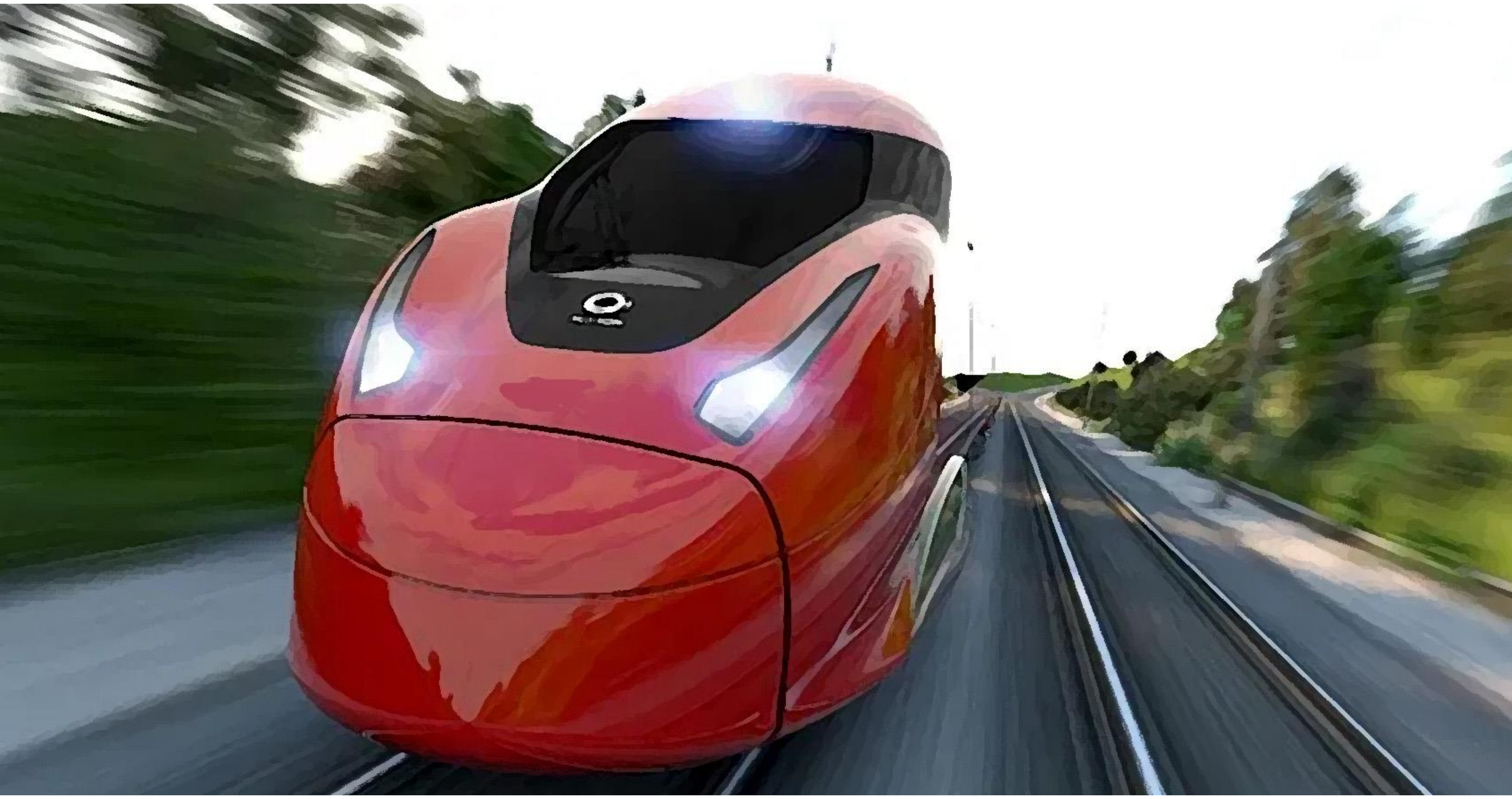
Cascadia High Speed Rail
Tier 1 EIS Corridor
Service NEPA Environmental Scan
Report



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Prepared by

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1. Introduction

For implementation of high-speed rail service in the Cascadia Corridor, a Tier 1 Alternatives Analysis and Environmental Study is needed to determine the most appropriate and effective alignment option. This chapter covers: a) the requirements of the National Environmental Policy Act (NEPA); b) Project History, including the Purpose and Need for the project: c) Description of the corridor and project benefits; d) Decisions to be made and connected actions e) Freight Railroad Principles; and finally, f) the list of databases such as geographic boundaries, cultural resources, ecology, hazardous material sites, and air quality in the proposed environmental study area.

1.1 Background

The National Environmental Policy Act (NEPA) of 1969 requires that the social, economic, and natural environmental impacts of any proposed action of the federal government be analyzed for decision-making and public information purposes. There are three classes of action. Class I Actions, which are those that may significantly affect the environment, require the preparation of an Environmental Impact Statement (EIS). Class II Actions (categorical exclusions) are those that do not individually or cumulatively have a significant effect on the environment and do not require the preparation of an EIS or an Environmental Assessment (EA). Class III Actions are those for which the significance of impacts is not clearly established. Class III Actions require the preparation of an EA to determine the significance of impacts and the appropriate environmental document to be prepared (40 C.F.R. § 1508.4) either an EIS or a Finding of No Significant Impact (FONSI).

This document is a Tier 1 Service NEPA Environmental Scan for developing the Cascadia High Speed Rail corridor linking Seattle, WA to Portland, OR. A companion document, the Service Development Plan, describes the type of service being proposed, communities being served, types of operations (speed and electric or diesel powered), ridership projections, major infrastructure components, and improvement alternatives being proposed. The Service NEPA is a companion document to the Service Development Plan focusing on the measures taken to minimize harm to the corridor. Both documents are needed for supporting funding requests to the Federal Railroad Administration (FRA). While some information must be duplicated between the two documents, the extent of this duplication can be minimized by including mutual references.

Due to the size of the project and the need for developing significant new infrastructure on new right-of-way (Greenfield alignment) it must be assumed that the preferred alternative will have significant impacts, so preparation of a Tier 2 EIS will be required once the FRA agrees to a specific Alternative. The purpose of conducting this Tier 1 environmental scan has been to justify the route selection, as well as to identify and anticipate the level of impacts that are likely to be documented during the course of the Tier 2 EIS, along with possible mitigations.

The focus of this Tier 1 environmental scan has been on determining the overall character of the Preferred Option. Once the Preferred Option has been selected, then more detailed engineering studies will be needed for finalizing the location of the route in conjunction with acquisition of the needed right-of-way. Preliminary engineering coupled with a Tier 2 environmental study may fine tune the route and infrastructure package for ease in implementation and for further reducing environmental impacts. The goal of the current study is to facilitate a discussion with the Federal Railroad Administration in regards to the options that may need to be considered, as well as the level of detail to which the options will need to be developed in Tier 2 environmental studies.

This document was prepared by Transportation Economics & Management Systems, Inc. (TEMS), and documents the results of the Cascadia HSR corridor study efforts that were funded by Cascadia High Speed Rail, LLC.

1.2 Purpose of the Environmental Analysis

In developing route options for the study, an initial overview of environmental issues is considered a critical element of National Environmental Policy Act (NEPA) compliance for the development of high-speed passenger rail service. Under the Federal Railroad Administration's (FRA) HSIPR program guidance, FRA implements the environmental review process as required by the National Environmental Policy Act (NEPA) together with related laws and regulations, (including Section 106 of the National Historic Preservation Act and 49 U.S.C. 303, which protects public parks, recreation areas, wildlife and waterfowl refuges, and historic sites). The statutory requirement as stated in the High-Speed Intercity Passenger Rail (HSIPR) NEPA Guidance[1] is that "*NEPA requires that appropriate environmental documentation be available to public officials and citizens before decisions are made and actions are taken. The available information should be relevant to the decision to be made at any particular stage of project development*" including the decision as to whether or not to launch a detailed environmental study in the first place.

To apply for funding for a high-speed rail system, FRA has defined the creation of a Service Development Plan (SDP) as well as a Service NEPA as essential first steps. *It is important to note that neither the "Service NEPA" nor SDP are actually NEPA legal documents; they are only support for an FRA funding application.* A "Service NEPA" has been defined by the FRA as a *landscape level of environmental review that defines from day one the most critical environmental issues before any substantial investments in the corridor are made.* The reason for developing a Service NEPA is to ensure that there are no *obvious* fatal flaws associated with the proposals being submitted to the FRA, and that due diligence and reasonable consideration have been given to the environmental issues associated with the project.

However, the *HSIPR NEPA Guidance* allows that "Several different approaches are available to accomplish Service NEPA," including for advanced projects, "Tiered NEPA (Tier 1 environmental impact statement (EIS) or environmental assessment (EA) followed by Tier 2 EISs, EAs or categorical exclusion determinations (CE) or non-Tiered NEPA (one EIS or EA covering both service issues and individual project components)"[1]. A large expansive project such as a high-speed rail corridor development would typically be addressed in a Tier 1/2 EIS process requiring several rounds of environmental review, such as the multiple EIS's that have been prepared by the California High-Speed Rail Authority, and the Georgia and North Carolina Departments of Transportation. However, it is clear that SDP's and Service NEPA's can only be developed to a level of detail reflecting the stage of development of each project. As projects advance, more detail is needed to support the progressively increasing funding amounts required. Clearly a Service NEPA associated with a construction application will have more detail than one associated with an application for EIS Preliminary Engineering funds, as is the case here.

This Service NEPA Study presents a high-level Environmental Scan that is intended to give insight into the issues that may be associated with a decision to proceed with further development of the high-speed rail system. An initial "Service NEPA" at this stage should consist of a mapping analysis of environmental factors within the corridors where proposed alignments are likely to be located. A

[1] Compliance With The National Environmental Policy Act In Implementing the High Speed Rail Intercity Passenger Rail Program, August 2009. https://www.fra.dot.gov/Elib/Document/2319

preliminary conceptual analysis is sufficient to show that there are no obvious fatal flaws along the routes that might be developed. Where environmental issues do arise, there should be an understanding of potential mitigation or avoidance strategies. This level of environmental planning ensures that the routes proposed for a Tier 1 EIS are in fact “Reasonable Routes” and that they are likely able to be developed into fully engineered alternatives. Clearly, detailed development of such routes will be part of the Tier 2 EIS. Any representative alignments used as the basis of the analysis are highly conceptual and preliminary. The primary reason for considering environmental issues along the corridors is to identify (and avoid) *obvious* fatal flaws, and to develop an order-of-magnitude assessment of potential impacts. This document, therefore, serves as the “bridge” between preliminary feasibility-level planning and the formal NEPA environmental documentation and preliminary engineering phase which are still to come, if development of the high-speed rail system is going to be further pursued.

1.3 Project History

Transportation Economics & Management Systems, Inc. (TEMS) has been commissioned by Cascadia High Speed Rail, LLC (CHSR) to assist them in developing a practical, implementable Business Plan for improving passenger rail service in the Cascadia corridor. In response to an FRA solicitation for innovative rail corridor concepts, an initial Phase 1 of work was completed by TEMS in August 2016. This resulted in the submission of a proposal to FRA for implementing a high-speed rail corridor. The proposed 2016 alignment has survived into the current study as Alternative 2.

Since then, stakeholders like Microsoft have pressured Washington and Oregon State DOT’s to improve the transportation options available in the Pacific Northwest. As a result, Washington DOT has developed several studies of ultra high-speed rail and political momentum in favor of advancing this project seems to be building.

However, the 2016 CHSR alignment was developed on the basis of incremental improvements to the existing BNSF rail corridor; as such the 2016 alignment, now identified as Alternative 2, could not meet the performance requirements of ultra high-speed rail. As a result, CHSR undertook to develop Alternative 3, a new alignment that can realize the objectives for ultra high-speed rail in the Pacific Northwest. Alternative 3 is a true 220-250 mph ultra high-speed alternative based on all-new alignment, not just an improved existing rail line. To complete the options set, Alternative 1, as a variation of Alternative 2 would develop only a single tracked, non-electrified line for use by diesel trains.

These three options cover a full range of development options for a high-speed rail corridor ranging from an improved diesel service all the way up to a new line for 220-250 mph ultra high-speed electric trains.

1.3.1 Purpose and Need for Action

The purpose of the project is to develop new, dedicated high-speed rail infrastructure and passenger rail service and intermodal connections within the Pacific Northwest, which will promote economic integration, growth and development, and enhance energy efficiency and environmental quality. The project will allow for 220-250 mph high speed rail at high capacity, providing a safe, convenient and reliable alternative mode of travel. The study area’s transportation network has many links and facilities that are functionally inadequate. The Pacific Northwest is one of the most densely populated areas of the country and its major roadways and air traffic corridors experience chronic congestion. This has led to delays and reliability problems for all modes of transportation. Intercity trips are one of the most rapidly growing trip types in the study area and present the greatest opportunity to shift future riders from less efficient, more congested modes to high-speed rail.

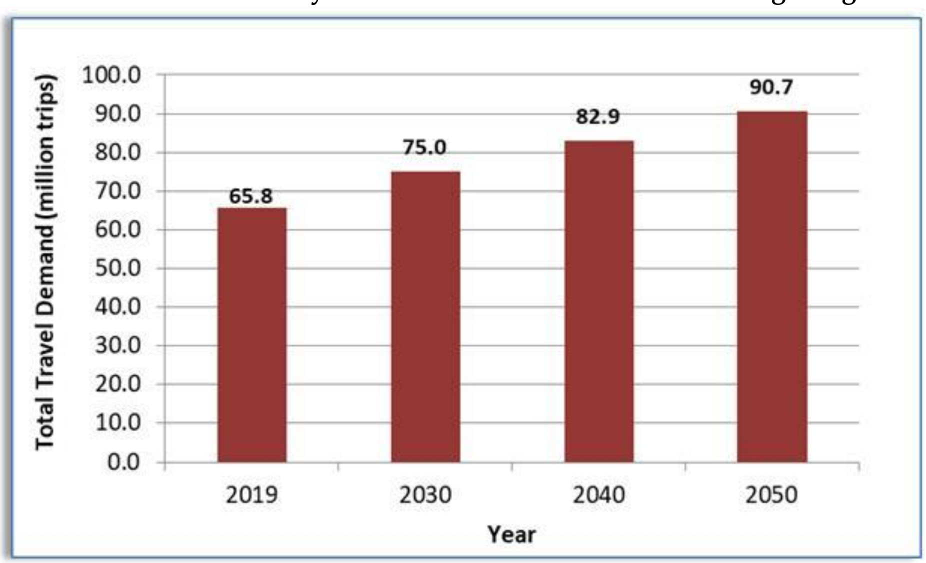
Exhibit 1-1: CHSR Corridor

The project focuses first on the critical Seattle, WA to Portland, OR segment, with planned future extensions north to Vancouver, BC and south to Eugene, OR as shown in Exhibit 1-1.

By linking the larger cities together with high-speed passenger rail, the Pacific Northwest mega-region can function as an integrated economic unit in spite of existing State and National boundaries. The rail system will serve key destinations within the corridor and also address growing express freight capacity needs, which are necessary for continued economic growth. The project will serve as a beneficial economic stimulus at proposed station locations. It will act as a catalyst for integrating the existing transit systems and enhancing regional economic growth and development opportunities in a way that is consistent with smart growth and long-term sustainability.

The Cascadia region has an extensive multi-modal transportation system–highways, airports, links to intercity and commuter rail, and public transit serving all major cities and many intermediate markets. However, after significant investment over decades in all modes, the study area still faces major congestion and capacity constraints. These constraints, if not addressed, have the potential to curtail future mobility, lead to slowing economic growth. With forecasted demographic growth, coupled with growing capacity constraints on highways and at major airports, a 38 percent increase in total trip making as shown in Exhibit 1-2 could easily lead to doubling passenger rail ridership, even if no improvements are made to the rail system. This would overwhelm the capacity of the existing rail system even at the same time as all the other transportation modes likewise become saturated.

Exhibit 1-2: Total Intercity Travel Demand for the Cascadia Mega-Region

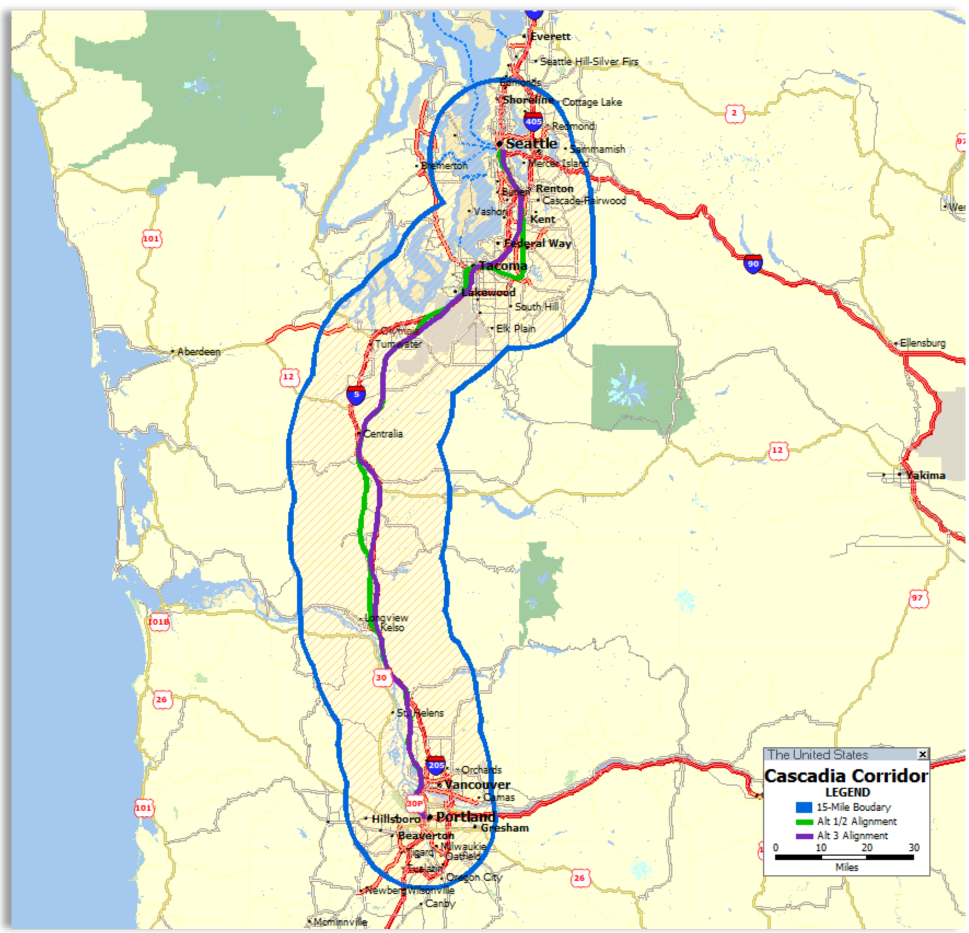


The need for the project is based on current and projected traffic congestion and safety concerns in the Interstate corridors, resulting from a lack of an integrated rail alternative to air travel, automobile, and truck usage. The project would provide an attractive alternative mode of transportation for travel within the Cascadia corridor, and by providing direct connections to the two major passenger and freight airports within the region would provide for effective connections to destinations outside the region as well. The project is part of an integrated, multi-modal vision that supports the transportation goals of the states in the project area and would be more cost effective and environmentally sensitive than attempting to meet the transportation demand by investing in highways alone. Without the project, the ability to develop a truly integrated intercity high-speed rail system in the Pacific Northwest will not be possible.

