARGO FORECAST

The Legislature required the JTC study of road-rail conflicts to consider the results of the updated Marine Cargo Forecast being jointly conducted by FMSIB and the WPPA. The 2016 forecast update is expected to include information about rail capacity needs to accommodate forecasted increases in freight rail traffic. The forecast update is expected to be completed by the end of 2016, so information was unable to be included in the study. However, the information may be useful to include at a later time, depending on the next steps beyond this study effort.

1.4 STUDY OBJECTIVES

The purpose of evaluating prominent road-rail conflicts and developing a prioritization process was to identify at-grade crossing locations that impact the movement of people, goods, and services. Through feedback from key stakeholders and the legislative direction, the following objectives guided this study.

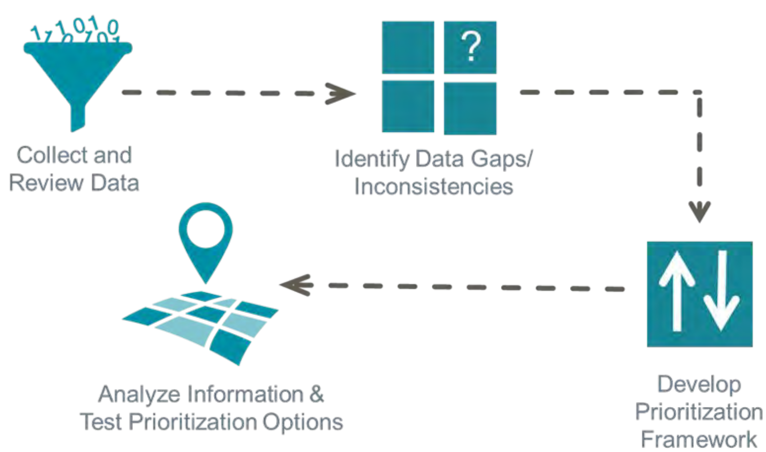
- An understanding of the current and future mobility, community impacts, and safety problems at-grade crossings in the state;
- An understanding of state, local, and private entity policy interests in improving at-grade crossings;
- Consideration of how a data-driven analysis of crossing impacts can be used in a corridor-based project prioritization process; and
- A criteria-based decision-making process for prioritizing statewide investments in at-grade crossing solutions.

These objectives helped frame each of the study tasks. For example, compiling an inventory of statewide crossing data improved understanding of the extent of current and future problems at crossings. The prioritization process included criteria that reflect state, local, and private policy interests, and acknowledged the importance of freight movement, emergency response routes, and the general mobility of goods and people. The analysis of crossing impacts included an evaluation of corridor strategies that could help address impacts at a single crossing or potentially help address impacts at multiple crossings. Finally, the resulting list of prioritized crossings used criteria to assist policymakers in understanding the magnitude of needs and potential priorities when considering crossing investments on a statewide basis.

1.5 STUDY APPROACH

The study developed and incorporated a data-driven approach to evaluate and prioritize crossings throughout the state as shown in Figure 1. It started with collecting and reviewing available data for crossings. Data gaps and inconsistencies were identified, such as where no data existed or where data quality was in question.

Figure 1. Illustration of the Study Approach



Products of this study:

- Database of at-grade crossings

- Online mapping tool

A prioritization framework was then prepared to analyze and test various evaluation criteria and scoring methodologies to understand the magnitude of crossing needs. To assist in the overall prioritization process, a crossing database was created along with an online mapping tool to store and display the results of the prioritization effort.

The work was guided by an eleven-member Advisory Panel made up of representatives of agencies and organizations across the state. The Advisory Panel met four times throughout the study – in May, August, September and November – and provided policy and technical guidance on the identification of the evaluation criteria used to determine crossing priorities, development of the database and the prioritization process, how to maintain a statewide perspective, how the tool developed in the study might best be used and maintained in the future, and potential findings and recommendations from the study.

Additional support and direction was provided by a Staff Work Group made up of legislative staff and staff of the Advisory Panel members. While these groups provided valuable input to the consultants, the findings and recommendations are those of the consultant team.

ADVISORY PANEL MEMBERS

Paul Roberts **City of Everett, AWC**

Sean Guard **City of Washougal, AWC**

Lisa Janicki **Skagit County, WSAC**

Al French **Spokane County, WSAC**

Kevin Murphy **Skagit COG**

Ashley Probart **FMSIB**

Dave Danner **UTC**

James Thompson **WPPA**

Ron Pate **WSDOT**

Johan Hellman **BNSF**

Sheri Call **Washington Trucking Association**

STAFF WORK GROUP MEMBERS

Beth Redfield **JTC**

Mary Fleckenstein **JTC**

Dave Catterson **AWC**

Gary Rowe **WSAC**

Jason Lewis **UTC**

Sean Ardussi **PSRC**

Kyle McKeon **WSDOT**

David Biering **WSDOT**

Matt Neeley **WSDOT**

Jason Beloso **WSDOT**

Chris Herman **WPPA**

Steven Ogle **DOE**

Hayley Gamble **Senate Transportation Committee**

Jennifer Harris **House Transportation Committee**

Paul Ingiosi **House Transportation Committee**

Jackson Maynard **Senate Republican Caucus**

Hannah McCarty **Senate Democrat Caucus**

Debbie Driver **House Democratic Caucus**

Dana Quam **House Republican Caucus**

2 PRIORITIZATION PROCESS

The prioritization process utilized a wide range of criteria to create a data-driven approach to evaluating crossing locations. Evaluation criteria were critical to understanding the differences between crossings, and to rank the Top 300 crossings in the state. This chapter outlines the specific details regarding the prioritization process used in this study.

2.1 CROSSINGS, CORRIDORS, AND PROJECTS

The focus of the study was the evaluation of individual “crossings,” however “corridors” and “projects” are also discussed to understand how they could be considered in the prioritization process. Each term is distinctly different as a corridor could contain multiple crossings, and one crossing could contain multiple projects. Developing solutions to road-rail conflicts would lead to an identification of a project. A corridor strategy could identify one or more projects to improve traffic flow at multiple crossings. The following defines each term and confirms how each relates to one another.

Crossings are the intersection of roads and rail lines. The prioritization process is a data-driven approach, and the data sets used in the prioritization process are linked to discrete geographic points located at these road-rail crossings. In other words, a crossing database becomes the location where the data is stored to evaluate road-rail conflicts. Each crossing has its own characteristics that can have various levels of impact on the full transportation system.

Corridors represent groupings of crossings, often along the same rail line or multiple parallel lines with a common road crossing. Crossings on the same rail line will also have the same level of train activity, leading to interrelated impacts along multiple crossings. Corridor-based metrics are not intended to evaluate mobility of trains along the rail corridor, but rather how train movements impact the surrounding roadway transportation system, and the movement of people and goods through the roadway corridors in each community.

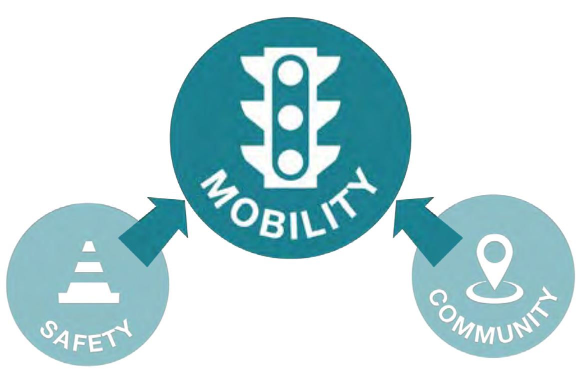
Projects that address road-rail conflicts typically are roadway improvements and can be implemented at individual crossings or at a corridor level. The needs of individual crossings can be determined by looking at specific crossing criteria. Identifying solutions takes a broader view of the corridor. For example, a grade-separation project could shift roadway traffic away from several other crossings and so this type of project is a corridor-based solution addressing the needs of several crossings.

One of the original objectives of the study was to consider a corridor-based prioritization process. However, to introduce a corridor-based prioritization without exploring solutions, identifying specific projects, engaging project teams from multiple juristictions and engineering disciplines, or knowing funding parameters, was challenging and potentially premature. This study compiles the database of crossings and ranks them according to needs. The database and crossing prioritization tool helps policy makers, state agencies, RTPOs and local jurisdictions to understand crossing impacts, leading to the next step of project identification and corridor-based solutions.

2.2 THREE CATEGORIES OF CRITERIA

The database contains detailed characteristics, or information, about each of the 2,180 public, active, at-grade crossings in the state. A select number of the characteristics that describe each crossing can then be used as evaluation criteria to analyze crossings. Evaluation criteria were grouped into categories as illustrated in Figure 2: mobility, safety, and community. The three common categories represent shared values in the transportation industry, and have been regularly applied in other funding or prioritization processes. The categories are also inter-related, for example, as population and employment density increase, mobility and safety impacts might

Figure 2. Three Common Categories Used to Evaluate Crossings



- **MOBILITY** How does the crossing impact the mobility of people, goods, and services?
- **SAFETY** How does the crossing impact public safety?
- **COMMUNITY** How does the crossing impact the community and local economy?

be more pronounced. For purposes of this prioritization process, mobility criteria are weighted more heavily at 50% of the final score, with safety and community receiving weightings of 25% each. As will be discussed later in section 2.6, the weighting is designed to focus the prioritization results on mobility impacts, while still recognizing the importance of safety and community needs.

RELATIONSHIP WITH OTHER PROGRAMS

Local planning organizations can use this tool to evaluate solutions to road-rail conflicts on a corridor basis.

The three evaluation categories of mobility, safety and community reflect shared values in the state and national transportation industry. Many policies and programs at state and federal agencies, as well as transportation-related professional organizations are centered around these three categories. For example, mobility, safety, and economic vitality are three of the six Washington State Transportation System Policy Goals. Listed below are other groups, guidelines, and programs that list these categories as top criteria:

- Washington State Freight Mobility Strategic Investment Board
- Washington State Transportation Improvement Board
- California Public Utilities Commission for Rail Crossings Prioritization
- FHWA Railroad-Highway Grade Crossing Handbook
- USDOT TIGER Program

MOBILITY EVALUATION

Based on the study objectives and feedback from the Advisory Committee, the central focus of the study and prioritization effort was on mobility. This was not intended to diminish the importance of the other two evaluations (safety and community). The crossing's impact on mobility of people, goods, and services was considered the driving force to address road-rail crossing impacts. In many ways, the different metrics within the crossing database were either directly or indirectly related to mobility metrics. Greater roadway traffic volumes (a mobility-related metric) would increase collision risks at crossings (a safety-related metric) and increase impacts to air pollution (a community-related metric). Furthermore, the level of detail of mobility metrics found in the database of crossings matches the intended use of a statewide tool. As discussed below, a primary focus on improving safety-related and community-related impacts would require site specific analyses not possible for a database of 2,180 at-grade crossings.

SAFETY EVALUATION

High-level safety data, such as historical collisions, type of safety equipment present, and proximity to emergency service providers, were incorporated into the evaluation to assist in prioritizing the crossings. This safety data, in combination with the other criteria, is meant to highlight comprehensive crossing impacts. The inclusion of indicators of safety impacts strengthens the mobility-focused methodology. The combined strength of these categories recognizes that traffic volumes alone do not adequately represent a crossing's impact on the public.

The prioritization tool is meant to compliment existing safety programs.

The safety data may be considered "indicator data" pointing to locations requiring further safety analysis, but cannot be used on their own to diagnose safety-related problems.

Detailed safety data for individual crossings is very limited. WSDOT and UTC have funding programs and processes in place to investigate, evaluate, and implement improvements primarily focused on locations with past collisions or where crossing geometrics do not meet existing standards. The crossing database and prioritization tool in this study is intended to complement rather than replace these existing safety programs and processes.

COMMUNITY EVALUATION

High-level human health and economic metrics such as population and employment densities, socio-economic indicators, emissions, and noise, were also incorporated in the prioritization process. The combined strength of these categories recognizes that traffic volumes alone do not adequately represent a crossing's comprehensive impact on the local community. Like safety data, these community metrics were considered "indicator data" related to health and the economy, and the quality of life impacts at congested at-grade intersections.

Community impacts are important and hard to quantify. For example, the crossing may be considered critical to the development potential of specific areas, or it may be near care facilities whose patrons are especially sensitive to air pollution. The ranking of projects is intended to highlight crossings with the greatest overall impacts from a high-level statewide comparison. Local communities and MPOs will need to develop project solutions to address specific community-related needs of the area.

Figure 3. Overview of the Prioritization Steps

2.3 PRIORITIZATION APPROACH

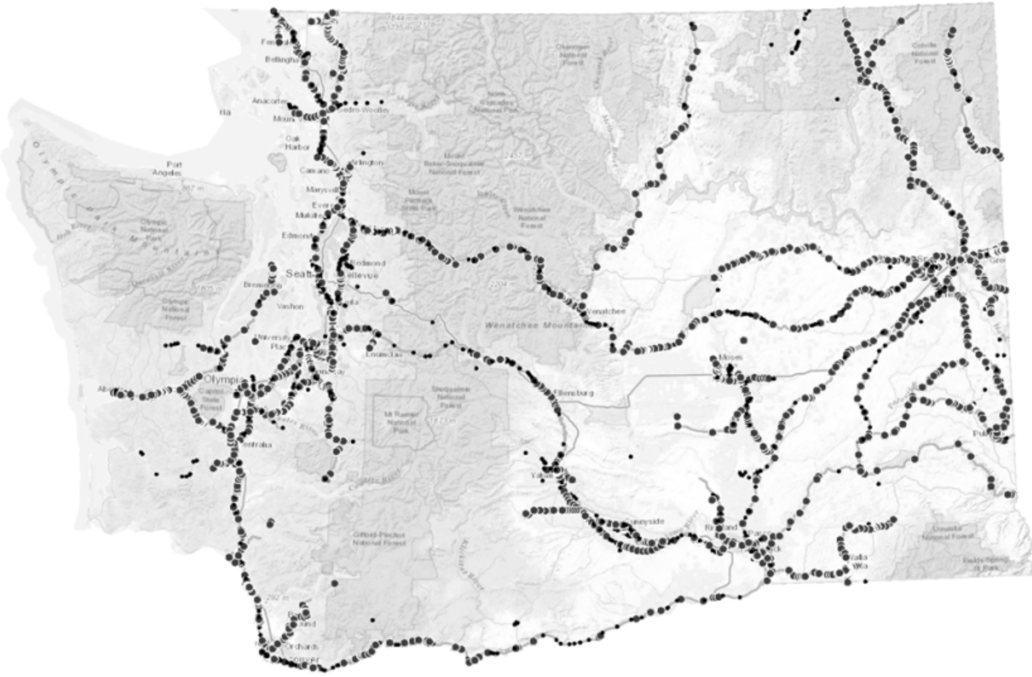
The prioritization approach included a preliminary screening process of the 4,171 total crossings statewide followed by two steps as illustrated in Figure 3. The first step was meant to "filter out" railroad crossings that did not meet defined thresholds and create a manageable number of crossings to evaluate in more detail. The second step "sorted" the remaining crossings by the evaluation criteria to create a ranked list of crossings.

The two step prioritization process helped address the fact that detailed data was not available for all crossings. The existing data came from a wide variety of sources and the Staff Work Group acknowledged that some level of "scrubbing" or cleaning of the database would be needed to complete the final stage of prioritization, as well as collection of additional data. The objective of the second step was to reduce the number of crossings that would receive a detailed evaluation, due to the resources that would have been needed to collect and test the various data sets for all 2,180 study crossings.

2.4 PRELIMINARY SCREENING PROCESS

There are 4,171 railroad crossings in Washington as shown in Figure 4. This includes crossings intersected by both public and private roads. Also included are crossings that are considered inactive, meaning there is no train activity anticipated. Approximately 76% of active crossings are at-grade, meaning the roadway users come in direct conflict with rail traffic. Grade-separated crossings, where rail and road traffic operate independently without conflict, were screened out of the study crossings.

Figure 4. Locations of All 4,171 Railroad Crossings in Washington State



This study focuses on at-grade crossings of active rail lines located on public-use roadways. The total number of study crossings is 2,180 crossings, or about 52% of all crossings.

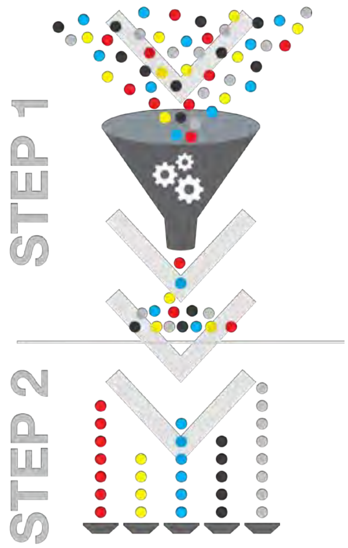
2.5 STEP 1 FILTERING

The first step in the prioritization process began with all 2,180 study crossings. This step used readily available datasets for all study crossings. The intent was to capture a diverse set of important crossings and create a candidate list of crossings for further detailed evaluation.

The Step 1 data were collected from various state and federal organizations including Federal Railroad Administration (FRA), UTC, and WSDOT. Information was also collected from MPOs and RTPOs about anticipated projects related to road-rail crossings. Data pertaining to historical safety records, such as details about collisions, were not readily available for all crossings, and

Study crossings were defined as at-grade crossings of active rail lines located on public-use roadways. The total number of study crossings is 2,180 crossings, or about 52% of all crossings in the state.

Figure 5. Filtering and Sorting Processes



were used only in Step 2. Figure 5 shows the relationship of Step 1 and Step 2 processes.

The criteria used in Step 1 were assigned to one of the three common criteria categories (mobility, safety, and community) based on the type of data. Table 1 shows that most of the criteria were assigned to the mobility category, with two each assigned the safety and community categories. This highlights that safety- and community-related data sets are less available on a statewide basis at this time.

The purpose of Step 1 was to qualify prominent crossings for further evaluation. To receive a full score, the crossings had to meet a threshold as indicated in Table 1. Table 1 shows the scores for each criteria by category. The Step 1 process identified the Top 50 crossings in each of the categories (mobility, safety, and community)

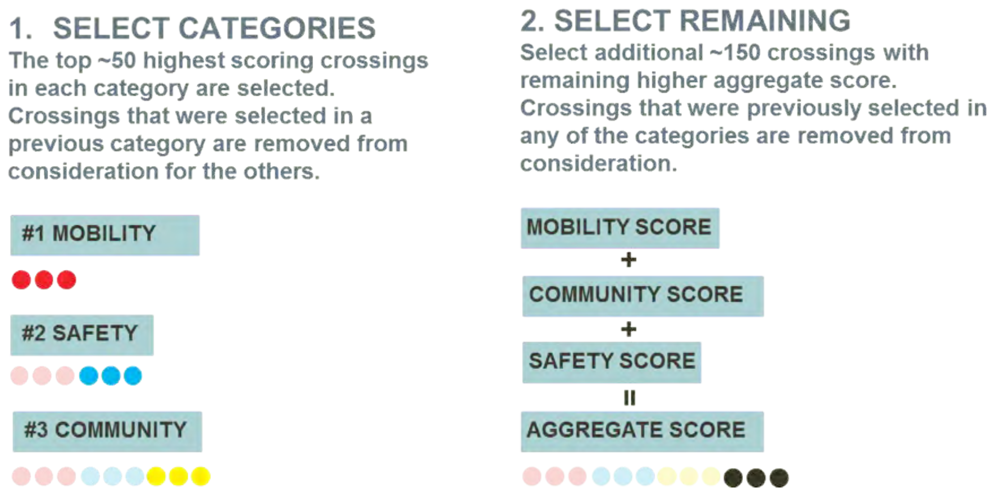
Table 1. Step 1 Thresholds by Criteria

STEP 1 CRITERIA	THRESHOLD FOR RECEIVING MAXIMUM POINTS	MAXIMUM NUMBER OF POINTS AVAILABLE
MOBILITY GROUP		
Railroad Classification	Class I Railroads	2
Existing Freight Train Volumes (2015)	10 or more Trains per Day	3
Future Freight Train Volumes (2035)	15 or more Trains per Day	3
Existing Passenger Train Volumes (2015)	10 or more Trains per Day	2
Future Passenger Train Volumes (2035)	10 or more Trains per Day	2
Presence of Unit Trains	Yes	2
Existing Vehicle Volumes (2015)	Greater than 8,000 ADT[1]	3
Future Vehicle Volumes (2035)	Greater than 8,000 ADT[1]	3
SAFETY GROUP		
Presence of Alternate Grade-Separated Crossing	No	3
Number of Mainline Tracks	2 or more	3
COMMUNITY GROUP		
Roadway Classification	Major Collector or higher	2
Previously Identified Project Location	Yes	2

1. Average Daily Traffic

as well as the Top 152 crossings qualifying due to combined point totals across categories, which is illustrated in Figure 6. The 302 prominent crossings, which moved on to the Step 2 analysis, all exceeded a clear break point in the total scores.

Figure 6. Step 1 Selection Process



2.6 STEP 2 SCORING AND WEIGHTING

The second step in the prioritization process began with the 302 crossings that remained after Step 1. These 302 were sorted using more detailed evaluation criteria to allow a higher level of comparison and contrast between the crossings. The evaluation criteria identified in Table 2 used many of the same GIS data sets as in Step 1, but incorporated more detailed information.

STEP 2 DATA ENHANCEMENTS

Step 2 database development required new analysis specific to the 302 crossing locations. In the future, if the prioritization process is modified to conduct a more in-depth evaluation of all at-grade crossings, this additional data analysis would need to be performed for many more locations.

As noted in Table 2, additional calculations and analysis of the raw data were performed for a majority of the final 19 criteria. In some cases, the data development required GIS analysis, and in other cases the development and summary of the data

Table 2. Step 2 Evaluation Criteria and Sources

STEP 2 CRITERIA	SOURCE DESCRIPTION
SAFETY GROUP	
1. Number of Alternate Grade-Separated Crossings	UTC, Parametrix
2. Number of Mainline Tracks	UTC
3. Proximity to Emergency Services	DOH (Hospital and Fire), Wikipedia/ Google Maps (Police), Parametrix
4. Incident History: Total	UTC
5: Incident History: Severity	UTC
6: Level of Protection	UTC (Geometry Issues), Google Maps/ Transpo (Gates/Lights/Medians)
MOBILITY GROUP	
7: Roadway Freight Classification	WSDOT
8: Existing Vehicle Volumes	UTC
9: Future Vehicle Volumes	UTC, WSDOT, Parametrix
10: Network Sensitivity	WSDOT (Roadway Functional Classification), Google Maps/Transpo (Traffic Signals)
11: Crossing Density	UTC, Parametrix
12: Gate Down Time	FRA/WSDOT/DOE (Train Volumes by Type), Parametrix
COMMUNITY GROUP	
13: Employment Density	EPA Smart Location Database, Parametrix
14: First/Last Mile Freight Facilities	WSDOT (Freight Economic Corridors), Parametrix
15: Population Density	EPA Smart Location Database, Parametrix
16: Daily Emissions	Gate Down Time (see above), EPA (emission factors), Transpo
17: Noise: Quiet Zones	UTC
18: Percent Minority	US Census, Parametrix
19: Percent Low-Income	US Census, Parametrix

was more involved, such as reviewing individual collision reports or reviewing the specific site conditions of the crossing using aerial photography.

The following section describes the criteria in each of the categories before the scoring and weighting process is defined.

STEP 2 MOBILITY CRITERIA

The mobility criteria include three types of data sets: freight demand, people demand, and mobility barriers. More information on the sources of data can be found in Appendix A.

Freight demand refers to the volume of freight on the roadways at the crossings. The criteria is the "roadway freight classification" which reflects the annual tonnage of truck freight on the road segment. The data is from WSDOT's Freight and Goods Transportation System classification system which was updated in 2016.

People demand refers to the volume of vehicle traffic on the roadways at the crossings. The criteria are "existing vehicle volumes" and "future vehicle volumes" on the road segment.

Mobility barriers refers to the barriers that the crossing creates for overall vehicle mobility in the area. There are three criteria to reflect types of barriers. The crossing "gate down time" reflects the most basic barrier to mobility: the time vehicles must wait for a train to pass. The impacts of a crossing closure due to train activity is compounded with the two other barrier metrics. One is "network sensitivity," which measures how close the crossing is to major intersections, traffic signals, and major urban roadway systems. Traffic at crossings close to major transportation facilities takes more time to clear after the crossing gates rise and is considered more sensitive to gate down time impacts. The other criteria, "crossing density," reflects the fact that closely spaced at-grade crossings would all be closed at the same time due to one train. The higher the crossing density, the more overall mobility in the area is limited by a single train.

STEP 2 SAFETY CRITERIA

The safety criteria include three types of data sets: increase risks, safety record, and infrastructure status, as shown in Table 3.

Increase risks to safety refer to the type of conditions that increase the overall safety risk at the road-rail crossing intersection. There are three criteria used to account for risks. The first is "number of alternate grade-separated crossings." Grade-separated crossings provide uninterrupted access across the corridor for emergency services or other vehicles. With fewer grade-separated crossing options, response times may increase for emergency providers and more vehicles will be concentrated at at-grade crossings, resulting in increased exposure risks. The second criteria is "number of mainline tracks." Multiple tracks create an inherent safety risk as drivers may not expect a second train appearing on a different track and may choose to ignore safety warnings. The third criteria is "proximity to emergency services," which reflects the fact that if a crossing is near an emergency facility, it has a higher risk of impacting emergency response times.

Safety record refers to the incident history at the crossing including vehicle, pedestrian, and bicycle collisions with trains. There are two criteria. The first criteria reflects "total incident history" meaning the total number of safety incidents. The second criteria, "incident history: severity," adds weight to incident scoring based on the severity of the collision. For example, fatalities would be the most severe, followed by collisions resulting with an injury, then collisions only involving property damage.

Table 3. Step 2 Categories, Sub-Categories, and Evaluation Criteria Points

SUB-CATEGORIES	SUB-CATEGORY POINTS	EVALUATION CRITERIA	INITIAL CRITERIA POINTS	CRITERIA POINTS AFTER WEIGHTING
SAFETY GROUP			100 POINTS	25 POINTS
Increase Risks	30 points	1. Number of Alternate Grade-Separated Crossings	10 points	2.5 points
		2. Number of Mainline Tracks	10 points	2.5 points
		3. Proximity to Emergency Services	10 points	2.5 points
Safety Record	30 points	4. Incident History: Total	20 points	5 points
		5: Incident History: Severity	10 points	2.5 points
Infrastructure Status	40 points	6: Level of Protection	40 points	10 points
MOBILITY GROUP			100 POINTS	50 POINTS
Freight Demand	15 points	7: Roadway Freight Classification	15 points	7.5 points
People Demand	30 points	8: Existing Vehicle Volumes	20 points	10 points
		9: Future Vehicle Volumes	10 points	5 points
Mobility Barrier	55 points	10: Network Sensitivity	15 points	7.5 points
		11: Crossing Density	10 points	5 points
		12: Gate Down Time	30 points	15 points
COMMUNITY GROUP			100 POINTS	25 POINTS
Economic	50 points	13: Employment Density	25 points	6.25 points
		14: First/Last Mile Freight Facilities	25 points	6.25 points
Human Health	50 points	15: Population Density	10 points	2.5 points
		16: Daily Emissions	20 points	5 points
		17: Noise: Quiet Zones	10 points	2.5 points
		18: Percent Minority	5 points	1.25 points
		19: Percent Low-Income	5 points	1.25 points

Infrastructure status refers to the "level of protection" provided at the crossing. Facilities that already have gates and lights are prioritized lower in the scoring. In cases where the crossing does not have gates or lights, the geometry of the crossing becomes the metric to understand safety impacts. Protection infrastructure such as gates, lights, and medians reduces possible driver errors and increase safety.

STEP 2 COMMUNITY CRITERIA

The community criteria include two types of data sets: economic and human health impacts. Economic impacts refer to how the crossing impacts elements related to the community's economy. The first criteria is "employment density," meaning that if a crossing is located in an area with a large number of employees, then crossing issues could impact overall employment activities. The second is "first-and-last mile freight facilities," meaning that if the crossing is near these key freight facilities, the crossing could impact freight-related businesses in the community.

Human health impacts refer to crossings that could impact the overall health of community residents. The five health related criteria include "population density" (more people produce more impacts), "noise" (quality of life issues), "daily emissions" (vehicle pollution due to idling cars and trucks), "percent minority," (percent of population that is minority) and "percent low-income" (percent of population that is low-income). More detailed definitions are described in Chapter 4.

SCORING AND WEIGHTING THE CROSSINGS

Unlike Step 1 scoring, the Step 2 process uses a sliding scale to assign points for each of the evaluation criteria. In other words, a crossing could get partial points depending on the value of the criteria. In most cases, the maximum points go to the 90th-percentile value, so that crossings with unusually high impacts do not skew the scale against which others are measured. That means about 30 of the 302 crossings would receive maximum points, with the remaining crossings receiving partial or no points. By using a sliding scale for points, the scoring is more sensitive to each metric and overall scores are less likely to result in a tie. This promotes a more robust way to prioritize and rank the final list of crossings.

The structure of scoring is based on a 100-point scale. Mobility scores, safety scores, and community scores each separately receive 100 points. Those points are sub-divided into the 19 criteria used in Step 2 as shown in Table 3.

These resulting scores are then weighted to achieve an overall score for the crossing which is also a 100-point scale. Three different weighting strategies were tested to understand impacts to rankings.

One strategy was to weight mobility, safety, and community equally. This strategy had the effect of increasing the rankings of crossings with relatively minor vehicle or train volumes, which are key contributors to road-rail conflicts.

Another strategy was to focus exclusively on the mobility criteria and ignore the safety and community criteria. The problem with a mobility-only weighting option was that safety and community factors still play an important role in ranking crossing impacts.

The final weighting strategy is meant to put more focus on mobility, but still reflect the elements of safety and community. The final score for each crossing reflects weighting mobility at 50%, safety at 25%, and community at 25%. Table 3 shows what the relative criteria points become after the weighting is applied.

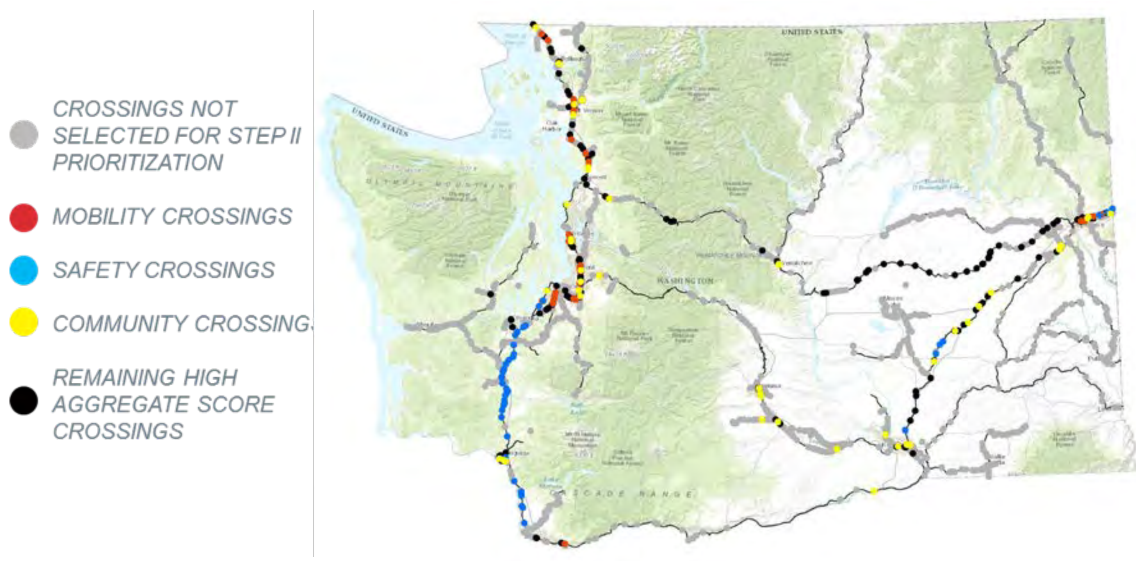
3 PRIORITIZATION RESULTS

The results of the Step 1 and 2 prioritization process are presented along with information about the impacts at the Top ranked crossings. Included in the results summary is a comparison between the list of planned crossing improvements and the results of the prioritization effort to understand the linkage to past planning efforts. In addition, various corridor strategies were evaluated to consider how a corridor-based prioritization process may assist in identifying crossing impacts and potential solutions.

3.1 PROMINENT CROSSINGS: STEP 1 RESULTS

The Step 1 process identified 302 crossings out of 2,180 study crossings, or approximately 14%, to move on to Step 2. Mobility crossings were identified first. As shown in Figure 7, the Top 50 mobility crossings were mostly along the I-5 corridor in urban areas in Western Washington, though some were located in the Spokane area. Top safety-related crossings (besides those in the Top 50 mobility crossings) were in Southwest Washington with a few along the US 395 corridor in Southeast

Figure 7. Crossings Selected for Step 2 Evaluation



Washington. The community and remaining high aggregate score crossings were distributed throughout the state.

Step 1 methodology was purposely developed to identify a wide spectrum of crossings with different characteristics and also incorporate a range of crossings from all areas of the state. The goal was to include all important crossings, which is the subject of a more detailed analysis as part of Step 2.

FINDINGS: STATISTICS DESCRIBING THE AT-GRADE CROSSINGS SELECTED

The data collected for this prioritization study may also serve as a means to understand the nature of the potential impacts experienced at at-grade crossings around the state.

Of the 302 prominent crossings:

- 84% have over 10 freight trains per day
- 79% do not have a nearby alternative route with a grade separated crossing
- 77% have unit trains present
- 71% are on major collectors, arterials, or state highways
- 41% have a regionally prioritized project identified
- 35% have 2 or more mainline tracks for vehicle traffic to cross
- 33% have over 8,000 daily vehicle trips
- 31% have more than 10 passenger trains per day

For more detail on these findings, please see the Step 1 Report Card in Appendix B.

DISCUSSION ON CROSSINGS NOT SELECTED

The reduction in crossings to 302 created a more manageable data set to evaluate in a more detailed way, while moving as many crossings forward as possible. In some cases, crossings important to some communities did not make it through Step 1. The general reasons for crossings not moving to Step 2 are that they did not meet basic thresholds. Crossings that were not on rail mainlines, not on arterial roadways, or had low vehicle volumes did not score as high. Lack of previously defined project or the presence of a nearby grade-separated route also reduced scores.

For example, there are several crossings near the Port of Grays Harbor that did not advance to Step 2. These crossings did not score well in community metrics because of a lack of projects or low roadway classification (rail is adjacent to major roads, but rarely crosses major roads in the area). From a mobility perspective, train and vehicle volumes are lower, and the rail corridor is not considered a mainline route. From a safety perspective, it is mostly a single track with nearby grade-separated crossings.

Another example is the City of Sunnyside which is nearly encircled by rail lines, with over a dozen crossings located on three of the four sides of the city. The tracks are not a mainline, and volumes for trains and vehicles are lower. There are no defined projects. Based on the Step 1 criteria, none of the crossings were selected.

To capture crossings such as the ones near the Port of Grays Harbor or Sunnyside would likely require expanding Step 2 crossings to a larger number, leading to questions about manageability of the data sets. Alternatively, if train volumes and lengths were to increase substantially along the route, the crossings would likely rank higher on a statewide basis and make it into the Step 2 process. The Step 1 process can be updated in the future as data about each crossing changes to confirm that the Top crossings receive a more detailed evaluation as part of Step 2.

3.2 TOP PRIORITY CROSSINGS: STEP 2 RESULTS

In Step 2, the 302 prominent crossings which qualified for further analysis were ranked based on weighted scores as was discussed in Section 2.6. The crossing locations were sorted into three categories for purposes of reporting and summarizing. The categories included the Top 50 locations, the locations ranked from 51 to 100, and the remaining crossing locations between 101 and 302, as shown in Figure 8.

The Top 50 crossings are located throughout the state. They are typically located within an urban area, along a mainline railroad track, and on a major roadway corridor. Table 4 lists the Top 50 crossings in order from highest to lowest score. Any previously identified project that would impact the crossing is also listed in the table. A majority of the locations are within the Puget Sound region, but others are located north in Skagit and Whatcom Counties, south in Lewis County, and east in Yakima and Spokane Counties. It is important to note that if data improves, the relative rankings could change.

Figure 8. Crossings Summarized by Priority Groups

Table 4. List of the Top 50 Crossings from the Step 2 Prioritization Results

RANK	LOCATION	CITY	COUNTY	PLANNED PROJECT?[1]
1	S Lander St	Seattle	King	S Lander Grade Separation
2	W James St	Kent	King	All 3 Kent Projects
3	Broad St	Seattle	King	No
4	3rd St SE	Puyallup	Pierce	No
5	15th St SE	Puyallup	Pierce	Canyon Rd Northerly Extension
6	W Kincaid St (SR 536)	Mount Vernon	Skagit	Kincaid St
7	S Spokane St (EB)	Seattle	King	SoDo Rail Corridor Grade Sep.
8	Willis St (SR 516)	Kent	King	Willis St Grade Separation
9	88th St NE	Marysville	Snohomish	SR 529/I-5 interchange
10	S Holgate St	Seattle	King	SoDo Rail Corridor Grade Sep.
11	S 212th St	Kent	King	S 212th Grade Separation
12	N Pines Rd (SR 27)	Spokane Valley	Spokane	SR 27/SR 290 Underpass (Pines Rd)
13	N Park Road	Spokane Valley	Spokane	No
14	5th St NW	Puyallup	Pierce	Canyon Rd Northerly Extension
15	S Horton St	Seattle	King	SoDo Rail Corridor Grade Sep.
16	West Smith St	Kent	King	All 3 Kent Projects
17	Meridian St	Puyallup	Pierce	Canyon Rd Northerly Extension
18	4th Ave (SR 528)	Marysville	Snohomish	SR 529/I-5 interchange
19	Main St	Chehalis	Lewis	No

1. Notes whether a project is planned at the crossing or in the vicinity of the crossing. The project could either propose grade separation or at-grade safety enhancements or a much larger project that includes these elements. Not every MPO or RTPO responded to the request for information about planned projects, so this information should not be considered complete.

Table Continued on Next Page

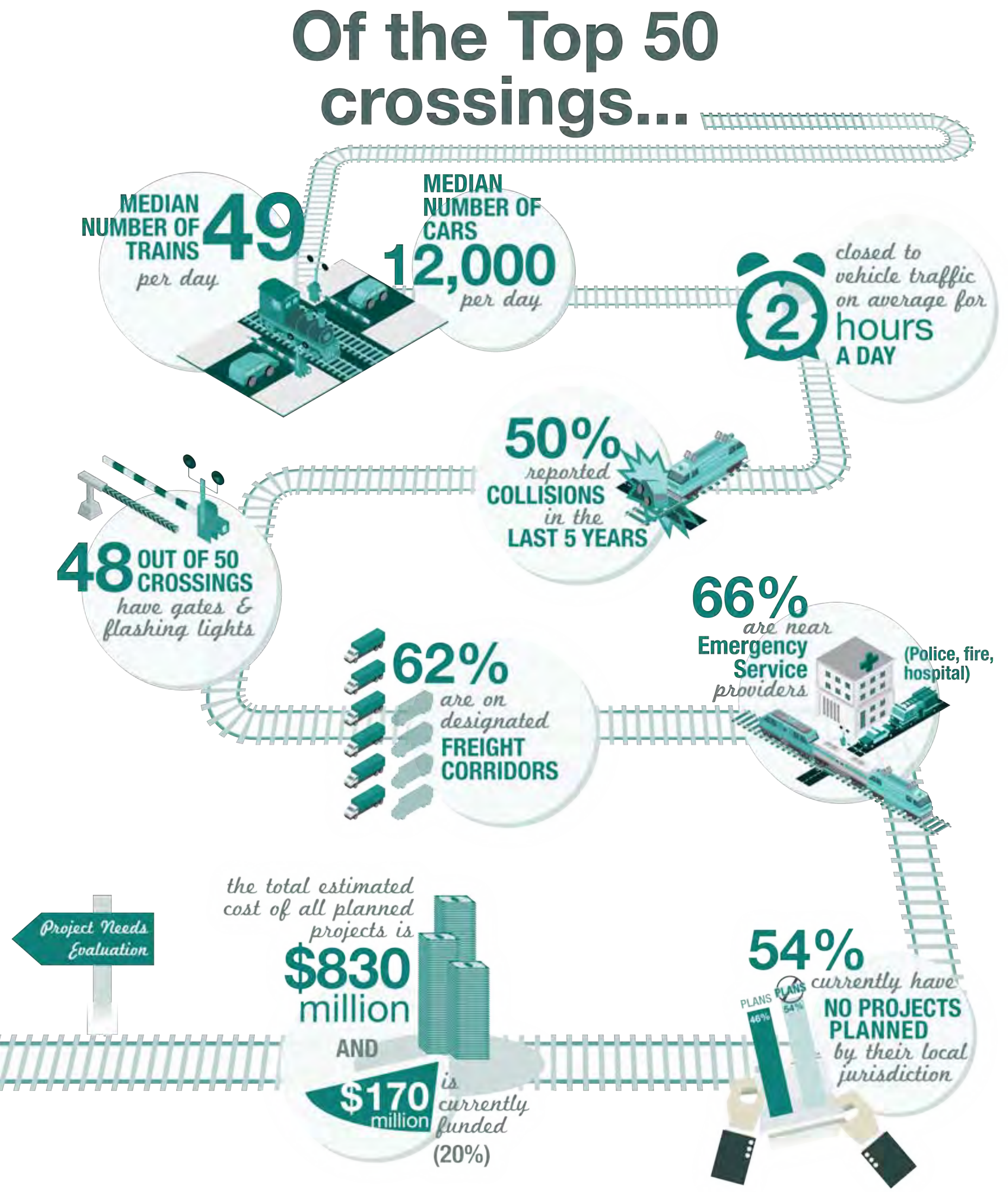
Table 4 (continued). List of the Top 50 Crossings from the Step 2 Prioritization Results

RANK	LOCATION	CITY	COUNTY	PLANNED PROJECT?[1]
20	Yakima Ave	Yakima	Yakima	No
21	Riverside Drive	Mount Vernon	Skagit	No
22	F St / Cheney-Spangle Rd	Cheney	Spokane	No
23	SR 20 - Avon	Burlington	Skagit	No
24	Willis St (SR 516)	Kent	King	Willis St Grade Separation
25	5th St SE	Puyallup	Pierce	Canyon Rd Northerly Extension
26	College Way (SR 538)	Mount Vernon	Skagit	College Way RR Grade Sep.
27	15th St SW	Auburn	King	BNSF Yard Grade Sep.
28	S Spokane St (WB)	Seattle	King	SoDo Rail Corridor Grade Sep.
29	F Street	Bellingham	Whatcom	No
30	Argonne Rd	Millwood	Spokane	No
31	116th St NE	Marysville	Snohomish	No
32	37th St NW	Auburn	King	No
33	Main St (SR 104)	Edmonds	Snohomish	Edmonds Grade Separation
34	E Fairhaven Ave	Burlington	Skagit	No
35	Wall St	Seattle	King	No
36	Barker Rd	Spokane Valley	Spokane	Barker Rd Overpass
37	E Locust St	Centralia	Lewis	No
38	Pines Rd (SR 27)	Spokane Valley	Spokane	No
39	Clay St	Seattle	King	No
40	Union Ave	Steilacoom	Pierce	No
41	Washington Ave	Yakima	Yakima	Washington Ave RR Grade Sep.
42	Park Rd	Spokane Valley	Spokane	No
43	C St SW	Auburn	King	No
44	3rd St NW	Auburn	King	No
45	W Main St	Auburn	King	No
46	Mission Ave	Spokane	Spokane	No
47	C St	Bellingham	Whatcom	Gates and lights
48	Vista Rd	Spokane Valley	Spokane	No
49	Old 99 / E Blackburn Rd	Mount Vernon	Skagit	No
50	Walnut St (SR 505/603)	Winlock	Lewis	No

FINDINGS

To highlight the findings of Step 2, an infographic was prepared to show statistics based on the Top 50 crossings and is shown in Figure 9. The median number of trains and vehicles using these crossings each day are 49 trains and 12,000 vehicles, respectively, leading to substantial on-going conflicts. In addition, the Top 50 crossings are closed to vehicle traffic for an average of two hours per day. Almost two-thirds (62%) of these crossings are on a designated freight corridor and 96% of them (all but 2) have gates and flashing lights, yet there was at least one collision between pedestrians and/or vehicles and trains at or near half the crossings in the

Figure 9. Key Findings from the Step 2 Prioritization Effort



last five years. Almost two-thirds (66%) are in close proximity to emergency providers leading to potential delays for public safety services.

Figure 9 highlights that the Top 50 crossings have substantial road-rail conflicts, but these crossings already have gates and flashing lights. Furthermore, some local agencies have taken the initiative to identify projects to address the mobility needs at crossings. While there are existing state and federal funding programs for safety measures, such as gates and lights, they do not address the mobility issues experienced by freight and non-freight related vehicle traffic at crossings. In other words, there are limited statewide programs to address the broader context of road-rail conflicts, even as more narrowly-focused existing programs have been largely successful.

DISCUSSION OF RELATIONSHIP WITH IDENTIFIED PLANNED PROJECTS

Table 4 shows that 23 of the Top 50 projects, or less than half, have an associated project. The estimated costs of these projects is $830 million, of which only about $170 million is funded.[1] The UTC and WSDOT were members of the Advisory Panel and reported that their crossing safety programs receive more applications than they can fund, pointing to the need for additional investments in grade crossings to improve mobility and further bolster efforts to enhance safety. It is worth noting that not every MPO or RTPO responded to the request for information about planned projects, this information should not be considered complete.

While not all crossings in the Top 50 may need an associated project, some jurisdictions may have not yet identified and prioritized needed crossing improvements. It is likely that when crossing improvements compete with other local funding priorities including funding for preliminary design, they often rank lower than other priorities. This may be due to information found in this crossing database not being compiled or as accessible in the past to local agencies.

However, there are cases where a crossing is a high priority for a community as indicated by a planned project, but does not rank near the Top when compared to crossings across the state. Low ranking crossing locations with projects were generally at crossings with lower train and traffic volumes, and in non-urban areas. Although crossings with proposed projects may not rank high on a statewide basis, site-specific congestion issues or mobility needs due to planned economic development or unique situations may still justify the need for the projects. This

1. Funding includes Connecting WA, FMSIB, federal and local funds as follows: $55 million for SR 529/I-5 in Marysville; $18 million for S 228th in Kent; and $100 million for Lander in Seattle.

highlights that a statewide database such as this is a key tool in identifying the magnitude of crossing needs, but policies around site-specific solutions may also be needed in ranking future projects (not crossings) on a statewide basis.

It is important to highlight that a single project may be listed as a solution for multiple crossings listed in Table 4. This reinforces the idea of using corridors to help identify solutions for road-rail conflicts. Many RTPOs have already identified planning solutions at the corridor level, based on the needs of individual crossings.

3.3 CORRIDOR-BASED EVALUATION

One of the study objectives was to consider a “corridor-based prioritization process” as part of the analysis. When evaluating corridors (a group of crossings), information about each individual crossing within a corridor would be critical to understanding impacts to the corridor and potential solutions to improve network traffic flow within the corridor. Therefore, the database of individual at-grade crossings is a key foundation for any type of corridor-based evaluation.

To consider how a possible corridor-based evaluation process could work, the crossings were summarized by three geographical groupings: major rail corridors, rail corridors by RTPO boundaries, and smaller distinct rail corridors (by cities) where transportation projects were already identified.

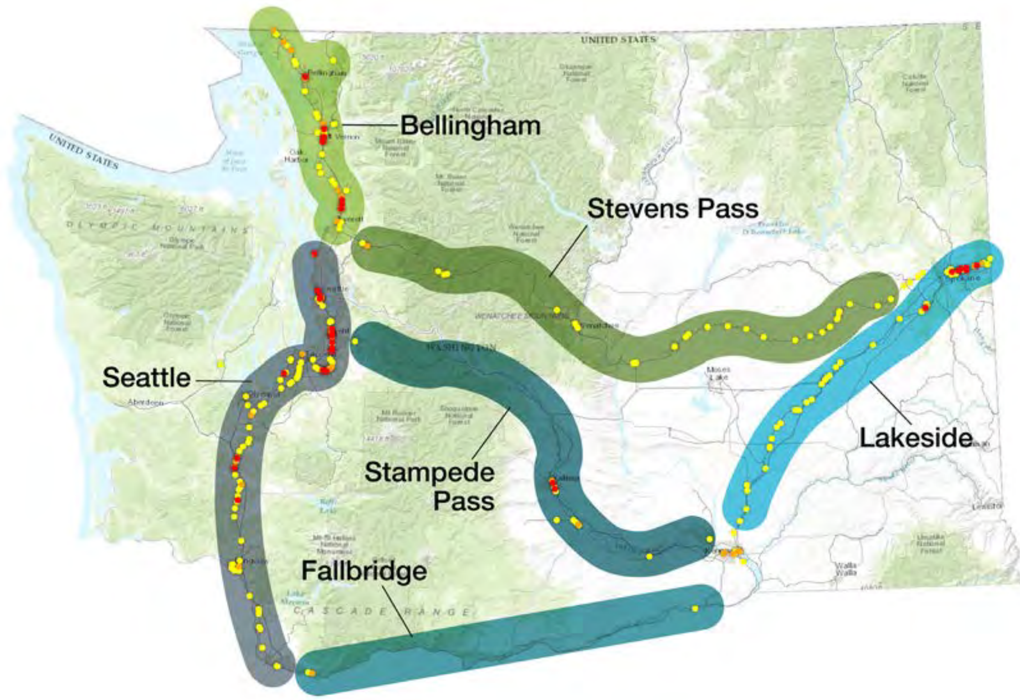
Given that 70% of the 302 prominent crossings are inside city limits, and conversely only 30% are outside city limits, a corridor-based approach might seek to address non-urban crossings separately from those within city limits. Another interpretation of the corridor approach could involve ranking crossings within a designated corridor as an alternative to the statewide ranking. This would mean that places with relatively low traffic (road or rail) would rank higher in their own region.

CROSSINGS BY RAIL CORRIDOR

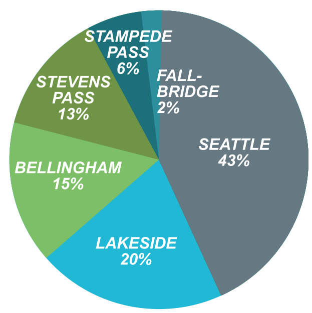
Crossings were summarized by six major Washington State rail corridors. These are the same six corridors used in the Marine Cargo Forecast. Figure 10 shows the location and name of each of the corridors.

The Bellingham and Seattle corridors are north-south corridors within western Washington generally following the I-5 corridor. The Lakeside corridor in eastern Washington connects Spokane to the Tri-Cities area. The other three corridors are east-west corridors connecting between western and eastern Washington. Stevens

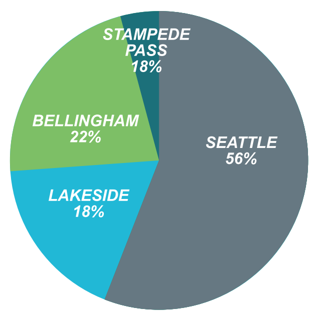
Figure 10. Crossings by Rail Corridors



PERCENT OF THE TOP 302 CROSSINGS WITHIN EACH CORRIDOR



PERCENT OF THE TOP 50 CROSSINGS WITHIN EACH CORRIDOR



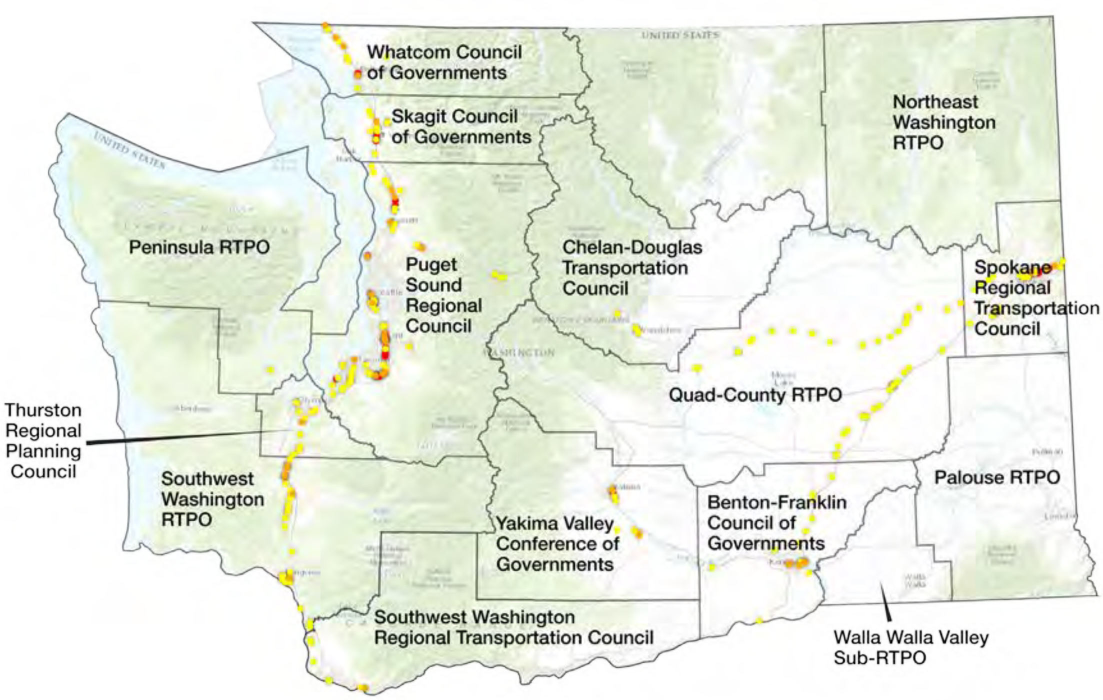
Pass and Stampede Pass corridors cross the Cascade mountains, and the Fallbridge corridor runs parallel to the Columbia River.

The Top 50 crossings were only located along four of the six major rail corridors. A majority of the Top 50 crossings were located along the Seattle corridor, but Bellingham, Stampede Pass, and Lakeside corridors also had crossings in the Top 50.

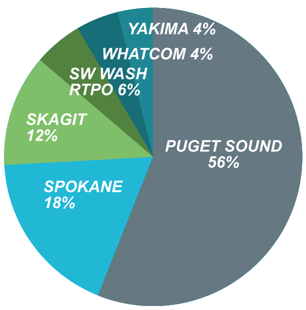
CROSSINGS BY RTPO CORRIDORS

The RTPO corridors reflect all the rail lines and crossings within each respective RTPO boundary. Figure 11 shows the location and name of each of the corridors. The Puget Sound, Spokane, and Skagit reflect half of the Top 302 crossings, and 86% of Top 50 crossings. Interestingly, Quad-County has the second highest number of Top 302 crossings, but none of them made it into the Top 50 crossings due to lower traffic volumes, each crossing being isolated and not impacting adjoining roadways, and low population and employment densities.

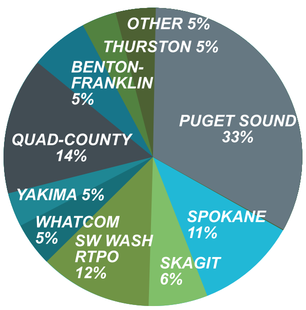
Figure 11. Crossings by RTPO Corridors



PERCENT OF THE TOP 50 CROSSINGS WITHIN EACH CORRIDOR



PERCENT OF THE TOP 302 CROSSINGS WITHIN EACH CORRIDOR



USING SMALLER CORRIDORS TO GROUP PROJECTS

Projects have already been identified to address impacts at many of the Top 50 crossings, and address many crossings within a corridor group. For example, a project may be located at one crossing but still can address impacts at many crossings in a corridor. Table 5 lists the nine corridor groups (by city) that have projects planned that would address some or all crossings within that group. The smaller rail corridor groups allow for potential community needs and solutions to be evaluated more closely to understand whether a solution will address a single crossing or multiple crossings. In addition, scaling corridors to specific communities could assist in focusing on the types of projects envisioned, such as either a grade separation project, or multiple network improvements. Smaller corridors could also be more sensitive to surrounding development patterns that may further justify the need for crossing improvements.

CORRIDOR-BASED EVALUATION FINDINGS

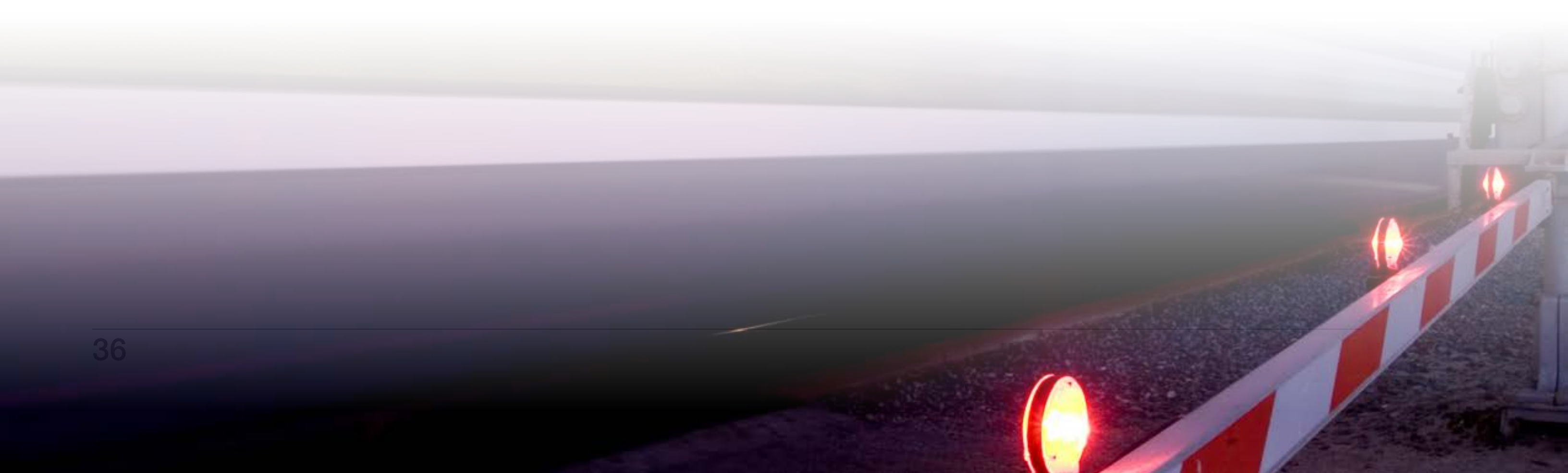
Corridor evaluation and prioritization is most useful when defining and ranking solutions which address crossing impacts, rather than identifying crossing issues. The objective of this study, the ranking of high-impact crossings, is less suited to a corridor approach. This conclusion is based on consideration of a variety of corridors, such as crossings along a rail corridor or within RTPO boundaries. A finer geographic focus on the transportation system is necessary to maximize the benefits of a corridor approach to the community's transportation system (rather than the rail system).

Table 5. Small Corridor Groups Within Top 50 That Have a Project Identified

CITY CORRIDOR GROUP	NUMBER OF TOP 50 CROSSINGS IN CORRIDOR	PROJECTS ALREADY IDENTIFIED IN CORRIDOR
Mount Vernon	4 crossings	Kincaid Street; College Way Grade Separation
Marysville	3 crossings	SR 529 / Interstate 5 Interchange
Edmonds	1 crossing	Edmonds Grade Separation
Seattle	8 crossings	Lander Grade Separation; Other SODO crossing improvements
Kent	5 crossings	3 projects (Willis St Grade Separation; S 212th Grade Separation; other)
Auburn	5 crossings	BNSF Yard grade separation
Puyallup	5 crossings	Canyon Road north extension
Yakima	2 crossings	Washington Avenue Grade Separation
Spokane Valley	6 crossings	SR 27 / SR 290 grade separation; Barker Road grade separation.
Other (Multiple Corridors)	11 crossings	No projects identified in these other corridors

In addition, corridor-based prioritization requires more specific context about potential community needs and solutions, such as type of crossing improvement or surrounding development patterns.

A corridor-based strategy could help evaluate solutions at a single crossing that would address multiple crossings, or evaluate a suite of solutions at multiple crossings to help traffic move through a larger corridor. In other situations, a project could result in closing one major crossing, thereby alleviating the need to address multiple, adjacent crossings within the same corridor. Corridor evaluation could be useful in identifying or evaluating specific project proposals and addressing regional or rural needs. The database and prioritization tool would still serve as a key input into a corridor-based project prioritization, but the corridors will need to be determined by users of the database with guidance from policy makers.



4 DATA AND TOOL OVERVIEW

The database development focused on locations rather than projects. The assembled data described location-specific characteristics for the 2,180 public, active, at-grade crossings in the state, such as traffic volumes, collision history, and train counts, rather than project-specific conditions, such as type of improvement, feasibility, and cost. A project prioritization effort, in contrast, would include more contextual information for each location and would be guided by specific objectives developed by the funding entity. The database can be used as a starting point for state, regional, and local jurisdictions to understand the magnitude of needs, and how a specific crossing would compare against other locations on a statewide or regional basis. The prioritization tool can also be used to assist in future planning efforts and serve as an indicator of the need for more detailed analysis of individual crossings.

A detailed description of the prioritization tool, its development, and the data is included in Appendix A.

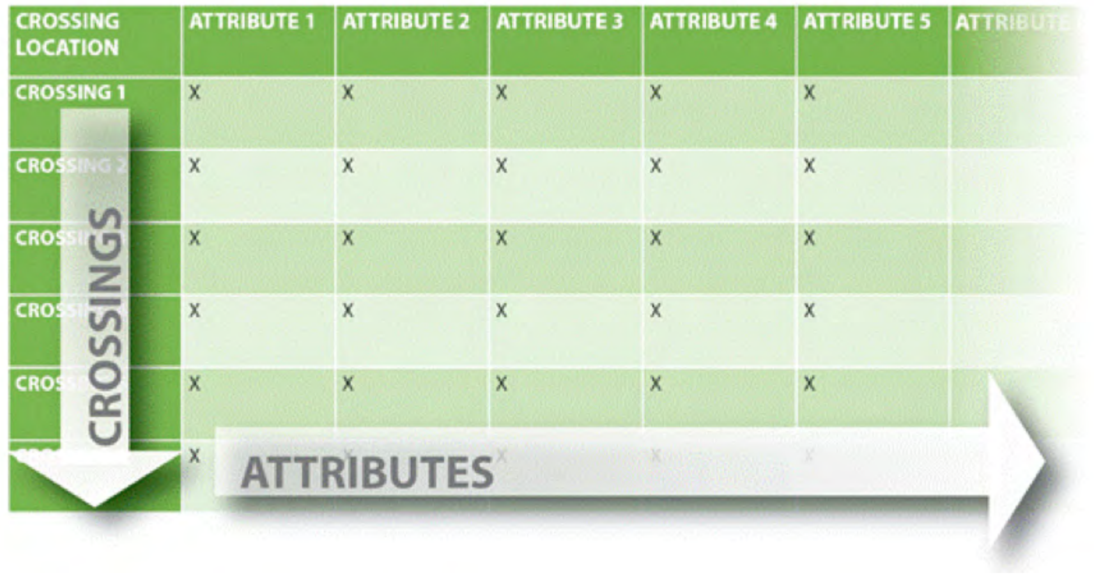
4.1 DATABASE DEVELOPMENT

In order to evaluate and prioritize at-grade crossings, a database was created that assembled common data and criteria for all crossings in the state. In the context of the study, a database is a structured set of data maintained in Microsoft Excel and ESRI GIS formats. See Figure 12 for a visual representation of the database structure.

The database is organized by columns that contain attributes/ criteria and rows that contain each at-grade crossing location.

The database only included data for crossings that are publicly accessible, at-grade, and located on active rail lines. Over- and under-crossings were considered to be functioning well and were not evaluated as part of the study. The database included both general attributes and evaluation criteria for each crossing that were assembled from a number of different

Figure 12. Example Database Structure



sources. There are 2,180 rows representing each at-grade crossing, 87 columns containing attributes, and 103 columns containing criteria.

A major objective of the database development was to design it to be flexible for future enhancements given uncertainty about how the prioritization tool might be used after study completion. The database has the flexibility to:

- Include new or updated data,
- Reflect different weighting schemes based on priorities,
- Include different screening methodologies, i.e. Step 1 could be modified to screen out all lower train count crossings rather than using a threshold methodology used in this study

Although the tool provides flexibility for modifications and/or enhancements in the future, it is important for standards to be implemented and maintained to ensure that the tool remains useful at the statewide level (see Chapter 5 for a discussion of a multi-stakeholder committee). Coordinated decisions will be needed on questions related to incorporating new or updated data, changing the weighting schemes, and/or modifying the prioritization methodology.

4.2 DATA ASSEMBLY AND SOURCES

The database was created by assembling readily available data from a variety of sources, including the UTC, WSDOT, the FRA, and the DOE. Table 6 summarizes the data that was assembled or developed for evaluating at-grade crossings in the state.

The database was designed to be flexible for future modifications after completion of the study. It has the flexibility to include new or updated data, different weighting schemes, and/or different screening methodologies.

DATA FROM UTC

UTC operates a Rail Safety Program that focuses on reducing deaths, injuries, and property damage on or around railroads. As part of this program, UTC maintains and regularly updates an official inventory of all private and public railroad crossings in the state. It includes a variety of data including general locational information, crossing infrastructure, and operational conditions. This inventory was used as the beginning organizational structure for the database. UTC also maintains historical incident data and produces reports that analyze rail safety.

DATA FROM WSDOT

WSDOT develops and maintains the State Rail Plan that serves as a strategic blueprint for future public investment in the state's rail transportation system. The Plan includes data on train counts for passenger and freight rail. Train count data was included in the prioritization tool for all mainlines for the existing and future years. The train count data included in the State Rail Plan is estimated using Freight Analysis Framework data and provides an order of magnitude estimate of train projections. WSDOT also provides a variety of transportation and environmental data for public download that was used in this study. This includes information on roadway and freight classification and important freight economic corridors.

DATA FROM FRA

The FRA is part of the USDOT and oversees freight and passenger rail. The FRA maintains information on the rail network, crossings and rail safety. Railroad classification data was assembled from FRA and used in the prioritization tool.