1.3.2 Defining the Environmental Study Area for the Cascadia High-Speed Corridor

The Environmental Study Area is defined by the potential region or area within which potential rail alignments lay and for which environmental data must be collected. The environmental study area from Seattle, WA to Portland, OR has been defined based on a 15-mile buffer area surrounding the rail alignments. Landscape environmental data such as cultural resources, ecology, hazardous materials, air quality, noise and vibration, utilities have been collected within this area. In Exhibit 1-3 the blue line charts the path of the Ultra High-Speed Alternative 3, whereas the green line charts Alternatives 1 and 2. For much of the distance however, the prospective alignments are close enough that they lay on top of one another at this scale of mapping.

Exhibit 1-3: Environmental Study Area



1.3.3 Current Study Focus

Rail improvements along the Cascadia HSR Corridor from Seattle to Portland will require a thorough assessment of the impacts, including evaluating all structural and environmental impacts along the corridor alignment. This Tier 1 Service NEPA update is designed to show the USDOT FRA the environmental issues associated with the corridor and their potential mitigation for the core segment of the corridor linking Seattle to Portland.

1.4 Benefits to the Corridor

The proposed Cascadia HSR Corridor will:

- Provide modern comfortable energy efficient high-speed passenger trains with travel times of 2½ hours or less between Vancouver, BC and Eugene, OR, and one hour between Seattle and Portland.
- Be competitive with air travel and with high-speed rail corridors across the U.S.
- Provide “state of the art” intercity travel at affordable prices of 50 to 70 percent of air fares.
- Create opportunities for the private sector to participate in the building, operations and financing of the project.
- Support National Security, military and government mobility to and from the big cities and many smaller communities in between the major cities of the corridor.
- Provide “state of the art” terminals that are large in size and that offer significant opportunities for joint development, including having enough retail and commercial space to entice private sector developers.
- Create new jobs, joint development, income and tax base increases in city centers where such development will help to bolster urban development.
- Provide a new energy efficient and environmentally friendly mode for express freight shipping.
- Increase rail safety by ensuring a “sealed” and “secure” passenger rail corridor and reduce community impacts by upgrading highway rail protection and separation.

The Cascadia HSR Corridor presents a great opportunity to link together a string of livable downtowns and neighborhoods. Many station locations already boast a vibrant mixture of land uses in compact and walkable nodes of activity, supported by effective transit systems that will be advanced by enhanced intercity rail service. Investment in high-speed rail will reinforce these communities as economic, residential, and cultural hubs of their respective areas and will lay the foundation for continued private sector investment in and around station locations. With high levels of forecasted ridership, rail will be one of the most energy efficient means of passenger transportation. Shifting ridership from automobile to rail will provide congestion relief on highways and result in a corresponding reduction in greenhouse gases. Additionally, rail investments promote compact growth patterns, which is consistent with national, state, and local policies encouraging smart growth.

1.5 Decisions to be Made

Washington and Oregon DOT and FRA must comply with all NEPA requirements when considering the impacts of their proposed action on the human, physical or biological environment. All potential impacts need to be identified and steps to minimize, mitigate or compensate for these impacts must be identified in the NEPA document. The NEPA process is intended to help public officials make decisions that are based on an understanding of environmental consequences and take actions that protect, restore, and enhance the environment (40 CFR 1500.l).

This Tier 1 Service NEPA Environmental Scan provides FRA and the public with an early understanding of the potential environmental consequences of the proposed action that was developed to meet the project purpose and need. However, a Tier 2 Environmental Impact Statement will need to be prepared for fully detailing all the proposed impacts and mitigations.

1.6 Connected Actions and Independent Utility

The NEPA process also requires an evaluation of any connected actions to the proposed project. Connected action means that the actions are closely related; and therefore, should be discussed in the same environmental document. Actions are connected if they:

- Automatically trigger other actions which require environmental clearance
- Cannot or will not proceed unless other actions are taken previously or simultaneously, or
- Are interdependent parts of a larger action and depend on the larger action for their justification.

Possible corridor extensions north to Vancouver, BC and south to Eugene, OR are clearly connected actions. But in reality, the ability to execute these extensions depends on the completion of the Seattle to Portland core segment first. The Service Development Plan shows that the Seattle to Portland segment has independent utility from both an environmental and economic perspective. This means that the Seattle to Portland segment can be assessed as a stand-alone project, since it does not depend on any of these other segments for its viability.

1.7 Freight Railroad Principles

Any shared use of freight rail corridors or tracks must respect the need for continued safe and economical rail freight operations. At a minimum, freight railroads must be able to operate their trains as effectively as they could if passenger service did not exist. Beyond this, it is desirable to actually create benefits for freight rail service if possible while developing the infrastructure needed to support passenger services. Freight railroads must retain their ability not only to handle current traffic, but also to expand their own franchises for future traffic growth.

As such, both BNSF and Union Pacific have established “Letters of Principle” to provide guidance to passenger rail planners. The purpose of the principles is to protect the safety of railroad employees and communities, service to freight customers, and the right-of-way and land needed to fulfill the railroads’ freight transportation mission.

At present the passenger proposals laid out here are still un-negotiated, un-funded and at a feasibility level. While the sharing of freight railroad right-of-way may be possible in some places, in others it may be necessary to shift the high-speed alignment off the freight railroad right-of-way, so as not to infringe the freight capacity of the railroad. It is understood that in following detailed engineering and environmental studies, the details of integrating the proposed passenger operations with freight operations will be subject to close negotiations with the railroads. This will include detailed engineering and operation studies as needed. The final capital plan and capital costs for segments of shared right-of-way will eventually need to be worked out in negotiations with the freight railroads.

In the meantime, this report contains preliminary data which is subject to review, verification and approval by both BNSF and Union Pacific Railroad. As of the date of this report, this review process has not taken place. Findings are not to be construed as a commitment on the part of either BNSF or Union Pacific to share any portion of their rights of way.

1.8 List of Data Collection and Mapping Sources

This section identifies the potential list of factors that impact on the community and environment to include transportation, air quality, noise and vibration, energy, land use, socioeconomic factors, community impacts, environmental justice, parklands, farmlands, aesthetics, utilities, contaminated sites, cultural resources, geologic resources, hydrologic and water resources, wetlands, and biological resources (habitats and species). Potential environmental constraints will be reported in the next phase of the study based on the proposed alternatives. Exhibit 1-4 provides an overview of the list of data collection elements that will be discussed in the following report sections, and which provided significant input to the development of this Service NEPA.

Exhibit 1-4: List of Elements and Data Sources

Data Element	Source
Geographic Boundaries: State, County, Census tract, Census Block Group, City, MPO, MSA, Congressional Districts, Community Facilities	US Census Bureau: Line Shapefiles, Washington and Oregon state GIS, National Transportation Atlas Database (NTAD)
`Cultural Resources: Parks, Wildlife Refuge, Heritage preserves, Archaeology resources, Historical resources, Federal lands, etc.	Washington and Oregon DNR United States Department of Agriculture Forest Service National Park Service U.S. Department of the Interior U.S. Fish and Wildlife Service
Ecology: Wetlands, Hydric Soils, Streams, Waters of US, State waters, federally protected species, State protected Species, Critical stream habitats, Migratory bird habitat, floodplain encroachment/impacts, coastal zone encroachments	Washington and Oregon DNR, National Wetlands Inventory, US Fish & Wildlife Service, Washington Wildlife Habitat Connectivity Mapping Tool
Hazardous Materials	US EPA, Washington and Oregon DNR
Air Quality	US Environmental Protection Agency
OTHER (Satellite Imagery, Street Views, Land Parcel Data, etc.)	Google Earth, TransCAD GIS shapefiles

Noise and Vibration	*High-Speed Ground Transportation Noise and Vibration Impact Assessment*, U.S. Department of Transportation, Federal Railroad Administration, Washington, DC, December 1998 standards
Utilities	Aerial photographs and mapping available from Google Earth
Environmental Justice	U.S. Census Bureau
Geology and Soil	USDA Soil Database, Washington and Oregon DNR
Transportation	U.S. Census, National Transportation Atlas Database (NTAD)
Socioeconomic Conditions	U.S. Census
Public Health and Safety: Railroads grade crossings, Pedestrians and Rail operations	Federal Highway Railroad (FRA) and Federal Highway Administration (FHWA)

2. DESCRIPTION OF THE ALTERNATIVES

This chapter includes a generic discussion of the alternatives proposed for the Cascadia Corridor including the "No Build Alternative", proposed improvement alternatives, and station improvements. Specific detailed engineering and environmental assumptions for the selected alternatives will be discussed in Chapters 3 and 4.

2.1 DESCRIPTION OF THE CASCADIA HSR CORRIDOR

The Cascadia HSR Corridor extends all the way from Vancouver, BC to Eugene, OR, and interconnects with long-distance VIA Rail and Amtrak services. These link the corridor with both the Canadian (CN, Yellowhead Pass) and US (BNSF, Marias Pass) transcontinental passenger rail routes, as well as to California via Klamath Falls. In addition, Amtrak's Cascadia trains share a portion of their route with Sounder commuter trains, which currently operate from Everett, WA on the north to Lakewood, WA on the south. Sounder has announced plans to extend further south to Tillicum and Dupont by 2036.[2]

However, this Service NEPA focuses only on the core of the Cascadia corridor from Seattle, WA to Portland, OR. It is assumed that existing commuter and long-distance Amtrak services, such as the Coast Starlight, will continue to operate without change. Only the short distance Amtrak corridor services would be replaced by upgrading these trains to the higher standards proposed in Alternatives 1, 2 or 3.

Traveling south from Seattle, the Cascadia corridor may include some segments of existing rail right-of-way between Seattle and Portland. In Alternatives 1 and 2, existing rights of way would be used mostly in urban areas, where development of new alignment would require extensive tunneling. Alternative 3 however, includes the tunnels under the urbanized areas of Lakewood, Tacoma, Lakeland and Seattle. In the rural areas between cities where the development of new alignment is less costly, all Alternatives utilize mostly new alignment. The alignment Alternatives will be further described in the sections below.

2.2 NO BUILD ALTERNATIVE

This Alternative involves taking no action to improve rail service in the Cascadia corridor. The existing rail line within the corridor would remain operational. The No Build Alternative would not improve the level and quality of passenger rail service; or contribute to economic growth or strengthen the manufacturing, service, and tourism industries within the corridor. Over time, highway congestion would continue to get worse, triggering additional costs for highway expansion as the capacity of the existing facilities is reached and exceeded. Negative environmental impacts would be associated with practically exclusive reliance on the automobile as practically the sole means for providing transportation and accessibility in the Pacific Northwest.

The No Build Alternative serves as a baseline comparison with the proposed Improvement Alternatives being considered. This alternative does not meet the Purpose and Need of the project.

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[2] See: https://www.soundtransit.org/system-expansion/dupont-sounder-extension

2.3 Alternative 1 – Low Infrastructure, Diesel Service

With a maximum speed of 125 mph on an improved, dedicated rail line which includes some segments of greenfield alignment, this alternative would develop an option that is comparable to Brightline service in Florida. By alleviating many of the geometric limitations associated with the existing rail lines, train speeds will be just high enough to compete with auto travel times on a door-to-door basis. The option will remain fundamentally limited by the top speed capability of diesel technology, which maxes out at around 125 mph even though some stretches of improved alignment could be capable of supporting even higher speeds.

While Alternative 1 has nominally been defined as a single tracked dedicated track option, this option still admits some possibility of sharing some track with the freight railroad as Brightline does. Thus, this Alternative is more subject to design compromises in actual implementation than any other option. Any shared track areas, however, will increasingly become bottlenecks as freight rail traffic increases in the future. Passenger trains will tend to get caught behind freight trains that are delayed in these areas, increasing train delays and hurting the service reliability for both freight and passenger users of the system. The speed improvement will result in a rail service that is barely auto competitive in terms of travel time. If implemented as proposed here, the service will be fast enough to be able to cover its own operating costs and be subsidy free, but it will not make a large enough operating surplus to be able to cover a significant share of its own capital costs.

2.4 Alternatives 2 and 3 – Low and High Infrastructure, Electric Service

To achieve the full benefits of a high-speed rail system, improvements to existing rail alignments and development of new greenfield alignments, including electrification, are proposed. The higher the speed, in general the less existing rail alignments can be used and the more new greenfield alignment is needed.

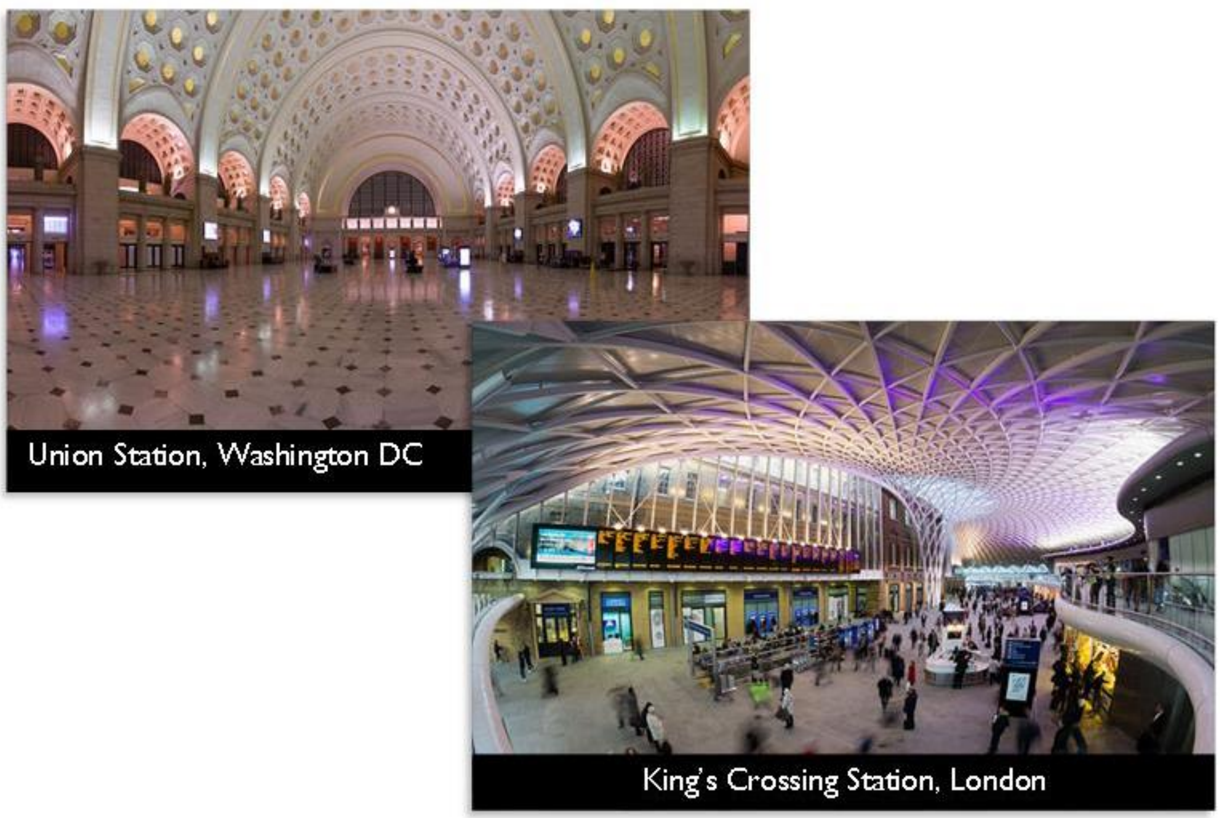
- Alternative 2 was originally developed in 2016 as an option that would make as much use of existing BNSF rail alignment as possible, where it may be possible to improve it enough to attain high speed performance standards. Where existing rail rights-of-way are used, improvements such as the easing of curves and adding new track along-side the existing rail are proposed, although this could not always be done to 220 mph standards. Curve easements in this option were determined more based on what may be practicable to achieve. In other places, new greenfield segments were proposed. The main objective in developing Alternative 2 was to upgrade and realign existing rail rights of way where possible, and to develop greenfield corridors in the rural areas only where needed to bypass areas of very difficult geometry. Dedicated passenger tracks would be added to existing rail corridors within urban areas. By doing this, current Amtrak travel times can be cut by more than half and reliability can be greatly improved. The resulting service would be comparable to Acela in the northeast corridor.
- Alternative 3 develops a high quality ultra high-speed rail alignment independent of existing rail corridors. Even so, there are some places where it makes sense to parallel existing rail or highway corridors. For achieving ultra high-speed geometric standards, it is necessary to depart from existing rights of way to a much greater extent. As such, a practical effect of developing a high-quality alignment was to reduce the impact on freight railroad rights of way, since much of the existing right-of-way is simply unsuitable for use by ultra high-speed trains. The resulting service would be comparable to the French TGV or Japanese Shinkansen.

2.5 Station Improvements

A key part of "The Vision" for the Cascadia High Speed Rail System is the provision of modern multimodal passenger terminals. These are a critical element in the success of a passenger rail system as they are not only the gateway to the system, but they provide the access and egress to the system for local residents. Access and egress should be as seamless and quick as possible, and should include LRT and bus connections, taxi and van service, and rental car facilities. The terminals need significant parking facilities, particularly in suburban areas, since many people will drive to the station. The terminals themselves should be modern with desirable spaces to sit, meet and wait. The stations depending on size should offer a range of facilities such as restaurants and cafes, shops, newspaper and bookstores, and the other travel facilities such as restrooms and seating areas needed by travelers.

These multimodal terminals will also offer significant opportunities for Joint Development projects by local and private development communities. Work is needed with local communities to maximize the potential of these locations. Modern passenger rail service requires terminals that are large in size and that offer significant opportunities for Joint Development including enough retail and commercial space to entice private sector developers. Examples of modern HSR terminals incorporating joint development (Exhibit 2-1) can be seen in Washington D.C.'s Union Station, London's King's Cross Station and California's proposed San Jose High-Speed Terminal.

Exhibit 2-1: Example Station Joint Development Projects



For the Cascadia corridor, major stations would be located at the corridor endpoints of Seattle and Portland. These stations would be configured to permit future run-through operations to Vancouver, BC and Eugene, OR but would initially serve as the terminal stations for the high-speed rail service. Mid-sized stations would be located at Tacoma, Olympia, and the two airports PDX and SEA-TAC. Smaller stations would be located at Vancouver, WA, Longview/Kelso, and Centralia. These stations would have more limited stops.

Development of the stations may have environmental impacts, such as wetland displacement or historic property impacts which may tend to scale with station size. The station development plans are not far enough along to be able to assess the specific impacts associated with their development, but in any case, stations will be needed for all the possible route alternatives. Since the rail project is only responsible for its direct impact, primarily platforms and tracks; and since stations will be needed for any alternative, station impacts tend to be relatively independent of the route alternative chosen, except that higher development options (like Alternative 3) may tend to spur greater levels of joint development than would the lower investment options.

2.6 Train Technology Options

Train technology options are discussed in extensive detail in the Cascadia HSR Corridor Service Development Plan (SDP). Please refer to the CHSR SDP Report for specific details on the train technology options.