Table 6. Summary of Data Sources

DATA SOURCE	TYPE OF DATA	EVALUATION CRITERIA
UTC	Vehicle Volume Data	Existing Vehicle Volumes
	Crossing Characteristics	Number of Mainline Tracks
		Level of Protection
		Quiet Zone
	Collision Data	Incident History
WSDOT	Train Count Data	Existing Freight Train Counts
		Future Freight Train Counts
		Existing Unit Train Presence and Count
		Existing Passenger Train Counts
		Future Passenger Train Counts
	Roadway Characteristics	Roadway Functional Classification
		Roadway Freight Classification
		Freight Economic Corridors
FRA	Railroad Characteristics	Railroad Classification
DOE	Train Count Data	Existing Unit Train Presence and Count
OTHERS		
MPO/RTPO Plans	Project Information	Previously Identified Project
EPA	Demographic Information	Employment Density
		Population Density
US Census Bureau	Demographic Information	Proximity to Minority Populations
		Proximity to Low Income Populations
DOH, Google Maps	Community Characteristics	Proximity to Emergency Services
Parametrix	Crossing Characteristics	At-Grade Crossing Density
		Presence of Alternate Grade Separated Crossing
	Community Characteristics	Network Sensitivity
	Rail Impacts	Gate-Down Time
Transpo Group	Environmental Data	Daily Emissions

DATA FROM DEPARTMENT OF ECOLOGY (DOE)

The Washington DOE produced a report in 2014 called the Marine and Rail Oil Transportation Study that included information on the movement of oil trains in the state. This information was used in the prioritization tool to inform the movement of unit trains.

OTHER DATA SOURCES

Data from other sources was also assembled and organized in the database by crossing. This included data from the MPOs and RTPOs, the US Census Bureau, the Environmental Protection Agency (EPA), and the Washington State Department of

Health (DOH). A number of criteria were also created during this study using data from existing sources.

PACIFIC NORTHWEST MARINE CARGO FORECAST AND RAIL CAPACITY ASSESSMENT

The Pacific Northwest Marine Cargo Forecast and Rail Capacity Assessment (Marine Cargo Forecast) is updated every five years. The existing version of this report was released in December 2011 and is currently being updated. The Marine Cargo Forecast includes information on train volume projections and activity in the state based on domestic and international economic factors. Once released, this data can be used to confirm train volumes and gate-down time information contained in the database. Because the updated data in the Marine Cargo Forecast was not available during development of the database, data from WSDOT's Rail Plan became the primary source to estimate future train activity.

4.3 DATA QUALITY AND LIMITATIONS

This is the first tool in Washington State, and perhaps the nation, that assembles this breadth of data related to at-grade crossing impacts into one database. There are some inherent consistency challenges that arise when assembling data from multiple sources. Challenges were addressed to the extent possible within the resources available to the study as described below. As the prioritization tool is used in the future, data will need to be maintained and updated to remain relevant and useful.

DATA CHALLENGES AND SOLUTIONS

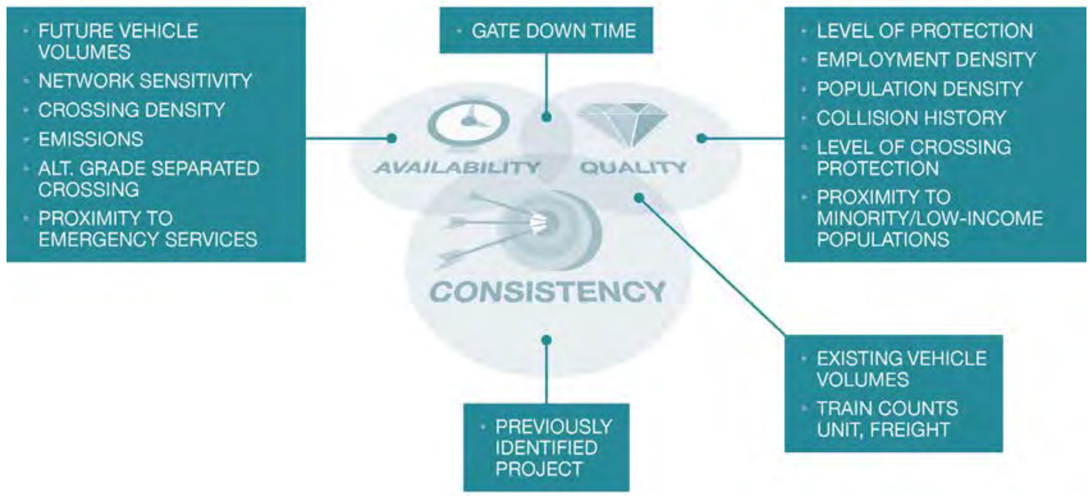
Several data challenges were identified and addressed during the database development process. Data challenges fell into three main categories:

- Quality: data is incorrect and inaccurate
- Consistency: data is not available for all crossings and/or from the same source
- Availability: data does not exist

Figure 13 summarizes the data challenges associated with each of the evaluation criteria.

Data challenges were resolved in several ways depending on the type of issue. In most cases, data was either created or modified, or included as is since it was the best existing information.

Figure 13. Data Challenges Associated with the Evaluation Criteria



For availability concerns, it was possible to estimate some data using recognized industry methodologies; it was also possible to create some data that was otherwise unavailable, using GIS functions and other readily available information (e.g. crossing density was created using GIS to calculate how many nearby at-grade crossings were on the same rail line within a half mile).

Quality concerns were addressed by reviewing the specific quality issue and either removing or replacing that data. In some cases, the quality concerns were minor and the data was included in the database.

Consistency concerns were addressed by manually updating the data for some crossings with secondary information. The level of effort required to address data challenges was also considered. At times, the processing required to improve or replace the data would be substantial, making it unfeasible to include the data as part of this study (i.e. a criteria measuring sight distance concerns was not included because existing data would require a large amount of processing in order to provide this information).

The purpose of the tool was to allow state, regional, and local agencies to understand the overall magnitude of impacts at at-grade rail crossings on a statewide basis. Consistency of the level of detail and quality of the data across all crossing locations is critical for understanding how crossings compare across the state. It is likely that as the database is introduced to and used by agencies across the state, higher quality data will be developed and incorporated into the database. Users of the tool will have an interest in providing better data and a process to allow data to be updated efficiently could be designed.

As more refined data is incorporated into the tool, it is likely that the rankings of crossings will change. For example, crew changes in Wenatchee currently close multiple at-grade crossings simultaneously for one to four hours per day. The methodology for calculating gate-down time does not capture this and there is no existing data on exactly how long crossings are closed for crew change activity, so the measure of gate-down time for Wenatchee crossings may be lower than what actually occurs. This impact is likely captured by the Network Sensitivity criteria but if improved gate-down time data were provided, these Wenatchee crossings would likely rise in the statewide ranking list. Solutions to data challenges that could be implemented in the future are described in Section 4.6.

DATA VERIFICATION STEPS:

Data Availability: *data for the analysis was identified and collected as available through online sources, the Advisory Panel, and the Staff Workgroup.*

Identify Data Challenges: *Data for crossings was reviewed for quality and consistency using secondary data sources where possible.*

Group Review: *Crossing data was reviewed by the project team to identify any data challenges.*

DATABASE LIMITATIONS

There are some limitations in the type of analysis that the database created in this study can produce. The database is a good tool for understanding current impacts and measuring the prominence of impacts at at-grade crossings. Inherent to any data-driven analysis are the difficulties of forecasting based on past behavior and the availability of detailed data for a large data set.

The database includes information to attempt to account for future impacts, such as projected vehicle volumes and train counts. The future projections of the number of vehicles and trains requires a significant amount of analysis in order to produce detailed projections for each crossing, which was beyond the scope of this study. However, the vehicle volumes and train count projections can provide an indication of future changes, but were not a major influence in the prioritization methodology since it was impossible to produce detailed projections for each crossing.

Other measures of future changes that could impact conditions at at-grade crossings include nearby land use and zoning decisions, changes in the economy, and the possibility for development, among other things. This information was not available for inclusion in the database on a statewide basis, but could be included in future database enhancements. Alternatively, these factors could be analyzed on an individual crossing basis during more detailed studies.

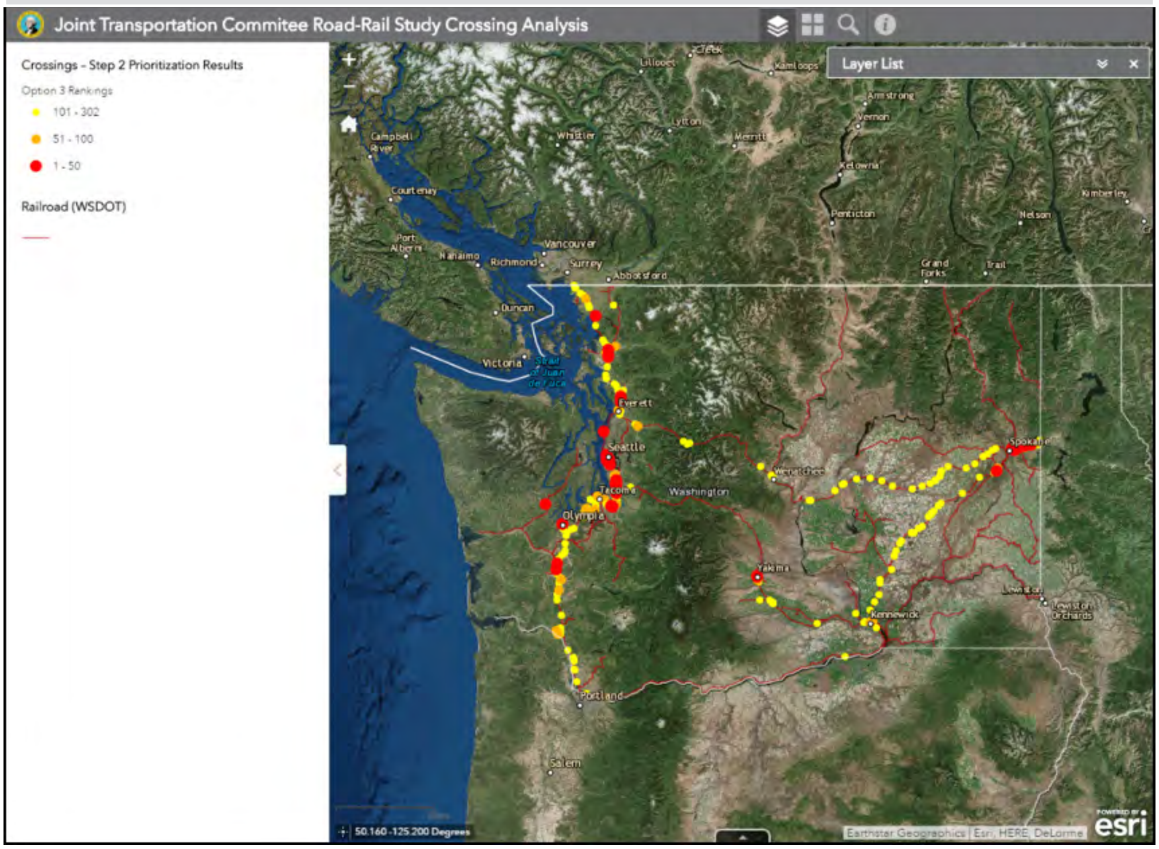
The safety data was high-level and was incorporated to assist in the rankings of crossings. The data that was available on a statewide basis was only detailed enough to provide an indicator of potential problems. The analysis produced by the database should be used as an indication of problems and not as a detailed assessment of safety concerns.

Finally, a strictly data-driven analysis is not sufficient to find the best solution for each road-rail conflict or to narrow investment opportunities due to constrained funding sources. More in-depth analysis will likely be required than is possible by running a database query.

4.4 ONLINE TOOL

An online tool was developed as part of this study to allow agencies and the public to review and analyze the database in a user-friendly format. The online tool is an interactive mapping platform that connects to the database using ESRI GIS software. Figure 14 is a screen capture showing the Online Tool interface.

Figure 14. Online Tool Interface



The online tool allows users to view the data associated with each crossing. Users are able to turn data layers on and off, search for crossings based on city or crossing ID, and select a crossing location and review the data associated with that location. The online tool is useful for quickly locating and digesting information associated with crossings that are of interest to the user. It is also useful for understanding patterns across the state.

The online tool is the best way to understand the data due to the amount of data that is included in the database. This is the first online mapping tool for at-grade crossings on a statewide basis. Due to its usefulness and effectiveness in communicating the information, the tool is likely just as important as the data behind it.

4.5 USING THE PRIORITIZATION TOOL

The tool is the only unified, statewide resource for information about crossings and is designed to be used by state, regional, and local jurisdictions in a variety of ways. Some examples of how the tool could be used include the following:

- Describe the importance of a crossing (or a series of crossings) on state or federal grant applications
- Assist in future planning efforts for local and regional jurisdictions
- Provide a starting point for identifying locations to develop specific project proposals

As mentioned in Section 4.3, some of the data is not fine-grained enough to serve as the only analysis for identifying crossings of concern for potential funding. The safety data included in the tool is high-level. Evaluation of safety impacts requires more information than a database can provide, such as site visits, predictive analysis, and review of specific causes of collisions.

The safety criteria in the database can indicate the presence of potential safety concerns, allowing the tool to be used as a supplement to the more robust and detailed safety evaluations conducted through UTC's and FHWA's programs. Many mobility problems also have implications for safety, such as gate down times that stop emergency response vehicles moving across town or cause frustrated drivers to take risks to beat safety gates at crossings. The database can be used to identify potential problematic crossings, which can then be further evaluated through other existing processes and programs.

Similarly, the criteria included for mobility and community are not intended to provide a prescriptive analysis of potential issues at a crossing. Like the safety criteria, the community and mobility data are indicators of potential impacts. The prioritization tool should be used to inform more detailed study of individual crossings that are problematic.

4.6 FUTURE DATA AND TOOL ENHANCEMENTS

There are several enhancements that could be made to the database and the online tool after completion of this study. The level of effort and time needed to accomplish both the data and online tool enhancements would vary. There may also be other database or tool functionality improvements that could arise once agencies begin using them. Future improvements of the database and tool could improve its usefulness as a means for identifying problematic at-grade crossings in Washington State. It is important to note that data enhancements may also change how crossings rank against each other.

DATA ENHANCEMENTS

As described earlier, some data enhancement opportunities were identified during the study. Future enhancements of the database could improve or resolve these concerns:

- New data could be created to replace data that had consistency, availability, or quality concerns, such as existing vehicle volumes and gate-down time.
- Data that was not readily or publicly available could be assembled, such as near-miss data and regional growth projections.
- Data included in the database could be updated more regularly during future iterations of the tool.

If this tool is used as an input into a project prioritization process, it will be important to ensure that data is up to-date and accurate so that the prioritization results could be updated.

A number of the criteria currently have good accuracy and would not require extensive enhancements, including railroad classification, passenger train counts, roadway functional classification, proximity to emergency services, roadway freight classification, and first/last mile roadway crossing. Actual data collection at the at-grade crossing location could improve accuracy for existing vehicle volumes, existing freight and unit train counts, and daily gate-down time. Verification of data on a crossing by crossing basis would improve a number of other criteria. The data verification could be completed for presence of alternate grade separated crossings, number of mainline tracks, level of crossing protection, major roadway intersection density, at-grade crossing density, and quiet zones. Other data enhancements for existing criteria could include more detailed modeling or estimation of data. Additional

Table 7. Data Additions or Enhancements for Consideration

DATA	CATEGORY	DESCRIPTION	REASON NOT CURRENTLY INCLUDED/SUGGESTED IMPROVEMENT
Near Miss Data	Safety	Data that documents when incidents/collision almost occurred between trains and vehicles/non-motorized users.	Available from only one rail company source (BNSF)
Collisions within 250 feet	Safety	Data that documents collisions within a certain distance of an at-grade crossing; could be used to indicate collisions due to congestion/queuing related to train crossing events.	Requires assembly from multiple sources and processing to evaluate collisions
Transit Volumes/ Presence	Mobility	Data that indicates the presence and magnitude of transit service near an at-grade crossing	Requires assembly from multiple sources
Non-motorized Volumes/ Presence	Mobility	Data that indicates the presence and magnitude of non-motorized activity near an at-grade crossing	Requires assembly from multiple sources and/or is not consistently available
Regional Growth Projections	Community	Data that documents potential development and/or land use nearby an at-grade crossing	Requires assembly from multiple sources and/or is not consistently available
Future Vehicle Volumes	Mobility	Data that documents future increases in traffic volumes	Requires assembly from regional travel demand models; may not be consistently available
Gate-Down Time	Mobility	Data that documents actual gate-down time, including train building and other activities	Requires actual data collection of gate-down times, or inclusion of model results from Marine Cargo Forecast
School Bus/ Walking Routes	Safety	Data that indicates whether a school bus or walking route is designated across an at-grade crossing	Requires assembly from multiple sources and/or may not be consistently available
Crossing Geometrics/ Sight Distance	Safety	Data that indicates if there are sight distance issues at a crossing	Requires some processing of existing data and/or may not be consistently available
Vehicle Queuing	Mobility	Data that measures queuing due to train crossing events	Requires actual data collection and analysis
Proximity to Sensitive Receptors	Community	Data that indicates proximity to sensitive receptors, such as hospitals, schools, etc	Requires assembly from multiple sources and/or may not be consistently available
Designated Routes	Community	Data identifying crossings that are located on designated response or evacuation routes, such as emergency response routes, oil spill response routes, and/or evacuation routes (lahar, tsunami)	Partial data available and/or requires assembly from multiple sources
Accident Predictive Modeling	Safety	Data that identifies estimated number of collisions to occur at the at-grade crossing	Requires substantial processing and expertise with modeling tools

analysis would benefit future vehicle volumes, future freight and unit train counts, gate-down time, and daily emissions.

Table 7 summarizes the data that could be included in the database in the future. This includes information that could be created, such as vehicle queuing, as well as existing data that could be incorporated from other sources, such as near miss data and/or data from the Marine Cargo Forecast. Future data additions or incorporations could be guided by existing or new funding programs that focus on certain criteria. Alternatively, some criteria could become unnecessary to collect or maintain depending on how the prioritization tool is used in the future.

For the tool to remain useful, the data should be updated and maintained over time. Depending on the nature of what is being measured in each criteria, the timing for when data should be updated or replaced varies. Much of the data will not change drastically between update cycles and could be replaced only as changes happen. For example, railroad classification does not change frequently and could be updated only when there is a known update to a classification. Also, updates to the overall list of at-grade crossings could be modified when projects are completed or changes occur, as this would not be expected to occur often.

Vehicle volumes change more frequently depending on local factors such as development, population or employment growth, and the economy. More regular updates to this information would ensure the tool remains useful. As mentioned in Section 4.2.6, the Marine Cargo Forecast is updated every five years. Data updates to the prioritization tool could be aligned with the update cycle of the Marine Cargo Forecast. The following criteria would benefit from a five-year update cycle. The remaining criteria listed below would not be expected to change frequently.

- Existing Vehicle Volumes (AADT)
- Future Vehicle Volumes (AADT)
- Gate-down Time
- Collision History
- Daily Emissions
- Existing Freight Train Volumes (daily average)
- Level of Crossing Protection
- Future Freight Train Volumes (daily average)
- Existing Unit Train Presence and Count
- Existing Passenger Train Volumes
- Future Passenger Train Volumes
- Previously Identified Project

There are varying degrees of processing and expertise required to maintain the criteria. Although all of the criteria requires review before inclusion into the database, some of the criteria require calculations in order to update. The majority of the criteria can be incorporated with minimal processing. Criteria that require calculations include future vehicle volumes, average daily gate-down time, and daily emissions. Other criteria will require some GIS processing before they can be updated, including employment density, population density, proximity to low-income populations, and proximity to minority populations.

ONLINE TOOL ENHANCEMENTS

The purpose of the online tool is to communicate what the data means in a way that is accessible to all users and to allow users to visualize the geography of crossing impacts. Improvements to the tool should focus on allowing people to easily interpret the data and share results. Other enhancements could improve functionality. As described in Section 4.4, the amount of data in the database can make it difficult to interpret. The online tool allows users to efficiently understand the data on either the local, regional, or state level, making the tool as important to maintain as the data behind it. Improved functionality of the tool will likely influence the usefulness of the prioritization process to agencies.

The tool could be improved to allow users to:

- Symbolize and create additional maps based on the user's preference. This would allow the user to more easily understand different patterns associated with the data.
- Select and compare individual crossings so that users could review a select grouping of crossings of interest.

A major theme that was voiced throughout the study was that agencies and users of the tool should be able to understand groupings of crossings and how they relate to each other, which could be improved through future modifications, such as allowing the tool to query a grouping of crossings. There may also be improvements currently unavailable that become possible to incorporate through technology advancements.

5 TOOL SUSTAINABILITY

With the database and online tool developed, there are several possibilities and questions related to next steps. This chapter outlines key questions and considerations related to tool sustainability.

5.1 DISCUSSION

To remain useful in the future, the tool will need to be maintained and updated as new or improved data is available and crossing projects are completed. The term sustainability is used in this section to describe the ownership, maintenance, and updating of the tool itself (both the database and the online mapping components). This has staffing and other resource implications.

In addition to simply keeping the tool up and running, questions remain as to how the tool might assist with existing and future funding programs, how to ensure data consistency and ability to benchmark crossings, and others related to tool use and application. One of the benefits of the tool for federal, state, and local decision makers is the ability to have a statewide view of rail crossings. To ensure that this benefit continues and to provide a decision-making body for questions related to data updates or new data, a multi-stakeholder committee with similar membership to the Advisory Panel for this study (e.g. WSAC, AWC, FMSIB, WSDOT, RTPO/MPOs) should be created. This committee could help ensure continued data integrity and facilitate tool sustainability by providing a decision-making body for data or evaluation questions and stewardship over the data. This committee could also work to address many of the questions raised by this study.

5.2 TOOL MAINTENANCE AND UPDATING

There are two likely scenarios related to the ownership and ongoing maintenance of the tool depending on whether or not funding is available.

Scenario 1: No Funding

If no additional funds are secured, the tool produced for this study will become a one-time exercise with no future updates of the statewide data. A copy of the original Excel workbook produced for this study would be housed at the Association of Washington Cities and the JTC as the study sponsor and study lead respectively, who could make it available to anyone who requests it. The online mapping function could be taken over by AWC if they can maintain it within existing resources. An alternative is that an agency like WSDOT or PSRC might step forward and take on tool maintenance and online mapping support using existing resources or contingent on securing funding to cover it.

Scenario 2: With Funding

If funds are secured to maintain and update the data and online mapping functions, then questions need to be answered around which organization is best suited to own and maintain the tool and coordinate the multi-stakeholder committee.

With both Scenario 1 and 2, the tool could still be used by various local and regional transportation organizations to help with planning and preparation of various funding applications as the information will remain current enough for the next three to five years.

OWNERSHIP RESPONSIBILITIES

If Scenario 2 is realized, an organization must be identified and agree to take on the ownership and maintenance of the tool. In thinking about candidate organizations and how much funding would be needed to realize Scenario 2, several considerations were identified.

Given the data sources (outlined in Chapter 4), it is assumed that updates would need to occur on five-year intervals depending on the source, but could occur more frequently, if necessary. Major tool-related tasks are likely to include:

- Ongoing maintenance, including troubleshooting issues with the online mapping platform, quarterly data back-ups, and periodic software and data updates.
- Updates as new data is released, including completed crossing projects.
- Incorporating new or modified data sources (see Section 4.6).
- Coordinating multi-stakeholder committee (does not have to be the same person, but ideally is at the same organization).

Infrastructure Costs

- Annual license for ArcGIS Online ($2,500 - $17,500 depending on number of users)
- Data storage/hosting
- Future enhancements outlined in Section 4.6

Staffing

This is not a full time position and could be absorbed by an existing staff person or team. The staff member(s) responsible for the tool would need strong capabilities in Excel and ArcGIS. Familiarity with the data and its limitations are also needed to enable a review for any anomalies before the tool is updated with new information. This staff member or team would also need to be available to instruct others on the use of the tool and the data fields. This could include organized trainings or responding to phone calls and emails.

CANDIDATE ORGANIZATIONS

Throughout the course of the study several participant organizations, including WSDOT and AWC communicated a willingness to house the tool, provided adequate resources to pay for staffing and infrastructure costs were appropriated.

5.3 GOVERNANCE AND POLICY GUIDANCE

The Advisory Committee noted that a statewide perspective is critical to ensure alignment with other goals and funding programs. Whether governance beyond the multi-stakeholder committee is needed and what form it takes depend on whether statewide funding for crossing improvement projects are enhanced or a new funding source is established. However, it is clear that specific policy objectives to guide crossing investments on a statewide basis will be needed.

There is no existing program specifically focused on mobility at rail crossings, but there are significant needs in large and small communities. Some projects are funded through existing programs at UTC, WSDOT, and FMSIB, but additional investments are critical. To the extent that a statewide ranking based on high magnitude impacts does not address geographic or other needs, the policy or geographic objectives guiding the prioritization process will need to be clarified by the Legislature or the governing board.

GOVERNANCE SCENARIOS

In the event that a program is established to fund crossing improvements, and a governing or review board is determined necessary, the policy objectives should help determine potential candidate organizations based on mission alignment and grant review and award experience. Three scenarios were discussed with the Advisory Panel, all of which assume a program is established and funded with clear objectives and parameters.

Scenario 1: Decision-making by New Board or Committee

- This could be an ad hoc or new board depending on program purpose and objectives.
- The Board would develop grant funding criteria based on the enabling legislation and a scoring system and then review and score applications. Recommendations would be approved by the Legislature or the Board itself depending on program structure and/or authorization.
- Experience reviewing and administering grants is recommended.
- Mission alignment between the Board and the program purpose and policy objectives would be important if the Board is to be seen as fair and objective, especially as funding is involved.

Scenario 2: Incorporated into Existing Agency or Program

- Grant funding criteria and scoring are developed. This could come from legislative direction and/or public comment and/or significant stakeholder involvement.
- Applications are reviewed and scored by an existing granting agency (e.g. WSDOT Local Programs, FMSIB or TIB) and funding recommendations go to the Legislature.

Scenario 3: Funds are Allocated to Regional Transportation Planning Organizations

- Available funding would be allocated to RTPOs (presumably using a population based allocation).
- RTPOs would decide which crossing projects to fund and coordinate among themselves to identify corridors with more than one project due to overlapping boundaries.
- The final project list could be submitted to the Legislature for final appropriation or the funds could simply be distributed to the regions.

WHAT ARE THE IMPLICATIONS?

The price tag for currently identified grade separation projects exceed state or federal funding program available at this time. If this problem is to be addressed, a statewide prioritization process should consider how to partner effectively with existing regional prioritization efforts.

This study has pointed to a significant shortfall to implement crossing solutions and raised the question of whether a new statewide prioritization process needs to be accompanied by new funding or whether the database will become a tool for use by applicants and funders of related funding programs and for planning purposes.

6 FINDINGS AND RECOMMENDATIONS

The study effort is one of the first in the nation to systematically evaluate potential road-rail conflicts at at-grade crossings on a statewide basis, and attempt to prioritize the magnitude of needs. Such an effort is of critical importance as vehicle and train volumes continue to grow, increasing the potential for road-rail conflicts in the future.

During the course of the study several findings emerged related to the need for additional crossing investments, the usefulness of the tool, how safety needs should be addressed, and what may need to be improved. Recommendations related to several findings are also discussed.

1 The road-rail conflicts at the Top 50 at-grade crossings are substantial and there are few funding sources to address them

Today the Top 50 crossings are closed to vehicle traffic for an estimated average of two hours per day, which will only increase in the future as train volumes increase. The median number of trains and vehicles using these crossings each day are 49 trains and 12,000 vehicles, respectively, leading to substantial on-going conflicts. Almost two-thirds (62%) of these crossings are on a designated freight corridor and 96% of them (all but two) have gates and flashing lights, yet there was at least one collision between pedestrians and/or vehicles and trains at or near half the crossings in the last five years. Almost two-thirds (66%) are in close proximity to emergency providers leading to potential delays for public safety services.

While there are existing funding programs for safety measures, such as enhanced gates and lights, they do not address the mobility issues experienced by freight and non-freight related vehicle traffic at crossings. The UTC and WSDOT were members of the Advisory Panel and reported that their crossing safety programs receive more applications than they can fund, pointing to the need for additional investments in grade crossing improvements both to address the gap in solutions for mobility impacts and to further bolster efforts to enhance safety.

2 The prioritization results point to a significant need for additional funding to address crossing improvements

Half of the Top 50 crossings have identified solutions with estimated costs of $830 million. Of the $830 million, only $170 million is funded and $100 million of that is for a single project. This leaves at least $660 million in unfunded needs just for the 25 crossings with identified projects. Assuming projects are needed for some share of the remaining 25 crossings, plus needs for crossings not making it into the Top 50, the unfunded needs amount is much higher.

While additional FMSIB and federal FAST Act freight funds will add $150 million over the next five years for all types of freight projects, it is not clear how much, if any, will be available to address the Top 50 road-rail conflicts identified in this study. Each funding program has specific eligibility criteria, and these crossings may or may not meet that criteria, or rank well when compared to other freight infrastructure investments. Further, the first call for projects has already been prioritized by WSDOT and the Freight Advisory Committee and only two projects address impacts at the Top 50 crossings.

RECOMMENDATIONS

i. Establish a dedicated funding source to address mobility impacts not covered under the current crossing safety programs.

ii. Secure additional funds for the safety programs.

iii. Further analyze Top ranked crossings to identify potential solutions individually and at the corridor level (see Finding 8).

3 The database and prioritization process provide a mechanism to compare and understand the magnitude of crossing improvement needs on a statewide basis

The database of crossings in its current form is a valuable tool for agencies throughout the state to evaluate and compare the needs of at-grade crossings. It is the only unified, statewide resource for detailed information about crossings and is a flexible tool that can be used in a variety of ways by state, regional, and local jurisdictions or other organizations. Some examples include:

- Describe the importance of a crossing (or a series of crossings) on state or federal grant applications.
- Assist in future planning efforts for local and regional jurisdictions.
- Provide a starting point for identifying locations to develop specific project proposals.

For the tool to remain useful at the statewide level, standards will need to be implemented and maintained to ensure consistency. Decisions will also need to be made on questions related to new data releases, changing the weighting of criteria, or other data to better align with a funding program, or other changes.

In order to maintain the relevance and usefulness of the tool, funding should be provided to update and maintain it and host it at an agency. This same agency could serve as the coordinator for a multi-stakeholder committee with similar membership to the Advisory Panel for this study (e.g. WSAC, AWC, FMSIB, WSDOT, UTC, RTPO/MPOs) to help with decision-making and continued data integrity. This committee could also work to address many of the questions raised by this study.

RECOMMENDATIONS

iv. Establish a multi-stakeholder committee to create database and tool standards, make decisions about future data enhancement or other changes, and address the outstanding questions raised by this study.

v. Identify an agency to maintain the database and tool and serve as the coordinator for the multi-stakeholder committee.

4 In some cases, projects prioritized locally did not rank high when evaluated on a statewide basis

Several crossing locations with planned projects did not make it into the Top 100 crossings statewide. Low ranking project locations were generally at crossings with lower train and traffic volumes, and in non-urban areas. Although proposed projects may not rank high on a statewide basis, the tool is not meant to discount legitimate congestion issues or mobility needs due to planned economic development projects or other site specific issues. There is no existing program specifically focused on mobility at rail crossings, but there are significant needs in large and small communities.

RECOMMENDATION

vi. Identify specific policy objectives to guide investments in crossings on a statewide basis. This may necessitate a separate program targeted at smaller communities similar to the Transportation Improvement Board's Small Cities Program to ensure their needs can be addressed and that state funding programs balance investments between Puget Sound, Western Washington, and Eastern Washington communities.

5 Safety data serves as a contributor towards mobility impacts, but further analysis is needed to confirm specific safety needs

High-level safety data, where available, were incorporated into the prioritization process to assist in ranking the crossings. Safety data in the tool is related to collisions between trains and pedestrians, bicycles, or vehicles. Half of the Top 50 crossings had a reported collision at or near a crossing in the last five years. The Advisory Panel agreed that the data was not specific or detailed enough to provide a safety assessment beyond an indicator of potential problems.

In addition, there was discussion around the safety specific grant programs administered by UTC and WSDOT that focus on evaluating collisions and funding lower-cost crossing improvements. Funding sources such as the federal Railway-Highways Crossing (Section 130) Program focus on safety and evaluate crossings on a case-by-case basis given a set of uniform criteria. Evaluation of collisions requires more information than a crossing database can provide, such as site visits, predictive analysis, and review of specific causes.

The federal Section 130 Program and the UTC's Grade Crossing Protective Fund Grant Program have a finite amount of money and are unable to address all the identified needs related to crossing safety. The combined funding from both programs is approximately $5 million per year in 2016, with funding levels set to decline by 2020.

While the crossing database cannot provide an authoritative safety analysis, it can supplement safety programs by identifying indicators of safety and mobility problems. Many mobility problems have implications for safety, such as gate down times that stop emergency response vehicles moving across town and cause drivers to take risks to beat safety gates at crossings. However, solutions to address mobility problems may be ineligible for funding under the current safety programs, highlighting the need for a funding source to address mobility impacts.

RECOMMENDATIONS

vii. Coordinate efforts with the WSDOT and UTC safety programs to continue focusing on reducing collisions at crossings and ensure funding levels are adequate.

viii. Separately address mobility and safety impacts at crossings.

6 The database and prioritization tool would benefit from future enhancements

Determining how the database and online tool will be used will determine how it will be updated and maintained in the future. For example, existing or new funding programs may emphasize certain criteria, resulting in other criteria not being necessary to collect or maintain. Further, if funding is provided to address crossing improvements, local jurisdictions will have a strong incentive to improve the data and plan for projects.

Future enhancements should be considered by the multi-stakeholder committee to improve the results and usefulness of the prioritization process. For example, the screening method could be modified to remove crossings with low train and vehicle counts and additional safety data could be incorporated. The soon to be released Marine Cargo Forecast will provide projections of train traffic through 2035 and could also be incorporated into the database.

RECOMMENDATIONS

ix. Provide the agency hosting the tool with additional resources to maintain, update and enhance the database and prioritization tool.

x. Incorporate data from the Marine Cargo Forecast once it is complete.

7 Corridor evaluation and prioritization are most useful when defining projects to address crossing impacts

One of the objectives of the study was to consider a corridor-based prioritization process. A variety of corridors were considered, such as crossings along a rail corridor or within RTPO boundaries, but a finer geographic focus on the transportation system is likely necessary to maximize benefits of a corridor approach. In addition, corridor-based prioritization requires more specific context about potential community needs and solutions, such as type of crossing improvement or surrounding development patterns. The ranking of high-impact crossing locations on a statewide basis is less suited to a corridor approach. However, the database and prioritization tool would still serve as a key input and a common set of data when identifying a corridor-based project prioritization strategy.

A corridor-based strategy could help evaluate projects at a single crossing that would address multiple crossings, or evaluate a suite of projects at multiple crossings to help traffic move through a larger corridor. Corridor evaluation could be useful in identifying or evaluating specific project proposals and addressing regional or rural needs.

RECOMMENDATION

xi. Utilize a corridor-based prioritization strategy to assist in developing solutions and prioritizing investments

8 Some jurisdictions have not yet identified and prioritized needed crossing improvements

While most large jurisdictions have tried to address crossing impacts, a lack of dedicated funding sources for crossing improvements creates a disincentive for smaller jurisdictions to plan for and implement crossing improvements. Some communities may not know the range of possible solutions for crossings, or groups of crossings, and default to expensive grade-separation projects for all.

When crossing improvements compete with other local funding priorities, they often rank lower than other priorities. This is partially due to information about train activity and crossing impacts not being easily accessible (until the development of this database).

RECOMMENDATION

xii. Ensure that local jurisdictions, state agencies, and other organizations, including Regional Transportation Planning Organizations and Metropolitan Planning Organizations, are aware of the tool and the data it contains and how they might use it to assist with planning or funding decisions.

Appendix A

Data Dictionary and Definitions

(This Page is Intentionally Blank)

Appendix A:
Data Dictionary and Definitions

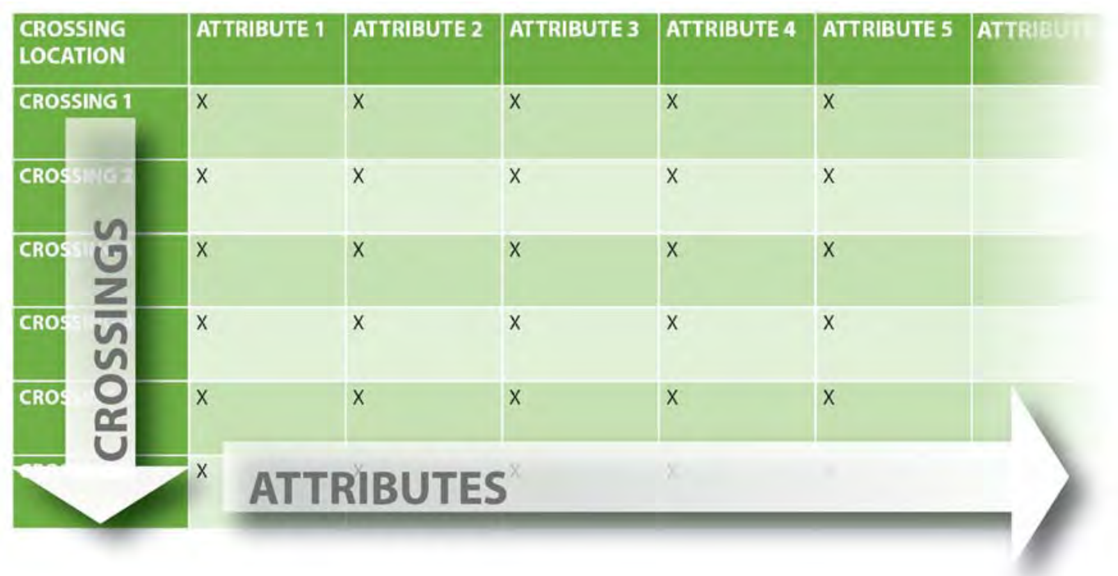
The Database Dictionary and Definitions Appendix provides information on the database created for the JTC Road-Rail Conflicts Study, including the process used to develop it, the data that was assembled, and the scoring scheme that was used.

The central database created as part of the Road-Rail Conflicts Study contains all 2,180 at-grade rail crossings in Washington State that are on active rail lines and publicly accessible. The purpose of the database is to create a central repository of mobility, safety, and community impacts information for all at-grade crossings in the state. The database is a tool that can be used by local, regional, and state agencies and decision-makers to evaluate road-rail conflicts and prioritize at-grade rail crossing solutions.

1.0 DATABASE DESCRIPTION

In the context of the Road-Rail Conflicts Study, a database is a structured set of data maintained in Microsoft Excel and ESRI GIS formats. The database is organized by columns that contain attributes and rows that contain each at-grade crossing location. See Figure 1 for a visual representation of the database structure.

Figure 1 Example Database Structure



The attributes associated with each crossing location can be categorized as either general data or criteria. General data includes information that will not be used to score and prioritize crossing locations, such as latitude, longitude, city, USDOT crossing number, and county to name a few. Criteria data will be used to evaluate crossings, such as train volumes, traffic volumes, and environmental impacts. See Section 3.0 below for a detailed list of each of the different attributes and criteria. The database includes 2,180 rows representing each at-grade crossing, 87 columns representing attributes, and 103 columns containing criteria for each crossing.

2.0 DATABASE DEVELOPMENT

The database was created by assembling readily available data from a variety of sources, including the Washington State Department of Transportation (WSDOT), the Washington Utilities and Transportation Commission (UTC), the Federal Railroad Administration (FRA), and the Washington Department of Ecology (DOE).

UTC maintains an official inventory of public railroad crossings in Washington State. UTC updates this inventory on a monthly basis and makes it available to the public for download on their website (http://www.utc.wa.gov/regulatedIndustries/transportation/rail/Pages/CrossingInventory.aspx). Washington UTC also provides additional information beyond what is included in the inventory that is downloadable from their website. This information was requested from UTC through a public records disclosure request and was received in April of 2016. The public records request included information such as crossing status, traffic volumes, crossing level of protection, road and rail speeds, among other things (see Section 3.0 for a detailed summary of the data).

The UTC inventory was used as the basis for creating the Road-Rail Conflicts database because it contains a large set of data that is regularly updated and maintained by the UTC. The UTC inventory contained a total of 4,171 discreet crossings locations, including a number of crossings that were beyond the scope of this project. Analysts performed the following filters to remove crossings that would not be included in the database:

- Filter 1: identified all crossings that were on active rail lines and publicly accessible (2,831 crossings)
    - This removed crossings with the following crossing status:
        - Abandonment
        - Closed
        - Closed in UTC-Not Main Line
        - Inactive
        - Private Not Routinely Inspected
        - Proposed
        - Proposed Abandonment
    - This removed crossings with the following category description:
        - Private Pedestrian
        - Private
- Filter 2: identified all crossings that were at-grade (2,180 crossings[1])
    - This removed crossings with the following crossing type description:
        - Overcrossing
        - Undercrossing

The Federal Railroad Administration (FRA) also maintains an inventory of rail crossings by State that can be downloaded from their website (http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/downloaddbf.aspx). The FRA inventory was retrieved in April 2016 and some data was used to assemble the Road-Rail Conflicts database. This inventory was not used as the basis for the Road-Rail Conflicts database because it is not updated and

1 The database includes 2,080 at-grade crossings because the crossings at Spokane Street in Seattle (USDOT Crossings 099009M and 099007Y) were combined into one crossing to address the fact that they operate as one crossing rather than two.

maintained as routinely as the UTC inventory. Of the 2,180 crossing from the UTC inventory that met the crossing status, category, and grade requirements described above, a total of 2,140 (~98%) had matching records in the FRA inventory.

Data from the abovementioned sources were retrieved in Microsoft Excel format. To prepare the data for ESRI GIS, analysts performed the following steps:

- Convert Data: Before crossings could be spatially located into ESRI GIS software, the dataset was converted from a Microsoft Excel file into an ESRI compliant file geodatabase table.
    - Locate Data: Using the latitude and longitude values that were included in the database, the crossings were spatially located and the ensuing points were added as a feature class to the geodatabase described above.
    - Filter Data: Using the crossing status, category, and crossing type variables listed above, the initial 4,171 crossings included in the UTC database were reduced to 2,180 publicly accessible, at-grade crossings for either cars or pedestrians and cyclists.
    - Populate Data and Criteria: After locating and filtering the crossings to include only publicly accessible at-grade crossings, individual criteria and data were added.

Once the data was incorporated into ESRI GIS, analysts verified the data to ensure accuracy and identify any data challenges using the following steps:

- Review Spatial Accuracy: 10% or 218 records from the 2,180 eligible crossings were randomly selected and visually reviewed in GIS to confirm the point location matched the street description provided.
- Review Data Accuracy: Prior to adding specific attributes, the existing information for crossings (FRA and WSDOT) was reviewed for consistency and accuracy through a series of summaries. Whenever possible crossing data values were reviewed against a secondary data source to ensure accuracy. Visual reviews and a histogram of each project criteria were also completed using GIS. Visual reviews included displaying individual data sets on maps to confirm the data was consistent with the primary data source and consistent across rail lines. Histograms were used as a secondary quality control measure to review consistency and completeness and identify outliers.
- Group Review: Points representing each of the 2,180 crossings as well as thematic map layers representing each criteria were loaded to a web map and made available to the project team for review.

3.0 DATA SOURCES

The Road-Rail Conflicts Database was developed by assembling readily available data from a variety of sources. This section lists and sources the data that is included in the database, as shown in Table 1. Limitations or issues with the data are also summarized.

Table 1 Data Description, Sources and Limitations

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Railroad Classification	L1 Mobility Value: Railroad Class	Railroad classification designation from the FRA; Class I or Class III in Washington State.	Step I Criteria	FRA (HERE)	• Selected Level I routes by company name. • All crossings not identified as Level I attributed as Level III	None
Railroad Classification Score	L1 Mobility Score: Railroad Class	Score assigned to the Railroad Classification in Step 1 (1 or 2)	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Existing Vehicle Volumes (AADT)	L1 Mobility Value: Vehicles (existing) (Step I), mExVehVols (Step II)	Existing average annual daily vehicles volumes at crossing.	Step I, Step II Criteria	UTC	• If year of AADT was provided, vehicle volume grown by 1% per year to 2015. • If no year of AADT was provided, assumed 2015.	• Data could be outdated. • Inconsistencies in year of count.
Existing Vehicle Volumes Score	L1 Mobility Score: Vehicle (existing)	Score assigned to Existing Vehicle Volumes in Step 1 (1 or 2)	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Future Vehicle Volumes (AADT)	L1 Mobility Value: Vehicles (future) (Step I), mFutVehVols (Step II)	Projected average annual daily vehicle volumes at crossing.	Step I, Step II Criteria	WSDOT Historical Volume Counts by road segment (HERE)	• Existing AADT volume grown using nearest annual growth rate (historical growth rate between 2005 to 2015) to 2035	• Growth rates used are a historical average and could change in future years.

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Future Vehicle Volumes Score	L1 Mobility Score: Vehicle (Future)	Score assigned to Future Vehicle Volumes in Step 1 (1 or 2)	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Existing Freight Train Volumes (daily average)	L1 Mobility Value: Freight (Existing)	Existing average daily freight train counts at crossing	Step I Criteria	WSDOT State Rail Plan	• Existing Freight Train Volumes as reported in the State Rail Plan were applied wherever available. • Where Existing Freight Train Volumes were not available in the State Rail Plan, an assumption of 2 freight trains per day was applied.	• Data sourcing inconsistent (WSDOT and assumptions used). • Data is a daily average and does not reflect daily fluctuations in volumes.
Existing Freight Train Volumes Score	L1 Mobility Score: Freight (Existing)	Score assigned to Existing Freight Train Counts in Step 1 (1 or 2)	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Future Freight Train Volumes (daily average)	L1 Mobility Value: Freight (Future)	Projected Average daily freight train counts at crossing.	Step I Criteria	WSDOT State Rail Plan	• Future Freight Train Volumes as reported in the State Rail Plan were applied wherever available. • Assumed same Freight Train Volume as existing wherever data was not available.	• Data sourcing inconsistent (WSDOT and assumptions). • Data is a daily average and does not reflect daily fluctuations in volumes.

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Future Freight Train Volumes Score	L1 Mobility Score: Freight (Future)	Score assigned to Future Freight Train Counts in Step 1 (1 or 2)	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Existing Unit Train Presence and Count	L1 Mobility Value: Unit (existing)	Existing average daily unit train count at crossing.	Step I Criteria	WSDOT, DOE	• Crossings along BNSF lines known to carry oil trains based on Bakken Train GIS data provided by DOE. • Cereal grains and agricultural product trains and coal trains as reported by WSDOT were applied.	• Unit train volumes are highly dependent on economic trends and can fluctuate.
Existing Unit Train Presence and Count Score	L1 Mobility Score: Unit Trains	Score assigned to presence of Unit Trains in Step 1 (1 or 2)	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Existing Passenger Train Volumes	L1 Mobility Value: Passenger (existing)	Existing average daily passenger train count at crossing.	Step I Criteria	WSDOT	• Existing Passenger Train Volumes as reported in the State Rail Plan were applied wherever available. • Volumes were confirmed against Amtrak and Sounder Schedules.	None

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Existing Passenger Train Volumes Score	L1 Mobility Score: Passenger (future)	Score assigned to existing passenger train counts in Step 1 (1 or 2)	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Future Passenger Train Volumes	L1 Mobility Value: Passenger (future)	Projected average daily passenger train count at crossing.	Step I Criteria	WSDOT	• Future Passenger Train Volumes as reported in the State Rail Plan were applied wherever available.	None
Future Passenger Train Volumes Score	L1 Mobility Score: Passenger (future)	Score assigned to future passenger train counts in Step 1 (1 or 2)	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Presence of Alternate Grade Separated Crossing	L1 Safety Value: Alternate Crossings	Presence of an alternate grade separated crossing (over- or undercrossing) within a half-mile of the at-grade crossing.	Step I, Step II Criteria	Parametrix	• Alternate crossings were identified by completing a half-mile proximity analysis using ESRI GIS software. • The locations of over- and undercrossings were provided by UTC.	• Could indicate the presence of a grade separated crossing that would not actually allow travel around a blocked crossing (i.e. road network does not provide access).
Presence of Alternate Grade Separated Crossing Score	L1 Safety Score: Alternate Crossings (Step I); sAltGradeSep (Step II)	Score assigned for presence of alternate grade separated crossings	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Number of Mainline Tracks	L1 Safety Value: Mainline Tracks	Number of mainline tracks at crossing.	Step I, Step II Criteria	UTC	• No processing required	None
Number of Mainline Tracks Score	L1 Safety Score: Mainline Tracks (Step I); sNumTracks (Step II)	Score assigned for number of mainline tracks at crossing	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Roadway Functional Classification	L1 Community Value: Functional Class	Federal Roadway Functional Classification that denotes the character of service a street should provide.	Step I Criteria	WSDOT (Here)	• A table was developed to link the functional class described in the UTC data (*Roadway Type Code* attribute) with the WSDOT functional class standards.	None
Roadway Functional Classification Score	L1 Community Score: Functional Class	Score assigned for roadway classification at crossing (1 or 2)	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Previously Identified Project	L1 Community Value: Previously Identified (Step I); Project, ProjectIdentifiedbyRTPO (Step II)	Identified by regional and local agencies as a crossing included in an existing or planned project.	Step I Criteria	MPO, RTPO Plans	• Crossings identified by MPO and RTPO Plans were selected based on location and crossing ID.	None
Previously Identified Project Score	L1 Community Score: Previously Identified	Score assigned for previously identified projects	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Freight Gate-Down Time (minutes)	ExistingFreightGateDownTime(mins) (in spreadsheet)	The estimated total average daily delay at a crossing associated with freight trains.	Step II Criteria (used to calculate Total Gate-Down Time)	Parametrix	• Freight train gate-down time = freight train volume*((freight train length + crossing width/(train speed in ft/s)+lead/lag time)/60) • {freight train volume *(((6660/(freight train speed*5280/3600))+30)/60}	• Assumptions are used to calculate; actual gate-down times could be different depending on the location.
Passenger Gate-Down Time (minutes)	ExistingPassengerGateDownTime(mins) (in spreadsheet)	The estimated total average daily delay at a crossing associated with passenger trains.	Step II Criteria (used to calculate Total Gate-Down Time)	Parametrix	• Passenger train gate-down time =passenger train volume*((passenger train length + crossing width/(train speed in ft/s)+lead/lag time)/60) • {passenger train volume*(((660/(passenger train speed*5280/3600))+30)/60}	• Assumptions are used to calculate; actual gate-down times could be different depending on the location.
Unit Train Gate-Down Time (minutes)	ExistingUnitGateDownTime (in spreadsheet)	The estimated total average daily delay at a crossing associated with unit trains.	Step II Criteria (used to calculate Total Gate-Down Time)	Parametrix	• Unit train gate-down time (assumes 30 mph operating speed) = unit train volume*3.5	• Assumptions are used to calculate; actual gate-down times could be different depending on the location.

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Combined Gate-Down Time	ExistingTotalGateDownTime(mins) (in spreadsheet)	The estimated total average daily delay at a crossing associated with freight, passenger, and unit trains.	Step II Criteria	Parametrix	• Combined time of Freight, Passenger, and Unit Train Gate Down time	• Assumptions are used to calculate; actual gate-down times could be different depending on the location.
Combined Gate-Down Time Score	mGateDownTime (Step II)	Score assigned to total gate-down time at crossing in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Proximity to Emergency Services	ProximityToEmergencyServices_Miles (in spreadsheet)	Miles to nearest emergency service provider (hospital, police, fire)	Step II Criteria	DOH, Wikipedia (HERE), Google Maps	• DOH Hospital and Fire station databases joined with all police locations gathered from Wikipedia and Google Maps. Nearest Emergency point distance joined to crossings	• Only points with emergency location within 100 miles was evaluated.
Proximity to Emergency Services Score	sProxEmergSrv1	Score assigned to proximity to emergency service providers in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Collision History	Collisions 5 Years, PDO, Injuries, Fatalities, Total Accidents (in spreadsheet)	A five-year history of incidents involving trains at crossings.	Step II Criteria	UTC	• Data Joined based on USDOT Number	• Only captures collisions with trains (i.e. collisions between vehicles near the crossing due to congestion/delay are not captured).

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Collision History Score	sIncidTotal1 (Total Collisions); sIncidFatal1 (fatal collisions); sIncidServer (injury accidents)	Score assigned to total, fatal, and injury collisions in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Level of Crossing Protection	S2LevelProtection, S2_Lights, S2_Gates, S2_SignsOnly, S2_MedianBarrier, S2_PoorGeometry , S2)CrossingAngleLess60, S2_RoadGradeMore6	Passive and active protection improvements at crossings.	Step II Criteria	UTC; Google Maps; Transpo	• Level of Protection was verified using Google Maps street view	None
Level of Crossing Protection Score	sProtection1	Score assigned to level of protection in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Roadway Freight Classification	FGTSClass (in spreadsheet)	Freight and Goods Transportation System classification for roadways.	Step II Criteria	WSDOT	• No processing required	None
Roadway Freight Classification Score	mRdFreightClass1	Score assigned to freight classification at crossing in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Employment Density	Employment Density (in spreadsheet)	Number of jobs per acre.	Step II Criteria	EPA Smart Location Database (HERE)	• Intersect UTC Crossings with 2010 SLD Blockgroups	• Density per blockgroup
Employment Density Score	cEmpDen	Score assigned to employment density in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Population Density	Population Density	Number of people per acre.	Step II Criteria	EPA Smart Location Database (HERE)	• Intersect UTC Crossings with 2010 SLD Blockgroups	• Density per blockgroup
Population Density Score	cPopDen	Score assigned to population density in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
First/Last Mile Roadway Crossing	FirstLastMile (in spreadsheet)	Roadway designated as a first/last mile connection between major freight and goods origins and destinations.	Step II Criteria	WSDOT Freight Economic Corridors Database (HERE)	• First/Last mile line segment information joined spatially to rail lines.	• Only Step II Selection set evaluated closely – Analysis required looking at intersections on case by case basis due to lines and points not being snapped in GIS • 0= no, 1=yes
First/Last Mile Roadway Crossing Score	cFLMFreight	Score assigned to first/last mile roadway crossing in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Proximity to Minority Populations (percent)	NONWHITE_PER (in spreadsheet)	Minority population density by census tract within proximity to crossing.	Step II Criteria	US Census Bureau	• Intersect UTC Crossings with 2010 Census Tracts (Percent Non-White Reported)	• Percent by census tract
Proximity to Minority Populations Score	cPercMinority	Score assigned to percent minority near crossing in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Proximity to Low-Income Populations	Percent Low Income Population (in spreadsheet)	Low-income population density by blockgroup within proximity to crossing.	Step II Criteria	US Census Bureau	• Intersect UTC Crossing with 2007-2010 American Community Survey Summary File – Blockgoups. Percent Low Income Reported	• Percent by blockgroup
Proximity to Low-Income Populations Score	cPercLowInc	Score assigned to percent low income near crossing in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Network Sensitivity	Major Intersections Within 200 Ft (in spreadsheet)	Number of major (arterials and above) roadway intersections within 200 feet of crossing.	Step II Criteria	Parametrix	• Create Major Intersection points where Major Streets intersected (Major Collectors, Arterials, and above). Join count of intersections within 200 foot buffer of crossings	• Only Step II Selection set evaluated closely – Accurate count required looking at intersections on case by case basis due to inaccuracy of centerlines and crossing locations at 200 foot scale.

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Network Sensitivity Score	mNetSense	Score assigned to crossing network sensitivity in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
At-Grade Crossing Density	At Grade Crossings Within 1 Mile (in spreadsheet)	Number of at-grade crossings on the same rail line within a half mile in each direction of crossing.	Step II Criteria	Parametrix	• Count of all At-grade crossings joined to Step II crossings within 1 mile buffer of crossings on same rail line.	• Only Step II Selection set evaluated closely – Accurate count required looking at intersections on case by case basis
At-Grade Crossing Density Score	mCrossDen	Score assigned to crossing density in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Quiet Zone	Quiet_Zone (in spreadsheet)	Crossing is located within a quiet zone.	Step II Criteria	UTC	• No processing required	• 0=no, 1=yes
Quiet Zone Score	cNoise1	Score assigned to quiet zone presence at crossing in Step II	N/A (score)	See Chapter 2 in the report for scoring methodology		• Score will change as data changes
Daily Emissions	cAnnEmission1	Score assigned to estimated emissions at crossing associated with delay and vehicle volumes.	Step II Criteria	Transpo	• Emissions were estimated using assumptions of emissions and vehicle volumes at crossings.	• This is an estimate and may not reflect exact emissions at a crossing due to traffic volumes and queuing.
USDOT Number	Same	Crossing assigned by USDOT	Attribute	UTC	• No processing required	None

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Crossing Status	Same	Status of crossing (closed, active, private, proposed abandonment, etc)	Attribute	UTC	• No processing required	None
Last Inspection Date	Same	Date when crossing was last inspected by UTC staff	Attribute	UTC	• No processing required	None
UTC Number	Same	Identification number assigned by UTC	Attribute	UTC	• No processing required	None
Crossing Type	Same	Description of whether crossing is at-grade, overcrossing, or undercrossing	Attribute	UTC	• No processing required	None
Category	Same	Denotes whether public, private, or pedestrian crossing	Attribute	UTC	• No processing required	None
City Name	Same	City crossing is located in	Attribute	UTC	• No processing required	None
County Name	Same	County crossing is located in	Attribute	UTC	• No processing required	None
Latitude	Same	Latitude of crossing	Attribute	UTC	• No processing required	None
Longitude	Same	Longitude of crossing	Attribute	UTC	• No processing required	None
Section Township Range	Same	Locational description assigned by UTC	Attribute	UTC	• No processing required	None

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Roadway	Same	Roadway crossing intersects with	Attribute	UTC	• No processing required	None
In City Limits	Same	Whether crossing is located within city limits	Attribute	UTC	• No processing required	• True=within city limits; false=not within city limits
Highway Milepost	Same	If located on a highway, mile post location of where crossing is located	Attribute	UTC	• No processing required	• 0=not located on highway
State District Code	Same	Locational description assigned by UTC	Attribute	UTC	• No processing required	None
Roadway Type Code	Same	Roadway designation assigned by UTC	Attribute	UTC	• No processing required	None
State System Code	Same	Identifier designation assigned by UTC	Attribute	UTC	• No processing required	None
Highway	Same	If applicable, description of highway crossing is located on	Attribute	UTC	• No processing required	None
Road Surface	Same	Type of road surface of roadway crossing intersects	Attribute	UTC	• No processing required	• Pav=paved • Unp=unpaved • UPA=unpaved with asphalt apron
Road Grade	Same	Grade of roadway crossing intersects	Attribute	UTC	• No processing required	None

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Road Grade Opposite	Same	Roadway grade of opposite approach	Attribute	UTC	• No processing required	None
Number of Lanes	Same	Number of lanes of roadway crossing intersects	Attribute	UTC	• No processing required	None
Percent of Trucks Using Crossing	Same	Percentage of trucks traveling over crossing	Attribute	UTC	• No processing required	None
Road Type	Same	Whether roadway that crossing intersects is one-way or two-way	Attribute	UTC	• No processing required	• 1W=one-way • 2W=two-way
AADT Year of Count	Same	Year that AADT count was taken	Attribute	UTC	• No processing required	None
Vehicle Speed	Same	Vehicle speed of roadway crossing intersects	Attribute	UTC	• No processing required	None
Road Width	Same	Width in feet of roadway crossing intersects	Attribute	UTC	• No processing required	None
Average Daily Bus Count	Same	Counts of buses traveling over crossing	Attribute	UTC	• No processing required	None
School Bus Count Year	Same	Year that bus count was recorded	Attribute	UTC	• No processing required	None

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Road Designation	Same	Designates whether roadway that crossing intersects is a street or state highway	Attribute	UTC	• No processing required	None
Railroad Company	Same	Rail Company that owns the crossing	Attribute	UTC	• No processing required	None
Line	Same	Rail line designation	Attribute	UTC	• No processing required	None
Branch	Same	Rail line branch designation	Attribute	UTC	• No processing required	None
Railroad Milepost	Same	Rail line milepost where crossing is located	Attribute	UTC	• No processing required	None
Is Spur Track	Same	Rail line that crossing is located on is spur line	Attribute	UTC	• No processing required	• 0=no • 1=yes
Spur Location	Same	Locational designation of spur line	Attribute	UTC	• No processing required	None
Spur Identifier	Same	Identification designation of spur line	Attribute	UTC	• No processing required	None
Freight Train Speed	Same	Allowable freight train speed over crossing	Attribute	UTC	• No processing required	• Used to calculate freight train gate-down time

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Passenger Train Speed	Same	Allowable passenger train speed over crossing	Attribute	UTC, FRA	• No processing required	• Used to calculate passenger train gate-down time. • Some Step 2 crossings had no data from UTC database; FRA inventory sheets were queried and used.
Bike Lane	Same	Presence of bike lanes at crossing	Attribute	UTC	• No processing required	• False=none • True=present
Commercial Power	Same	Presence of commercial power at crossing	Attribute	UTC	• No processing required	• False=none • True=present
High Speed Corridor	Same	Crossing is located on a high speed rail corridor	Attribute	UTC	• No processing required	• False=no • True=yes
USDOT Number is Posted	Same	Sign posted with USDOT number at crossing	Attribute	UTC	• No processing required	• False=no • True=yes
Number of Siding Tracks	Same	Number of siding tracks at crossing	Attribute	UTC	• No processing required	None

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Crossing Surface	Same	Type of crossing surface	Attribute	UTC	• No processing required	• AS=asphalt • CC=concrete • TM=timber • TAA=timber with asphalt apron • CAA=concrete with asphalt apron • Un=unconsolidated (gravel) • RB=rubber • GR=gravel with asphalt apron • Other designations also included that are uncommon/no longer used
Crossing Angle	Same	Angle of intersection between road and crossing	Attribute	UTC	• No processing required	None
Truck Pullout Lanes	Same	Presence of truck pullout lanes at crossing	Attribute	UTC	• No processing required	• False=no • True=yes
Sidewalk	Same	Presence of sidewalks at crossing	Attribute	UTC	• No processing required	None
Emergency Number Posted	Same	Sign with emergency number posted at crossing	Attribute	UTC	• No processing required	None
Other Surface Siding Spur	Same	Spur/siding has other surface	Attribute	UTC	• No processing required	• All values are null

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Wayside Horn	Same	Use of Wayside Horn at crossing	Attribute	UTC	• No processing required	None
Number of Spur Tracks	Same	Number of spur tracks at crossing	Attribute	UTC	• No processing required	None
RTU	Same	Remote terminal unit present	Attribute	UTC	• No processing required	• False=no • True=yes
Power Off Indicator	Same	Presence of power off indicator at crossing	Attribute	UTC	• No processing required	• False=no • True=yes
Active Advance Warning Signs	Same	Presence of active advance warning signs	Attribute	UTC	• No processing required	• False=no • True=yes
Number of Bells	Same	Number of bells at crossing	Attribute	UTC	• No processing required	None
Circuit Overlay	Same	Description of infrastructure at crossing	Attribute	UTC	• No processing required	None
Event Recorder	Same	Description of infrastructure at crossing	Attribute	UTC	• No processing required	None
Gate Delay Timer	Same	Description of infrastructure at crossing	Attribute	UTC	• No processing required	None
Train Detection Type	Same	Description of train detection type	Attribute	UTC	• No processing required	None

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Interconnect	Same	Description of infrastructure at crossing	Attribute	UTC	• No processing required	None
Switch Cutout	Same	Description of infrastructure at crossing	Attribute	UTC	• No processing required	None
Stick Release Timer	Same	Description of infrastructure at crossing	Attribute	UTC	• No processing required	None
Number of Flashing Light Pairs	Same	Number of flashing light pairs at crossing	Attribute	UTC	• No processing required	None
Cantilever Lights	Same	Presence of cantilever lights at crossing	Attribute	UTC	• No processing required	• False=no • True=yes
Four Quadrant Gates	Same	Presence of four quadrant gates at crossing	Attribute	UTC	• No processing required	• False=no • True=yes
Advance Warning Sign (North, South, East, West)	Same	Number of advance warning signs for each approach	Attribute	UTC	• No processing required	None
Road Markings (North, South, East, West)	Same	Roadway markings for each approach	Attribute	UTC	• No processing required	None
Reflectorized Crossbucks (North, South, East, West)	Same	Reflectorized crossbucks for each approach	Attribute	UTC	• No processing required	None

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Reflectorized Crossbuck Post (North, South, East, West)	Same	Crossbuck posts for each approach	Attribute	UTC	• No processing required	None
Median Barriers (North, South, East, West)	Same	Presence of median barriers for each approach	Attribute	UTC	• No processing required	None
Stop Lines (North, South, East, West)	Same	Presence of stop lines for each approach	Attribute	UTC	• No processing required	None
Stop Line Distance (North, South, East, West)	Same	Stop bar distance from crossing for each approach	Attribute	UTC	• No processing required	None
Siding Tracks	Same	Number of siding tracks at crossing	Attribute	UTC	• No processing required	None
Comments	Same	UTC inspection comments	Attribute	UTC	• No processing required	None
Down a Street	Same	Whether track runs down a street rather intersect it	Attribute	UTC	• No processing required	• False=no • True=yes
Number of Yard Tracks	Same	Number of yard tracks at crossing	Attribute	UTC	• No processing required	None

Data Name	Name in Online Tool/ Database	Description	Attribute or Criteria	Source	Processing	Limitations/Notes
Intersection Density	Same	Density of intersections near at-grade crossing	Attribute	EPA Smart Location Database (HERE)	• Intersect UTC Crossings with 2010 SLD Blockgroups	None
Passenger Train Type	Same	Type of passenger train service	Attribute	Various	• Conducted online search to locate commuter, passenger, and tourist trains.	None
RTPO	Same	Regional Transportation Planning Organization crossing is located in	Attribute	WDOT	• Intersect UTC Crossings with RTPO dataset	None
MPO	Same	Metropolitan Planning Organization crossing is located in	Attribute	WDOT	• Intersect UTC Crossings with MPO dataset	None
TMA	Same	Transportation Management Area crossing is located in	Attribute	WDOT	• Intersect UTC Crossings with TMA dataset	None
Legislative District	Same	Legislative District crossing is located in	Attribute	WDOT	• Intersect UTC Crossings with Legislative District dataset.	None

3.1 Methodologies for Created Data

Some data included in the database was created using other existing data and GIS mapping functions. This allowed analysts to address data gaps and evaluate certain criteria that were not readily available. Table 2 in Section 3.2 describes in additional detail why it was necessary to create each of the data described below.

Presence of Alternate Grade Separated Crossings

This criteria was developed for all 2,180 at-grade crossings before completing Step I of the prioritization process. Analysts were able to identify whether there were grade separated crossings within a half-mile of an at-grade crossing by using a network proximity function and the locations of over- and undercrossings (retrieved from the UTC database). This function populated the criteria for each at at-grade crossing with the number of grade-separated crossings were located within a half-mile on the road network.