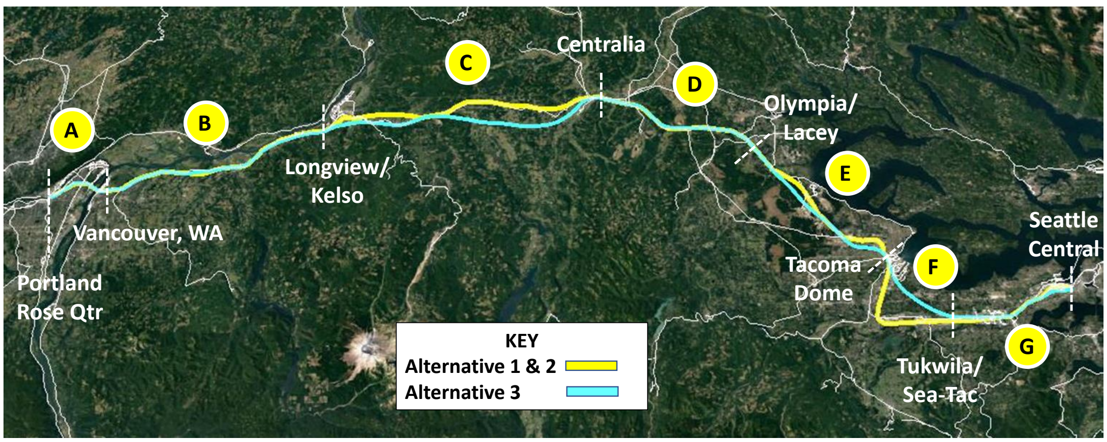
Exhibit 2-2: Electric High-Speed Train

3. Portland to Seattle Route Analysis

Route options have been developed at a conceptual level based on a mapping analysis of the routes. Particularly for new greenfield alignments, environmental considerations not only determine where an alignment might go, but also directly drive the capital costs in terms of unavoidable consequences and mitigation costs. Particular attention has been paid to crossings of highways and other rail lines, required property takings, river bridges and wetland crossings since these are key capital cost drivers. This route analysis focuses primarily on the factors that directly impact capital cost and develop the key environmental and engineering findings, upon which the preliminary capital cost development for each option will be based.

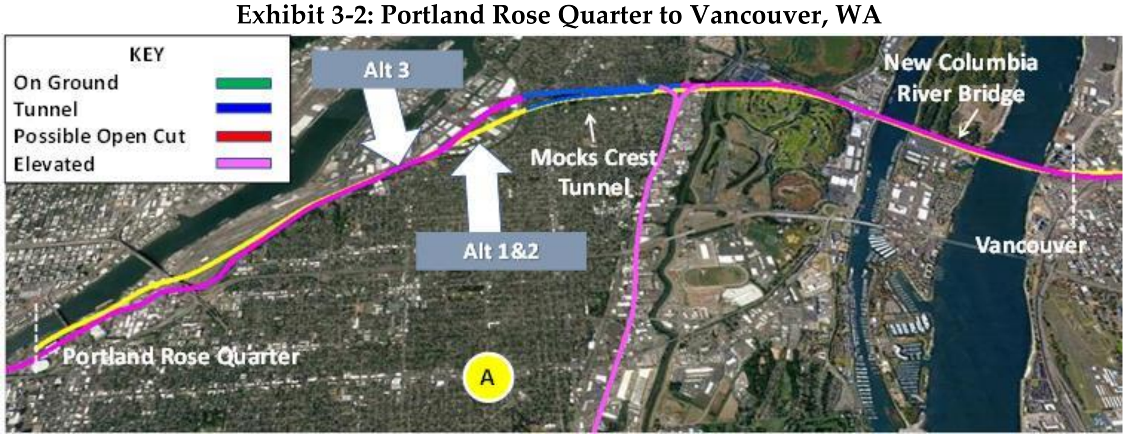
The focus of this chapter will be on further defining the three Alternatives for the Portland to Seattle segment of the Cascadia corridor. The following subsections will address the development of the route options for the Cascadia corridor alternatives. Exhibit 3-1 shows that the proposed route from Portland to Seattle has been broken down into seven segments.

Exhibit 3-1: High-Speed Rail Alternatives for the Portland to Seattle Corridor



Segment A: Portland Rose Quarter to Vancouver, WA – Exhibit 3-2 shows the proposed CHSR alignment from Portland's Rose Quarter to Vancouver, WA. The yellow line shows the location of the originally proposed 2016 alignment (identified as Alternatives 1&2) which was subsequently refined in Alternative 3 for reducing impacts on structures and on the Union Pacific rail yard. Since the alignments are so similar, all options would use the newest, optimized alternative (pink and blue line) through this area. The alignment may be adjusted again for further reducing impacts during the Tier 2 EIS and Preliminary Engineering phase.

Exhibit 3-2: Portland Rose Quarter to Vancouver, WA



A key goal for CHSR station location will be to optimize walking, transit and auto connectivity, as well as the availability of available land for economic development and parking facilities. Where existing stations optimize accessibility, those sites should continue to be used. Where other sites work better, the location should be shifted. The proposed Portland station site at Rose Quarter station offers much better transit connectivity than does the existing Union Station site. Rose Quarter also has plenty of under-utilized land for re-development and parking, and the light rail connection from Rose Quarter to Portland International Airport is very direct. Interstates I-5 and I-84 also intersect nearby, and river taxi service, bike and pedestrian access can easily be accommodated at the station's proposed Willamette River front location.

A new Rose Quarter Transportation Hub would be the catalyst to invigorate the east side of downtown Portland. In Portland, all options would start at a new station in the Rose Quarter (Exhibit 3-3) which is the only location in Portland that provides direct connections to all routes of Tri-Met's MAX light rail system (Exhibit 3-4). Departing the station northbound, the use of an elevated structure would keep the CHSR tracks separate from and avoid any interference with Union Pacific's Albina freight yard.

Exhibit 3-3: Proposed New CHSR Station as part of New Rose Quarter Transportation Hub

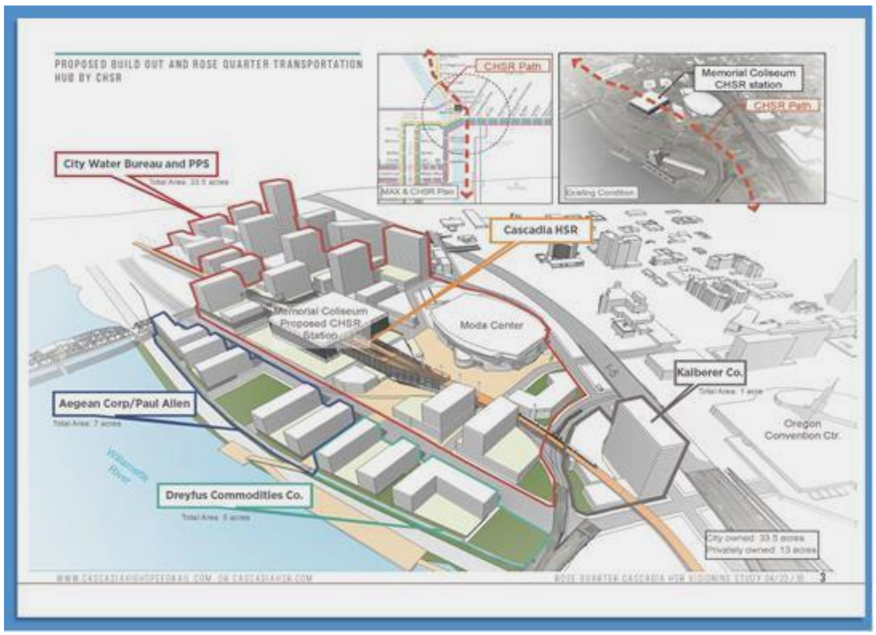
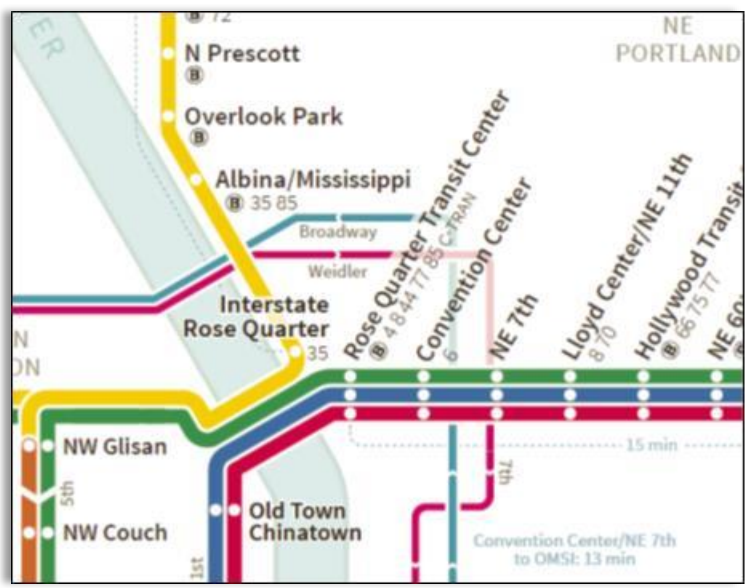


Exhibit 3-4: Excellent Transit Connectivity at Rose Quarter in Portland, OR



All CHSR alternatives departing the Portland Rose Quarter would follow the UP corridor and would be elevated around UP's freight yard and intermodal facility, because this offers the most direct route north to Vancouver, WA. Exhibits 3-5 and 3-6 shows the new CHSR alignment staying on the north side of the Willamette River departing the Rose Quarter, heading northwest towards the Mock's Crest tunnel. For comparison, Amtrak's current BNSF routing along the west side of the Willamette River is also shown. Trains heading south from Vancouver on BNSF/Amtrak routing must cross the Willamette River *twice* – first at BNSF's St John's Bridge[3] downstream, then to the east side using the Steel Bridge[4]. By comparison, the CHSR alignment stays on the east side of the Willamette River, so it does not have to cross the river at all.

Exhibit 3-5: Proposed New CHSR vs. Existing BNSF/Amtrak Alignment departing the Downtown Portland Area

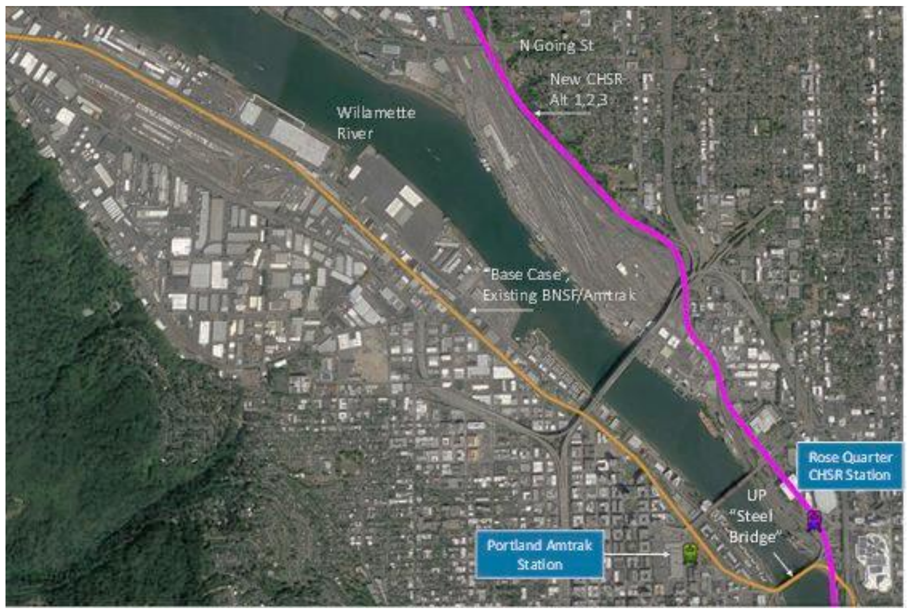


Exhibit 3-6: CHSR vs. Existing BNSF/Amtrak Alignment showing St. Johns Bridge crossing on the Existing Route

[3] See https://en.wikipedia.org/wiki/Burlington_Northern_Railroad_Bridge_5.1
[4] See https://en.wikipedia.org/wiki/Steel_Bridge

Exhibit 3-7 shows how on the approach to Mock's Crest tunnel the improved Alternative 3 alignment has been shifted to avoid several warehouses; but zooming in a little closer, it also shows that given the current arrangement of the structures, it will not be possible to find a route that can completely avoid impacts.

Exhibit 3-7: Alignment Refinements in the Mocks Crest Tunnel Area

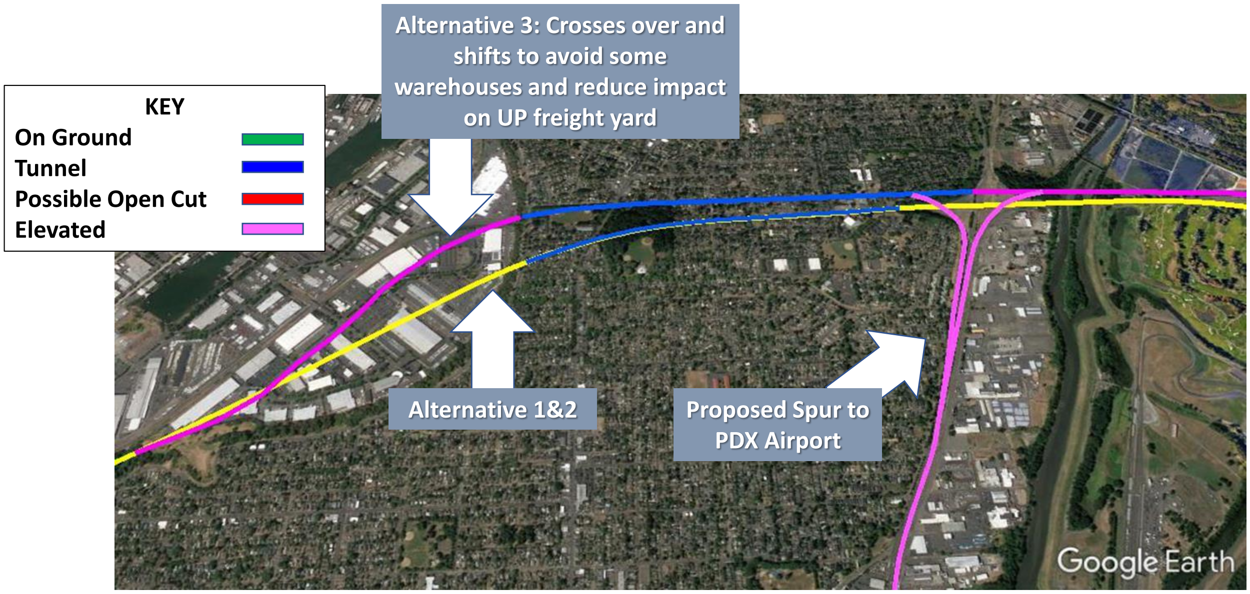
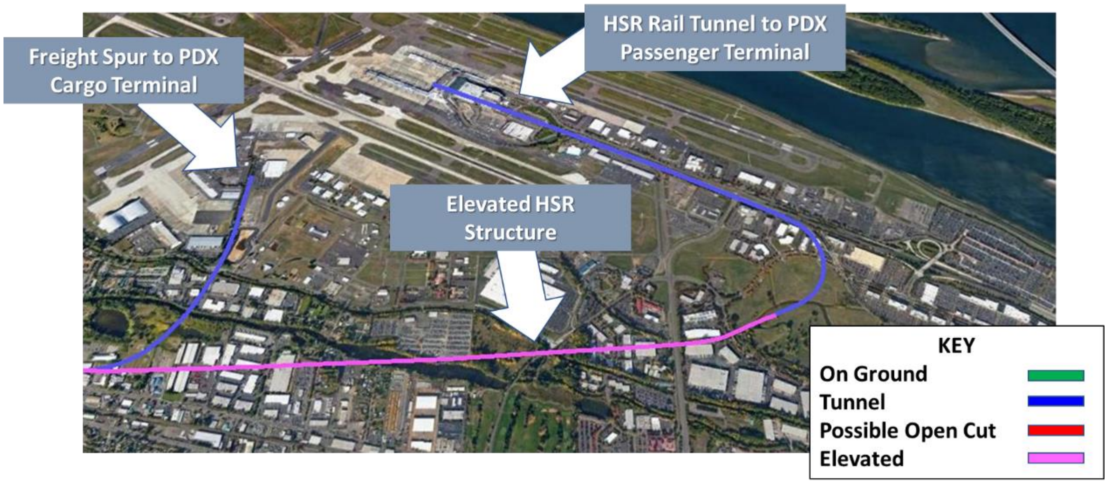


Exhibit 3-7: Alignment Refinements in the Mocks Crest Tunnel Area (ctd., zoomed)

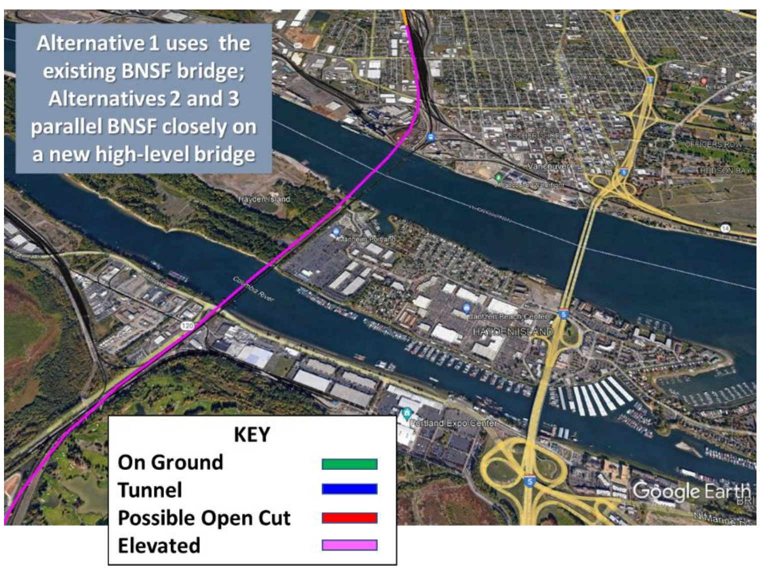
A new tunnel above and parallel to Union Pacific's existing Mock's Crest tunnel would be separate from the existing rail tunnel. Beyond the tunnel is a possible connection to a PDX airport branch line that would extend east along Columbia Boulevard to the PDX airport terminal, as shown in Exhibits 3-7, 3-8 and 3-9. Exhibit 3-8 shows how the rail line can approach the PDX airport terminal by looping around the end of the runway. Exhibit 3-9 suggests, this branch can even be extended east beyond PDX to reach major FedEx and Amazon hubs in Troutdale, OR for express freight shipping.

Exhibit 3-8: PDX Airport Spur



Heading north from the tunnel, as shown in Exhibit 3-9 the alignment would connect either with the existing Columbia River BNSF Railroad Bridge (in Alternative 1) or with a proposed Cascadia Multi-Modal Bridge (in Alternatives 2 and 3.) In either case the alignment would land on the north side of the Columbia River in Vancouver, WA. This will be further analyzed in the Tier 2 EIS.