Gate-Down Time

This criteria was estimated for the 302 at-grade crossing included in Step II using the train count by type (freight, passenger, unit), the allowable freight and passenger train speeds (UTC database), and some assumptions regarding train lengths. Gate-down time was calculated for each type of train and then summed to develop the total amount of estimated daily gate-down time. The following equations were used to calculate gate-down time:

- Freight trains: freight train volume*((freight train length + crossing width/(train speed in ft/s)+lead/lag time)/60)
    - freight train volume *(((6660/(freight train speed*5280/3600))+30)/60)
- Passenger trains: passenger train volume*((passenger train length + crossing width/(train speed in ft/s)+lead/lag time)/60)
    - passenger train volume*(((660/(passenger train speed*5280/3600))+30)/60)
- Unit trains: unit train volume*3.5

The following assumptions were used to calculate gate-down time:

- Average train lengths were assumed for freight and passenger trains to calculate gate-down time. Freight train lengths were determined by multiplying the average dimension of BNSF rail equipment (http://www.bnsf.com/customers/equipment) by the average number of cars for trains on Western Class I railroads (Cambridge Systematics, Inc., National Rail Freight Infrastructure Capacity and Investment Study, 2007). Passenger train lengths were calculated based on equipment dimensions (Amtrak, Amtrak Station Program and Planning Guide, 2013) and the average number of cars used on the Amtrak Cascades route as reported by WSDOT (http://www.wsdot.wa.gov/Rail/TrainEquipment.htm):
    - Freight trains: 1.25 miles long
    - Passenger train: 600 feet
- Unit trains were assumed to close a crossing for 3.5 minutes each. This was based on the assumption that unit trains are traveling at approximately 30 mph. Unit train lengths were consistent with train lengths reported in recent unit train studies for Washington State (Washington Department of Ecology, Washington State 2014 Marine and Rail Oil Transportation Study, 2014; Pacific International Terminals, Inc., Project Information Document, 2011).

- It was assumed that gates would close approximately 20 seconds before a train reached the crossing and would remain closed an additional 10 seconds after the train cleared the crossing for a total of 30 seconds of lead/lag time.
- It was assumed that crossings were approximately 60 feet wide. The width of the crossings was added to the train length in the gate-down time calculation.

At-Grade Crossing Density

This criteria was developed for the 302 crossings that were included in Step II of the prioritization process using a network proximity buffer of a half-mile. Analysts used this function to identify to the number of at-grade crossings were located within the half-mile distance on the same rail line of an at-grade crossing.

Proximity to Emergency Services

This criteria was completed only for the 302 crossings that were included in Step II of the prioritization process using a network proximity buffer of a half-mile. Similarly to other criteria, the Proximity to Emergency Services populated the criteria for each crossing with the distance to the nearest emergency service provider, including fire, hospital, and police.

Daily Emissions

This criteria was completed only for the 302 crossings that were included in Step II of the prioritization process based on daily traffic volumes and gate down time. The emissions are for VOC (volatile organic compounds), THC (total hydrocarbons), CO (carbon monoxide), and NOx (nitrogen oxides) for a vehicle fleet that is 95 percent cars (gasoline) and 5 percent trucks (diesel). The formula used was:

- Grams of emissions per day = (Delay/(60*16))*AADT*(84.7049/60)
- Where:
  - "Delay" is gate down time in minutes
  - "60*16" is a unit conversion factor based on a 16-hour travel day (most daily vehicle travel occurs in a 16-hour window).
  - "AADT" is the daily traffic volume
  - "84.7049/60" is grams per minute of emissions

Network Sensitivity

This criteria was completed only for the 302 crossings that were included in Step II of the prioritization process. This metric is supposed to highlight the sensitivity the local network to trains blocking the crossing. If the crossings in blocked, and that crossing is within 200 feet of a major traffic signal (or signal corridor), the local network could have major delays even for vehicles not using the crossing. The following datasets were gathered:

- Functional classification (WSDOT)
- Traffic Signal, or Signal System (Google Maps).

Based on the characteristics above, the crossing received a Network Sensitivity score. For example, a crossing within 200 feet of a traffic signal that was on a state highway got a higher score than a crossing with a nearby traffic signal on a local street.

3.2 Data Challenges

Relevant data was assembled from a variety of sources. This is the first tool in Washington State, and perhaps the nation, that assembles this breadth of data related to at-grade crossing impacts into one database. There are some inherent consistency challenges that arise when assembling data from multiple sources. Those challenges were addressed to the extent possible within the resources available to the study. As the prioritization tool is used in the future, data will need to be maintained and updated to remain relevant and useful. Data challenges that were identified during data assembly included the following:

- Quality: data is correct and accurate
- Consistency: data is available for all crossings and from the same source
- Availability: data exists and is available for inclusion

There were several steps that analysts took to address data challenges. Table 2 summarizes the specific challenges and the solutions that were developed for each of the criteria.

Table 2 Data Challenges and Solutions

Criteria	Type of Data Challenge	Challenge Description	Solution
Railroad Classification	None	N/A	N/A
Existing Vehicle Volumes (AADT)	Quality, Consistency	• Data could be outdated. • Inconsistencies in year of count.	• Data was included as is since it still provides a relative measure of traffic volumes for crossings across the state. • Some locations that did not have a year of traffic count were verified against traffic counts that were readily available online.
Future Vehicle Volumes (AADT)	Availability	• Future traffic volume projections do not exist. • Growth rates used to project volumes are a historical average and could change in future years.	• Analysts used readily available data to estimate future traffic volumes.
Existing Freight Train Volumes (daily average)	Quality, Consistency	• Data sourcing inconsistent (WSDOT and assumptions used). • Data is a daily average and does not reflect daily fluctuations in volumes.	• WSDOT data was used as is for Mainline crossings. • A reasonable assumption was used for branch lines. • A daily average is the best available estimate.

Criteria	Type of Data Challenge	Challenge Description	Solution
Future Freight Train Volumes (daily average)	Quality, Consistency	• Data sourcing inconsistent (WSDOT and assumptions used). • Data is a daily average and does not reflect daily fluctuations in volumes.	• WSDOT projections data was used as is for Mainline crossings. • A reasonable assumption was used for branch lines. • A daily average is the best available estimate.
Existing Unit Train Presence and Count	Quality, Consistency	• Unit train volumes are highly dependent on economic trends and can fluctuate.	• WSDOT data was used as is for crossings. • A daily average is the best available estimate.
Existing Passenger Train Volumes	None	N/A	N/A
Future Passenger Train Volumes	None	N/A	N/A
Presence of Alternate Grade Separated Crossing	Availability	• Included in UTC database but not accurate. • Data created could indicate the presence of a grade separated crossing that would not actually allow travel around a blocked crossing (i.e. road network does not provide access).	• Data was created using the locations of grade separated crossings using GIS functions.
Number of Mainline Tracks	None	N/A	N/A
Roadway Functional Classification	None	N/A	N/A
Previously Identified Project	Consistency	• Data was provided voluntarily by RTPOs/MPOs and may not be comprehensive	• Data was verified where possible against available plans. • Data included as is since it is currently the best possible measure.
Combined Gate-Down Time	Availability, Quality, Consistency	• Actual gate-down time data not available. • Assumptions are used to calculate; actual gate-down times could be different depending on the location.	• Data was estimated using best possible information and assumptions.
Proximity to Emergency Services	Availability	• Data did not exist	• Data was created using locations of emergency services and GIS function.

Criteria	Type of Data Challenge	Challenge Description	Solution
Collision History	Quality	• Data for collisions with trains readily available. • Only captures collisions with trains (i.e. collisions between vehicles near the crossing due to congestion/delay are not captured).	• Data was used as is since it is a good measure of incident history.
Level of Crossing Protection	Quality	• Data available from UTC but not accurate	• Data was verified and corrected using Google Maps Streetview
Roadway Freight Classification	None	N/A	N/A
Employment Density	Quality	• Data uses information from 2010 Census, which could be outdated.	• Data used as is since this is the best available estimate.
Population Density	Quality	• Data uses information from 2010 Census, which could be outdated.	• Data used as is since this is the best available estimate.
First/Last Mile Roadway Crossing	None	N/A	N/A
Proximity to Minority Populations	Quality	• Data uses information from the 2010 Census, which could be outdated.	• Data used as is since this is the best available estimate.
Proximity to Low-Income Populations	Quality	• Data uses information from the 2007-2010 American Community Survey, which could be outdated.	• Data used as is since this is the best available estimate.
Network Sensitivity	Availability	• Data not readily available.	• Data created using Roadway Functional Classification and GIS function.
At-Grade Crossing Density	Availability	• Data not readily available.	• Data created using locations of other at-grade crossings and GIS function.
Quiet Zone	None	N/A	N/A
Daily Emissions	Availability	• Data not readily available.	• Data created using traffic volume information, gate down time, and assumptions of vehicle emissions.

As the database tool is introduced to and used by agencies across the state, it is likely that higher quality data will be developed and incorporated into the database. Users of the tool will have an interest in providing better data and a process to allow data to be updated efficiently could be provided.

4.0 FUTURE UPDATES OF THE DATABASE

There were some data limitations that were identified during the study. Future enhancements of the database could improve or resolve these concerns:

- New data could be created to replace data that had consistency, availability, or quality concerns, such as existing vehicle volumes and gate-down time.
- Data that was not readily or publicly available could be assembled from their respective sources, such as near-miss data and regional growth projections.
- Data included in the database could be updated more regularly during future iterations of the tool.

Table 3 summarizes the enhancements that could be made to data that is currently included in the database. Future data enhancements would be needed to ensure that data is up-to-date and accurate, which could change how the crossings rank.

Table 3 Enhancements to Existing Evaluation Criteria

Data Name & Description	Source	Data Enhancement Opportunity
Railroad Classification		
Railroad classification designation from the FRA; Class I or Class III in Washington State	FRA	Data is accurate; changes in railroad classification would occur rarely
Existing Vehicle Volumes (AADT)		
Existing average annual daily vehicle volumes at crossing	UTC	Data could be collected on location at the crossing and incorporated into the database
Future Vehicle Volumes (AADT)		
Projected average annual daily vehicle volumes at crossing	WSDOT Historical Volume Counts	Project vehicle volume data could be incorporated from local travel demand models, or could be projected by local jurisdictions
Existing Freight Train Count (daily average)		
Existing average daily freight train counts at crossing	WSDOT State Rail Plan, Interviews with Chris Herman	Train count data could be collected on location at the crossing and/or provided by rail operators

Future Freight Train Count (daily average)		
Projected Average daily freight train counts at crossing	WSDOT State Rail Plan	Future freight train counts could be projected using more detailed models, such as the Marine Cargo Forecast
Existing Unit Train Presence and Count		
Existing average daily unit train count at crossing	WSDOT, DOE	Train count data could be collected on location at the crossing and/or provided by rail operators
Existing Passenger Train Count		
Existing average daily passenger train count at crossing	WSDOT, Sound Transit, Amtrak	Data is currently available and reliable from passenger rail schedules
Future Passenger Train Count		
Projected average daily passenger train count at crossing	WSDOT, Sound Transit, Amtrak	As changes in future passenger rail operations occur, those could be incorporated
Presence and Number of Alternate Grade Separated Crossing		
Presence of an alternate grade separated crossing (over- or undercrossing) within a half-mile of the at-grade crossing	Parametrix	Data could be verified on a crossing by crossing basis to ensure that only grade-separated crossings that allow travel around a blocked at-grade crossing are included
Number of Mainline Tracks		
Number of mainline tracks at crossing	UTC	Data is currently available and reliable, but could be verified on a crossing by crossing basis
Roadway Functional Classification		
Federal Roadway Functional Classification that denotes the character of service a street should provide	WSDOT	Data is accurate; changes in roadway functional classification would occur rarely
Previously Identified Project		
Identified by regional and local agencies as a crossing included in an existing or planned project	MPO, RTPO Plans	Data could be updated and assembled from agencies on a routine basis

Average Daily Gate-Down Time (minutes)		
The estimated total average daily delay at a crossing associated with freight, passenger, and unit trains	Parametrix, UTC	Data could be recorded in the field, or more detailed modeling could be completed, such as that completed in the Marine Cargo Forecast
Proximity to Emergency Services		
Number of emergency service providers (hospital, police, fire) within a half mile of a crossing	DOH, Google Maps, Parametrix	Data is accurate; changes would occur rarely
Incident History		
A five-year history of incidents involving trains at crossings	UTC	Data could continue to be included from UTC; additional collision data and analysis could be included to analyze collisions between vehicles near the crossing due to congestion/delay
Level of Crossing Protection		
Passive and active protection improvements at crossings	UTC, Google Maps	Data could be verified on a crossing by crossing basis
Roadway Freight Classification		
Freight and Goods Transportation System classification for roadways	WSDOT	Data is accurate; changes would occur rarely
Employment Density		
Number of jobs per acre	EPA Smart Location Database	Data is accurate; major changes in land use would require the data to be updated
Population Density		
Number of people per acre	EPA Smart Location Database	Data is accurate; major changes in land use would require the data to be updated
First/Last Mile Roadway Crossing		
Roadway designated as a first/last mile connection between major freight and goods origins and destinations	WSDOT Freight Economic Corridors Database	Data is accurate; changes would occur rarely

Proximity to Minority Populations (percent)		
Minority population density by census tract within proximity to crossing	US Census Bureau	Data is accurate; major changes in land use would require the data to be updated
Proximity to Low-Income Populations		
Low-income population density by block group within proximity to crossing	US Census Bureau	Data is accurate; major changes in land use would require the data to be updated
Network Sensitivity		
Number of major (arterials and above) roadway intersections within 200 feet of crossing	Parametrix	Data could be verified on a crossing by crossing basis
At-Grade Crossing Density		
Number of at-grade crossings on the same rail line within a half mile of crossing	Parametrix	Data could be verified on a crossing by crossing basis
Noise: Quiet Zone		
Crossing is located within a quiet zone	UTC	Data could be verified on a crossing by crossing basis; any changes to quiet zones could be incorporated as they occur
Daily Emissions		
Estimated emissions at crossing associated with delay and vehicle volumes	Transpo	Data could be modeled using more detailed methodologies

Table 4 summarizes the data that could be included in the database in the future. This includes information that could be created, such as vehicle queuing, as well as existing data that could be incorporated from other sources, such as near miss data.

Table 4 Data that could be Included or Enhanced in the Future

Data	Category	Description	Reason not Currently Included/Suggested Improvement
Near Miss Data	Safety	Data that documents when incidents/collision almost occurred between trains and vehicles/non-motorized users.	Available from only one rail company source (BNSF)

Data	Category	Description	Reason not Currently Included/Suggested Improvement
Collisions within 250 feet	Safety	Data that documents collisions within a certain distance of an at-grade crossing; could be used to indicate collisions due to congestion/queuing related to train crossing events.	Requires assembly from multiple sources and processing to evaluate collisions
Transit Volumes/Presence	Mobility	Data that indicates the presence and magnitude of transit service near an at-grade crossing	Requires assembly from multiple sources
Non-motorized Volumes/Presence	Mobility	Data that indicates the presence and magnitude of non-motorized activity near an at-grade crossing	Requires assembly from multiple sources and/or is not consistently available
Regional Growth Projections	Community	Data that documents potential development and/or land use nearby an at-grade crossing	Requires assembly from multiple sources and/or is not consistently available
Future Vehicle Volumes	Mobility	Data that documents future increases in traffic volumes	Requires assembly from regional travel demand models; may not be consistently available
Gate-Down Time	Mobility	Data that documents actual gate-down time, including train building and other activities	Requires actual data collection of gate-down times, or inclusion of model results from Marine Cargo Forecast
School Bus/Walking Routes	Safety	Data that indicates whether a school bus or walking route is designated across an at-grade crossing	Requires assembly from multiple sources and/or may not be consistently available
Crossing Geometrics/Sight Distance	Safety	Data that indicates if there are sight distance issues at a crossing	Requires some processing of existing data and/or may not be consistently available
Vehicle Queuing	Mobility	Data that measures queuing due to train crossing events	Requires actual data collection and analysis
Proximity to Sensitive Receptors	Community	Data that indicates proximity to sensitive receptors, such as hospitals, schools, etc	Requires assembly from multiple sources and/or may not be consistently available

Data	Category	Description	Reason not Currently Included/Suggested Improvement
Designated Routes	Community	Data identifying crossings that are located on designated response or evacuation routes, such as emergency response routes, oil spill response routes, and/or evacuation routes (lahar, tsunami).	Partial data available and/or requires assembly from multiple sources.
Accident Predictive Modeling	Safety	Data that identifies estimated number of collisions to occur at the at-grade crossing.	Requires substantial processing and expertise with modeling tools.

For the tool to remain useful, the data should be updated and maintained over time. Depending on the nature of what is being measured in each criteria, the timing for when data should be updated or replaced varies. Much of the data will not change drastically between update cycles and could be replaced only as changes happen. For example, railroad classification does not change frequently and could be updated only when there is a known update to a classification. Also, updates to the overall list of at-grade crossings could be modified when projects are completed or changes occur, as this would not be expected to occur often.

Vehicle volumes likely change more frequently depending on local factors such as development, population or employment growth, and the economy. More regular updates to this information would ensure the tool remains useful. The Pacific Northwest Marine Cargo Forecast and Rail Capacity Assessment, another source of information on train volume projections and activity, is updated every five years. Data updates to the prioritization tool could be aligned with the update cycle of this report. The following criteria would benefit from a five-year update cycle:

- Existing Vehicle Volumes (AADT)
- Future Vehicle Volumes (AADT)
- Gate-down Time
- Collision History
- Daily Emissions
- Existing Freight Train Volumes (daily average)
- Future Freight Train Volumes (daily average)
- Existing Unit Train Presence and Count
- Existing Passenger Train Volumes
- Future Passenger Train Volumes
- Previously Identified Project

- Level of Crossing Protection

The remaining criteria would not be expected to change frequently. It’s important to note that there are varying degrees of processing and expertise required to maintain the criteria. Although all of the criteria at minimum will require review before inclusion, some of the criteria require calculations in order to update. The majority of the criteria can be incorporated with minimal processing. Criteria that require calculations include future vehicle volumes, average daily gate-down time, and daily emissions. Other criteria will require some GIS processing before they can be updated, including employment density, population density, proximity to low-income populations, and proximity to minority populations. Refer back to Section 3.0 for descriptions of processing required for the different criteria.

Appendix B

Step 1 Report Card

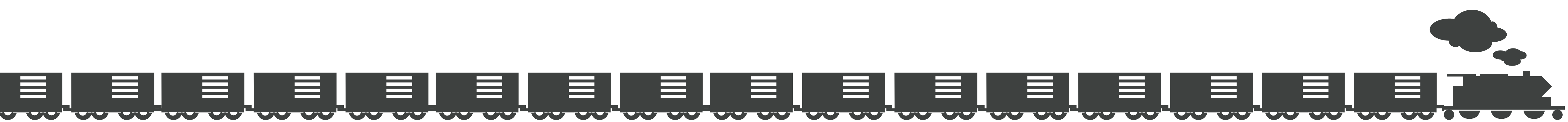
(This Page is Intentionally Blank)

APPENDIX B

Joint Transportation Committee

PRIORITIZATION OF PROMINENT ROAD-RAIL CONFLICTS IN WASHINGTON STATE

DATABASE REPORT CARD
STEP 1 SCREENING PROCESS



PROJECT CROSSINGS

There are many road-rail crossings in Washington State and some crossings fall outside of the scope of this project. Here is a summary of the initial screening process undertaken before prioritizing sites.

PROJECT CROSSINGS: 2,180

Sites were chosen that met the following characteristics:

- ***Active*** rail line
- ***Publicly*** accessible
- ***At-grade*** crossing

The Road-Rail Study crossing database includes all active, public, at-grade crossings in Washington State. This Report Card summarizes the results of the Step I screening process and the data and criteria used.

TOP 5 RTPOs (by number of crossings)

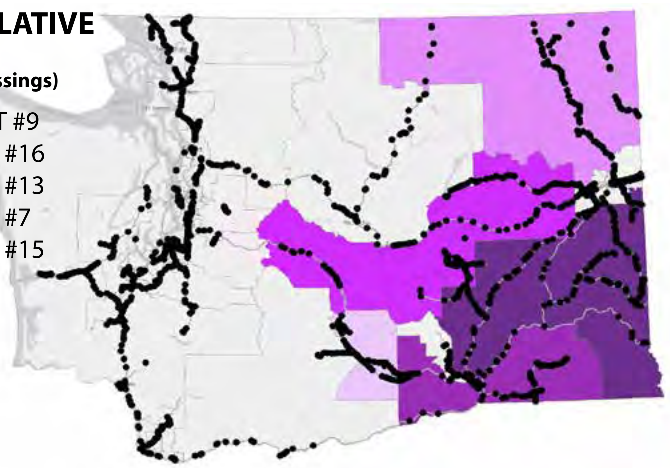
23% PUGET SOUND REG. COUNCIL
12% QUAD-COUNTY RTPO
10% SPOKANE REG. TRANS. COUNCIL
9% SW WASHINGTON RTPO
8% YAKIMA VALLE COUNCIL OF GOV.

TOP 5 MPOs (by number of crossings)

43% NO AFFILIATION
23% PUGET SOUND REG. COUNCIL
10% SPOKANE REG. TRANS. COUNCIL
4% WHATCOM COUNCIL OF GOV.
4% BENTON-FRANKLIN COUNCIL OF GOV.

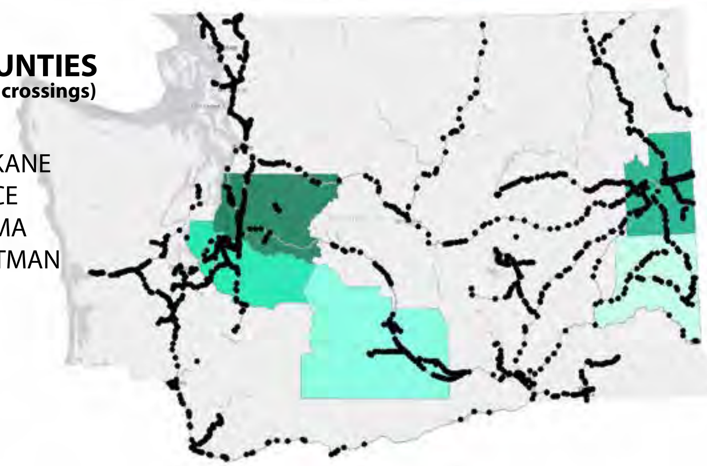
TOP 5 LEGISLATIVE DISTRICTS
(by number of crossings)

- 11% DISTRICT #9
- 9% DISTRICT #16
- 9% DISTRICT #13
- 6% DISTRICT #7
- 6% DISTRICT #15



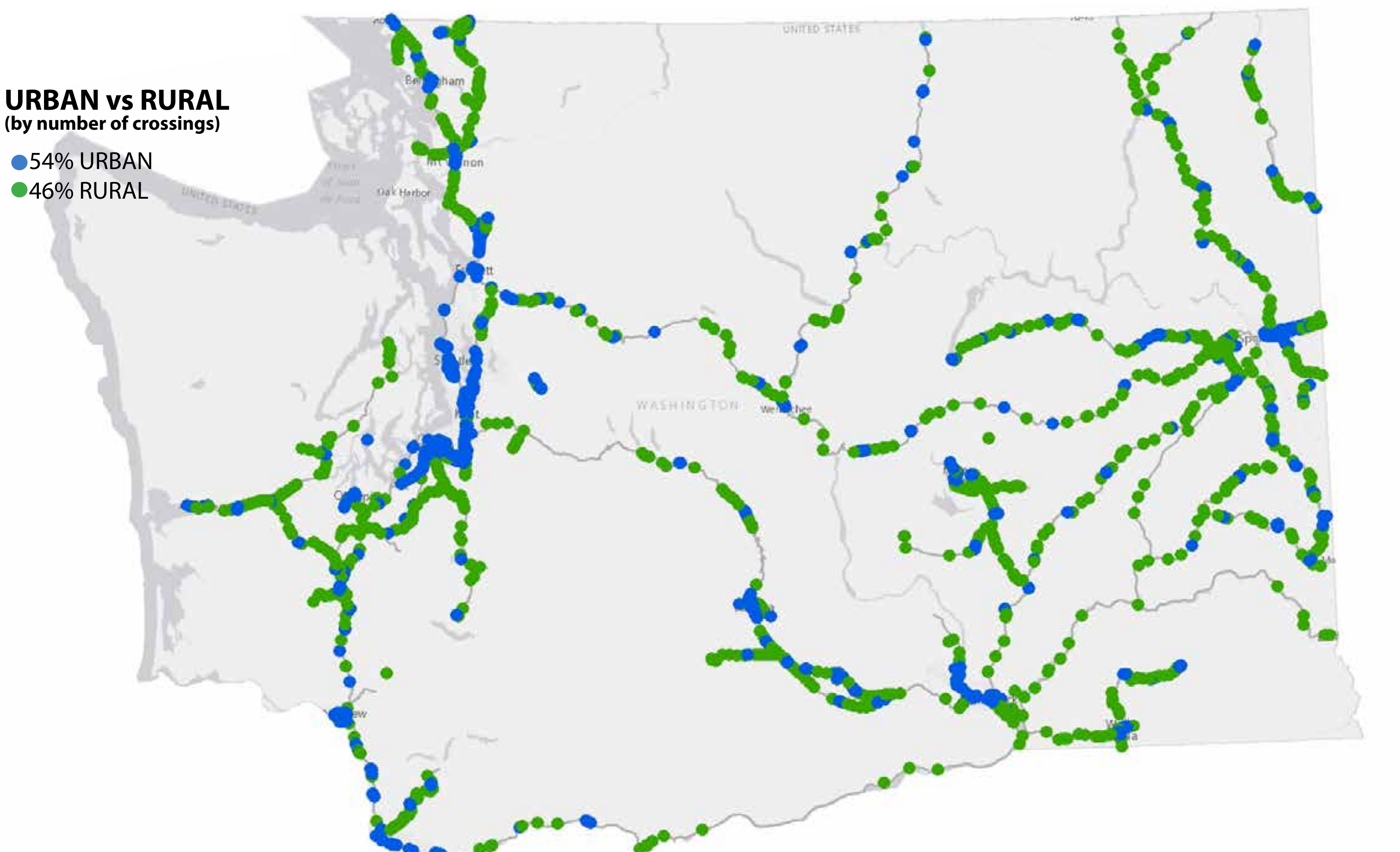
TOP 5 COUNTIES
(by number of crossings)

- 11% KING
- 10% SPOKANE
- 8% PIERCE
- 8% YAKIMA
- 6% WHITMAN



URBAN vs RURAL
(by number of crossings)

- 54% URBAN
- 46% RURAL



STATEWIDE CROSSING CHARACTERISTICS

TWO-STEP SCREENING PROCESS

A Two-Step Screening Process was used to focus detailed evaluation on the most prominent road-rail conflicts in the state. The first step of the screening process, Step I, was less detailed and included criteria that identify higher priority crossings. Lower priority crossings were filtered out in Step I from further evaluation. The Step II screening step is more detailed and the criteria are used to prioritize or rank the most prominent crossings.

STEP I OF THE SCREENING PROCESS - IDENTIFYING THE TOP 302 CROSSINGS

Step I of the Screening Process was completed using the following methodology:

- All 2,180 crossings were scored based on a series of Mobility, Safety, and Community criteria (described on the following pages)
- Approximately 50 highest ranking crossings under each category were selected for the Step II of the Screening Process
- To avoid duplication, Step II crossings were selected first from the Mobility category, followed by Safety and finally by Community
- If a crossing was selected in a previous category, the next highest scoring crossing was selected to provide the widest range of prominent road-rail conflicts
- An additional approximately 150 crossings were selected for Step II consideration based on having higher aggregate scores (total score of all Mobility, Safety, and Community Criteria) after the crossings that were included under Mobility, Safety, or Community were removed from consideration
- The Remaining Higher Aggregate Score crossings are locations where there are combined impacts from multiple categories.

302 CROSSINGS SELECTED FOR STEP II

This map summarizes the 302 crossings that were and were not selected for Step II of the Screening Process.

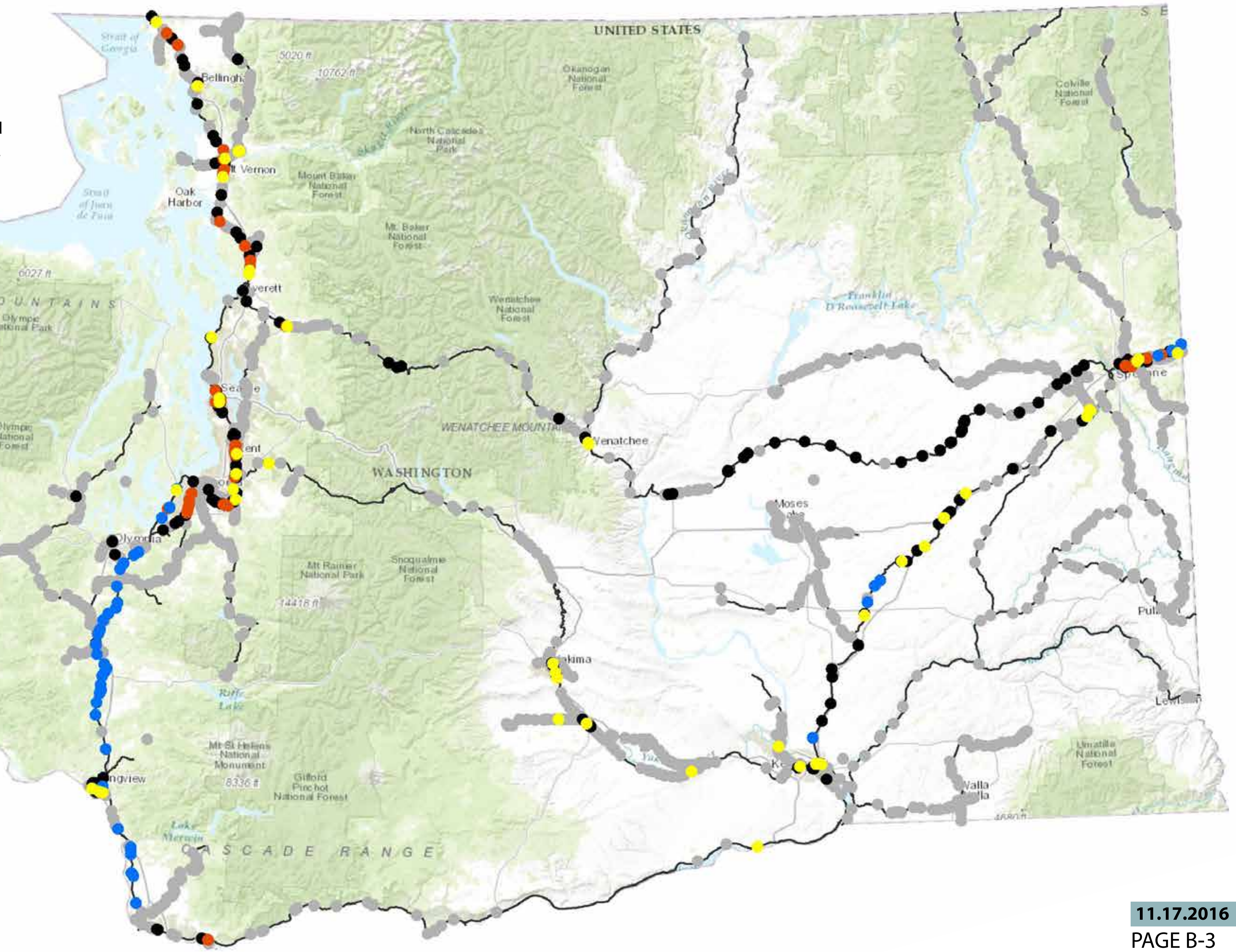
MOBILITY CROSSING SET

COMMUNITY CROSSING SET

SAFETY CROSSING SET

REMAINING HIGH AGGREGATE SCORE CROSSING SET

CROSSINGS NOT SELECTED FOR STEP II PRIORITIZATION



STEP I MOBILITY CRITERIA

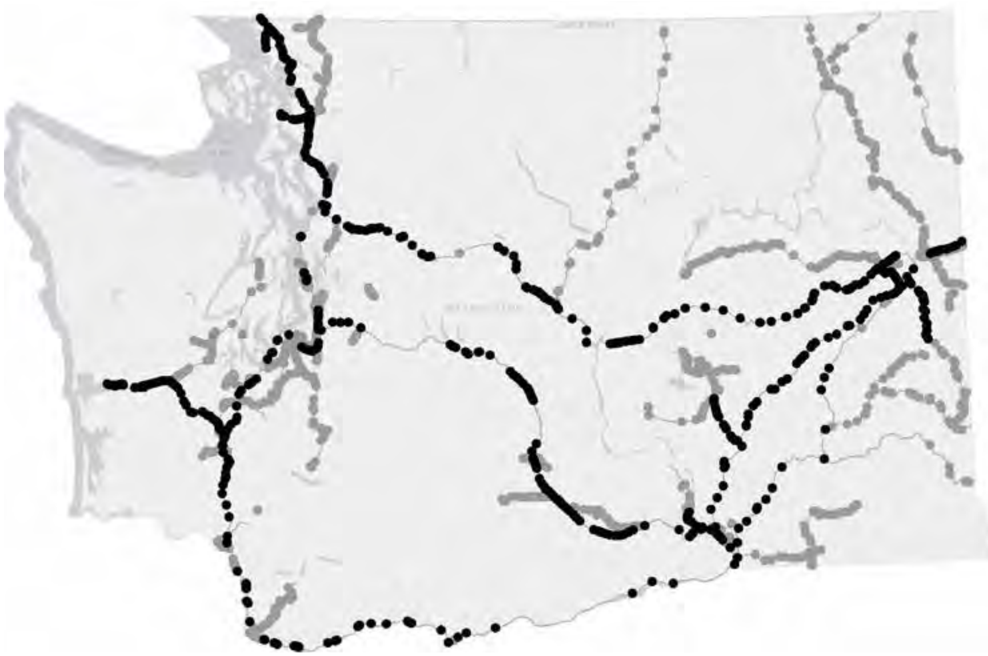
Mobility criteria assess road and rail traffic volumes at grade crossings, with higher volumes indicating larger impacts. Unit train data is included to reflect that these longer and slower-moving trains block vehicle traffic for longer periods of time.

SCORING

The individual criteria listed on this page were weighted and summed to produce an aggregate mobility score. These scores ranged from 10 to 20 with 47% of the crossing receiving a 10 versus less than 1% receiving a 20.

Of the 50 crossing selected for Step II based on the mobility criteria alone, 12 received a score of 20, 24 received a score of 18, and the remaining 14 received a score of 17. Of the remaining 150 crossings selected based on the remaining higher aggregate score for all criteria, 28 crossings received a mobility score of 17 and the lowest mobility score was 13.

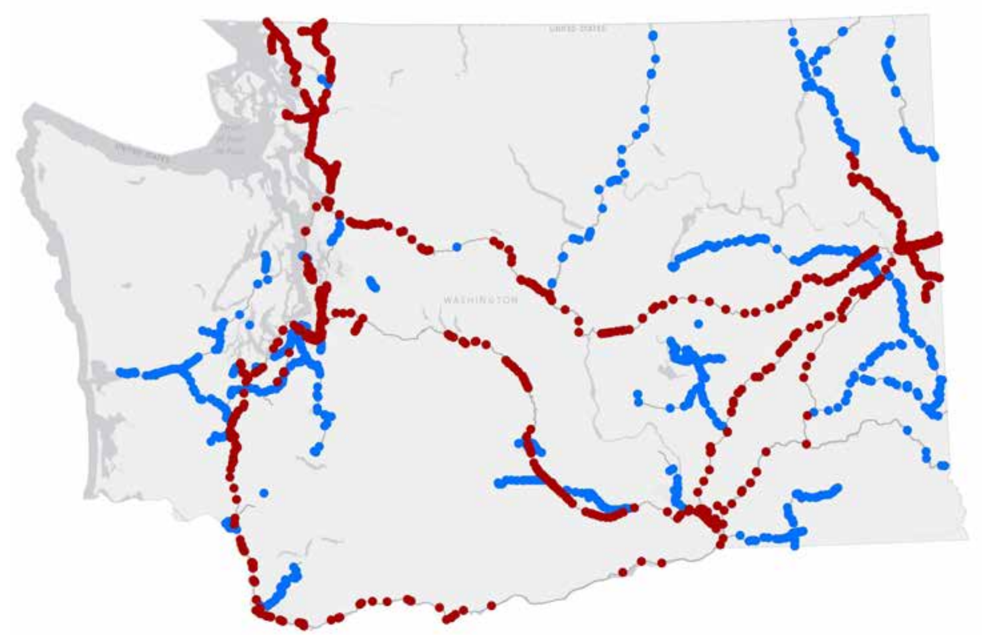
PRESENCE OF UNIT TRAINS



Description
Presence of units trains.
Source
WSDOT & Dept. of Ecology
Notes
None

TRAINS	% OF ALL CROSSINGS	SELECTED FOR STEP II
● PRESENT	629 (29%)	232 (77%)
● ABSENT	1,551 (71%)	70 (23%)

RAIL CLASS



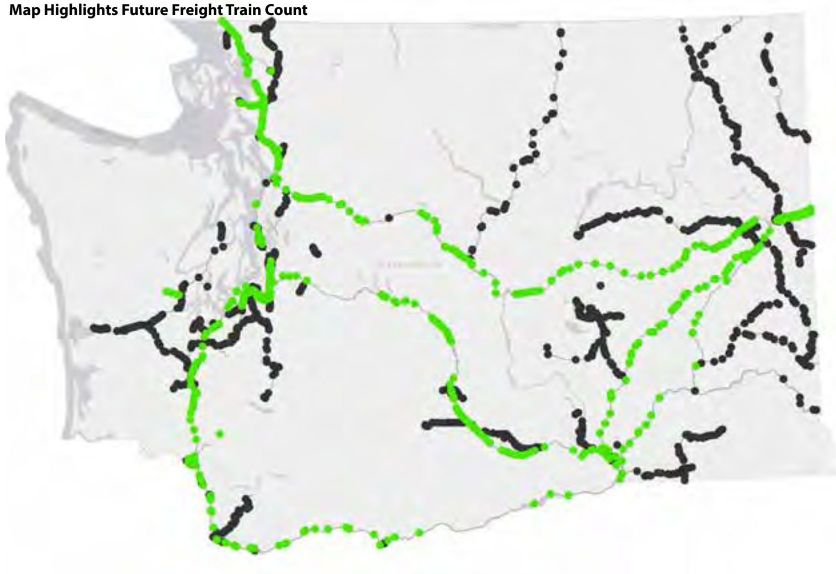
Description
The type of railroad classification associated with the rail line.
Source
Federal Rail Administration
Notes
No Class II rail lines in the state.

CLASS	% OF ALL CROSSINGS	SELECTED FOR STEP II
● CLASS I	1,044 (48%)	277 (92%)
● CLASS III	1,136 (52%)	25 (8%)

NOTE: The maps summarize the characteristics of all 2,180 crossings. The tables provide information on all crossings as well as a summary of the characteristics of the crossings that continued to Step II of the screening process.

FREIGHT TRAIN COUNT (CURRENT & FUTURE)

Map Highlights Future Freight Train Count



Description
The existing and estimated number of freight trains per day.
Source
2013 Washington State Rail Plan, FRA Database

Notes
For crossings where train volumes were not reported in the State Rail Plan, the FRA Database was used

CURRENT (AVG. DAILY TRAINS)

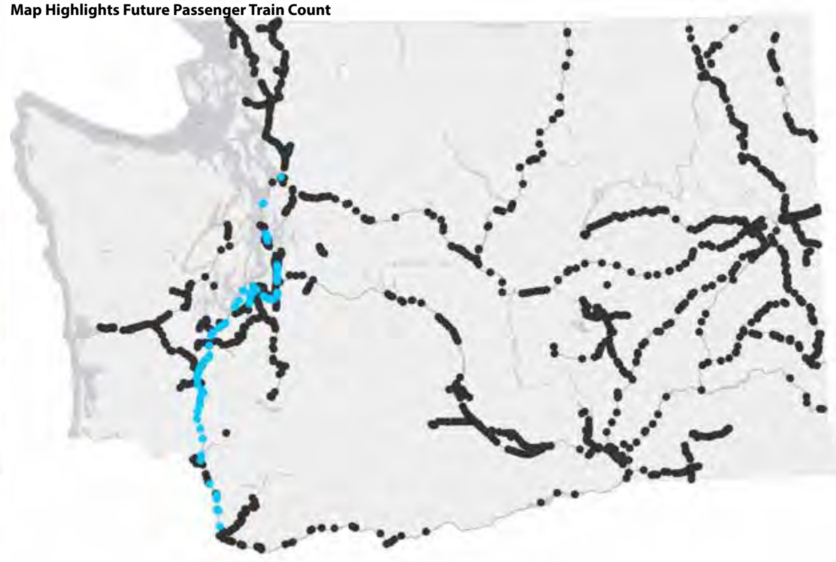
TRAINS	% OF ALL CROSSINGS	SELECTED FOR STEP II
<10	1,664 (76%)	49 (16%)
≥10	516 (24%)	253 (84%)

FUTURE (AVG. DAILY TRAINS)

TRAINS	% OF ALL CROSSINGS	SELECTED FOR STEP II
● <15	1,671 (77%)	61 (20%)
● ≥15	509 (23%)	241 (80%)

PASSENGER TRAIN COUNT (CURRENT & FUTURE)

Map Highlights Future Passenger Train Count



Description
The existing and estimated number of passenger trains per day.

Source
2013 Washington State Rail Plan, Amtrak, & Sound Transit
Notes
None

CURRENT (AVG. DAILY TRAINS)

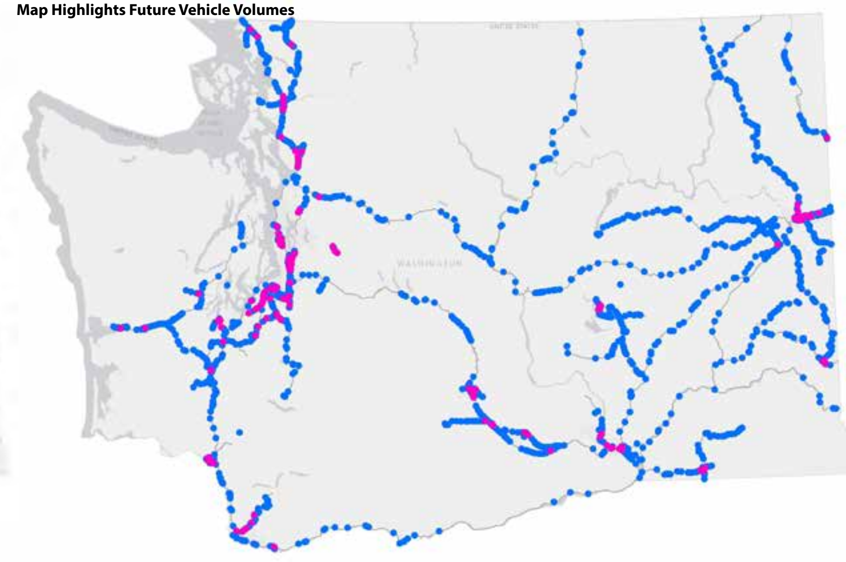
TRAINS	% OF ALL CROSSINGS	SELECTED FOR STEP II
<10	2,078 (95%)	210 (69%)
≥10	102 (5%)	92 (31%)

FUTURE (AVG. DAILY TRAINS)

TRAINS	% OF ALL CROSSINGS	SELECTED FOR STEP II
● <10	2,078 (95%)	210 (69%)
● ≥10	102 (5%)	92 (31%)

VEHICLE VOLUMES (CURRENT & FUTURE)

Map Highlights Future Vehicle Volumes



Description
The existing and estimated Average Annual Daily Traffic (AADT) counts.
Source
UTC Crossings Dataset & WSDOT AADT Counts 2005 and 2015.

Notes
Vehicle volumes included in the UTC Crossings dataset were grown at 1% per year to 2015 and then grown to 2035 using growth rates identified by WSDOT 2005 to 2015 section data.

CURRENT (AVG. DAILY VEHICLES)

VEHICLES	% OF ALL CROSSINGS	SELECTED FOR STEP II
≤8,000	1,992 (91%)	203 (67%)
>8,000	188 (9%)	99 (33%)

FUTURE (AVG. DAILY VEHICLES)

VEHICLES	% OF ALL CROSSINGS	SELECTED FOR STEP II
● ≤8,000	1,989 (91%)	201 (67%)
● >8,000	191 (9%)	101 (33%)

STEP I SAFETY CRITERIA

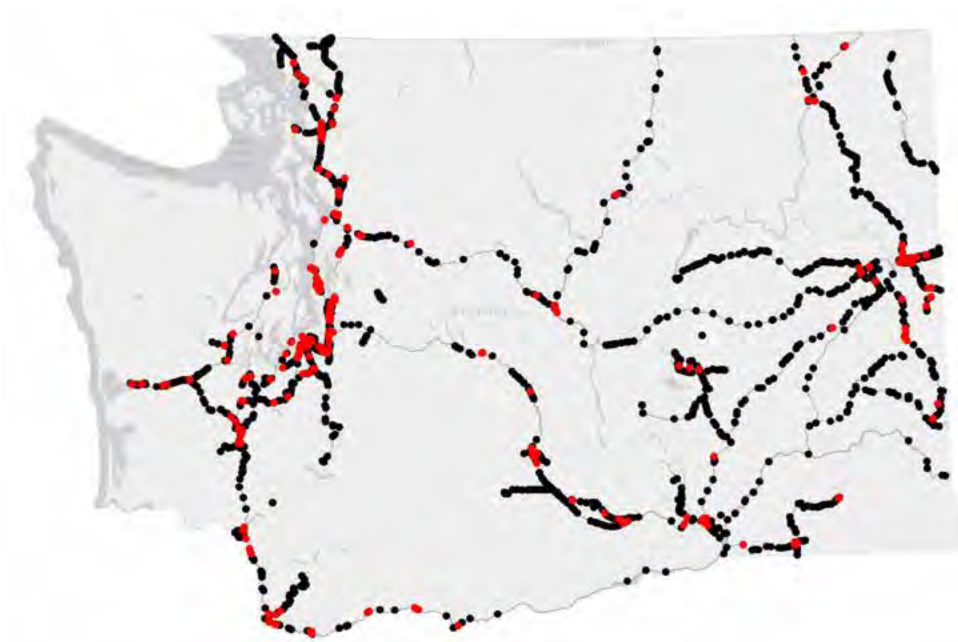
Safety criteria measure the potential for safety concerns at at-grade crossings in the state. The criteria measuring the presence of an alternate grade separated crossing identifies potential impacts to emergency vehicle access. The criteria measuring the number of mainline tracks assesses the potential for collisions to occur when an individual notices only one passing train where multiple trains could be crossing simultaneously.

SCORING

The individual safety criteria were weighted and summed to produce an aggregate safety score. Scores ranged from 3 to 6 with 22% of crossings receiving a 3 versus almost 4% receiving the highest score of 6.

All of the 50 crossings selected for Step II based on the safety criteria alone received the high score of 6. Of the remaining 150 crossings selected based on the remaining higher aggregate score for all criteria, 22 crossings received a safety score of 6, 117 crossings receiving a score of 4.5, and another 11 received a safety score of 3.

ALTERNATE GRADE SEPARATED CROSSINGS



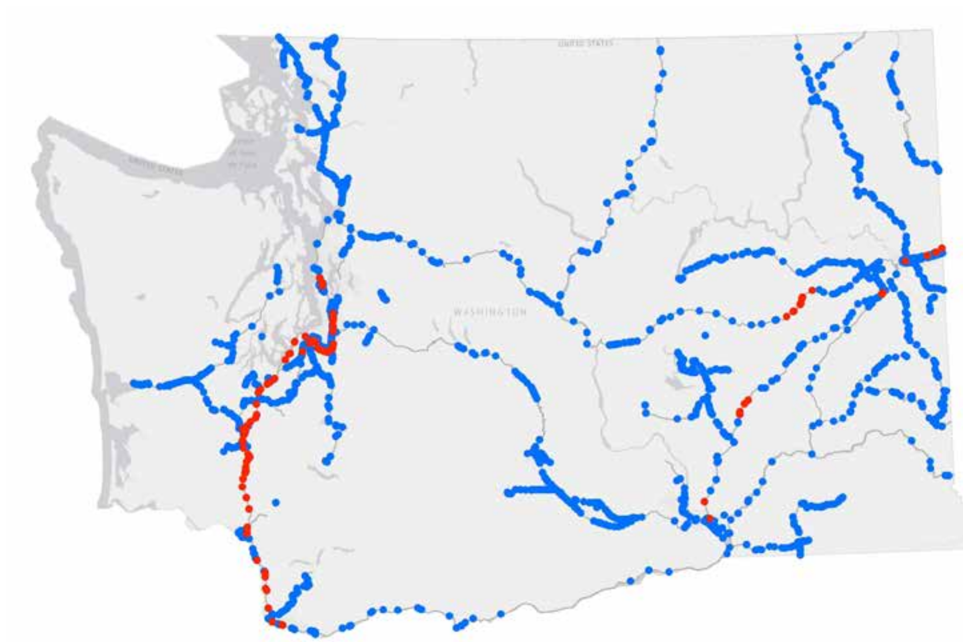
Description
Number of over or under crossings within 1/2-mile.

Source
Parametrix

Notes
None

ALTERNATE GRADE SEPARATED CROSSING	% OF ALL CROSSINGS	SELECTED FOR STEP II
● NONE	1,679 (77%)	237 (78%)
● 1 OR MORE	501 (23%)	65 (22%)

NUMBER OF MAINLINE TRACKS



Description
The number of mainline tracks at each crossing.

Source
UTC Crossings Dataset

Notes
None

TRACKS	% OF ALL CROSSINGS	SELECTED FOR STEP II
● 1 OR LESS	1,962 (90%)	196 (65%)
● 2 OR MORE	218 (10%)	106 (35%)

NOTE: The maps summarize the characteristics of all 2,180 crossings. The tables provide information on all crossings as well as a summary of the characteristics of the crossings that continued to Step II of the screening process.

STEP I COMMUNITY CRITERIA

Community criteria are intended to summarize potential impacts to community access as well as to reflect local and regional planning efforts related to at-grade crossings. The functional road classification criteria measures the potential impacts to community access by measuring the access functions that the various roadways serve. Previously identified projects are included to measure the locations that have been identified as problematic by individual communities or regions.

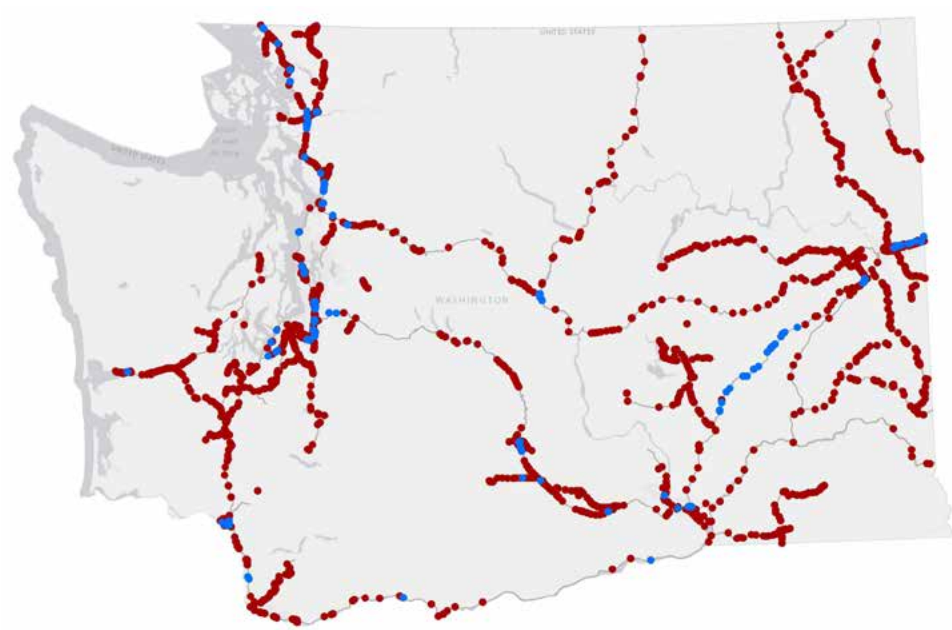
SCORING

The individual community criteria were weighted and summed to produce an aggregate community score. Scores ranged from 2 to 4 with 66% of crossings receiving a 2 versus 4% receiving the highest score of 4.

-

All of the 52 crossings selected for Step II based on the community criteria alone received the high score of 4. Of the remaining 150 crossings selected based on the remaining higher aggregate score for all criteria, 2 crossings received a score of 4, 121 crossings received a community score of 3, and 29 received a community score of 2.

PREVIOUSLY IDENTIFIED PROJECTS



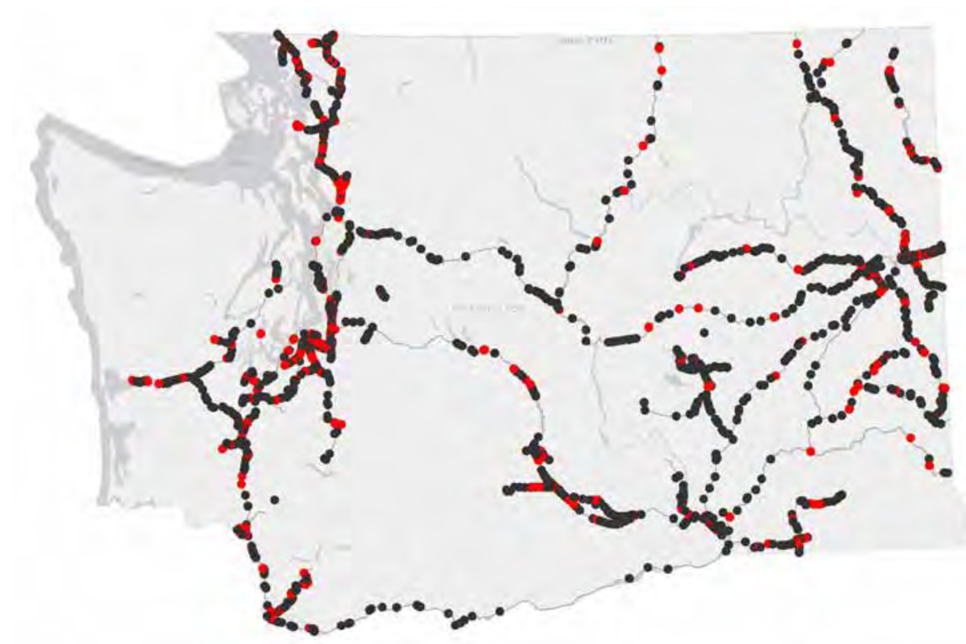
Description
Crossing identified in other local or regional plans and/or projects.

Source
MPO and RTPO Plans

Notes
None

IDENTIFIED	% OF ALL CROSSINGS	SELECTED FOR STEP II
YES	146 (7%)	125 (41%)
NO	2,034 (93%)	177 (59%)

FUNCTIONAL ROAD CLASSIFICATION



Description
The existing road categorized by its functional classification (WSDOT)

Source
WSDOT

Notes
None

CLASS	% OF ALL CROSSINGS	SELECTED FOR STEP II
MINOR COLLECTOR AND BELOW	1,649 (76%)	137 (45%)
MAJOR COLLECTOR AND ABOVE	531 (24%)	165 (55%)

(This Page is Intentionally Blank)

Appendix C

Full Prioritization List of Crossings

(This Page is Intentionally Blank)

Appendix C - Full Prioritization List of Crossings

Rank	Location	City	County	USDOT #	Railroad	RTPO	Mobility Score	Safety Score	Community Score	Branchline Adjustment*	Total Score**	Identified Project by RTPO***	Est. Project Cost (millions)
1	S Lander/3rd	Seattle	King	085584F	BNSF Railway Company	Puget Sound Regional Council	76.56	56.01	88.19	0.00	74.33	S Lander Grade Separation	$140.0
2	W James St	Kent	King	085629K	BNSF Railway Company	Puget Sound Regional Council	71.98	46.23	65.11	0.00	63.82	All 3 Kent projects	$188.0
3	Broad St	Seattle	King	085414L	BNSF Railway Company	Puget Sound Regional Council	72.56	25.95	81.29	0.00	63.09		
4	3rd St SE	Puyallup	Pierce	085695X	BNSF Railway Company	Puget Sound Regional Council	77.72	25.46	68.93	0.00	62.46		
5	15th St SE	Puyallup	Pierce	085691V	BNSF Railway Company	Puget Sound Regional Council	73.73	51.76	47.71	0.00	61.73	Canyon Road Northerly Extension	$68.0
6	SR 536 - Kincaid	Mount Vernon	Skagit	084744N	BNSF Railway Company	Skagit Council of Governments	78.21	20.82	69.57	0.00	61.70	Kincaid St	$5.0
7	S Spokane St EB	Seattle	King	085587B	BNSF Railway Company	Puget Sound Regional Council	65.92	23.92	88.19	0.00	60.99	SoDO Rail Corridor Grade Separations	unknown
8	SR516-Willis St	Kent	King	085640K	BNSF Railway Company	Puget Sound Regional Council	78.42	27.15	59.96	0.00	60.99	Willis St Grade Separation	$81.0
9	88th St NE	Marysville	Snohomish	084650M	BNSF Railway Company	Puget Sound Regional Council	75.18	25.89	64.00	0.00	60.06	SR 529/I-5 interchange, funded	$50.0
10	S Holgate W/O 3	Seattle	King	085583Y	BNSF Railway Company	Puget Sound Regional Council	53.85	44.00	88.19	0.00	59.97	SODO Rail Corridor Grade Separations	$17.0
11	S 212th St	Kent	King	085625H	BNSF Railway Company	Puget Sound Regional Council	79.23	25.77	54.45	0.00	59.67	S 212th Grade Separation	$83.0
12	Pines Rd-SR27	Spokane Valley	Spokane	066367E	BNSF Railway Company	Spokane Regional Transportation Council	82.50	20.65	52.17	0.00	59.45	SR27/SR290 Underpass (Pines Road)	$18.0
13	Park Road	Spokane Valley	Spokane	066377K	BNSF Railway Company	Spokane Regional Transportation Council	78.24	37.51	42.64	0.00	59.16		
14	5th St NW	Puyallup	Pierce	085699A	BNSF Railway Company	Puget Sound Regional Council	65.48	49.30	55.20	0.00	58.87	Canyon Road Northerly Extension	unknown
15	S Horton St	Seattle	King	085585M	BNSF Railway Company	Puget Sound Regional Council	55.20	44.77	80.00	0.00	58.79	SoDO Rail Corridor Grade Separations	unknown
16	West Smith St	Kent	King	085633A	BNSF Railway Company	Puget Sound Regional Council	60.52	45.92	65.11	0.00	58.02	All 3 Kent projects	unknown
17	Meridian St	Puyallup	Pierce	085696E	BNSF Railway Company	Puget Sound Regional Council	71.92	31.41	56.78	0.00	58.01	Canyon Road Northerly Extension	unknown
18	SR528-4th Ave	Marysville	Snohomish	084640G	BNSF Railway Company	Puget Sound Regional Council	75.98	22.97	56.32	0.00	57.81	SR 529/I-5 interchange, funded	unknown
19	Main St	Chehalis	Lewis	092508E	BNSF Railway Company	Southwest Washington RTPO	68.29	31.85	59.74	0.00	57.04		
20	Yakima Ave	Yakima	Yakima	099165Y	BNSF Railway Company	Yakima Valley Conference of Governments	65.71	30.32	58.14	0.00	54.97		
21	Riverside Drive	Mount Vernon	Skagit	084758W	BNSF Railway Company	Skagit Council of Governments	64.79	45.24	43.29	0.00	54.53		
22	F St/Cheney-Spangle	Cheney	Spokane	065970L	BNSF Railway Company	Spokane Regional Transportation Council	59.61	42.33	56.20	0.00	54.44		
23	SR 20 - Avon	Burlington	Skagit	084766N	BNSF Railway Company	Skagit Council of Governments	76.38	27.78	37.18	0.00	54.43		
24	Willis St - SR516	Kent	King	396581U	Union Pacific Railroad Company	Puget Sound Regional Council	67.95	25.71	53.08	0.00	53.67	Willis St Grade Separation	$81.0
25	5th St SE	Puyallup	Pierce	085694R	BNSF Railway Company	Puget Sound Regional Council	59.88	37.60	56.86	0.00	53.55	Canyon Road Northerly Extension	unknown
26	College - SR 538	Mount Vernon	Skagit	084759D	BNSF Railway Company	Skagit Council of Governments	60.98	37.69	54.33	0.00	53.50	College Way RR grade separation	$17.0
27	15th St SW	Auburn	King	396593N	Union Pacific Railroad Company	Puget Sound Regional Council	65.20	22.07	60.73	0.00	53.30	BNSF Yard Grade Sep Project	$35.0
28	S Spokane St WB	Seattle	King	085586U	BNSF Railway Company	Puget Sound Regional Council	58.53	19.98	75.41	0.00	53.11	SoDO Rail Corridor Grade Separations	unknown
29	F Street	Bellingham	Whatcom	077846P	BNSF Railway Company	Whatcom Council of Governments	46.37	34.66	79.72	0.00	51.78		
30	Argonne Rd	Millwood	Spokane	662514H	Union Pacific Railroad Company	Spokane Regional Transportation Council	73.76	24.68	34.11	0.00	51.58		
31	116th St NE	Marysville	Snohomish	084654P	BNSF Railway Company	Puget Sound Regional Council	68.13	24.03	44.15	0.00	51.11		
32	37th St NW	Auburn	King	085647H	BNSF Railway Company	Puget Sound Regional Council	55.22	34.41	57.70	0.00	50.64		
33	SR104-Main St	Edmonds	Snohomish	085445K	BNSF Railway Company	Puget Sound Regional Council	58.16	37.34	48.14	0.00	50.45	Edmonds Grade Separation	unknown
34	Fairhaven	Burlington	Skagit	084765G	BNSF Railway Company	Skagit Council of Governments	50.82	40.54	59.31	0.00	50.38		
35	Wall St	Seattle	King	085410J	BNSF Railway Company	Puget Sound Regional Council	56.50	36.24	51.80	0.00	50.26		
36	Barker Rd	Spokane Valley	Spokane	066244T	BNSF Railway Company	Spokane Regional Transportation Council	72.62	15.04	39.52	0.00	49.95	Barker Rd Overpass	$29.0
37	E Locust St	Centralia	Lewis	092519S	BNSF Railway Company	Southwest Washington RTPO	54.23	54.96	36.32	0.00	49.94		
38	Pines Rd/SR27	Spokane Valley	Spokane	662519S	Union Pacific Railroad Company	Spokane Regional Transportation Council	65.09	24.76	42.06	0.00	49.25		
39	Clay St	Seattle	King	085413E	BNSF Railway Company	Puget Sound Regional Council	51.27	52.13	41.71	0.00	49.10		
40	Union Ave	Steilacoom	Pierce	085755E	BNSF Railway Company	Puget Sound Regional Council	57.29	48.46	33.29	0.00	49.08		
41	Washington Ave	Yakima	Yakima	099169B	BNSF Railway Company	Yakima Valley Conference of Governments	50.28	28.68	63.84	0.00	48.27	Washington Ave RR Grade Sep	$20.0
42	Park Rd at Trent	Spokane Valley	Spokane	066378S	BNSF Railway Company	Spokane Regional Transportation Council	65.88	20.58	40.04	0.00	48.10		
43	C St SW	Auburn	King	085661D	BNSF Railway Company	Puget Sound Regional Council	43.60	69.53	35.51	0.00	48.06		
44	3rd St NW	Auburn	King	085652E	BNSF Railway Company	Puget Sound Regional Council	48.35	34.57	60.31	0.00	47.89		
45	Main St West	Auburn	King	085655A	BNSF Railway Company	Puget Sound Regional Council	47.29	41.82	54.31	0.00	47.68		
46	Mission Ave	Spokane	Spokane	662503V	Union Pacific Railroad Company	Spokane Regional Transportation Council	62.14	23.43	42.52	0.00	47.56		
47	C St	Bellingham	Whatcom	084815H	BNSF Railway Company	Whatcom Council of Governments	41.11	51.12	55.33	0.00	47.17		
48	Vista Rd	Spokane Valley	Spokane	066375W	BNSF Railway Company	Spokane Regional Transportation Council	58.47	44.00	27.67	0.00	47.15		
49	Old 99/Blackburn	Mount Vernon	Skagit	084739S	BNSF Railway Company	Skagit Council of Governments	51.56	26.74	58.42	0.00	47.07		
50	Walnut St - SR505/603	Winlock	Lewis	092493S	BNSF Railway Company	Southwest Washington RTPO	56.45	27.86	46.41	0.00	46.79		
51	32nd St/Russell	Washougal	Clark	090117D	BNSF Railway Company	Southwest Washington Regional Transportation Council	68.02	16.24	34.77	0.00	46.77	27th St ext and RR overpass, new crossing	$16.0
52	N Fruitland St	Kennewick	Benton	104572R	BNSF Railway Company	Benton-Franklin Council of Governments	46.60	27.15	65.67	0.00	46.50		
53	12th St NW	Puyallup	Pierce	085701Y	BNSF Railway Company	Puget Sound Regional Council	54.51	43.21	32.36	0.00	46.15		
54	Flora Rd	Spokane Valley	Spokane	066245A	BNSF Railway Company	Spokane Regional Transportation Council	63.58	25.28	31.60	0.00	46.01		
55	Harvard Rd	Spokane	Spokane	066240R	BNSF Railway Company	Spokane Regional Transportation Council	62.43	27.19	31.80	0.00	45.96		
56	McCarver St	Tacoma	Pierce	085730J	BNSF Railway Company	Puget Sound Regional Council	51.83	41.95	38.21	0.00	45.96		