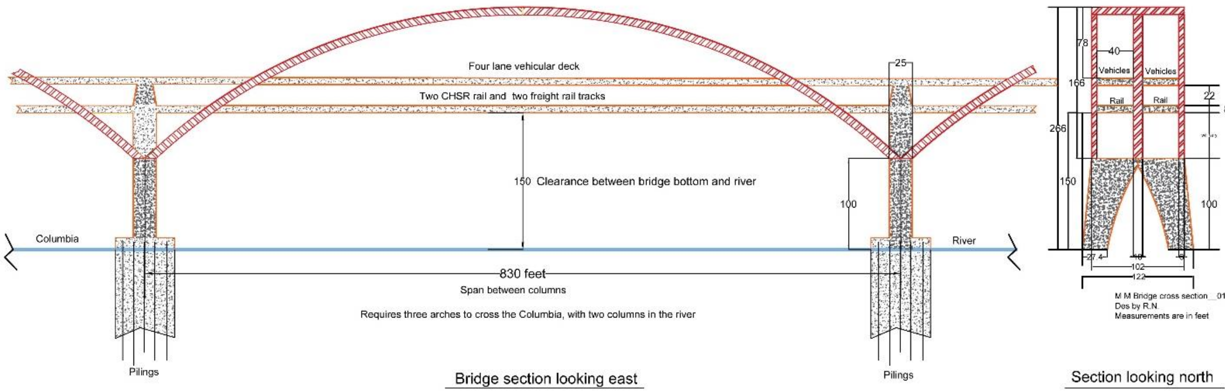
Exhibit 3-9: Columbia River Crossing Area



CHSR proposes to develop a new Cascadia Multi-Modal Bridge with four highway lanes on the top deck, and four rail tracks on the bottom deck. The I-5 Interstate bridge is too close to PDX airport to allow for a high-level fixed bridge crossing. However, shifting the location of the bridge 1.3 miles downriver to the vicinity of the existing BNSF railroad bridge provides enough room under the PDX flight path to allow a high-level fixed bridge to be built in that location. Even so, the flight path still constrains the height of the bridge precluding designs with towers, such as a cable-stayed bridge. Therefore, CHSR has proposed an arch bridge concept. This will provide the required vertical clearance above the river that is needed for barge traffic, as well as enough vertical clearance below the PDX flight path for air traffic. The bridge would allow plentiful 150’ vertical shipping clearance above the river, with a maximum bridge height of 320’ and a deck width of 72’, or 12’ per traffic lane and 18’ per rail lane.

Exhibit 3-10 shows the bridge concept. CHSR high-speed trains will only need 2 out of the 4 proposed tracks. It is assumed that the cost of the bridge would be shared with other potential users including the highway system on the upper deck.

Exhibit 3-10: Proposed Cascadia Multi-Modal Bridge



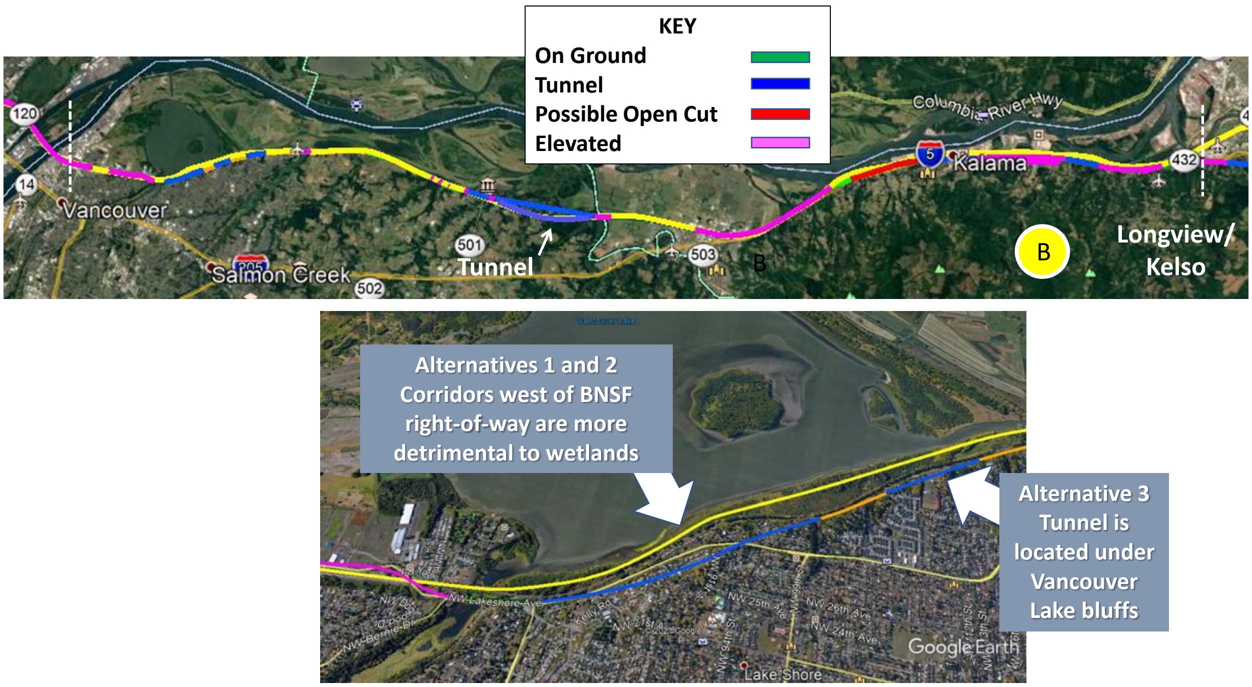
Cascadia Multi-Modal Bridge 150 ft over the Columbia River and 1.3 miles west of the I-5 Bridge. It is double decked with four lanes for vehicles on the top deck and two rail tracks for the CHSR and two rail tracks for BNSF and UP Railroad freight trains.

Exhibit 3-11: Vancouver, WA Station Concept with Related Transit-Oriented Development

Developing a high-speed rail station in Vancouver, WA would prove to be an economic boom to that part of the State of Washington as the station would likely spur substantial levels of transit-oriented development as shown in Exhibit 3-11.

Segment B: Vancouver, WA to Longview/Kelso, WA - All alternatives closely follow the BNSF right-of-way along the Columbia River in this stretch, with some curve easements and a tunnel under Ridgefield. As shown in Exhibit 3-12, Alternatives 1 and 2 tend to ease curves along the west side of the BNSF right-of-way, which is very close to the Columbia River, having wetland impacts. Curves can be eased on the river side, but there are limits to the level of improvement that can be made without shifting the rail line into the river itself. As currently defined, Alternative 3 tends to be east of the BNSF right-of-way cutting or tunneling through the bluffs and this approach results in better geometry than does Alternative 2, but has possible impacts on residential properties above the bluffs. This area needs more detailed study in the Tier 2 EIS and Preliminary Engineering to optimize the alignment.

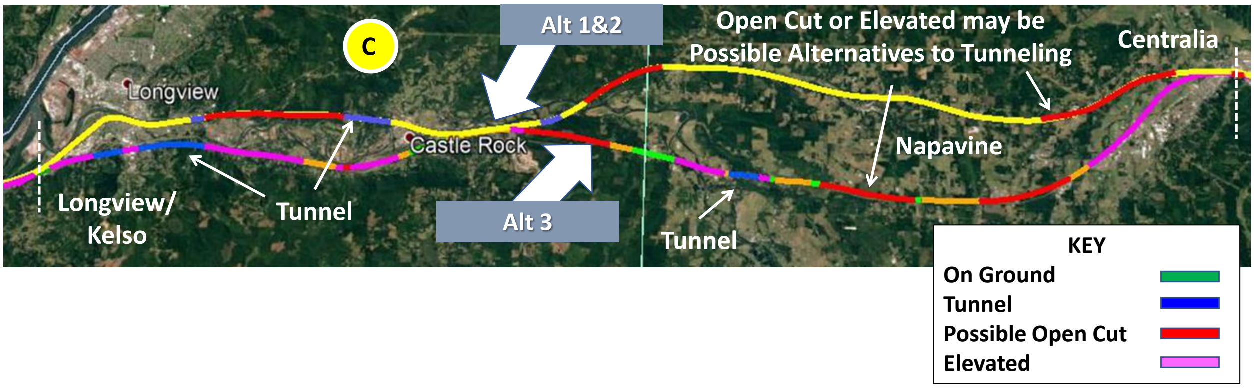
Exhibit 3-12: Vancouver to Longview/Kelso with a Zoom on the Vancouver Lake Area



Segment C: Longview/Kelso to Centralia – The Columbia River turns west at Longview while the rail corridor heads north towards Seattle, following the Lower Cowlitz River. The line climbs to a watershed divide at Napavine, where it enters the Chehalis River drainage. Beyond Napavine, the alignment follows the Upper Chehalis downgrade to Centralia. Because of the mountainous terrain, this segment existing rail line has poor geometry that will be impossible to upgrade to HSR standards.

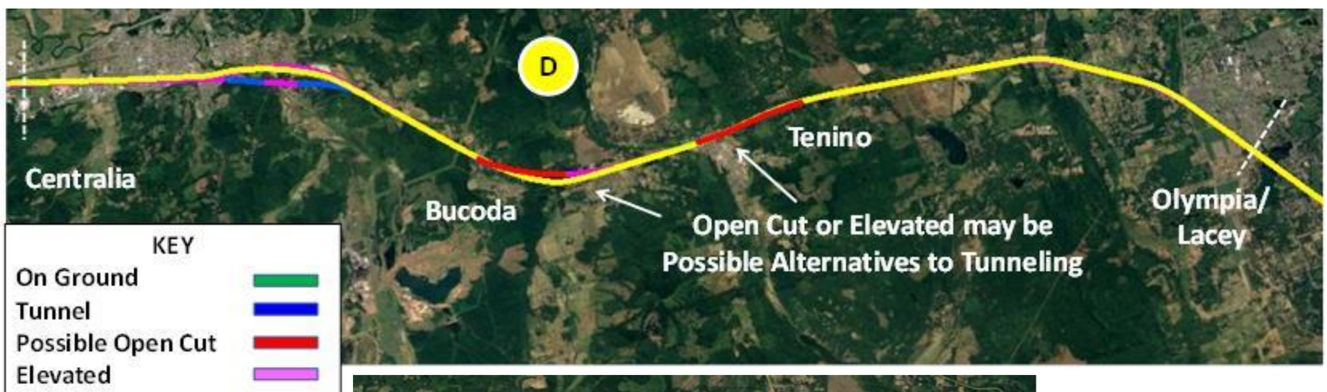
Therefore, two different (eastern and western) greenfield route alternatives have been developed in this stretch. As shown in Exhibit 3-13, Alternatives 1 and 2 would follow a western route that parallels the BNSF right-of-way but does not use much of it. Alternative 3 follow an eastern alternative corridor away from the BNSF rail line. This eastern corridor more closely follows I-5 than it does the BNSF rail line and offers improved geometry.

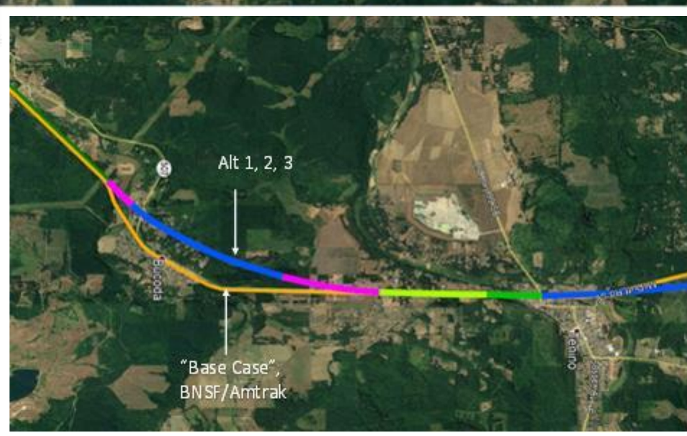
Exhibit 3-13: Longview/Kelso to Centralia



Segment D: Centralia to Olympia/Lacey - The segment from Centralia to Olympia/Lacey has much more moderate terrain. The alignment climbs to Tenino (about halfway between Centralia and Olympia) where the corridor enters the Deschutes River drainage, which empties into Puget Sound. Since the existing BNSF line has fairly good geometry in this stretch, all the alternatives are able to closely follow existing BNSF right-of-way, except that it needs some curve easements as shown in Exhibit 3-14. Alternative 3 has more aggressive curve easements than do Alternatives 1 and 2. This is an area where the environmental advantages of utilizing or at least paralleling an existing (improved) right-of-way can help minimize the environmental impacts of developing the high-speed rail system.

Exhibit 3-14: Centralia to Olympia/Lacey, with a Zoom on Bucoda to Tenino Easements





Since easements must always be towards the inside of a curve, and some curves are to the left and others to the right, this means that either the high-speed line must cross over the freight tracks, or else the freight tracks must be realigned as well to keep them to the same side of the high-speed alignment.

This detail of the curve realignment plan will be resolved in the Tier 2 EIS and Preliminary Engineering phase.

Segment E: Olympia/Lacey to Tacoma Dome - The existing rail line between Nisqually Valley and Tacoma includes the Point Defiance Bypass, which was recently reactivated for Amtrak passenger service. However, this segment has 21 grade crossings as well as some sharp curves, particularly in the area of Dupont where the Amtrak accident occurred. A challenge in this segment is that the geometry of the existing rail alignment through Lakewood (although it may be acceptable for Amtrak service) falls significantly short of the requirement for a high-speed rail system. However, regardless of the outcome of the high-speed rail discussion, the investment in improving the existing rail line will not be wasted, since it has already been decided to extend the Sounder commuter rail service farther south at least as far as Dupont by 2035. Exhibit 3-15 shows that:

- Alternatives 1 and 2 both include a short segment of new alignment to bypass the sharp curves at Dupont where the Amtrak accident occurred. North of Dupont, Alternatives 1 and 2 both rejoin the existing rail alignment, but to eliminate the grade crossings the track will be either elevated or depressed through Lakewood.
- Alternative 3 would develop shortcut tunnels under Lakewood and Nisqually. This would both reduce the length of the alignment and bypass geometric restrictions; it would minimize surface environmental impacts as well.

Exhibit 3-15: Olympia/Lacey to Tacoma Dome

Exhibit 3-16 shows the concept plan for the CHSR Tacoma Dome station. While all alternatives will have a station at Tacoma Dome, the alignment approaches they utilize for gaining access to that station are dramatically different. Alternatives 1 and 2 would utilize upgraded existing rail lines for access and egress to and from the Tacoma Dome station. Thus, they would access the station above ground. However, Alternative 3 may approach the station in an underground tunnel, although the alignment might rise to grade through the station itself. The best approach will be determined in future Tier 2 EIS and Preliminary Engineering studies.

Exhibit 3-16: Concept Plan for CHSR Tacoma Dome Station

Segment F: Tacoma Dome to Tukwila/SEA-TAC - As shown in Exhibit 3-17, both Alternatives 1 and 2 would follow the existing BNSF rail corridor from Tacoma into Seattle, although dedicated passenger tracks would be developed and an investment would be made for completely grade separating the BNSF corridor. By comparison, Alternative 3 would develop a shortcut tunnel under Lakeland straight to SEA-TAC airport. Although this would be a more expensive option, it would produce a faster alignment that would minimize the surface environmental impacts and increase capacity.

Exhibit 3-17: Tacoma Dome to Tukwila/SEA-TAC

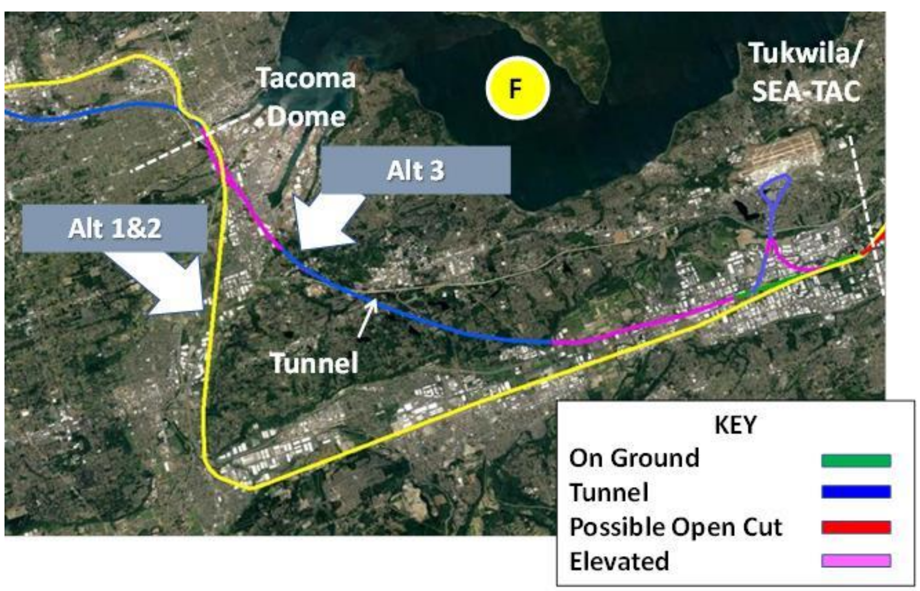
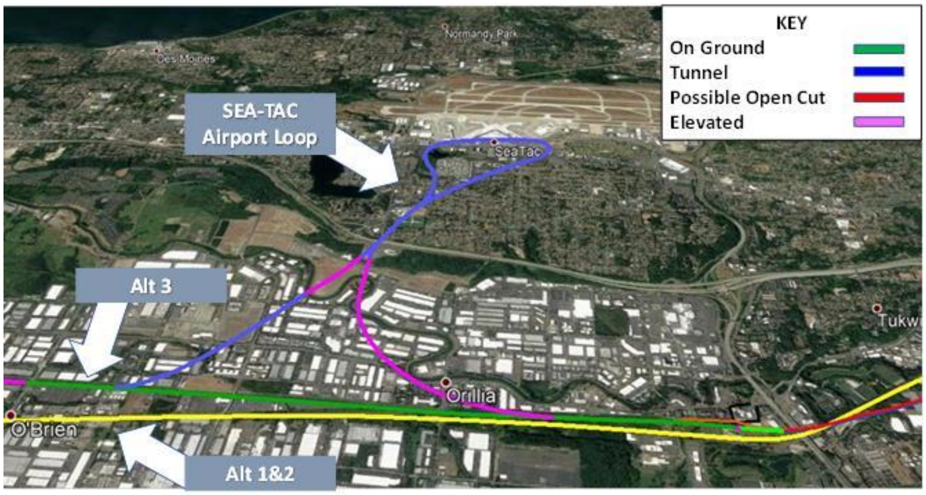


Exhibit 3-18 shows the proposed SEA-TAC Airport loop (underground) since the rail line is in a valley whereas SEA-TAC airport is on top of a hill. For transitioning into the north portal of the Lakeland Tunnel, Alternative 3 must elevate over a short section of the UP alignment in Tukwila. However, CHSR passenger train would have their own tracks; they would not need to share either the BNSF or UP tracks so this elevated structure would not interfere with UP's ability to use its rail line for freight traffic. Exhibit 3-18 shows a placeholder potential alignment that will be considered in more detail in the Tier 2 EIS analysis.

Exhibit 3-18: SEA-TAC Loop at Tukwila



Segment G: Tukwila/SEA-TAC to Seattle Central - The final segment north of Tukwila (Exhibit 3-19) links the high-speed rail alignment into the Seattle station (Exhibit 3-21.)

Exhibit 3-19: Tukwila to Seattle

Exhibit 3-20:
Alternative 3 on Separate Right-of-Way

All the alignments closely parallel in this stretch. However as shown in Exhibit 3-20, Alternatives 1 and 2 would be developed within the existing BNSF right-of-way, but Alternative 3 would develop a new independent right-of-way east of the existing BNSF tracks. Alternative 1 (diesel) might continue to use Seattle King Street, but Alternatives 2 and 3 (electric) would develop a new station called Seattle Central shown in Exhibit 3-21.

Exhibit 3-21: Seattle Central CHSR Station and Transport Hub

The CHSR route plates are provided in Appendix 1 of the CHSR Service NEPA Report Appendices.

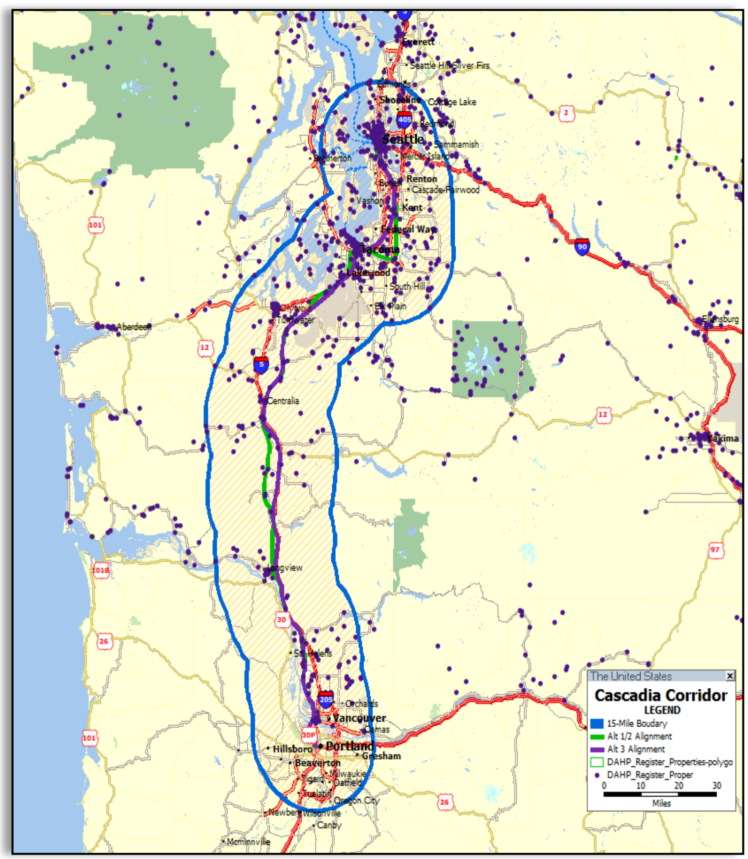
4. Environmental Scan

This chapter presents the results of an environmental scan/analysis for the Cascadia Portland to Seattle Corridor study area (Exhibit 1-3). Specifically, it includes environmental scans for cultural resources, conservation lands, historic resources, ecology (wetlands, wildlife and recreational resources), environmental justice, and agricultural land and soil values. It also includes brief summaries of data collection results for the following environmental impacts: hazardous materials, air quality, noise and vibration, utilities, and public health and safety. In addition, this environmental update includes discussion and data exhibits on natural land networks and biodiversity found in the study area; and in particular, discusses the use of the Washington State Wildlife Linkage Mapper tool for ensuring that development of the new rail line will not impair the ability of wildlife to cross the tracks from one side to the other.

4.1 Cultural Resources

As part of the overall environmental scan of the Cascadia study area, potential impacts to cultural resources were identified. Cultural resources include parks, wildlife refuges, heritage preserves, archaeology resources, historical resources, federal lands, etc. Washington Department of Natural Resource GIS Open Data[5] provides information on parks, wildlife refuge, heritage preserves, federal lands, etc. The National Park Service (NPS) provides information on historic resources. Exhibit 4-1 shows the locations of protected historical sites.

Exhibit 4-1: Historic Resources in the Portland to Seattle Environmental Study Area



[5] See https://data-wadnr.opendata.arcgis.com/

It can be seen that historic sites are almost a ubiquitous feature of the landscape as there are 863 historical sites within the study corridor. However, as shown in Exhibit 5-5, no direct impacts on historic structures (US Register of Historic Places) were found. Most properties were several blocks away from the alignment. However, the Tenino Depot, Centralia Union Depot, Olympic Club Saloon and Hulda Klager Lilac Gardens, are close enough to the track to be potentially impacted by the project. These locations will need extra attention in the Tier 2 EIS for avoiding impacts.

4.2 Ecology

A scanning of ecological resources was conducted as part of the overall environmental scan for the environmental study area. This ecological scan included identifying potential ecological impacts: wetlands, hydric soils, streams, waterways (US & State waters), federally protected species, state protected species, critical stream habitats, migratory bird habitats, floodplain encroachment/impacts, and coastal zone encroachments come under ecology. These ecology systems are discussed in the next subsections.

4.2.1 Wetlands

Wetlands are defined by the United States Fish and Wildlife Service (USFWS) as: "Land that has a predominance of hydric soils and that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances does support, hydrophytic vegetation adapted for saturated soil conditions."[6] Wetlands are one of the most important resources for the CHSR corridor landscape; and, they are particularly critical in the tidal regions of Puget Sound, where they support a variety of vegetation and wildlife that are vital to the entire region's ecosystem. The US Fish and Wildlife Service provides information on wetlands throughout the US through its National Wetlands Inventory Program.[7] The inventory program classifies wetlands into the following types:

- Estuarine and Marine Deepwater
- Estuarine and marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine and
- Other wetlands

Exhibits 4-2 through 4-4 display wetlands located in the Portland to Seattle study corridor. It can be seen that wetlands are a ubiquitous landscape feature across the whole study area and as such, are not avoidable. Wetlands generally cover approximately 10-20% of the terrain in this area. In this study, an effort has been made to minimize wetland impacts in order to be in compliance with Executive Order 11990[8] for Protection of Wetlands. This has been done by shifting the alignment to avoid wetlands where possible, attempting to cross wetlands as near to a right angle as possible, and by bridging over all wetland areas that are in flood plains. Where wetland takes are deemed necessary, coordination with the U.S. Army Corps of Engineers will be required in the Tier 2 EIS to ensure that appropriate measures are used to mitigate any impacted wetlands, including replacing wetlands where necessary, at the required ratios.

[6] www.fws.gov/wetlands/nwi

[7] www.fws.gov/wetlands/nwi

[8] http://www.archives.gov/federal-register/codification/executive-order/11990.html

Exhibit 4-2: Wetlands on the North End of the Portland to Seattle Corridor

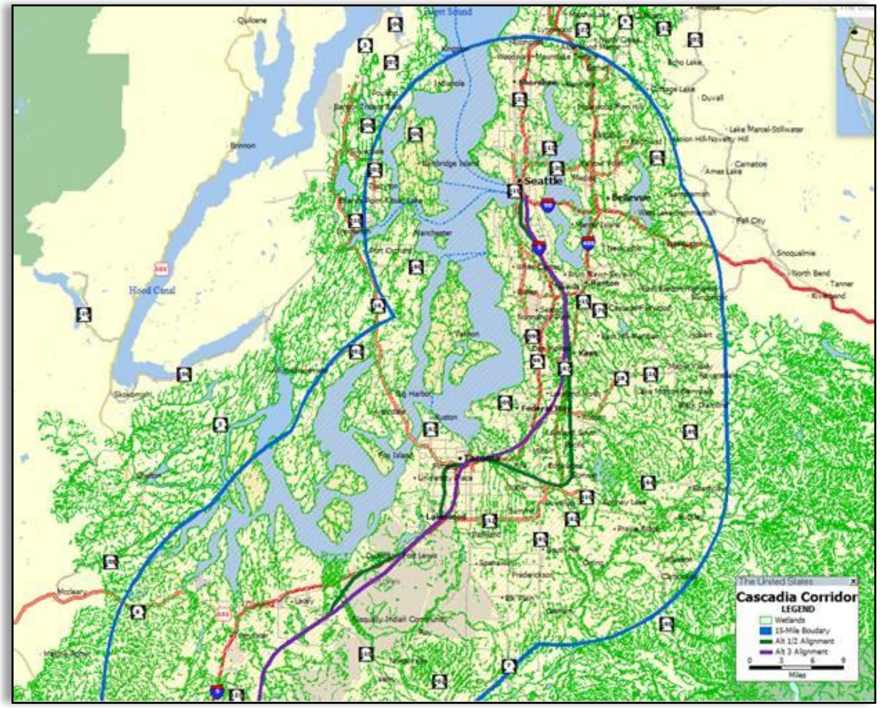


Exhibit 4-3: Wetlands in the Central Portion of the Portland to Seattle Corridor

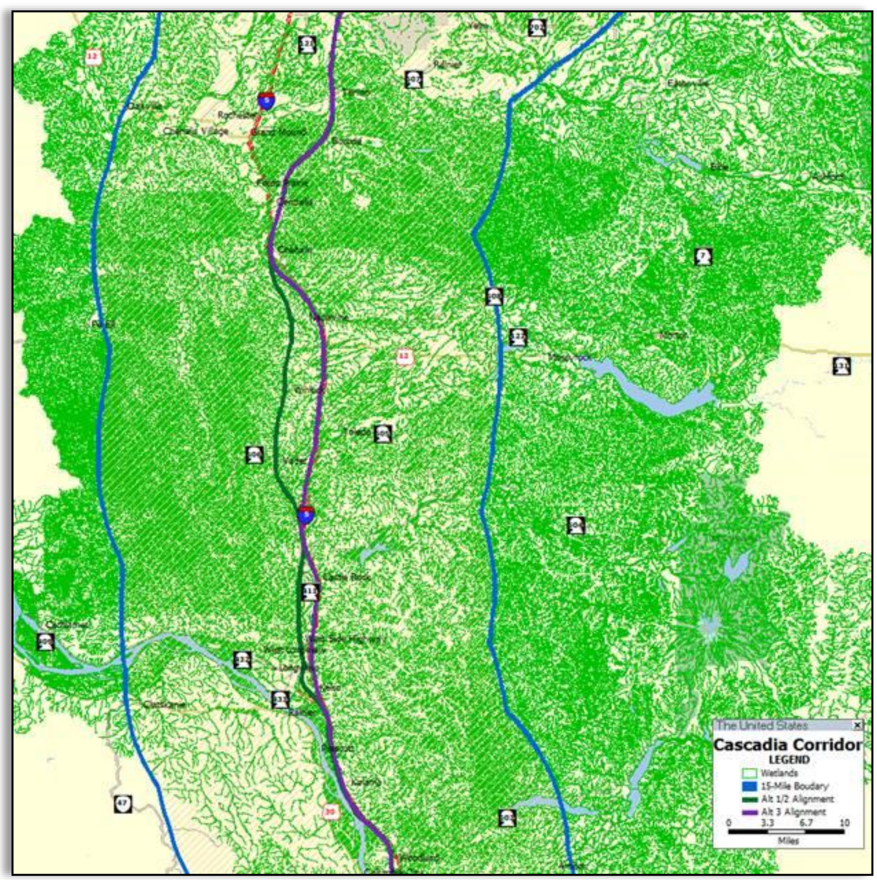
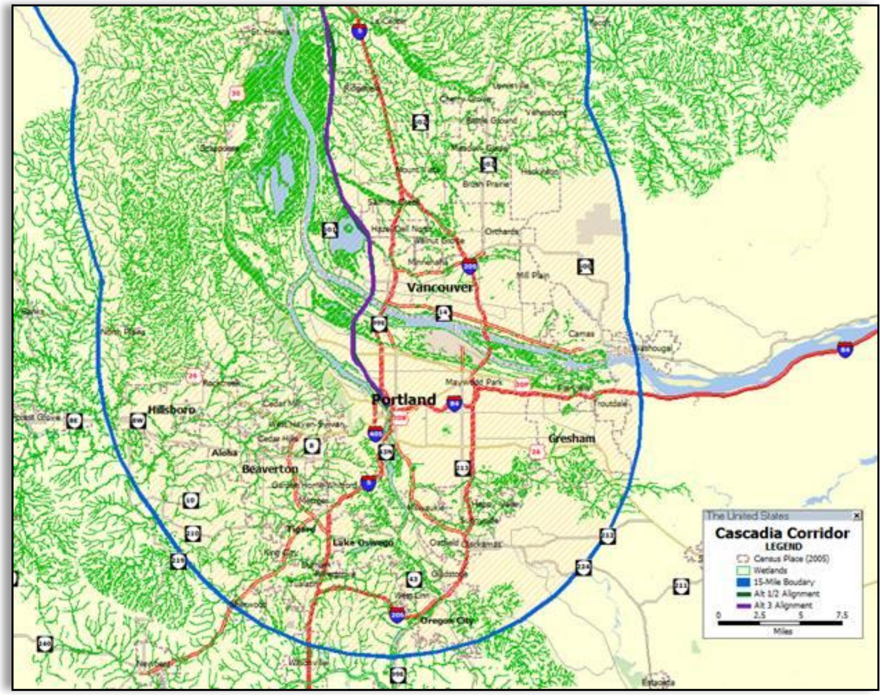


Exhibit 4-4: Wetlands on the South End of the Portland to Seattle Corridor



Impacts on freshwater lakes, ponds, and riverine impacts can be minimized by constructing bridges at the required specifications rather than by filling, depending on the area of coverage. Depending on the area of coverage, many of these freshwater forested/shrub wetlands, if not bridged because they are in a flood plain, can be mitigated by filling or replacing at the required ratios specified by current regulations.

In terms of development of the rail line corridors an effort has been made to minimize wetland takings, both by avoidance and bridging. The current estimates of wetland impact are 48.2 acres for Portland to Seattle for development of right-of-way segments only; in a future phase of work, an effort needs to be made to minimize or avoid any wetland takings that may be associated with development of station facilities – particularly parking lots – which may potentially have additional impacts.

4.3 Public Lands, Wildlife And Recreational Resources

The Washington Department of Natural Resource GIS Open Data site provides data on Wildlife Management Areas (WMAs) and public fishing lakes. This data also includes information on lakes, creeks, swamps, reservoirs, fishing areas, inland navigable waters, boating sites, and bird trails and wildlife loops. The goal of public management of such areas is to maintain and enhance habitats that support game and nongame wildlife while providing opportunities for the public to hunt, fish, trap, and view wildlife. Other uses of WMAs may be allowed, as long as they do not interfere with these goals and uses. Exhibit 4-5 shows the major public lands in the Cascadia Corridor environmental study area, comprising 286,802 acres of property within 15 miles of the rail alignment. Exhibit 4-6 shows privately held habitat conservation areas within 15 miles of rail alignment in 177 discrete holdings, comprising an additional 378,722 acres.

The only public land that is crossed by the rail alignment is Joint Base Lewis-McChord. There are potential impacts on two privately held wildlife preserves, however, it is Alternatives 1 and 2 that have these additional impacts, not Alternative 3. These impacts will be the subject of more detailed assessment in the Tier 2 EIS.

The prospective alignments considered for this Tier 1 EIS study have avoided wildlife and recreational areas where possible. To the extent that endangered species locations have been identified in the relevant databases, these have been avoided also. In the Tier 2 EIS, the U.S. Fish and Wildlife Service will need to be consulted to provide guidance, and assistance in addressing any impacts to endangered species or species habitat areas that may be identified in a future field survey of these resources.

Exhibit: 4-5: Major Public Lands in the Cascadia Corridor Study Area

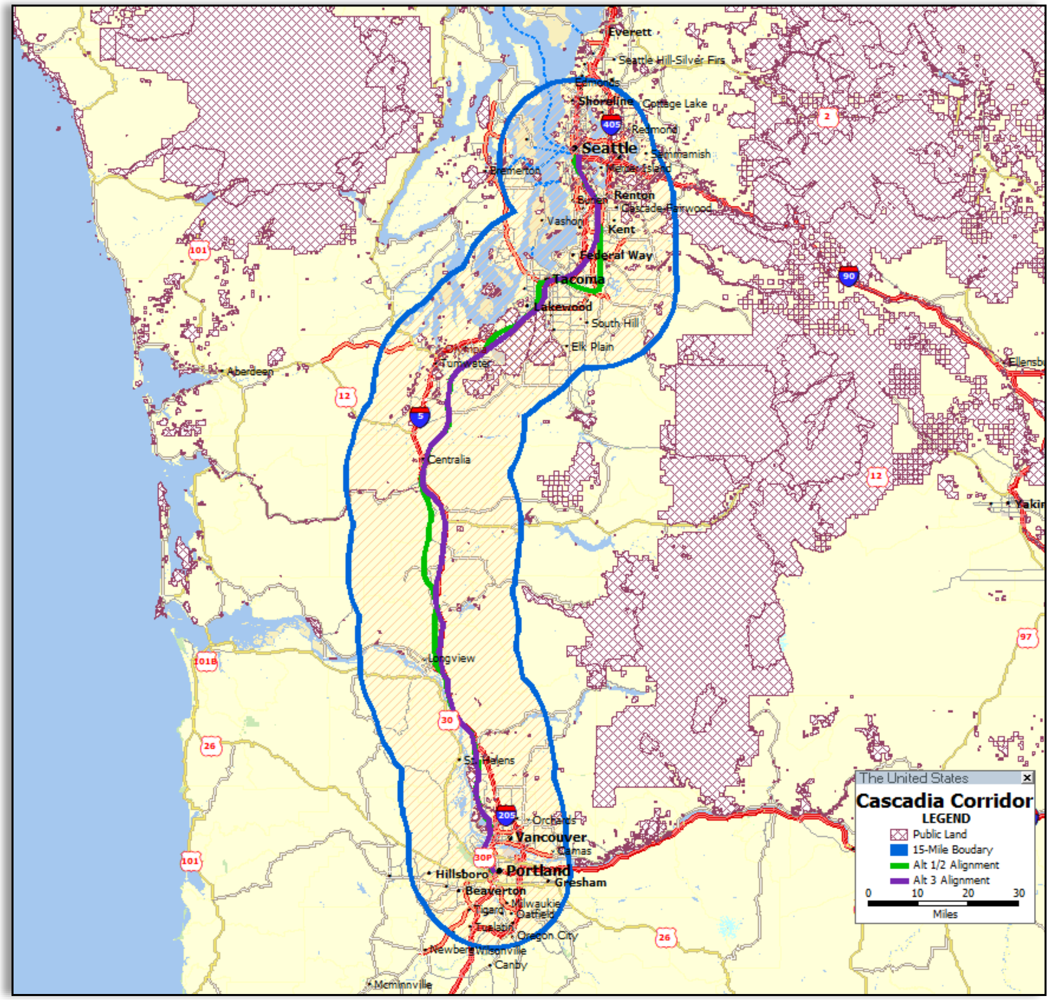
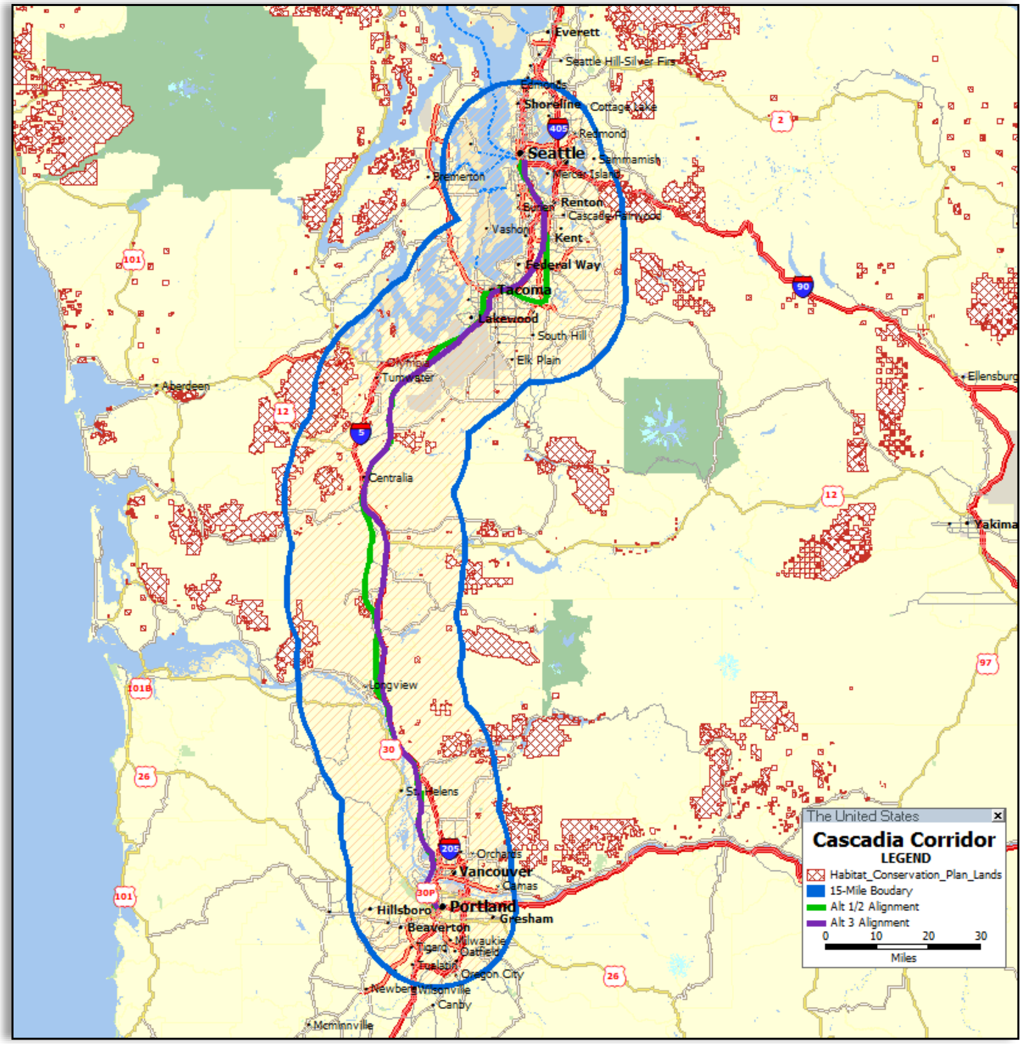