Appendix C - Full Prioritization List of Crossings

Rank	Location	City	County	USDOT #	Railroad	RTPO	Mobility Score	Safety Score	Community Score	Branchline Adjustment*	Total Score**	Identified Project by RTPO***	Est. Project Cost (millions)
57	Washington St	Napavine	Lewis	092504C	BNSF Railway Company	Southwest Washington RTPO	58.21	44.07	22.24	0.00	45.68		
58	SR203-Lewis St	Monroe	Snohomish	084564R	BNSF Railway Company	Puget Sound Regional Council	53.94	27.31	46.12	0.00	45.33		
59	Norton at 23rd	Everett	Snohomish	084620V	BNSF Railway Company	Puget Sound Regional Council	34.00	37.59	72.57	0.00	44.54		
60	Grandview Rd/SR 548	Ferndale	Whatcom	084841X	BNSF Railway Company	Whatcom Council of Governments	53.39	20.67	49.47	0.00	44.23		
61	Main St	Centralia	Lewis	092520L	BNSF Railway Company	Southwest Washington RTPO	59.06	31.26	27.32	0.00	44.17		
62	Gowe St	Kent	King	085637C	BNSF Railway Company	Puget Sound Regional Council	40.43	49.38	46.06	0.00	44.07	All 3 Kent projects	$188.0
63	Maple St	Sumner	Pierce	085685S	BNSF Railway Company	Puget Sound Regional Council	47.50	46.02	34.01	0.00	43.76		
64	Pine St	Cheney	Spokane	066315M	BNSF Railway Company	Spokane Regional Transportation Council	45.41	29.90	52.04	0.00	43.19		
65	Vista Rd NML	Spokane Valley	Spokane	066376D	BNSF Railway Company	Spokane Regional Transportation Council	58.47	26.92	28.57	0.00	43.11		
66	7th St NW	Puyallup	Pierce	085700S	BNSF Railway Company	Puget Sound Regional Council	52.72	26.68	39.70	0.00	42.95		
67	E Marg at S Spok	Seattle	King	096445R	BNSF Railway Company	Puget Sound Regional Council	56.07	67.93	71.36	-20.00	42.86		
68	Cornwall Ave	Bellingham	Whatcom	084806J	BNSF Railway Company	Whatcom Council of Governments	32.29	29.04	77.67	0.00	42.82		
69	S 212th St	Kent	King	396575R	Union Pacific Railroad Company	Puget Sound Regional Council	50.95	24.74	43.88	0.00	42.63	S 212th Grade Separation	$83.0
70	Zehnder Rd	Sumner	Pierce	085680H	BNSF Railway Company	Puget Sound Regional Council	38.91	42.31	50.06	0.00	42.55		
71	W "A" St at South 1st Avenue	Pasco	Franklin	089707D	BNSF Railway Company	Benton-Franklin Council of Governments	50.27	21.06	47.29	0.00	42.22	A Street Overpass	$10.0
72	136th St NE	Marysville	Snohomish	084664V	BNSF Railway Company	Puget Sound Regional Council	57.72	20.95	32.08	0.00	42.12		
73	So 259th St	Kent	King	085642Y	BNSF Railway Company	Puget Sound Regional Council	47.11	23.02	49.18	0.00	41.60	All 3 Kent projects	$188.0
74	West St	Chehalis	Lewis	092512U	BNSF Railway Company	Southwest Washington RTPO	55.71	25.09	29.73	0.00	41.56		
75	Titus St	Kent	King	085639R	BNSF Railway Company	Puget Sound Regional Council	37.08	49.43	42.60	0.00	41.55	All 3 Kent projects	$188.0
76	Prindle St	Chehalis	Lewis	092511M	BNSF Railway Company	Southwest Washington RTPO	40.11	32.02	53.14	0.00	41.35		
77	Center St	Chehalis	Lewis	092510F	BNSF Railway Company	Southwest Washington RTPO	40.11	31.84	53.14	0.00	41.30		
78	West James St	Kent	King	396578L	Union Pacific Railroad Company	Puget Sound Regional Council	44.95	22.46	52.82	0.00	41.30		
79	SR 22-Buena Way/SR 71	Toppenish	Yakima	099190G	BNSF Railway Company	Yakima Valley Conference of Governments	53.66	28.53	28.93	0.00	41.19		
80	Cook Rd	Burlington	Skagit	084775M	BNSF Railway Company	Skagit Council of Governments	59.36	15.04	30.58	0.00	41.09	Cook Road Grade Separation	$30.0
81	N Edison St	Kennewick	Benton	104568B	BNSF Railway Company	Benton-Franklin Council of Governments	44.48	16.67	58.53	0.00	41.04	Edison/BNSF Grade Separation	$13.0
82	Cheney-Plaza Rd	Cheney	Spokane	065971T	BNSF Railway Company	Spokane Regional Transportation Council	52.29	28.71	29.94	0.00	40.81		
83	Birch Bay - Lynden Road	Blaine	Whatcom	084845A	BNSF Railway Company	Whatcom Council of Governments	57.88	20.67	26.71	0.00	40.78		
84	S 228th St	Kent	King	396576X	Union Pacific Railroad Company	Puget Sound Regional Council	40.61	18.22	63.07	0.00	40.63	S 228th Grade Separation	$23.9
85	N Kellogg St	Kennewick	Benton	919073D	BNSF Railway Company	Benton-Franklin Council of Governments	39.72	20.67	61.92	0.00	40.51		
86	E "I" St	Yakima	Yakima	098492F	BNSF Railway Company	Yakima Valley Conference of Governments	42.34	24.03	52.08	0.00	40.20		
87	Rich Rd SE	Olympia	Thurston	085775R	BNSF Railway Company	Thurston Regional Planning Council	48.88	30.43	30.04	0.00	39.56		
88	Marine Dr	Blaine	Whatcom	084856M	BNSF Railway Company	Whatcom Council of Governments	51.15	29.28	26.45	0.00	39.50		
89	G St at N 1st	Yakima	Yakima	098447L	Central Washington Railroad Company	Yakima Valley Conference of Governments	59.84	39.21	78.90	-20.00	39.45	N. 1st Revitalization, Ph 2	$9.5
90	E Main St	Monroe	Snohomish	084560N	BNSF Railway Company	Puget Sound Regional Council	35.43	43.68	43.08	0.00	39.41		
91	Maple St	Centralia	Lewis	092521T	BNSF Railway Company	Southwest Washington RTPO	52.01	31.81	21.79	0.00	39.40		
92	Meeker St	Kent	King	085636V	BNSF Railway Company	Puget Sound Regional Council	40.93	27.27	46.58	0.00	38.93	All 3 Kent projects	$188.0
93	Vine St	Seattle	King	085411R	BNSF Railway Company	Puget Sound Regional Council	45.19	24.15	41.15	0.00	38.92		
94	Main St	Sumner	Pierce	085683D	BNSF Railway Company	Puget Sound Regional Council	46.40	20.14	41.41	0.00	38.59		
95	Marg/Dawson/SR-99	Seattle	King	809566M	Union Pacific Railroad Company	Puget Sound Regional Council	67.34	45.11	54.28	-20.00	38.52		
96	172 St NE/SR531	Marysville	Snohomish	084669E	BNSF Railway Company	Puget Sound Regional Council	54.02	17.55	28.14	0.00	38.43		
97	Mill St	Kelso	Cowlitz	092458D	BNSF Railway Company	Southwest Washington RTPO	32.13	54.35	34.43	0.00	38.26	South Kelso RR crossing	$23.6
98	East "A" St	Pasco	Franklin	089541B	BNSF Railway Company	Benton-Franklin Council of Governments	44.37	25.25	39.04	0.00	38.26		
99	W Summa St	Centralia	Lewis	092515P	BNSF Railway Company	Southwest Washington RTPO	43.56	40.52	25.37	0.00	38.25		
100	Puyallup St	Sumner	Pierce	101387L	BNSF Railway Company	Puget Sound Regional Council	46.56	24.09	34.09	0.00	37.83		
101	Dayton St	Edmonds	Snohomish	085439G	BNSF Railway Company	Puget Sound Regional Council	30.53	40.53	49.03	0.00	37.66	Edmonds Grade Separation	unknown
102	Wharf/Pine	Bellingham	Whatcom	396920W	BNSF Railway Company	Whatcom Council of Governments	33.82	29.27	52.68	0.00	37.40		
103	University Rd	Spokane Valley	Spokane	066371U	BNSF Railway Company	Spokane Regional Transportation Council	51.76	22.60	22.03	0.00	37.03		
104	Freya at Alki	Spokane	Spokane	066402R	BNSF Railway Company	Spokane Regional Transportation Council	69.09	49.40	40.46	-20.00	37.01		
105	SR 506-7th St	Vader	Lewis	092484T	BNSF Railway Company	Southwest Washington RTPO	41.14	22.33	43.14	0.00	36.94		
106	4th at Jefferson	Olympia	Thurston	807851E	Union Pacific Railroad Company	Thurston Regional Planning Council	66.59	46.24	47.67	-20.00	36.77		
107	Idaho Rd	Spokane	Spokane	066236B	BNSF Railway Company	Spokane Regional Transportation Council	51.87	22.33	21.00	0.00	36.77		
108	E Floral Ave	Centralia	Lewis	092514H	BNSF Railway Company	Southwest Washington RTPO	41.64	37.98	24.37	0.00	36.41		
109	Freya St	Spokane	Spokane	809122U	Union Pacific Railroad Company	Spokane Regional Transportation Council	71.09	41.40	39.76	-20.00	35.84		
110	16th S/EMarg	Seattle	King	809660B	Union Pacific Railroad Company	Puget Sound Regional Council	64.07	49.51	45.13	-20.00	35.70		
111	Sunnyside Beach Pedestrian Xin	Steilacoom	Pierce	085754X	BNSF Railway Company	Puget Sound Regional Council	32.12	64.69	13.45	0.00	35.60		
112	S 19th St West	Tacoma	Pierce	085743K	BNSF Railway Company	Puget Sound Regional Council	33.07	47.69	28.34	0.00	35.54		

Appendix C - Full Prioritization List of Crossings

Rank	Location	City	County	USDOT #	Railroad	RTPO	Mobility Score	Safety Score	Community Score	Branchline Adjustment*	Total Score**	Identified Project by RTPO***	Est. Project Cost (millions)
113	Mead Ave	Yakima	Yakima	099168U	BNSF Railway Company	Yakima Valley Conference of Governments	28.70	29.51	55.24	0.00	35.54	Mead Ave RR Grade Separation	$20.0
114	Greenleaf Avenue	Burlington	Skagit	084764A	BNSF Railway Company	Skagit Council of Governments	31.48	48.28	30.72	0.00	35.49		
115	52nd St E	Puyallup	Pierce	085706H	BNSF Railway Company	Puget Sound Regional Council	44.30	28.85	24.32	0.00	35.44		
116	Bell Rd-SR 548	Blaine	Whatcom	084853S	BNSF Railway Company	Whatcom Council of Governments	45.69	22.60	26.44	0.00	35.11		
117	Division St	Ritzville	Adams	089658J	BNSF Railway Company	Quad-County RTPO	45.67	30.15	18.72	0.00	35.05		
118	Jefferson St	Ritzville	Adams	089660K	BNSF Railway Company	Quad-County RTPO	37.23	47.16	18.08	0.00	34.93		
119	State at Jefferson	Olympia	Thurston	807852L	Union Pacific Railroad Company	Thurston Regional Planning Council	62.98	46.10	46.99	-20.00	34.76		
120	McKinzey Rd	Spokane	Spokane	066239W	BNSF Railway Company	Spokane Regional Transportation Council	44.87	28.04	21.12	0.00	34.72		
121	West Smith Ave	Kent	King	396579T	Union Pacific Railroad Company	Puget Sound Regional Council	32.84	23.58	49.60	0.00	34.72		
122	W Ahtanum	Union Gap	Yakima	099170V	BNSF Railway Company	Yakima Valley Conference of Governments	40.26	22.19	35.85	0.00	34.64	Regional Beltway Phase II	$19.0
123	Grove St	Marysville	Snohomish	084646X	BNSF Railway Company	Puget Sound Regional Council	37.85	29.50	33.09	0.00	34.57	SR 529/I-5 interchange, funded	unknown
124	S Lander at 7th S	Seattle	King	101004G	BNSF Railway Company	Puget Sound Regional Council	50.00	49.95	68.19	-20.00	34.53		
125	66th Ave at Stewart Ave E	Puyallup	Pierce	085703M	BNSF Railway Company	Puget Sound Regional Council	44.22	25.34	24.22	0.00	34.50		
126	Fir Island Rd	Mount Vernon	Skagit	084734H	BNSF Railway Company	Skagit Council of Governments	35.80	20.67	45.65	0.00	34.48		
127	SR 3/S 1st St	Shelton	Mason	856745E	Simpson Lumber Company, LLC	Peninsula RTPO	61.34	45.13	49.92	-20.00	34.43		
128	184th Ave	Tenino	Thurston	085784P	BNSF Railway Company	Thurston Regional Planning Council	49.43	22.33	16.34	0.00	34.38		
129	Division St	Cashmere	Chelan	084464L	BNSF Railway Company	Chelan - Douglas Transportation Council	32.96	32.67	38.35	0.00	34.24		
130	Toppenish Ave	Toppenish	Yakima	099191N	BNSF Railway Company	Yakima Valley Conference of Governments	39.49	30.16	27.67	0.00	34.20		
131	Sagemoor Rd	Pasco	Franklin	089700F	BNSF Railway Company	Benton-Franklin Council of Governments	36.68	20.67	41.72	0.00	33.94		
132	N Washington St	Kennewick	Benton	104574E	BNSF Railway Company	Benton-Franklin Council of Governments	39.11	22.22	34.52	0.00	33.74		
133	1st St	Lind	Adams	089672E	BNSF Railway Company	Quad-County RTPO	44.23	29.95	16.37	0.00	33.70		
134	Sixth Ave	Tacoma	Pierce	085742D	BNSF Railway Company	Puget Sound Regional Council	32.32	45.75	24.15	0.00	33.64		
135	SR 397/Oregon Ave	Pasco	Franklin	101351D	BNSF Railway Company	Benton-Franklin Council of Governments	35.81	38.38	24.28	0.00	33.57	Oregon RR Overpass (SR397)	$10.0
136	Davidson Avenue	Woodland	Cowlitz	092435W	BNSF Railway Company	Southwest Washington RTPO	32.96	26.46	41.45	0.00	33.46		
137	Montgomery Dr	Spokane Valley	Spokane	662517D	Union Pacific Railroad Company	Spokane Regional Transportation Council	34.00	27.14	37.93	0.00	33.27		
138	Herman Rd	0	Adams	089677N	BNSF Railway Company	Quad-County RTPO	33.13	50.33	15.94	0.00	33.14		
139	Slater Rd	Bellingham	Whatcom	084829R	BNSF Railway Company	Whatcom Council of Governments	30.28	26.05	45.65	0.00	33.06		
140	Toteff-Hendrick	Kalama	Cowlitz	092446J	BNSF Railway Company	Southwest Washington RTPO	46.42	22.33	16.78	0.00	32.99		
141	Lander St S/5th	Seattle	King	809503H	Union Pacific Railroad Company	Puget Sound Regional Council	60.25	22.18	68.19	-20.00	32.72		
142	Klickitat SW-S Spokane	Seattle	King	096451U	BNSF Railway Company	Puget Sound Regional Council	56.34	41.91	56.13	-20.00	32.68		
143	Sixth St	Bucoda	Thurston	085786D	BNSF Railway Company	Thurston Regional Planning Council	47.96	18.33	16.37	0.00	32.65		
144	Rich Rd SE (E Olympia)	Olympia	Thurston	085773C	BNSF Railway Company	Thurston Regional Planning Council	44.16	20.28	21.45	0.00	32.51		
145	Adams St	Ritzville	Adams	089659R	BNSF Railway Company	Quad-County RTPO	39.25	30.37	21.02	0.00	32.47		
146	Wilbur/City Rd	Lind	Adams	089673L	BNSF Railway Company	Quad-County RTPO	41.56	29.51	16.83	0.00	32.37		
147	Wildlife Refuge Rd	Ridgefield	Clark	092425R	BNSF Railway Company	Southwest Washington Regional Transportation Council	34.16	45.14	15.93	0.00	32.35	Ridgefield Wildlife Refuge Access	unknown
148	Mission Ave	Spokane	Spokane	065984U	BNSF Railway Company	Spokane Regional Transportation Council	58.23	46.39	45.87	-20.00	32.18		
149	Hampton Rd	Hatton	Adams	089682K	BNSF Railway Company	Quad-County RTPO	32.01	48.67	15.75	0.00	32.11		
150	Cowlitz Ave	Castle Rock	Cowlitz	092476B	BNSF Railway Company	Southwest Washington RTPO	31.30	46.84	17.62	0.00	31.77		
151	Sheffield Rd	Mesa	Franklin	089695L	BNSF Railway Company	Benton-Franklin Council of Governments	38.31	32.67	17.76	0.00	31.76		
152	Section St	Mount Vernon	Skagit	084741T	BNSF Railway Company	Skagit Council of Governments	33.51	29.23	30.36	0.00	31.65	Kincaid St	$5.0
153	Sumner Hts. Dr	Sumner	Pierce	400133W	Union Pacific Railroad Company	Puget Sound Regional Council	38.27	28.93	20.43	0.00	31.47		
154	Hanaford Valley Rd	Centralia	Lewis	092523G	BNSF Railway Company	Southwest Washington RTPO	41.51	22.33	20.36	0.00	31.43		
155	County Road #9220	Sprague	Lincoln	089645H	BNSF Railway Company	Quad-County RTPO	42.34	25.85	15.12	0.00	31.42		
156	Fryelands Blvd	Monroe	Snohomish	084571B	BNSF Railway Company	Puget Sound Regional Council	40.02	25.58	19.46	0.00	31.27		
157	Anderson Rd/Fode Road 800 E	Lind	Adams	089667H	BNSF Railway Company	Quad-County RTPO	30.02	48.67	16.08	0.00	31.20		
158	Columbia St	Ritzville	Adams	089657C	BNSF Railway Company	Quad-County RTPO	38.69	29.88	17.29	0.00	31.14		
159	Seidl Rd	Ritzville	Adams	089653A	BNSF Railway Company	Quad-County RTPO	30.05	48.67	15.53	0.00	31.07		
160	Mullinix Rd	Cheney	Spokane	089624P	BNSF Railway Company	Spokane Regional Transportation Council	38.73	21.28	24.17	0.00	30.73		
161	1st St	Marysville	Snohomish	084630B	BNSF Railway Company	Puget Sound Regional Council	29.13	26.07	37.08	0.00	30.35	SR 529/I-5 interchange, funded	$37.8
162	Beach Drive	Vancouver	Clark	090072Y	BNSF Railway Company	Southwest Washington Regional Transportation Council	32.90	40.63	13.91	0.00	30.08		
163	6th St	Prosser	Benton	104547H	BNSF Railway Company	Benton-Franklin Council of Governments	21.56	24.59	51.58	0.00	29.82	6th St	$0.6
164	Spokane St S	Seattle	King	809501U	Union Pacific Railroad Company	Puget Sound Regional Council	49.95	30.68	68.19	-20.00	29.69		
165	S River St/Yew St	Kelso	Cowlitz	092457W	BNSF Railway Company	Southwest Washington RTPO	33.34	28.88	23.19	0.00	29.68	South Kelso RR crossing	$23.6
166	Division St	Ridgefield	Clark	092428L	BNSF Railway Company	Southwest Washington Regional Transportation Council	34.92	31.02	17.18	0.00	29.51	Pioneer St Rail Overpass	$10.4
167	Mill St	Ridgefield	Clark	092426X	BNSF Railway Company	Southwest Washington Regional Transportation Council	34.74	31.60	16.89	0.00	29.49	Pioneer St Rail Overpass	$10.4
168	Fir St	Winlock	Lewis	092494Y	BNSF Railway Company	Southwest Washington RTPO	34.05	32.01	17.65	0.00	29.44		

Appendix C - Full Prioritization List of Crossings

Rank	Location	City	County	USDOT #	Railroad	RTPO	Mobility Score	Safety Score	Community Score	Branchline Adjustment*	Total Score**	Identified Project by RTPO***	Est. Project Cost (millions)
169	Pease Rd	Burlington	Skagit	084763T	BNSF Railway Company	Skagit Council of Governments	32.65	26.46	25.92	0.00	29.42		
170	Eltopia Rd W	Pasco	Franklin	089699N	BNSF Railway Company	Benton-Franklin Council of Governments	39.96	20.67	17.08	0.00	29.42		
171	Eighth St	Marysville	Snohomish	084644J	BNSF Railway Company	Puget Sound Regional Council	26.21	28.18	36.95	0.00	29.39	SR 529/I-5 interchange, funded	$37.8
172	Hawley St	Wenatchee	Chelan	065840P	BNSF Railway Company	Chelan - Douglas Transportation Council	23.11	43.58	27.55	0.00	29.34	Hawley Street Grade Separation	$22.0
173	Marvin Rd	Lacey	Thurston	085768F	BNSF Railway Company	Thurston Regional Planning Council	36.30	18.33	26.23	0.00	29.29		
174	143rd SE/McDuff	Tenino	Thurston	085780M	BNSF Railway Company	Thurston Regional Planning Council	40.47	19.68	16.00	0.00	29.15		
175	3rd Ave SW/SE Blvd	Ephrata	Grant	065779N	BNSF Railway Company	Quad-County RTPO	10.95	52.10	42.29	0.00	29.07		
176	6th St	Washougal	Clark	090112U	BNSF Railway Company	Southwest Washington Regional Transportation Council	38.02	23.51	16.56	0.00	29.03		
177	Avery Rd	Napavine	Lewis	092501G	BNSF Railway Company	Southwest Washington RTPO	39.21	22.33	15.35	0.00	29.02		
178	Selph Landing Rd	Pasco	Franklin	089702U	BNSF Railway Company	Benton-Franklin Council of Governments	37.59	22.33	17.88	0.00	28.85		
179	Russell Rd	Mesa	Franklin	089697A	BNSF Railway Company	Benton-Franklin Council of Governments	38.40	20.67	17.87	0.00	28.83		
180	Hills Rd	Ritzville	Adams	089651L	BNSF Railway Company	Quad-County RTPO	39.36	20.67	15.93	0.00	28.83		
181	Bauman Rd	Ritzville	Adams	089656V	BNSF Railway Company	Quad-County RTPO	37.11	25.45	15.61	0.00	28.82		
182	24th St SE	Sumner	Pierce	085675L	BNSF Railway Company	Puget Sound Regional Council	29.17	37.45	18.78	0.00	28.64	Stewart St Grade Separation	$23.1
183	Cunningham Rd	0	Adams	089680W	BNSF Railway Company	Quad-County RTPO	38.10	22.33	15.87	0.00	28.60		
184	Sage Rd	Ritzville	Adams	089655N	BNSF Railway Company	Quad-County RTPO	39.04	20.67	15.51	0.00	28.56		
185	Hatton Rd	Hatton	Adams	089683S	BNSF Railway Company	Quad-County RTPO	38.15	20.67	15.93	0.00	28.22		
186	Campbell Ave-Pedestrian	0	Lewis	092491D	BNSF Railway Company	Southwest Washington RTPO	34.32	28.58	15.48	0.00	28.18		
187	S 10th Ave	Pasco	Franklin	090017Y	BNSF Railway Company	Benton-Franklin Council of Governments	56.63	43.43	35.74	-20.00	28.11	Lewis St Overpass	$27.0
188	8th St E/Stewart	Pacific	Pierce	396597R	Union Pacific Railroad Company	Puget Sound Regional Council	32.90	25.58	20.81	0.00	28.05	Stewart St Grade Separation	$23.1
189	W Meeker St	Kent	King	396580M	Union Pacific Railroad Company	Puget Sound Regional Council	20.12	29.59	41.89	0.00	27.93		
190	100th St SW	Lakewood	Pierce	085402S	Tacoma Municipal Belt Line	Puget Sound Regional Council	64.76	23.55	36.95	-20.00	27.51		
191	McDonald Rd E	Prosser	Yakima	099189M	BNSF Railway Company	Yakima Valley Conference of Governments	21.09	36.36	31.14	0.00	27.42	BNSF/ E McDonald Rd, Track Circuitry	unknown
192	271st St NW	Stanwood	Snohomish	084687C	BNSF Railway Company	Puget Sound Regional Council	29.80	24.49	25.31	0.00	27.35		
193	Paha Packard Rd	Lind	Adams	089665U	BNSF Railway Company	Quad-County RTPO	36.21	20.67	15.74	0.00	27.21		
194	11th & Thorne	Tacoma	Pierce	852623L	Tacoma Municipal Belt Line	Puget Sound Regional Council	56.98	41.51	33.31	-20.00	27.19		
195	Pine Springs Rd	0	Spokane	089630T	BNSF Railway Company	Spokane Regional Transportation Council	36.32	20.67	15.22	0.00	27.13		
196	W Clark St	Connell	Franklin	089686M	BNSF Railway Company	Benton-Franklin Council of Governments	33.42	29.90	11.73	0.00	27.12		
197	Bowles Rd 9713	Kennewick	Benton	090038S	BNSF Railway Company	Benton-Franklin Council of Governments	34.92	20.67	17.82	0.00	27.08		
198	Whalen Rd	Woodland	Cowlitz	092434P	BNSF Railway Company	Southwest Washington RTPO	31.05	27.59	18.51	0.00	27.05		
199	Conner Rd	Bucoda	Thurston	085789Y	BNSF Railway Company	Thurston Regional Planning Council	30.11	30.85	14.06	0.00	26.29		
200	Lind-Hatton Rd/Providence Rd	0	Adams	089676G	BNSF Railway Company	Quad-County RTPO	33.16	22.33	16.29	0.00	26.24		
201	Atchinson Rd	Olympia	Thurston	085770G	BNSF Railway Company	Thurston Regional Planning Council	30.84	22.33	20.41	0.00	26.11		
202	W Scott Ave	Woodland	Cowlitz	092437K	BNSF Railway Company	Southwest Washington RTPO	30.90	25.20	16.37	0.00	25.84		
203	Lowell-River Rd/Lenora Street	Everett	Snohomish	084594H	BNSF Railway Company	Puget Sound Regional Council	16.90	46.88	22.61	0.00	25.82		
204	Jordan Rd	Napavine	Lewis	092502N	BNSF Railway Company	Southwest Washington RTPO	30.34	26.97	15.51	0.00	25.79		
205	Broadway at Lake	0	Spokane	809328U	Union Pacific Railroad Company	Spokane Regional Transportation Council	53.88	49.46	25.91	-20.00	25.78		
206	Andover Park W	Tukwila	King	400117M	Union Pacific Railroad Company	Puget Sound Regional Council	42.97	50.50	46.65	-20.00	25.77		
207	Larson Rd/227TH	Stanwood	Snohomish	084677W	BNSF Railway Company	Puget Sound Regional Council	31.05	25.19	15.65	0.00	25.74		
208	Heineman Rd	Ritzville	Adams	089663F	BNSF Railway Company	Quad-County RTPO	33.09	20.67	15.58	0.00	25.61		
209	Somerville Rd	Napavine	Lewis	092505J	BNSF Railway Company	Southwest Washington RTPO	30.19	25.58	16.31	0.00	25.56		
210	NW 122nd St	Vancouver	Clark	092421N	BNSF Railway Company	Southwest Washington Regional Transportation Council	30.38	22.33	18.62	0.00	25.43		
211	Hawkins Rd	Winlock	Lewis	092497U	BNSF Railway Company	Southwest Washington RTPO	30.12	24.97	15.88	0.00	25.27		
212	SR20-Burlington (Garl)	Burlington	Skagit	092255Y	BNSF Railway Company	Skagit Council of Governments	67.22	19.47	26.80	-20.00	25.18		
213	Kahlotus Rd	Lind	Adams	089670R	BNSF Railway Company	Quad-County RTPO	30.15	24.10	16.26	0.00	25.16		
214	Christy Rd 1110/PSH #8	0	Benton	090056P	BNSF Railway Company	Benton-Franklin Council of Governments	31.04	20.67	17.91	0.00	25.16	Christy Rd BNSF RR Crossing to Plymouth	$3.2
215	Solo Point Rd	Tacoma	Pierce	085758A	BNSF Railway Company	Puget Sound Regional Council	29.98	22.33	18.26	0.00	25.14		
216	Old Cascade Hwy East	Skykomish	King	084515U	BNSF Railway Company	Puget Sound Regional Council	30.56	24.37	14.44	0.00	24.98		
217	SR 23-Sherlock	Harrington	Lincoln	065719E	BNSF Railway Company	Quad-County RTPO	30.83	22.33	15.94	0.00	24.98		
218	SR 9	Sedro Woolley	Skagit	085007H	BNSF Railway Company	Skagit Council of Governments	40.23	44.16	55.30	-20.00	24.98		
219	SR4/Ocean Beach Hwy	Longview	Cowlitz	840536Y	Columbia and Cowlitz Railway Company	Southwest Washington RTPO	55.77	26.08	41.98	-20.00	24.90		
220	Hughes Ave	Blaine	Whatcom	084854Y	BNSF Railway Company	Whatcom Council of Governments	27.07	24.40	20.91	0.00	24.86		
221	SE Chelsea Ave	Vancouver	Clark	090074M	BNSF Railway Company	Southwest Washington Regional Transportation Council	32.17	25.44	9.59	0.00	24.85		
222	29th St NW	Auburn	King	085650R	BNSF Railway Company	Puget Sound Regional Council	23.62	26.80	25.21	0.00	24.81		
223	N Miller St	Wenatchee	Chelan	065839V	BNSF Railway Company	Chelan - Douglas Transportation Council	21.92	27.56	27.21	0.00	24.65	SR 285 Bypass/Confluence Parkway	closure
224	Rogers Rd	Chehalis	Lewis	092506R	BNSF Railway Company	Southwest Washington RTPO	30.26	22.33	15.59	0.00	24.61		

Appendix C - Full Prioritization List of Crossings

Rank	Location	City	County	USDOT #	Railroad	RTPO	Mobility Score	Safety Score	Community Score	Branchline Adjustment*	Total Score**	Identified Project by RTPO***	Est. Project Cost (millions)
225	Orondo St	Wenatchee	Chelan	065831R	BNSF Railway Company	Chelan - Douglas Transportation Council	20.89	24.02	32.42	0.00	24.55	BNSF Wenatchee Switchyard Relocation	$40.0
226	Old Pac Hwy-102nd St - Pioneer	Stanwood	Snohomish	084716K	BNSF Railway Company	Puget Sound Regional Council	29.53	20.67	17.79	0.00	24.38		
227	216th Ave SE	Maple Valley	King	085233G	BNSF Railway Company	Puget Sound Regional Council	24.38	27.72	20.28	0.00	24.19		
228	SR 904	Cheney	Spokane	066317B	Eastern Washington Gateway Railroad	Spokane Regional Transportation Council	53.32	20.21	49.01	-20.00	23.97		
229	Ferrier Rd	Vader	Lewis	092488V	BNSF Railway Company	Southwest Washington RTPO	28.60	22.33	15.57	0.00	23.77		
230	S Forest/7th Av S	Seattle	King	101003A	BNSF Railway Company	Puget Sound Regional Council	36.71	32.94	68.19	-20.00	23.63		
231	Indus Way/SR432	Longview	Cowlitz	101794P	Longview Switching Company	Southwest Washington RTPO	65.77	19.40	23.44	-20.00	23.60	?Industrial Way Oregon Way (SR 432/433)	$85.0
232	Worthen St North	Wenatchee	Chelan	065835T	BNSF Railway Company	Chelan - Douglas Transportation Council	6.72	48.97	31.84	0.00	23.56	BNSF Wenatchee Switchyard Relocation	$40.0
233	Bridgeport Way	Lakewood	Pierce	085821P	Sound Transit	Puget Sound Regional Council	64.00	19.47	26.26	-20.00	23.43		
234	Cowlitz Garden	Kelso	Cowlitz	092466V	BNSF Railway Company	Southwest Washington RTPO	29.18	14.70	20.51	0.00	23.39		
235	Ershig Rd	Burlington	Skagit	084784L	BNSF Railway Company	Skagit Council of Governments	26.46	23.13	15.50	0.00	22.89		
236	SR181-68th Ave	Tukwila	King	400106A	Union Pacific Railroad Company	Puget Sound Regional Council	45.34	30.37	49.76	-20.00	22.70		
237	Fairhaven/Cherry	Burlington	Skagit	092261C	BNSF Railway Company	Skagit Council of Governments	29.53	62.42	48.34	-20.00	22.46		
238	Pacific/Chestnut	Everett	Snohomish	084605T	BNSF Railway Company	Puget Sound Regional Council	24.80	15.42	23.75	0.00	22.19	Everett Avenue Extension	$13.4
239	Holgate Street	Seattle	King	927461X	BNSF Railway Company	Puget Sound Regional Council	39.98	19.72	69.05	-20.00	22.18		
240	Bow Hill Rd	Burlington	Skagit	084785T	BNSF Railway Company	Skagit Council of Governments	26.21	20.67	15.30	0.00	22.10		
241	SR 231/Idaho St	Davenport	Lincoln	058658Y	BNSF Railway Company	Quad-County RTPO	26.28	20.67	14.76	0.00	22.00		
242	Espanola Rd/City Road	Spokane	Spokane	058645X	BNSF Railway Company	Spokane Regional Transportation Council	17.52	36.67	14.52	0.00	21.56		
243	SR-224/Van Giesen #16	Richland	Benton	310386F	Tri-City & Olympia Rail Co/Port of Benton County	Benton-Franklin Council of Governments	60.02	24.31	20.43	-20.00	21.20	SR 224/SR 240 Grade Separation	$48.3
244	Schultz	Harrington	Lincoln	065712G	BNSF Railway Company	Quad-County RTPO	6.88	56.33	14.63	0.00	21.18		
245	S 56th St	Tacoma	Pierce	085392N	Sound Transit	Puget Sound Regional Council	50.91	25.68	35.34	-20.00	20.71		
246	13th Ave SW/R Road	Quincy	Grant	065801Y	BNSF Railway Company	Quad-County RTPO	14.26	28.34	25.89	0.00	20.69		
247	Charlton Rd	Harrington	Lincoln	065722M	BNSF Railway Company	Quad-County RTPO	8.47	50.33	15.38	0.00	20.66		
248	172nd St NE/SR 531	Arlington	Snohomish	092084A	BNSF Railway Company	Puget Sound Regional Council	57.77	25.34	21.23	-20.00	20.53		
249	Barksdale Ave/Dupont Avenue	DuPont	Pierce	085836E	Sound Transit	Puget Sound Regional Council	55.29	19.67	30.12	-20.00	20.09		
250	Brooks Rd	Spokane	Spokane	058642C	BNSF Railway Company	Spokane Regional Transportation Council	20.97	22.76	15.52	0.00	20.05		
251	Central Ave No	Quincy	Grant	065800S	BNSF Railway Company	Quad-County RTPO	12.24	29.83	25.89	0.00	20.05		
252	Starr Rd	Otis Orchards	Spokane	662536H	Union Pacific Railroad Company	Spokane Regional Transportation Council	19.93	22.30	16.79	0.00	19.74		
253	Sill Rd	Marysville	Snohomish	084673U	BNSF Railway Company	Puget Sound Regional Council	18.48	22.70	17.28	0.00	19.24		
254	Coyote Hts/2117	Odessa	Lincoln	065739R	BNSF Railway Company	Quad-County RTPO	5.80	48.67	15.38	0.00	18.91		
255	Old Cascade Hwy W	Skykomish	King	084520R	BNSF Railway Company	Puget Sound Regional Council	19.63	20.67	14.23	0.00	18.54		
256	3rd Ave-SR 432	Longview	Cowlitz	101826T	Longview Switching Company	Southwest Washington RTPO	52.77	26.77	21.72	-20.00	18.51		
257	Steilacoom Blvd SW	Lakewood	Pierce	085400D	Tacoma Municipal Belt Line	Puget Sound Regional Council	46.11	27.40	33.26	-20.00	18.22		
258	Andover Park E	Tukwila	King	400109V	Union Pacific Railroad Company	Puget Sound Regional Council	33.35	39.01	46.88	-20.00	18.15		
259	Rambo Road	Airway Heights	Spokane	058637F	BNSF Railway Company	Spokane Regional Transportation Council	16.52	22.93	14.19	0.00	17.54		
260	Irby Rd #1175	Odessa	Lincoln	065748P	BNSF Railway Company	Quad-County RTPO	8.78	36.67	15.38	0.00	17.40		
261	Main at 5th St	Skykomish	King	084517H	BNSF Railway Company	Puget Sound Regional Council	12.09	30.24	14.22	0.00	17.16		
262	West A St	Pasco	Franklin	090020G	BNSF Railway Company	Benton-Franklin Council of Governments	33.30	48.31	33.29	-20.00	17.05	A Street Overpass	$10.0
263	W Division St	Ephrata	Grant	065778G	BNSF Railway Company	Quad-County RTPO	9.34	30.08	19.33	0.00	17.02		
264	Railway Avenue	Everett	Snohomish	084992M	BNSF Railway Company	Puget Sound Regional Council	11.93	19.65	24.04	0.00	16.89	Everett Avenue Extension	$13.4
265	Knapp Rd/Country Road	Odessa	Lincoln	065728D	BNSF Railway Company	Quad-County RTPO	14.50	22.33	15.39	0.00	16.68		
266	Mohler Rd/2544	Harrington	Lincoln	065727W	BNSF Railway Company	Quad-County RTPO	14.47	22.33	15.38	0.00	16.66		
267	Main St	Ferndale	Whatcom	084843L	BNSF Railway Company	Whatcom Council of Governments	14.97	20.67	15.56	0.00	16.54		
268	Yacht Club Rd	Bellingham	Whatcom	084796F	BNSF Railway Company	Whatcom Council of Governments	14.21	20.67	16.52	0.00	16.40	Yacht Club Rd Quiet Zone	$50.0
269	Hovander Rd	Ferndale	Whatcom	084831S	BNSF Railway Company	Whatcom Council of Governments	13.13	23.63	15.67	0.00	16.39		
270	Waukon Rd 9335	Davenport	Lincoln	058650U	BNSF Railway Company	Quad-County RTPO	14.95	20.67	14.69	0.00	16.31		
271	Berkeley St SW	Lakewood	Pierce	085829U	Sound Transit	Puget Sound Regional Council	35.11	43.57	30.99	-20.00	16.19		
272	Yarwood Rd/County Road	Odessa	Lincoln	065733A	BNSF Railway Company	Quad-County RTPO	13.78	20.67	15.38	0.00	15.90		
273	Downs Rd/2535	Odessa	Lincoln	065730E	BNSF Railway Company	Quad-County RTPO	12.45	22.33	15.38	0.00	15.65		
274	Railroad St/Wilson Creek Loop	Ephrata	Grant	065764Y	BNSF Railway Company	Quad-County RTPO	13.50	20.67	14.86	0.00	15.63		
275	Adams St	Harrington	Lincoln	065720Y	BNSF Railway Company	Quad-County RTPO	12.13	22.33	15.73	0.00	15.58		
276	J Road NE-Stratford Rd NE	Ephrata	Grant	065770C	BNSF Railway Company	Quad-County RTPO	12.20	20.67	14.68	0.00	14.94		
277	SR432-Tennant Way	Longview	Cowlitz	101842C	Longview Switching Company	Southwest Washington RTPO	48.34	16.63	26.18	-20.00	14.87	Industrial Way Oregon Way (SR 432/433)	$85.0
278	Olaf St	Harrington	Lincoln	065718X	BNSF Railway Company	Quad-County RTPO	10.46	22.33	15.37	0.00	14.65		
279	Deno Rd	Spokane	Spokane	058634K	BNSF Railway Company	Spokane Regional Transportation Council	7.49	20.97	21.72	0.00	14.42		
280	E Branch Rd	Toppenish	Yakima	099186S	BNSF Railway Company	Yakima Valley Conference of Governments	8.57	20.67	19.67	0.00	14.37		