Exhibit: 4-6: Privately Held Wildlife Conservation Areas in the Cascadia Corridor Study Area



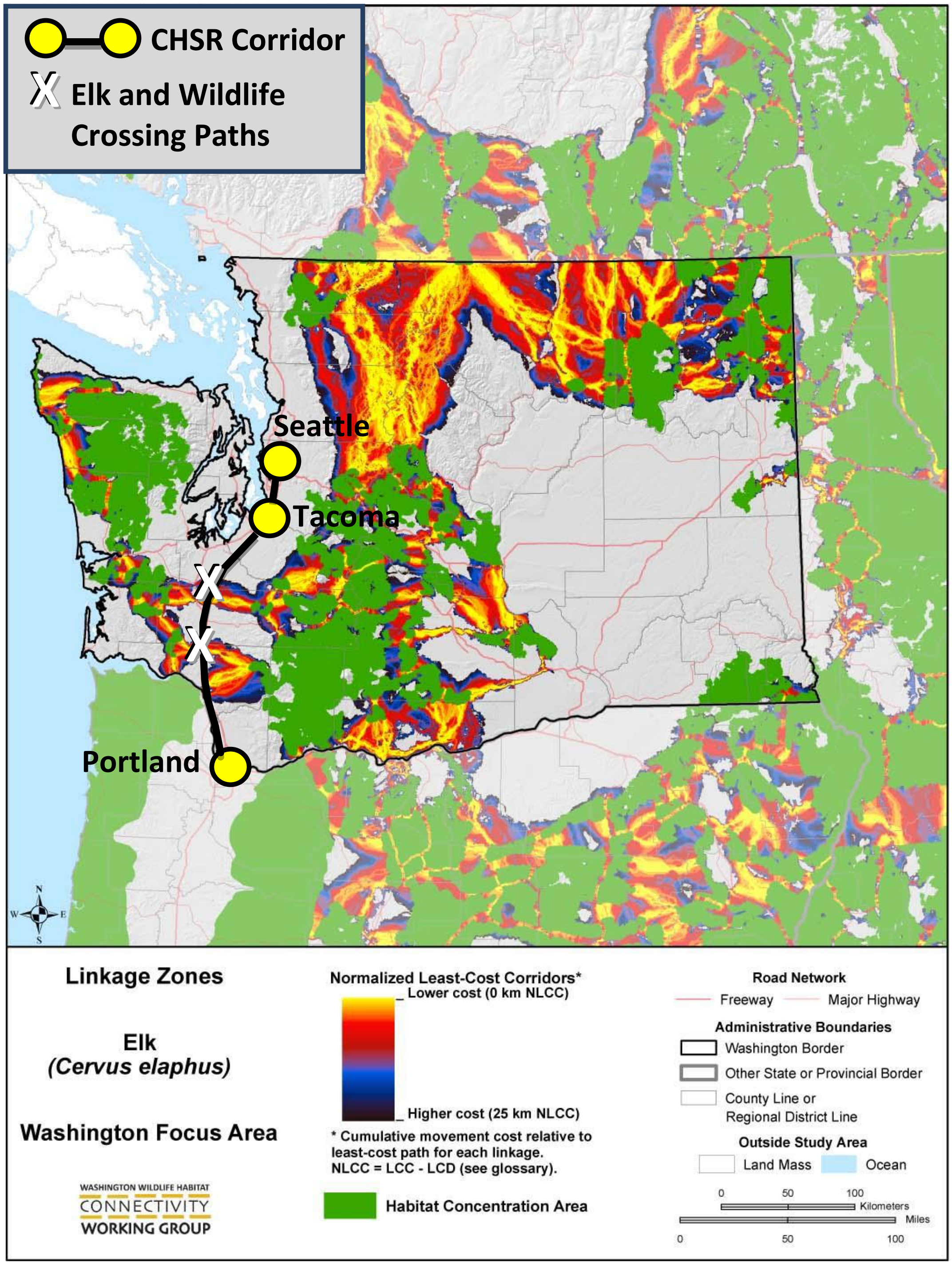
4.4 Preservation of Natural Land Networks and Biodiversity

The Washington State Wildlife Linkage Mapper tool provides a landscape-scale GIS analysis provided by the Washington State Wildlife Connectivity Working Group[9], is a science-based partnership that is composed of participants representing land and natural resource management agencies, organizations, tribes, and universities. It was formed in 2007 under the co-leadership of Washington Department of Transportation and Washington Department of Fish and Wildlife and is led by Core Team of individuals from public and private organizations that have been responsible for the overall preparation, interpretation, and coordination of products and oversee the current workload of the working group. It identifies, prioritizes and links natural habitats based on their overall ecological value in forming natural land networks connecting species habitats throughout the Pacific Northwest.

[9] See: https://waconnected.org/about-the-working-group/

Of particular interest is the maintenance of the continuity of landscape corridors allowing for wildlife movement across broader geographical areas. The movement patterns of sixteen species, consisting of thirteen mammals, two birds, and one amphibian were assessed in detail. Many of these species are confined to the eastern part of Washington state, but some species do exist in the western part of the state and may cross the Portland to Seattle rail corridor. For example, Exhibit 4-7 shows the movement patterns of Elk, showing that these animals will regularly need to cross the Portland to Seattle rail corridor in several areas.

Exhibit: 4-7: Elk Crossings of the Portland to Seattle Rail Corridor



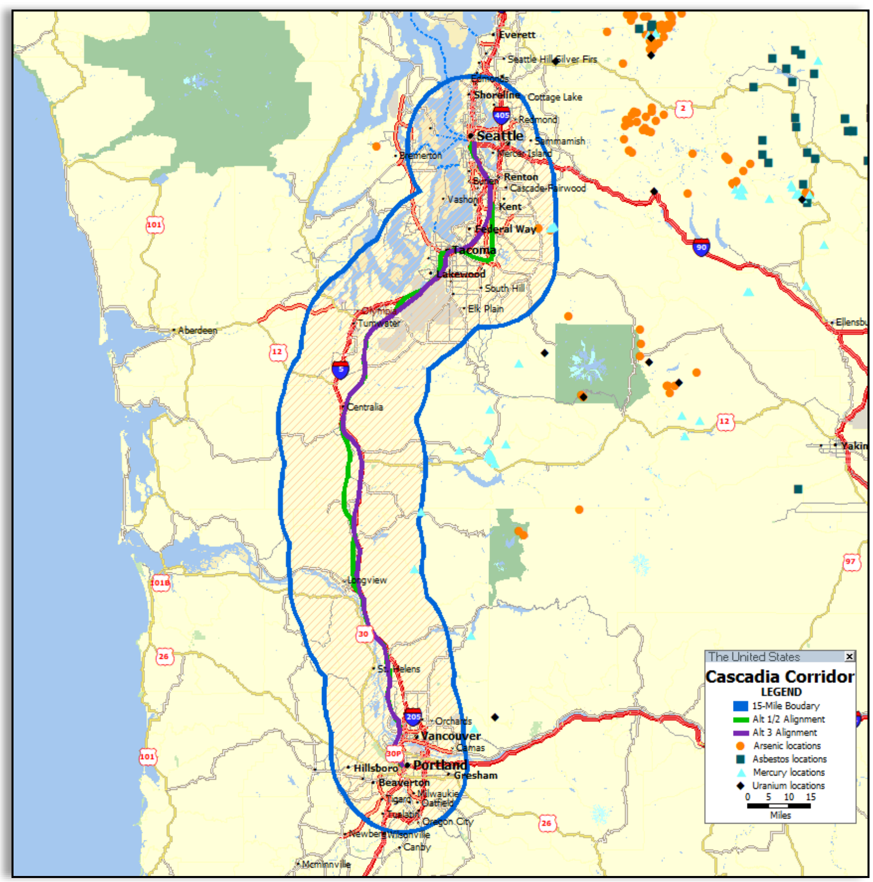
Based on this knowledge of species movements using natural land networks, most certainly it's important to try as much as possible to avoid fragmenting natural land networks and/or maintain habitat passageways that allow for the movement of bio-diverse species of wildlife. Somewhat similar to wetlands, it can be seen that wildlife corridors are a ubiquitous landscape feature, so it will be impossible to completely avoid impacts in development of new rail alignments. When it is necessary to cut across an established wildlife corridor or area, it will be necessary to agree appropriate mitigation measures (possibly including wildlife underpasses or overpasses, for example) with the licensing agencies. Likewise, knowledge of potential impacts to natural land networks can be used along with other data gathered about environmental impacts in the area (i.e., wetlands, conservation areas, wildlife habits, etc.), to assist in the process of prioritizing which impacts are most critical. For example, an unmodified wetland falling within the Linkage Mapper's network of links and nodes would be viewed as having a higher priority for mitigation or avoidance than other similar wetlands.

Alternative 3 in particular already includes extensive segments of tunnel and/or elevated structures. As a result, wildlife should have no problem crossing either under or over the tracks. However, at-grade segments of right-of-way may need to be fenced, and wildlife crossovers provided at regular intervals to prevent wildlife straying onto the tracks and potentially being killed by high-speed trains. Requirements for these types of wildlife mitigations will be subject to detailed study in the Tier 2 EIS.

4.5 Hazardous Materials

Because of the volcanic origin of the Pacific Northwest, its geology includes pockets of hazardous minerals in addition to whatever hazards man might have created. These locations are shown in Exhibit 4-8. Two known locations of arsenic and four locations of mercury are found with 15 miles of the rail alignment. The alignments do not directly pass through any of these locations, but this is an issue that construction crews must be aware of and be prepared to deal with if any of these materials are encountered.

Exhibit: 4-8: Hazardous Mineral Locations



During the Tier 2 EIS, a database search will need to be conducted using standard environmental record sources (see Exhibit 4-9). These databases contain the names and/or locations of reported hazardous waste sites, treatment, storage and disposal facilities, pollution and hazardous waste spills, including Leaking Underground Storage Tanks (LUSTs), and landfills. Any incident or facility identified within the search distance was reviewed to identify past activities that could potentially result in Recognized Environmental Conditions (RECs) at the subject property or within the search distance.

Exhibit 4-9: Standard Environmental Record Sources[10]

Source	Search Distance (miles)
Federal and State Equivalent – National Priorities List (NPL)	1.0
Federal and State Equivalent - Comprehensive Environmental Response, Compensation and Liability System (CERCLIS)	0.5
Federal and State Equivalent - Comprehensive Environmental Response, Compensation, and Liability System (CERCLIS), No Further Remedial Action Planned (NFRAP)	Subject and Adjoining Properties
Federal List of Treatment, Storage and Disposal (TSD) Facilities Subject to Corrective Action (CORRACTS) under the Resource Conservation and Recovery Act (RCRA)	1.0
Federal RCRA Non-CORRACTS	0.5
Federal RCRA Generators List	Subject and Adjoining Properties
Federal Emergency Response Notification System (ERNS) List	Subject Property Only
State Landfill and/or Solid Waste Disposal Site Lists	0.5
State Leaking Underground Storage Tanks (LUST) List	0.5
State Registered Underground and Aboveground Storage Tanks (USTs/ASTs) List	Subject and Adjoining Properties

At this stage of the project, superfund sites have been identified within the environmental study area. Superfund is the name given to the environmental program established to address abandoned hazardous waste sites. It is also the name of the fund established by the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA statute, CERCLA overview). This law was enacted in the wake of the discovery of toxic waste dumps such as the Love Canal and Times Beach sites in the 1970s, and it enables the EPA to clean up such sites and/or to compel responsible parties to perform cleanups or reimburse the government for EPA-lead cleanups. Exhibit 4-10 shows EPA regulated facilities and clean-up locations in the corridor study area.

[10] Source: 460_DEIS_Section_4_5-6.pdf

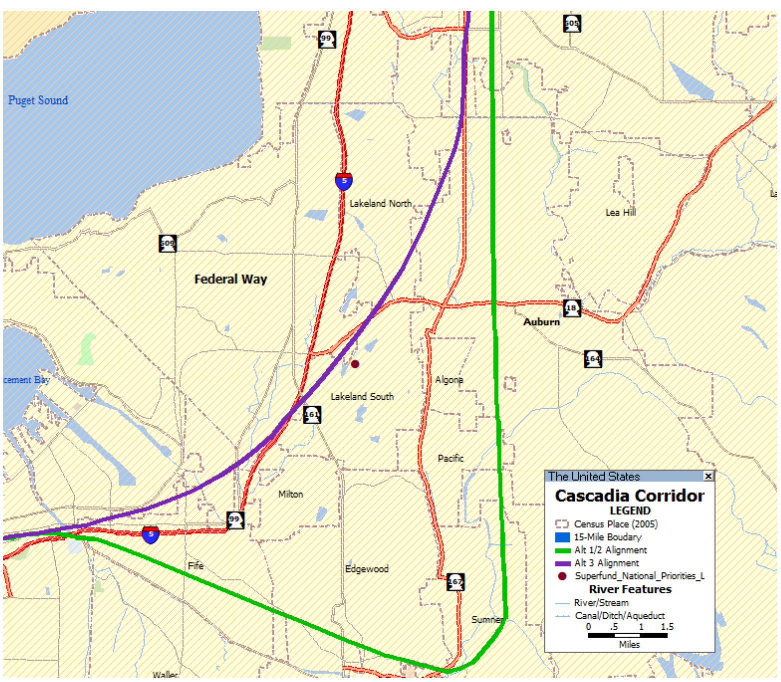
Exhibit 4-10: Final National Priority List (NPL) sites from Portland to Seattle

CERCLIS ID	Name	County	Reason	Proposed	Listed[3]	Construction completed [4]
WAD009624453	Boomsnub/Airco	Clark	Groundwater contaminated by chromium and VOCs, including TCE, PCE and freon-11. Soil on Boomsnub site contaminated by hexavalant chromium.[19]	1/18/1994	4/25/1995	–
WAD053614988	Frontier Hard Chrome, Inc.	Clark	Groundwater and soil contaminated by trivalent chromium and high concentrations of hexavalent chromium.[28]	12/20/1982	9/8/1983	9/22/2003
WAD988519708	Vancouver Water Station#1 Contamination	Clark	Groundwater contamination by PCE from an unknown source. Wells supply up to 20 million gallons of drinking water per day to Vancouver, Washington and Clark County, which is treated to remove PCE before supply.[79]	6/23/1993	5/31/1994	9/25/1998
WAD988475158	Vancouver Water Station#4 Contamination	Clark	Groundwater contamination by PCE, suspected to come from dry cleaning operations. Treatment facilities remove PCE from drinking water before supply.[80]	7/29/1991	10/14/1992	9/8/1999
WAD980722839	Harbor Island (Lead)	King	Groundwater contains benzene, ethylbenzene, xylene, mercury, cadmium, lead and zinc but is not a source of drinking water. Soil is contaminated primarily by heavy metals, PCBs and petroleum and sediments near the island by heavy metals, PAHs, tributyl tin and PCBs.[37]	12/30/1982	9/8/1983	–
WAN001002655	Lockheed West Seattle	King	Past industrial practices have contaminated sediment with heavy metals including arsenic, chromium, copper, lead, silver and zinc, with butyl tins and with PCBs and PAHs.[42][43]	9/29/2006	3/7/2007	–
WA0002329803	Lower Duwamish Waterway	King	Sediment contamination by mercury, arsenic, other heavy metals, PCBs, PAHs, dioxins, furans and phthalates.[44][45][46]	12/1/2000	9/13/2001	–
WAD980638910	Midway Landfill	King	Groundwater contamination by heavy metals and VOCs; landfill gas emissions contaminated by VOCs. Risks associated with heavy metals are now under control; groundwater VOCs are greatly reduced; gas VOCs have been addressed.[50]	10/5/1984	6/10/1986	9/21/2000
WAD009249210	Pacific Car & Foundry Co.	King	Soil was contaminated by heavy metals, PAHs and PCBs from former manufacturing facility. Groundwater contamination by heavy metals, petroleum products and solvents. Around 37,000 people obtain drinking water from wells within three miles of the site.[63]	6/24/1988	2/21/1990	8/5/1996
WAD009248287	Pacific Sound Resources	King	Soil and groundwater contamination by PCP, PAHs and heavy metals from former wood treatment operations. Marine sediment contamination, primarily by PAHs, has contaminated seafood.[64]	5/10/1993	5/31/1994	9/16/2005
WAD980511745	Queen City Farms	King	Former landfill site. Groundwater, surface water and sludge contamination by VOCs (including TCE and DCE); residential wells contaminated by arsenic. Soil contamination by PCBs and metals. Groundwater contamination is currently contained on-site.[70]	9/8/1983	9/21/1984	9/9/1997
WAD980639215	Quendall Terminals	King	Soil and groundwater contamination by PAHs, benzene and creosote products from former creosote manufacturing plant. Contaminant release to Lake Washington is a concern and could affect wildlife, including chinook salmon, a federal threatened species.[71]	9/14/2005	4/19/2006	–
WAD980639462	Seattle Municipal Landfill (Kent Highlands)	King	Landfill gas contains VOCs including toluene, xylene, vinyl chloride, and TCE. Groundwater is contaminated with VOCs and heavy metals.[72][73][74]	6/24/1988	8/30/1990	9/7/1995
WAD009487513	Western Processing Company, Inc.	King	Former industrial waste processing facility. Groundwater and sediment contamination by VOCs, phenols and heavy metals. Soil was contaminated by VOCs, PCBs, phenols and metals. VOCs and metals detected in surface water.[81]	12/30/1982	9/8/1983	12/23/1991
WAD057311094	American Crossarm & Conduit Co.	Lewis	Ground water, soil, and sediments were contaminated with PCP and creosote. The soil also contained dioxins.[8][9][10]	6/24/1988	10/4/1989	9/26/1996
WAD980836662	Centralia Municipal Landfill	Lewis	Groundwater contains elevated levels of chloride and heavy metals including manganese, arsenic and iron. Leachate has drained into nearby rivers.[20]	6/24/1988	8/30/1990	9/28/1999
WASFN1002174	Hamilton/Labree Roads GW Contamination	Lewis	Shallow drinking water aquifer contaminated by PCE and its decomposition products, and by tetrahydrofuran and methylene chloride. There are also very low levels of PCE contamination in soil and sediments.[31]	5/11/2000	7/27/2000	–
WAD980833065	American Lake Gardens/McChord Air Force Base	Pierce	Shallow groundwater is contaminated with VOCs, including TCE and DCE.[11][12][13]	9/8/1983	9/21/1984	9/29/1994