Appendix C - Full Prioritization List of Crossings

Rank	Location	City	County	USDOT #	Railroad	RTPO	Mobility Score	Safety Score	Community Score	Branchline Adjustment*	Total Score**	Identified Project by RTPO***	Est. Project Cost (millions)
281	Spokane St WB	Seattle	King	099009M	BNSF Railway Company	Puget Sound Regional Council	29.78	9.06	68.82	-20.00	14.36		
282	19 NE Rd	Ephrata	Grant	065775L	BNSF Railway Company	Quad-County RTPO	9.52	22.26	16.03	0.00	14.33		
283	S 74th St	Tacoma	Pierce	085396R	Sound Transit	Puget Sound Regional Council	42.02	17.10	35.60	-20.00	14.19		
284	108th St SW	Lakewood	Pierce	085404F	Tacoma Municipal Belt Line	Puget Sound Regional Council	37.56	20.07	40.14	-20.00	13.83		
285	Thorne Lane SW	Lakewood	Pierce	085828M	Sound Transit	Puget Sound Regional Council	33.48	44.75	23.02	-20.00	13.68		
286	Stone Rd	Harrington	Lincoln	065724B	BNSF Railway Company	Quad-County RTPO	8.43	22.33	15.37	0.00	13.64		
287	20 NE Rd	Ephrata	Grant	065773X	BNSF Railway Company	Quad-County RTPO	8.92	20.67	15.89	0.00	13.60		
288	Ferry St	Sedro Woolley	Skagit	085008P	BNSF Railway Company	Skagit Council of Governments	29.57	39.00	29.73	-20.00	11.97		
289	Urquhart Ave	Krupp	Grant	065755A	BNSF Railway Company	Quad-County RTPO	5.94	20.67	14.62	0.00	11.79		
290	Indus Way/SR 432	Longview	Cowlitz	840534K	Columbia and Cowlitz Railway Company	Southwest Washington RTPO	40.48	23.42	20.41	-20.00	11.20		
291	Pine St	Tacoma	Pierce	085382H	Tacoma Municipal Belt Line	Puget Sound Regional Council	34.53	18.71	36.39	-20.00	11.04		
292	Fancher Way north of Sprague	Spokane Valley	Spokane	397271D	Union Pacific Railroad Company	Spokane Regional Transportation Council	32.49	29.01	23.65	-20.00	9.41		
293	Henderson Blvd	Tumwater	Thurston	807836C	Union Pacific Railroad Company	Thurston Regional Planning Council	25.81	38.49	27.11	-20.00	9.30		
294	Avon-Allen Rd	Burlington	Skagit	092249V	BNSF Railway Company	Skagit Council of Governments	34.73	25.09	16.87	-20.00	7.86		
295	Euclid Ave-3200 East	Spokane	Spokane	065973G	BNSF Railway Company	Spokane Regional Transportation Council	34.11	25.55	17.03	-20.00	7.70		
296	California Way	Longview	Cowlitz	101821J	Longview Switching Company	Southwest Washington RTPO	23.09	36.36	20.19	-20.00	5.68	Industrial Way Oregon Way (SR 432/433)	$85.0
297	State St	Sedro Woolley	Skagit	085006B	BNSF Railway Company	Skagit Council of Governments	28.07	26.72	15.90	-20.00	4.69		
298	30th Ave	Longview	Cowlitz	840539U	Columbia and Cowlitz Railway Company	Southwest Washington RTPO	22.54	25.20	25.43	-20.00	3.93		
299	Washington Way	Longview	Cowlitz	840535S	Columbia and Cowlitz Railway Company	Southwest Washington RTPO	25.14	23.47	20.27	-20.00	3.51		
300	Cheney-Spokane	Cheney	Spokane	066316U	Eastern Washington Gateway Railroad	Spokane Regional Transportation Council	22.24	25.57	21.09	-20.00	2.78		
301	SR-542	Bellingham	Whatcom	084902L	BNSF Railway Company	Whatcom Council of Governments	25.93	20.67	15.92	-20.00	2.11		
302	Lateral A Rd	Harrah	Yakima	099216G	Yakima Central Railway	Yakima Valley Conference of Governments	13.68	32.67	18.99	-19.75	0.00	White Swan Branch Line, Safety Upgrade	$100.0

NOTE: See Appendix A for a detailed description of the data shown in this list.
* Branchline crossings received an adjustment to the total score to reflect low or no train activity
** Total score reflects the following weighting (Mobility 50%, Safety 25%, Community 25%)
*** Notes whether a project is planned at the crossing or in the vicinity of the crossing. The project could either be grade separation or at-grade safety enhancements. Not every MPO or RTPO responded to the request for information about planned projects, so this information, including the cost estimates, should not be considered complete.

Appendix D

Online Tool Guide

(This Page is Intentionally Blank)

Appendix D: Online Tool Guide

This guide is provided to help users get the most benefits out of the JTC Road-Rail Crossing online tool. The tool was built to help local and state agencies access a statewide database of relevant crossing information, which can be used to prioritize crossing needs and to assist in identifying improvement projects. This guide represents information current as of December 2016. The following topics are discussed:

1. How do I open the online tool on my computer?
2. What do the final rankings represent?
3. How do I find information on a specific crossing?
4. The crossing I want is shown as a black dot (not one of the 302 prominent crossings). How do I find information about those crossings?
5. Can we change the background to something different?
6. Is there a way to compare two crossings side-by-side?
7. Each crossing has lots of data. What are the most relevant things I should know about?
8. Can I search for crossings by their USDOT number?

How do I open the online tool on my computer?

The online tool does not require any special software, but runs on common internet browsers. This works both on desktop and mobile devices. Copy the following internet address (URL) to your web browser address bar:

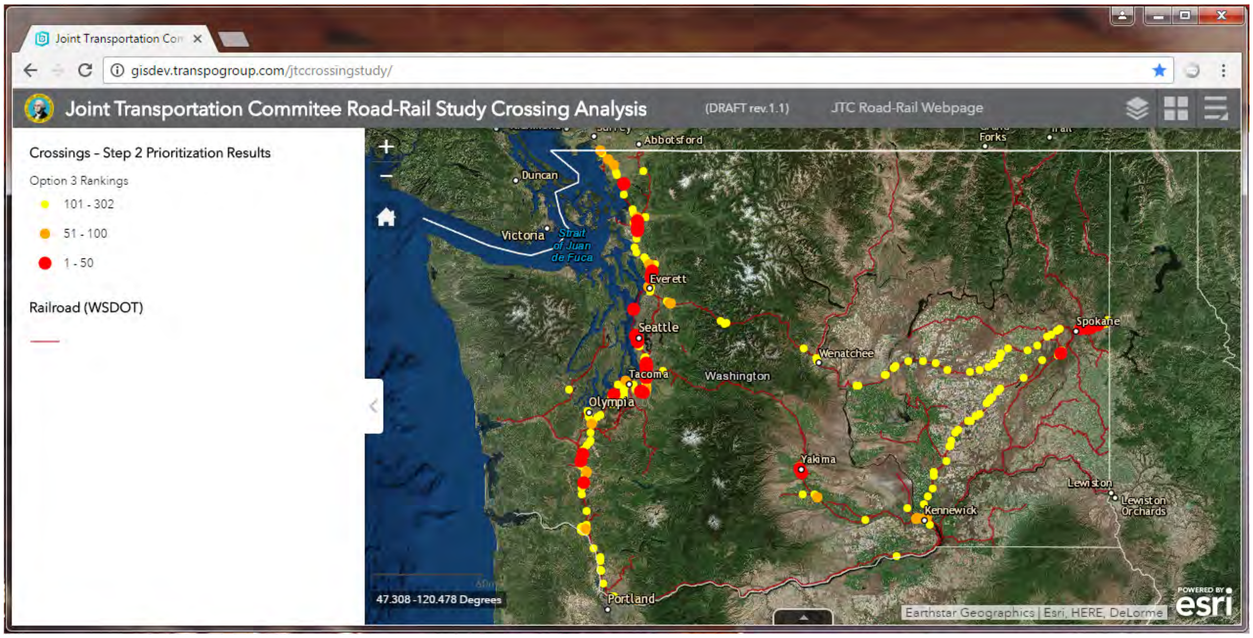
http://gisdev.transpogroup.com/jtccrossingstudy/

The default view is the full state of Washington. To pan around, click-and-drag anywhere on the map. To zoom in click the plus/minus buttons, use the mouse wheel (desktop), or pinch fingers (mobile).

What do the final rankings represent?

In the JTC Road-Rail Crossing Study, a total of 302 prominent crossings were selected from a total of 4,171 crossings within Washington State to be evaluated in more detail and ranked. These 302 prominent crossings are public, at-grade crossings with moderate-to-high train or vehicle volumes. The ranking is how each prominent crossing compared against the other 302 prominent crossings. The ranking represents the final ranking of the crossing based on its final score. A Top 50 ranking means that the crossing is one of the most prominent in the state, looking at statewide criteria related to mobility, safety, and community. A high ranking does not indicate that an improvement project is warranted or feasible, but that communities should consider how to best address the apparent road-rail conflicts at the crossing.

When you first open the tool, only the 302 prominent crossings are shown. The color indicates if the crossing was in the top (red dots), middle (orange dots), or bottom tier (yellow dots) of prominent crossings. If you zoom into the prominent crossings, the final ranking appears as a label near the crossing.



Final Rankings are the default item when tool is first opened.

How do I find information on a specific crossing?

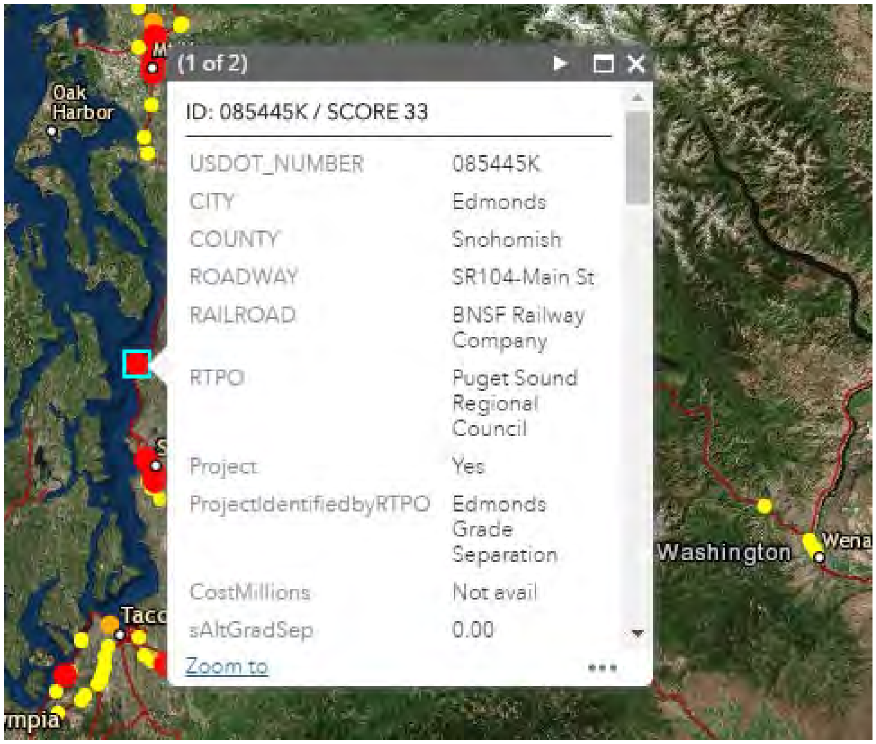
There is a lot of information tied to specific crossings. The two methods to generally find information is first shown, then a quick example is provided.

General Method #1: Click on Point

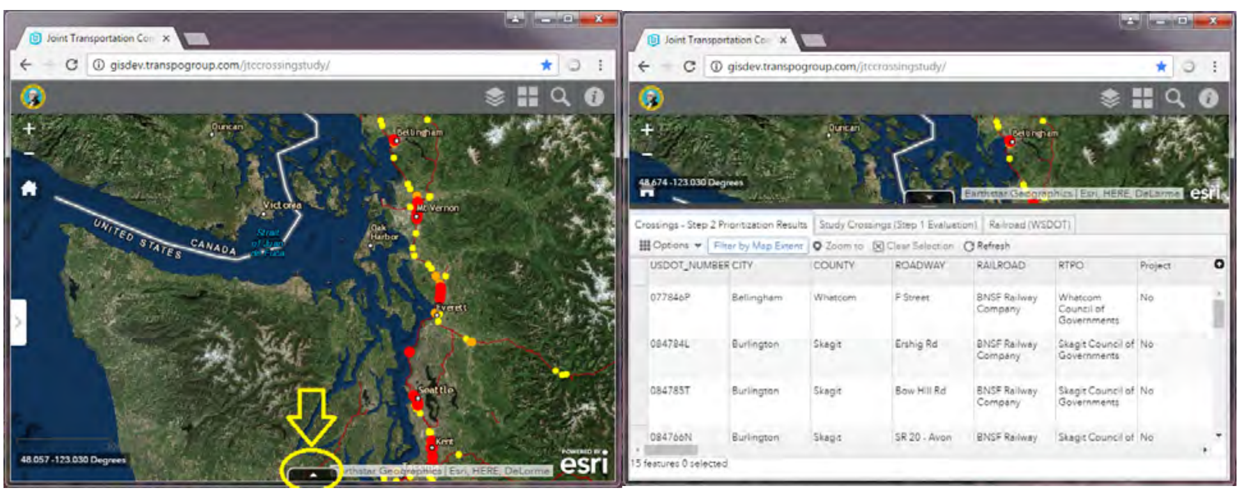
When you click on a crossing point, a pop-up box shows the data stored for that crossing. There is a lot of data stored for each crossing so you may need to scroll down. Appendix A includes a data dictionary that defines what each of the database fields represent.

General Method #2: Attribute Table

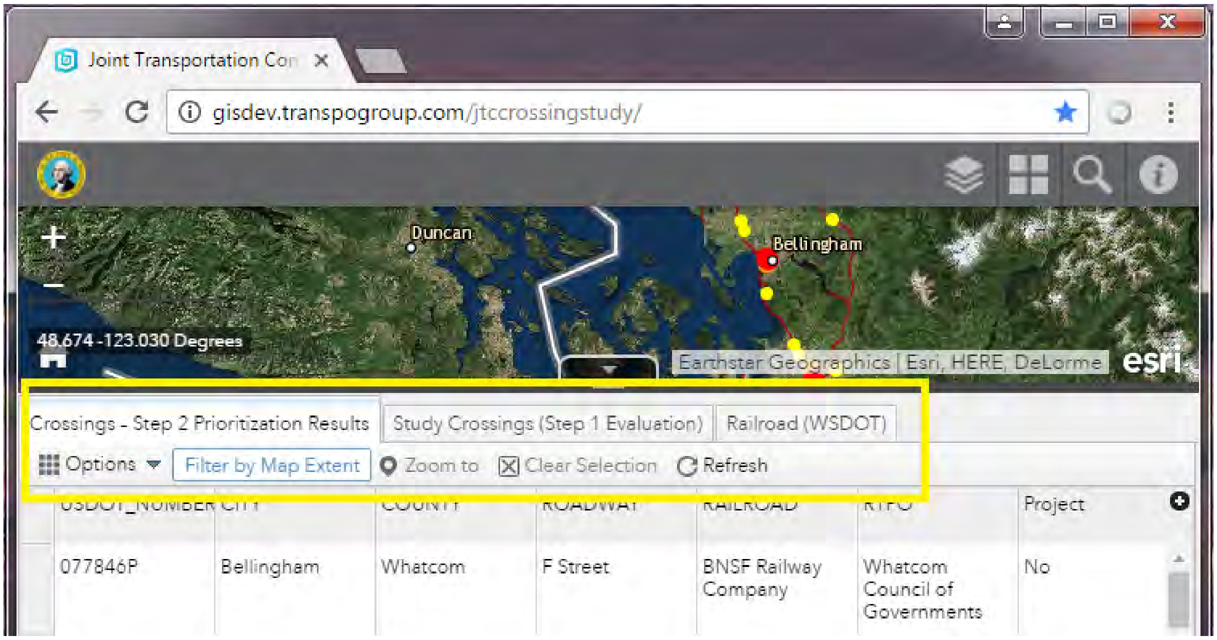
Another option is to use the table view to look at an attribute table. Click on the black arrow tab at the bottom of the map to bring up the table. By default, only the crossings currently shown in the map window are shown in the table window (you may need to scroll down to see all the table rows). You will notice that the table has three tabs at the top: [1] “Crossings – Step 2 Prioritization Results”; [2] “Study Crossings (Step 1 Evaluation)”; and [3] “Railroad (WSDOT)”. That first tab has detailed information about just the 302 crossings. The second tab as detailed information relating to approximately 2,180 crossings (the larger group of public, at-grade, active crossings) known as Step 1 crossings, which includes the 302 crossings. The third tab is reference information about the rail line and not the crossings.



(Method #1) Clicking on a crossing opens a pop-up box.



(Method #2) Clicking on the black arrow tab at the bottom of the screen opens the attribute table.



(Method #2) The table has three tabs referencing three data sets.

Example: Finding Information about a Crossing in Edmonds

The following example shows how to find information about the crossing using the two methods above. We will be looking at a crossing in Edmonds, WA (#085445K).

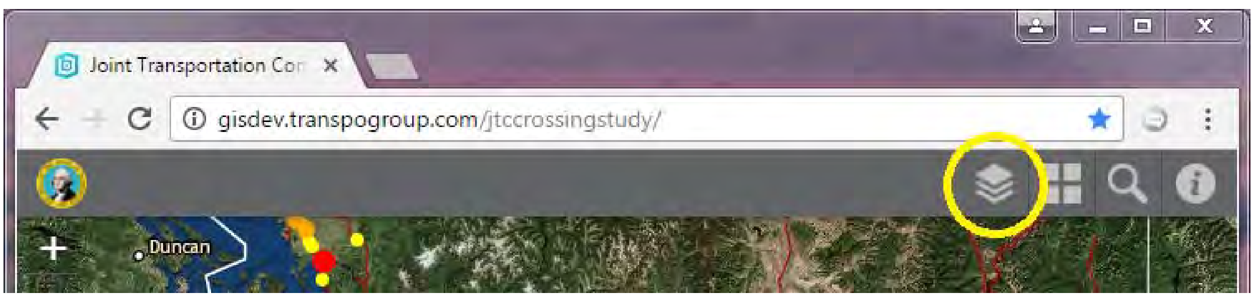
1. Open the tool and navigate the map to Edmonds, WA. Zoom into the city until you only see two crossings: #33 (red dot) and #101 (yellow dot).
2. **[*Example Method #1*].** Click on the red dot labeled “33” and a pop up box appears.
3. **How do I find the rank of the crossing?** The label actually shows the rank “33”. You can also find the value in the popup box by scrolling down about 90% of the table and look for the row called “Ranking”. On the right you will see “33” next to “Ranking”.
4. **How do I find the scores for mobility, safety, and community?** Looking in the same pop-up box, look five rows above “Ranking” and you will see “SafetyScore”, “MobilityScore”, and “CommScore”. These are the scores. For this crossing the safety score is 37.34, mobility score is 58.16, and community score is 48.14. Also provided is the final weighted average score (“TotalScore”) which is 50.45.
5. **How do I find the values for traffic volumes and collision history?** Looking in the same pop-up box, scroll back up to top to about 20% down on the table. You will see “mExVehVols” with a value of 5,667. This is the total existing daily vehicle volumes at the crossing. Above that you will see “sIncidTotal” with a value of 1.0. This is total number of collisions reported in the last five years. NOTE: do not use fields that end in “1” (such as “sIncidTotal1” = 12.0) as this is the score for that individual metric.
6. **Where are the train volumes?** Those are not shown in the default pop-up box, but are listed in the attribute table. We will use Method #2 to find train volumes.

7. **[*Example Method #2*].** Click on the black arrow tab at the bottom of the screen to open the attribute table.
8. Click on the middle tab named “Study Crossings (Step 1 Evaluation)”
9. Scroll the table to the right to about the 80% location, where numerous fields start with “L1…” Look for the “L1 Mobility Value: Freight (existing)” with value of 19. This is the existing freight train volumes per day. Similarly, “L1 Mobility Value: Unit (existing)” is 16, and “L1 Mobility Value: Passenger (existing)” is 14. These are the number of unit trains and passenger trains, respectively. The total number of existing trains using this crossing is the sum of these three values, or 49 trains.

The crossing I want is shown as a black dot. How do I find information about those crossings?

The black dots are the approximately 2,180 crossings known as Step 1 crossings. They represent all active, at-grade, public crossings in Washington State. They automatically appear when you zoom in close enough. You can see their information in the table view (see previous question).

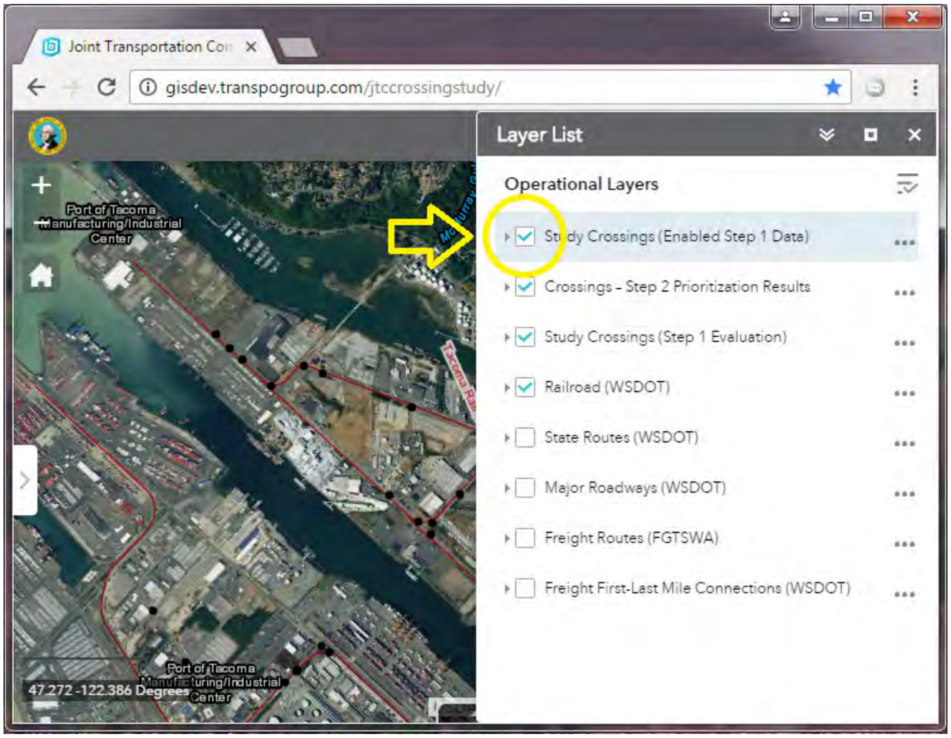
To click on the black dot and see crossing information, you must first turn-on a GIS layer that contains the data. In the upper right corner, click on the “Layer List” button.



Click on the Layer List Button

Then check the box next to the first layer called “Study Crossings (Enabled Step 1 Data)”.

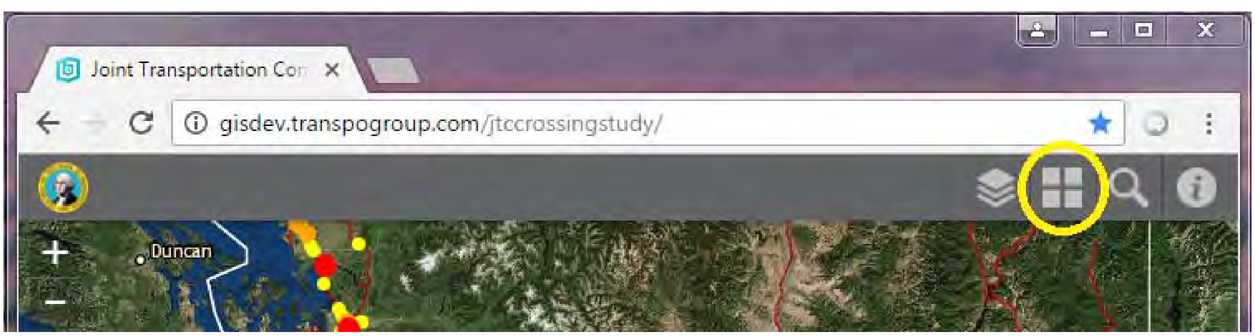
With that layer enabled, you can now click on a black dot (or any colored dot) and see Step 1 information pop-up about that crossing. Appendix A includes a data dictionary that defines what each of the database fields represent.



Check the "Study Crossings (Enabled Step 1 Data)" to enable pop-up information for all crossings.

Can we change the background to something different?

The aerial photo background is the default for this tool but can be changed based on viewing preferences. To change the background, click on the "Basemap Gallery" button in the top-right corner. There are 12 different choices for backgrounds.



Click on the "Basemap Gallery" Button

Is there a way to compare two crossings side-by-side?

At this time there is not a way to select distant crossings and compare side-by-side.

Each crossing has lots of data. What are the most relevant things I should know about?

There are two tables (or databases) shown in the online tool. The "Crossings-Step2 Prioritization Results" pertains to only the 302 prominent crossings, and mostly includes data directly used in the scoring of the crossings. The "Study Crossings (Step 1 Evaluation)" pertains to the 2,180 crossings that represent public, at-grade, active crossings. This database has a much broader array of information. All of the information in these two databases fall into three general categories:

1. Attributes, which are descriptive data about the crossing
2. Criteria, which are measured values of various impacts based on the attributes
3. Scores, which are calculated for Steps 1 and 2 based on the measured value (criteria) for a crossing compared to the range of measures for all crossings. In addition, weighted scores were calculated and used for the final ranking.

Some attributes that might be useful for users to reference include:

Crossings - Step2 Prioritization Results Table

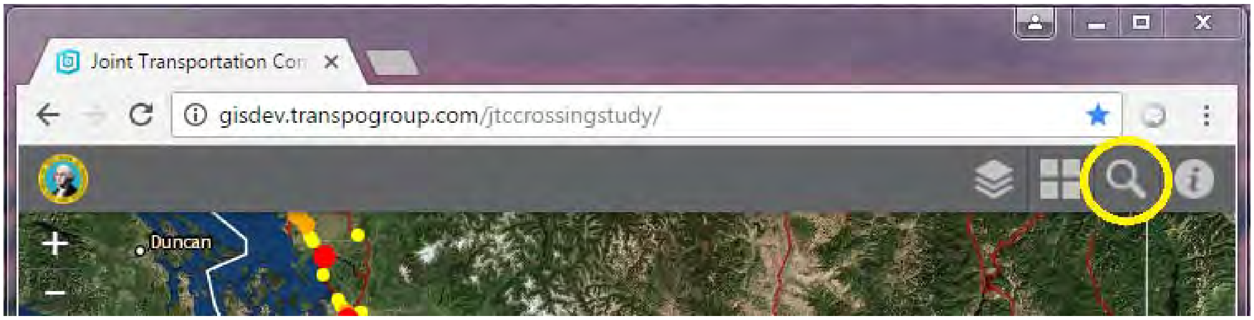
- "**USDOT_NUMBER**" – this is a unique identification number for each crossing. Can be used for later referencing the crossing or searching.
- "**ProjectIdentifiedbyRTPO**" – this lists the improvement project(s) as identified by RTPOs that would impact that crossing
- "**sIncidTotal**" – this lists the number of collisions reported at the crossing
- "**mExVehVols**" and "**mFutVehVols**" – this lists the daily vehicle volumes at the crossing for 2015 and 2035, respectively.
- "**mGateDownTime**" – this lists daily number of minutes that the gate is down (estimated by number of trains and type of train).

Study Crossings (Step 1 Evaluation) Table

- "**USDOT_NUMBER**" – this is a unique identification number for each crossing. Can be used for later referencing the crossing or searching.
- "**L1 Mobility Value: Freight (existing)**" – this lists the number of freight trains at the crossing per day. Note that total trains are the sum of freight, passenger, and unit trains.
- "**L1 Mobility Value: Passenger (existing)**" – this lists the number of passenger trains at the crossing per day. Note that total trains are the sum of freight, passenger, and unit trains.
- "**L1 Mobility Value: Unit (existing)**" – this lists the number of unit trains at the crossing per day. Note that total trains are the sum of freight, passenger, and unit trains. Unit trains are different than freight trains in that they are much longer and typically carry only one type of commodity (e.g. oil, grain, coal).

Can I search for crossings by their USDOT number?

Yes. Click on the “Search Button” in the top-right corner, and type in the USDOT number. The USDOT is a unique code for each crossing and is a good way to cross-reference a crossing location.



Click on the “Search Button” to find locations by USDOT Number