CERCLIS ID	Name	County	Reason	Proposed	Listed[3]	Construction completed [4]
WAD980726368	Commencement Bay, Near Shore/Tide Flats	Pierce	At the Asarco smelter, metals including arsenic, cadmium, copper and lead were released into the soil, air and bay and metals from slag have migrated to surface and groundwater. Soil in the Ruston/North Tacoma study area is contaminated by arsenic and lead. Soil, surface water and groundwater across most of the Tacoma Tar Pits site is contaminated by metals, PAHs, PCBs, and VOCs including benzene, from a former coal gasification plant and recycling operations. Ship building, oil refining, chemical manufacture and storage and other industrial activity has contaminated the land and sediments of the bay with hazardous waste.[22]	12/30/1982	9/8/1983	–
WAD980726301	Commencement Bay, South Tacoma Channel	Pierce	In the Tacoma Landfill site, soil and groundwater are contaminated by VOCs and heavy metals; groundwater is also contaminated by PAHs. Groundwater at Well 12A is contaminated by VOCs and soil by VOCs and lead. Industrial activities at South Tacoma Field led to soil contamination by lead, arsenic, copper and PCBs and groundwater contamination by VOCs and petroleum hydrocarbons.[23]	12/30/1982	9/8/1983	9/29/1999
WA7210090067	Fort Lewis Logistics Center (US Army)	Pierce	Soil and shallow groundwater contamination by VOCs including TCE, DCE and PAHs.[27]	7/14/1989	11/21/1989	–
WAD980511539	Hidden Valley Landfill (Thun Field)	Pierce	Groundwater and leachate contaminated by metals, VOCs and nitrates.[38]	6/10/1986	3/31/1989	9/28/2000
WAD050075662	Lakewood Site	Pierce	Groundwater and soil contamination by TCE and PCE from dry cleaning operations.[41]	12/30/1982	9/8/1983	9/29/1992
WA0000026534	Palermo Well Field Ground Water Contamination	Thurston	Groundwater and surface water contaminated by PCE from a dry cleaning business and TCE from former and current Washington DOT facilities. Three contaminated municipal drinking water wells have been closed.[65]	12/23/1996	4/1/1997	2/22/2001

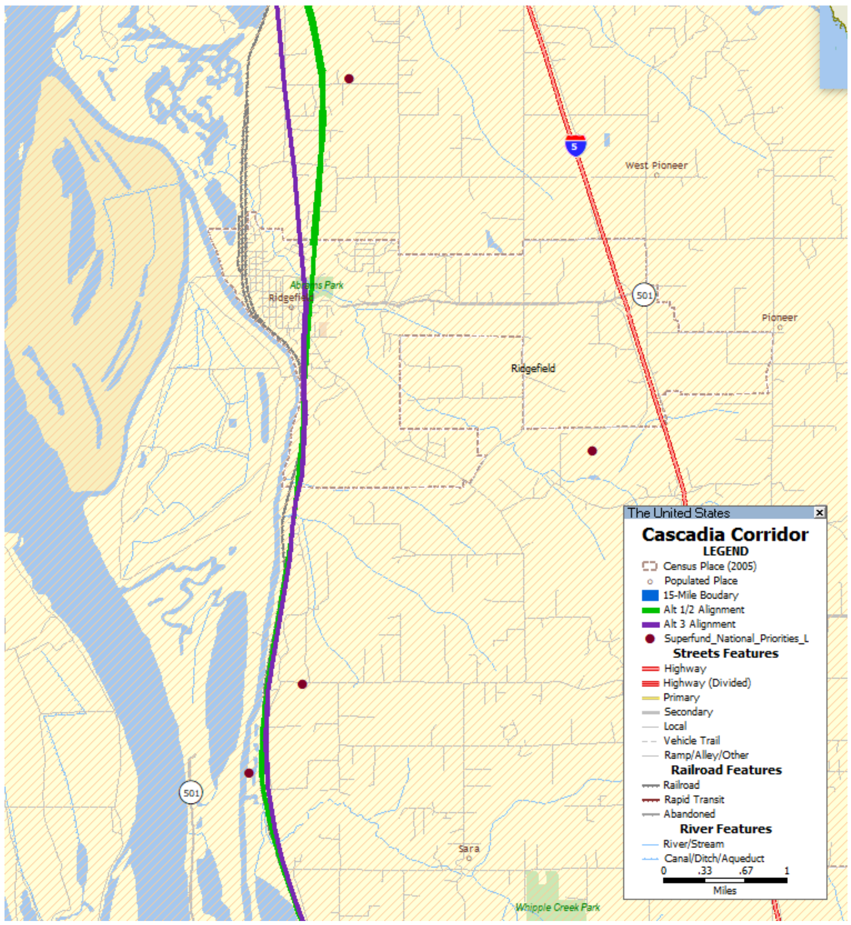
However, most of these Superfund sites are not close to the rail alignment. On the north end of the alignment, Exhibit 4-11 shows the location of one site in Lakeland; however, the proposed rail alignment would be in a tunnel at this point, so therefore no ventilation shaft or other surface feature should be installed near this location. As a result of being in a tunnel, the alignment would not disturb the site.

Exhibit 4-11: National Priority List (NPL) Site in Lakeland



Similarly, Exhibit 4-12 shows several Superfund sites in the vicinity of Ridgefield. In development of new alignments, as a rule, it is best to try to avoid passing the alignment through a hazardous waste site. However, should it prove necessary to pass through such a site, this is not necessarily a negative from an environmental perspective. It may then become necessary to clean up the site before the rail alignment can pass through it. This is good for the environment but adds cost to the rail project. This will receive a more detailed assessment and review in the development of the Tier 2 EIS analysis. Exhibit 4-12 shown that in the worst case, the proposed rail alignments only skirt the edges of the sites and would not pass directly through them.

Exhibit 4-12: National Priority List (NPL) Site in Lakeland



4.6 AIR QUALITY

The Environmental Protection Agency (EPA) has set National Ambient Air Quality Standards (NAAQS) for six principal pollutants. These six principle pollutants are: Carbon Monoxide (CO), Lead, Nitrogen Dioxide (NO2), Ozone, Particle matter and Sulfur Dioxide (SO2) – these are called "criteria" pollutants. Exhibit 4-13 shows the criteria for all the pollutants based on the NAAQS[11].

[11] http://www.epa.gov/air/criteria.html

Exhibit 4-13: National Ambient Air Quality Standards (NAAQS) [12]

Pollutant [final rule cite]	Primary/ Secondary		Averaging Time	Level	Form
Carbon Monoxide	Primary		8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead	Primary and Secondary		Rolling 3-month average	0.15 μg/m^3	Not to be exceeded
Nitrogen Dioxide	Primary		1-hour	100 ppb	98th percentile, averaged over 3 years
	Primary and secondary		Annual	53 ppb	Annual Mean
Ozone	Primary and Secondary		8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution	$PM_{2.5}$	Primary	Annual	12 μg/m^3	Annual mean, averaged over 3 years
		Secondary	Annual	15 μg/m^3	Annual mean, averaged over 3 years
		Primary and Secondary	24-hour	35 μg/m^3	98th percentile, averaged over 3 years
	PM_{10}	Primary and Secondary	24-hour	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide	Primary		1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary		3-hour	0.5 ppm	Not to be exceeded more than once per year

For the environmental study area from Portland to Seattle, only the urban areas at each end of the corridor have had a problem with air quality. Before 1997, the Portland OR area (this includes Vancouver, WA, in Clark County) had a problem with Ozone and Carbon Monoxide, but the area has been in attainment status since then. The intermediate counties of Cowlitz, Lewis, and Thurston have never been in non-attainment status. At the north end of the corridor, the Tacoma area (Pierce County) was in non-attainment status as recently as 2006 over the issue of PM-2.5. The Seattle area (King County) was in non-attainment status until 2001 over PM-10. However, the entire corridor is now in attainment status in regard to meeting EPA air quality regulations.

[12] http://www.epa.gov/air/criteria.html

Air quality measures are all defined across a very broad geographic area. They are not location specific to the level that they are likely to impact specific rail corridor location decisions. The best way to optimize the performance of this measure will be to select a rail option that will be able to maximize diversion from the automobile. The implementation of a rail system can reasonably be expected to further improve air quality, by reducing automobile use and hence automobile emissions throughout the study area.

4.7 Noise and Vibration

Railroad activity, street level traffic, and large truck traffic account for the majority of the noise and vibration impacts within the Cascadia Corridor study area. In the Tier 2 EIS study, the methodology used for measuring noise and vibration should be conducted in accordance with Federal Railroad Administration's (FRA) High-Speed Ground Transportation Noise and Vibration Impact Assessment guidelines.[13] At this phase of study, only the methodology is identified. Typically, mitigations for noise and vibration are construction of noise fencing, elimination of horn noise associated with trains passing though the grade crossings, and prohibiting use of trucks on bridges. It should be noted that most railroad-related noise complaints relate to train horns, but since the proposed high-speed alignments will all be completely grade-separated with no level highway crossings, train horn noise should not be a major issue for any of these alignments. In the current study, an allowance for sound wall protection has been included where the alignment passes close to existing development in urbanized areas. This is based on a very preliminary assessment and will need to be updated in a future phase of work, based on the results of a more detailed engineering analysis of noise impacts.

4.8 Utilities

Selection of alternatives should take into consideration the potential impacts on utility lines located along the alignment. These utility lines can be identified by reviewing aerial images and aerial mapping available from several internet sites and site specific photographs. Exhibit 4-14 shows a typical utility right-of-way. Any utilities situated in the right-of-way may need to be relocated. Should it be necessary for a rail system to use a utility right-of-way, a typical mitigation is to replace lattice towers (as shown) with simple monopole structures that have a much smaller footprint. This typically frees up enough room at ground level to enable the rail tracks to fit within the utility corridor. However, utility pole replacement should not be necessary for this project since no existing utility rights of way are being used by any of the options.

[13] High-Speed Ground Transportation Noise and Vibration Impact Assessment, U.S. Department of Transportation, Federal Railroad Administration, Washington, DC, December 1998 standards.

Exhibit 4-14: Utility Line Right-of-Way

4.9 Environmental Justice

Title VI of the Civil Rights Act and the Executive Order on Environmental Justice (EJ) (#12898) do not provide specific guidance to evaluate Environmental Justice (EJ) issues within a region's transportation planning process[14]. Thus, for this study, the Delaware Valley Regional Planning Commission (DVRPC)'s 2001 EJ technical assessment[15] has been used as a model for evaluating potential EJ issues within CHSR corridor area. Using this model, the following population groups need to be assessed as defined by the US Census Bureau:

- Non-Hispanic Minority
- Carless Households
- Households in Poverty
- Persons with a Physical Disability
- Female Head of Household with Child
- Elderly (over 75 years)
- Hispanic
- Limited English Proficiency

Poverty level data for all population groups is provided by the US Census Bureau. Exhibit 4-15 shows the percent of families falling below the poverty level (by county) within the study area. This map clearly shows some "hot spots" of poverty in the communities of Centralia and Longview/Kelso, both of which cities would be aided by the development of high-speed rail stations within their communities. Exhibits 4-16 and 4-17 show that the urbanized areas of Portland and Seattle do not have major poverty problems, but that some poorer people have been displaced to the suburbs, as is more typical in European rather than American cities.

[14] http://www.dvrpc.org/webmaps/ej

[15] http://www.dvrpc.org/webmaps/ej/

Since poverty in the Pacific Northwest seems to be strongly correlated with a lack of community accessibility, the development of a high-speed rail system should have a strongly positive effect on improving economic opportunity for the residents of these communities. Nonetheless, it would appear that the proposed rail alignments would pass along the edges rather than through the middle of the poverty zones. In any case, it is the geometric requirements of high-speed operation, rather than the political opportunity that may be associated with a politically disadvantaged population, that is the primary determinant of where the high-speed alignments must be placed.

Exhibit 4-15: Poverty Levels within the Portland-Seattle Corridor

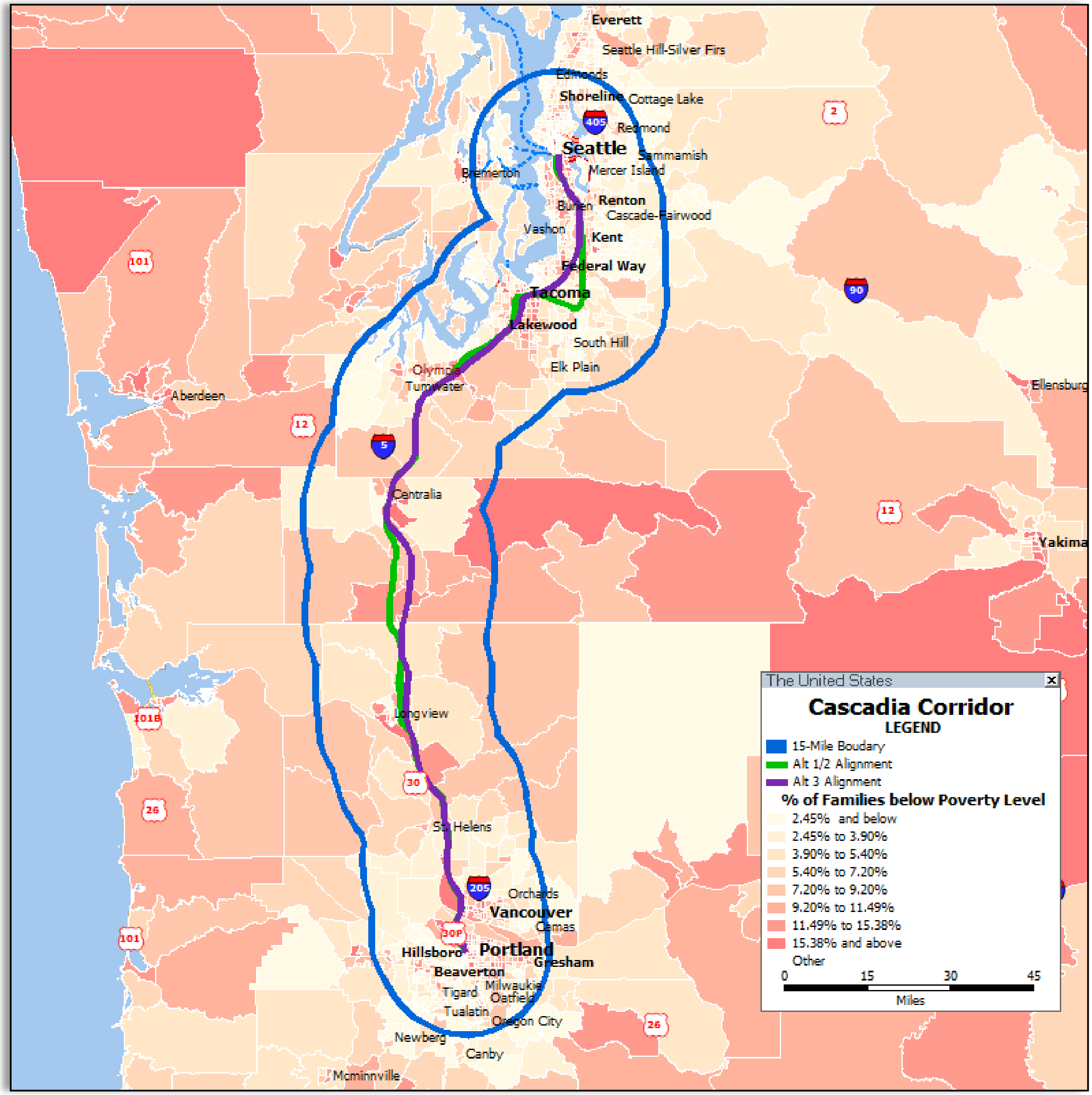


Exhibit 4-16: Poverty Levels within the Seattle-Tacoma Area

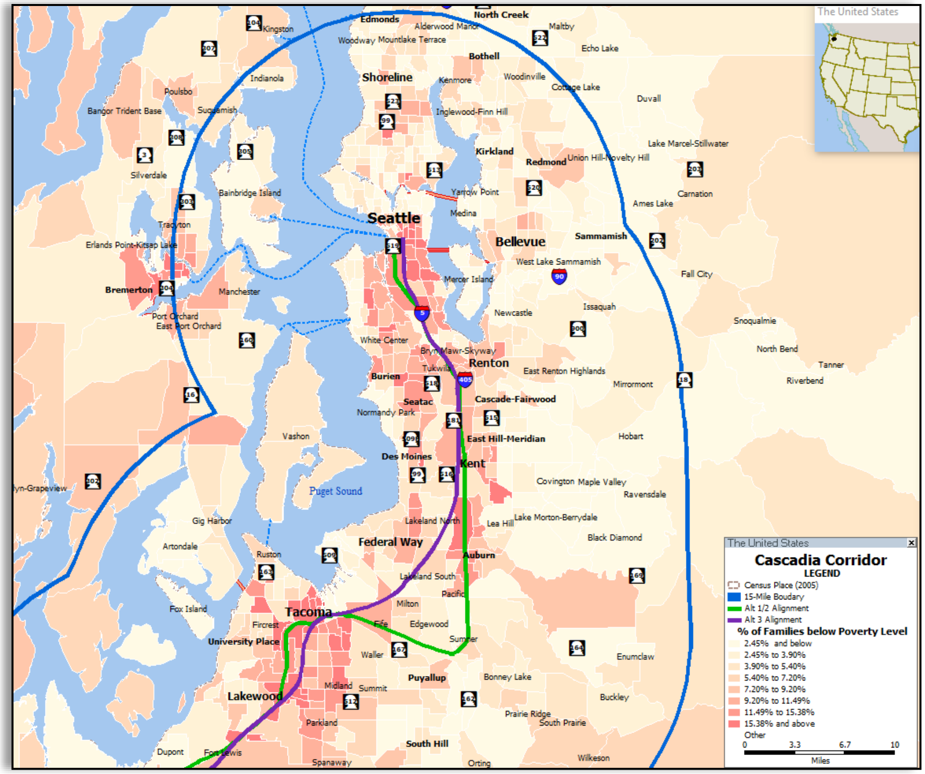
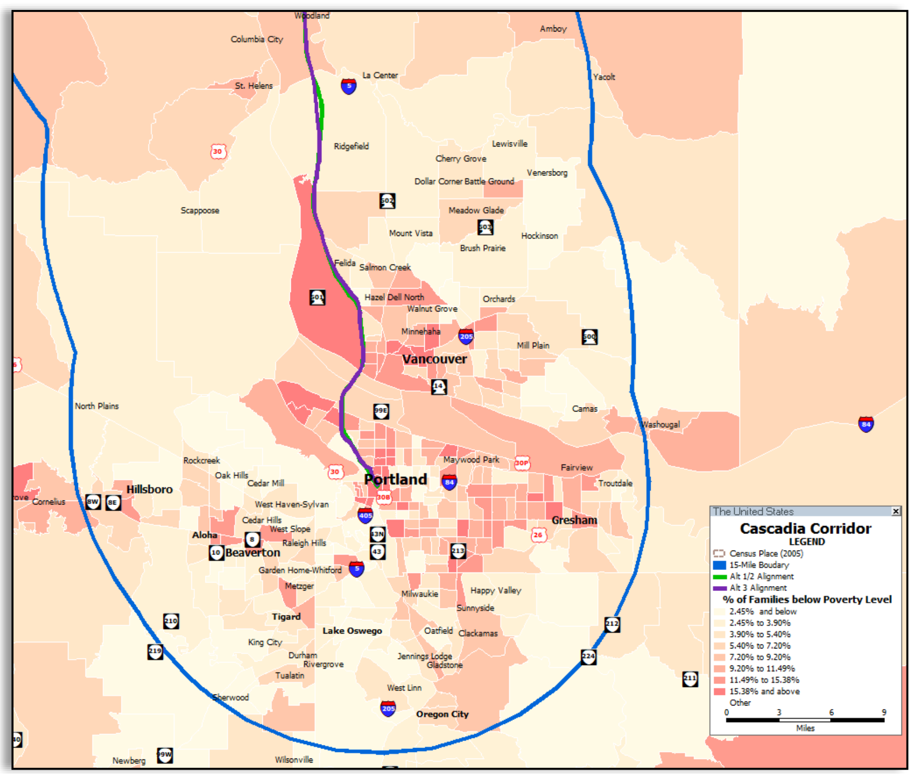


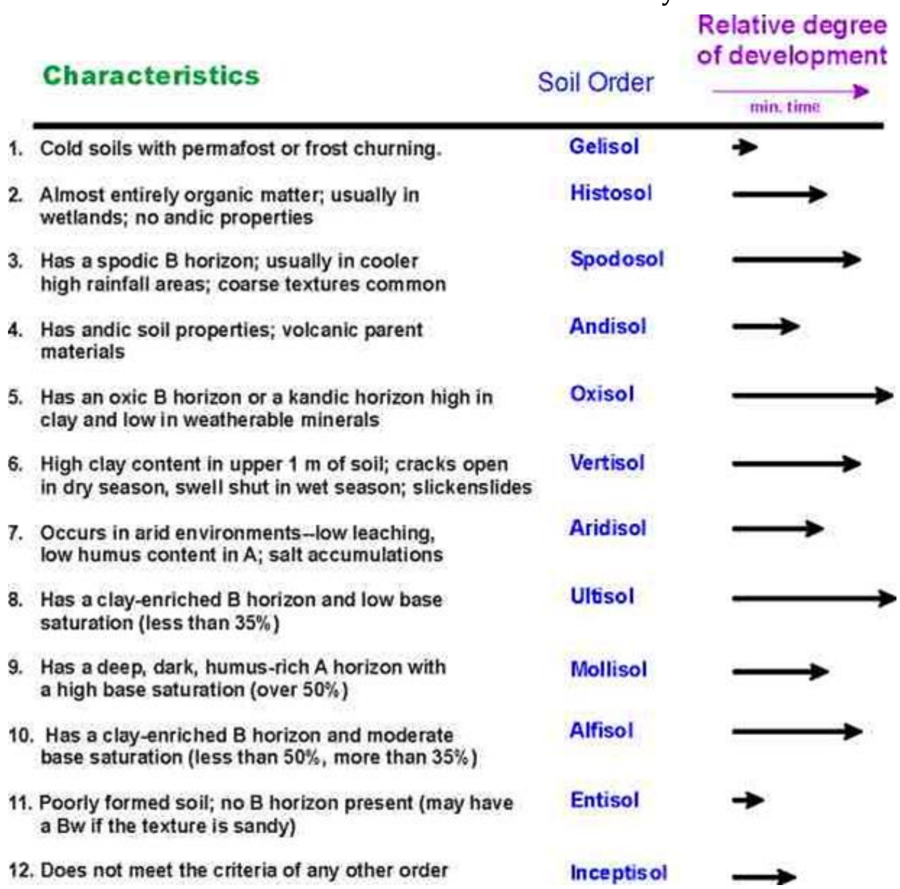
Exhibit 4-17: Poverty Levels within the Vancouver/Portland Area



4.10 Geology and Soils

Washington State has a wide variety of soils due to two factors: glaciation and climatic differences.[16] The state is divided into east and west halves by the Cascade Mountains, with a western, wet, windward half and a dry eastern half. It is also divided north to south. The northern half of the state was covered by glaciers 10,000 years ago and has young soils, and the southern, unglaciated part of the state has old soils. The Cascade Mountains also contain volcanoes which have deposited volcanic ash in many areas. This variety in climate, vegetation, geology and age provides Washington State with soil types from ten of the twelve different soil orders recognized by USDA soil classification system. Currently, 12 soil orders are recognized by the US Department of Agriculture Soil Classification system. A simplified key to the soil orders is given in Exhibit 4-18.

Exhibit 4-18: USDA Soil Classification System



	Characteristics	Soil Order
1.	Cold soils with permafost or frost churning.	Gelisol
2.	Almost entirely organic matter; usually in wetlands; no andic properties	Histosol
3.	Has a spodic B horizon; usually in cooler high rainfall areas; coarse textures common	Spodosol
4.	Has andic soil properties; volcanic parent materials	Andisol
5.	Has an oxic B horizon or a kandic horizon high in clay and low in weatherable minerals	Oxisol
6.	High clay content in upper 1 m of soil; cracks open in dry season, swell shut in wet season; slickenslides	Vertisol
7.	Occurs in arid environments--low leaching, low humus content in A; salt accumulations	Aridisol
8.	Has a clay-enriched B horizon and low base saturation (less than 35%)	Ultisol
9.	Has a deep, dark, humus-rich A horizon with a high base saturation (over 50%)	Mollisol
10.	Has a clay-enriched B horizon and moderate base saturation (less than 50%, more than 35%)	Alfisol
11.	Poorly formed soil; no B horizon present (may have a Bw if the texture is sandy)	Entisol
12.	Does not meet the criteria of any other order	Inceptisol

The impact of dynamic loads of active trains on the soil may result in very intense compression cycles. For this reason, the type of soil and soil stability are very important factors. In order to provide a good foundation, thick layers of aggregate, and frequent and expensive maintenance may be required depending on the soil stability[17]. In order to determine the soil stability, identification of the soil type is essential. This could affect the final alignment location.

[16] This section is heavily drawn from this reference. See: http://faculty.washington.edu/zabow/Index.htm

[17] http://www.haywardbaker.com/WhatWeDo/Applications/RRSubgradeStabilization/default.aspx; http://www.prestogeo.com/railroad_industry; http://www.tenaxus.com/en/geosynthetics/soil-stabilization/railroads-and-airport-runways.htm.

Soil data for prime farmland is provided by the National Resource Conservation Service (NRCS), State Soil Geographic (STATSGO) Database and Soil Survey Geographic Database (SSURGO).[18] Soil data obtained from the STATSGO site is available in both tabular and spatial format for each county and is expressed in proportion values that range from 0.01 to 0.87. These values represent the probability of finding prime farmland at a geographical location and are subdivided into 5 equal intervals of classes with ranking as below.

Range	Rank
0.8015686 – 1	5 (High)
0.6031372 – 0.8015686	4
0.4047058 – 0.6031372	3
0.2062745 – 0.4047058	2
0.0078431 – 0.2062745	1 (Low)

Rich soils, diverse climates and large-scale irrigation make Washington State one of the most productive agricultural regions in the world, producing over 300 different crops. Washington State is the #1 US producer of Apples, Blueberries, Hops, Pears and Spearmint Oil. It is the #2 producer of Apricots, Asparagus, Grapes, and Potatoes.[19] As such, agricultural production, food processing, and trade represent a significant segment of the state's economy.

The agricultural ranking values of soils within Cascadia corridor ranging from a high of 5 to a low of 1. However, most of the environmental study area falls under ranks 4 and 5. These highly productive soils need to be preserved. In the Tier 2 EIS, a more detailed soil inspection will be needed, both for development of a detailed alignment options and for identification of farmland impacts.

However, it should be noted that farmland impacts for a rail system would be far less than those for a comparable highway development. The typical cross section of a high-speed rail route is 80-100 feet, whereas a typical highway needs 300-500 feet cross sections. In addition, a primary consumer of land associated with highway development is low density "sprawl" housing development, and while rail systems are known to encourage more concentrated "densification" development that is much more conservative of land and property. Agricultural land impacts can be minimized by not purchasing any wider right-of-way than is needed for the actual development of the rail line (typically 50') or if a wider right-of-way is purchased in order to secure a buffer zone, leasing back any excess right-of-way within prime agricultural lands for continued agricultural use.

4.11 Transportation; Land Status, Land Use and Zoning; and Socioeconomic Conditions

- Transportation: The presence of interstates, highways or any major roadway impacts must be identified for the proposed alternatives. Alternative 3 uses some portions of the I-5 highway right-of-way. While much of the rail construction would occur in the highway median, there would be temporary construction impacts particularly in the transition zones where the rail line is entering or leaving the existing highway right-of-way. In these transitions the rail line would need to either bridge over or tunnel underneath the existing highway lanes. These impacts would be mitigated by maintenance of traffic measures and by limiting certain heavy construction, such as the placement of bridge beams, to the overnight hours. These impacts will be more fully studied in the Tier 2 EIS.

[18] See: http://www.ncgc.nrcs.usda.gov
[19] See: https://agr.wa.gov/washington-agriculture

- Land Status, Land Use, and Zoning: Right-of-ways for the proposed rail tracks must be taken into consideration as part of the study. It will be necessary to acquire the necessary rights of way and easements from current landowners. Some portions of the alignment may use some existing (public) highway right-of-way, and other portions would be tunneled. Access for adding tracks to certain segments of railroad right-of-way still needs to be negotiated, however, the railroads' staff are very busy, so this discussion cannot likely occur until the Tier 2 EIS. A key concern will be agricultural land preservation -- this will be facilitated by extensive use of elevated structure and tunnels particularly in Alternative 3 -- but access to these needed rights of way still need to be negotiated. This may start to occur as the project moves into Preliminary Engineering and the Tier 2 EIS.
- Socioeconomic Conditions: Major densely populated residential city areas with major transportation hubs are very important in the consideration and selection of proposed alternatives. Key considerations in urban areas will be the promotion of economic growth, along with avoidance of negative impacts particularly on disadvantaged communities. However, it is also important to note that the values of livable cities (e.g., parks, walkability, pedestrian friendliness and effective transit access) are already well established in the major endpoint cities of Seattle and Portland; the development of a high-speed rail connection between these two cities will only serve to further enhance and reinforce the development of these trends in both cities.

4.12 Public Health and Safety

Typical safety features that must be taken into consideration when proposing rail alignment alternatives include: the age of bridges that may be used by the alignment, water runoff, basal erosion, and accidents at railroad crossings. Railroad crossings, pedestrian safety and rail operations are also main factors contributing to the safety. Since the proposed rail system is to be developed on grade-separated alignment, it is anticipated that its development will improve safety. Trespasser risks will be mitigated by security and sound wall fencing, particularly in urban areas, to "seal" and secure the corridor.

4.13 Conclusion and Further Analysis

The environmental scanning/analysis discussed, identified and summarized potential environmental impacts within the environmental study area going from Portland to Seattle. This included collecting data on and mapping potential environmental impacts: conservation areas, historical resources, wetlands, wildlife resources, natural land networks, environmental justice, hazardous materials (data only), and air quality (data only). In addition, suggestions for possible mitigation measures for each of the potential environmental impact types were outlined. The highlights of the environmental scan, data collected and suggested mitigation measures are as follows:

- Conservation lands were identified and mapped within the environmental study area. Suggested mitigation measures include designing alignments so that they take a path that avoids or by-passes potential impacts with conservation land areas. Where it is necessary to pass through such areas, the use of tunnels or elevated structures can help reduce surface impacts.
- Protected historical resources were identified and mapped within the environmental study area including churches, buildings, houses, etc. Suggested mitigation measures include designing alignments so that they take a path that avoids or by-passes potential impacts with protected historic sites.
- Wetlands within the environmental study area were identified and mapped. Suggested mitigation for impacted wetlands include coordinating with the US Army Corps of Engineers to design appropriate

mitigating measures that meet compliance with Executive Order 11990[20] for Protection of Wetlands, including avoiding, filling, bridging, or replacing wetlands at the required ratios.

- Wildlife resources within the environmental study area were identified and mapped including the location of lakes, creeks, reservoirs, wildlife preserves, and public lands. Suggested mitigation measures include designing alignments so that they take a path that avoids or by-passes potential impacts with wildlife preserves and wildlife resources. Where the alignment must cross a wildlife corridor, suggested mitigation measures include designing alignments so that they take a path that avoids fragmenting intact land networks and intact core areas that have a high to excellent ecological integrity score rating. Where fragmentation cannot be avoided, it is recommended to keep impacts confined to the edges of highly valued core areas and/or to provide natural passageways that allow for the natural movement or migration of plant and animal species.
- Hazardous material superfund sites were identified within the environmental study area. These issues will be more thoroughly examined in the next phase of the study once route alignment options have been decided upon for further study.
- Air quality within the Cascadia corridor is now in compliance status for all air pollutants.
- Other human environmental elements that include noise and vibrations, utilities, environmental justice, geology and soils, transportation, land status, land use, and zoning, socioeconomic conditions, and public health and safety were briefly reviewed at a landscape level scan and should be discussed in more thorough detail in the Tier 2 EIS.

Using the summary of identified environmental resources and potential environmental impacts outlined in this chapter as a base, a more intensive Tier 2 environmental study can be performed in the next phase of the study once the route alignment options have been even more carefully defined and optimized.

[20] See: http://www.archives.gov/federal-register/codification/executive-order/11990.html

5. Mitigation and Summary of Impacts

The goal of mitigation measures is to preserve, to the greatest extent possible, existing neighborhoods, land use, and resources, while still improving transportation in the corridor. Although some adverse impacts are unavoidable, through the development, design, environmental, and construction processes precautions will be taken to protect as many social and environmental systems as possible.

5.1 Mitigation Tools

Two of the primary mitigation tools are tunneling and the use of elevated structures, as shown in Exhibit 5-1 with their "all in" average unit capital costs. As can be seen, tunneling is by far the most expensive option but it has the advantage of practically eliminating all surface impacts of the alignment. Elevated guideway structures (or flyovers) have surface impacts, but the land underneath the structures can still be used for other purposes. At-grade construction which usually involves cutting and filling, is the least expensive but also has the greatest environmental impacts. By relying more on tunneling and flyovers and less on at-grade construction, many of the environmental impacts of high-speed rail development can be mitigated.

Exhibit 5-1: Infrastructure Costs with "All in" Average Unit Capital Costs

Tunnel - $230M/mile

Elevated Guideway - $123M/mile

Cut and Fill - $25M/mile

Another key tool is rerouting the alignment to avoid impacts, but as the geometric requirements for high-speed rail alignments are very stringent, so it is not always possible to shift an alignment without either compromising the geometric standards, or creating even greater problems elsewhere. Wetland impacts have been avoided where possible by rerouting the alignment or trying to pass through such areas on established corridors, such as existing cut and fill structures. However, where it is not possible to avoid them, 100-year flood plain areas are bridged. For unavoidable wetland impacts that are not in flood plains, if it is determined that wetlands will be impacted during construction, an allowance has been made in the cost for compensatory mitigation at the required replacement ratios. This will need to be assessed in more detail in the Tier 2 EIS.

Standard engineering unit cost estimates assume that construction will include measures that are normally employed for environmental projects, including:

- Avoidance of underground utility impacts where possible, and relocation where not possible.
- Precautions for controlling erosion and sedimentation at the construction site
- Compliance with regulations governing disposal of solid waste
- Maintenance of rail and highway traffic during construction
- Minimization of construction noise impacts
- Dust-control measures
- Compliance with regulations regarding bituminous and Portland cement concrete proportioning plants and crushers.

However, the determination of specific mitigations is very site specific, so the particular measures to be applied cannot be fully determined until the Tier 2 EIS analysis has been undertaken. At the current level of assessment, the focus has mostly been on assessing aggregate levels of potential impacts, along with the identification of potential hot spots. Exhibit 5-2 summarizes the results in terms of the key Environmental metrics of interest. These identify on two main types of impacts:

- **Direct impacts** are site specific impacts that are a direct result of the location of the alignment. These include wetlands, structures, historic properties, land or property taking and freight railroad impacts.
- **Regional impacts** are only indirectly influenced by location decisions and have more to do with the overall usage of various transportation modes and their differential effects on the environment. These include highway traffic congestion, energy savings and emissions reduction impacts.

Exhibit 5-2: Environmental Impact Summary

Environmental Metric	Alternative #1	Alternative #2	Alternative #3
Total Route Miles	173.3	173.3	165.7
Tunnel Miles	18.4	18.4	43.5
Flyover Miles	34.7	34.7	60.9
Shared Rail Right-of-Way Miles *(40%)*	68.6 *(40%)*	68.6 *(40%)*	19.0 *(12%)*
Congestion Time Savings (millions/hours)	5.31	12.42	16.90
Energy Savings (millions of gallons of gas)	4.22	9.87	13.42
Emissions Savings (millions of tons e.g. $C0_2$)	0.34	0.82	1.11
Miles of Potential Wetland Impact	29.75 *(17.2%)*	29.75 *(17.2%)*	20.85 *(12.6%)*
Structures Potentially Impacted	73	73	103
Acres of Surface Right-of Way Required	1,553	1,685	1,164
Main Line CAPITAL COST ($Mill of 2021)	$8,027	$13,055	$20,780
Plus Airport Loops	$990	$1,500	$1,500
TOTAL CAPITAL COST w/AIRPORTS	$9,017	$14,555	$22,280

5.2 DIRECT IMPACTS

- In terms of direct impacts, it is immediately apparent that Alternative 3, the ultra high-speed option makes the most use of both tunnels (43.5 vs. 18.4 miles) and flyovers (60.9 vs 34.7 miles).
- Alternative 3 is the shortest route, so at-grade construction for Alternative 3 would comprise only 165.7 – 43.5 – 60.9 or 61.3 miles, only 19.0 of which would share existing rail right-of-way.
- Alternatives 1 and 2 as lower cost options make more use of at grade construction. For these options, 173.3 – 18.4 – 34.7 = 120.2 miles are at grade, 68.6 of which would share existing rail right-of-way.

From this, it is clear that Alternative 3 will be far less impactful on the freight railroads than would Alternatives 1 or 2. Having said this, the main effect of Alternatives 2 and 3 would be to completely remove Amtrak corridor services from the BNSF mainline, releasing all the capacity that existing Amtrak service (except for Long Distance trains) consumes. Even Alternative 1, by building a new passenger-dedicated track would remove most Amtrak train-miles from BNSF's Seattle to Portland rail line.

As a result, any of the options should have a positive impact on freight rail capacity, even if there is a need for building some passenger rail capacity enhancements within some segments of freight railroad right-of-way. While Alternative 1 should have a moderately favorable impact, Alternative 3 is clearly the best option for the freight railroads since it both completely removes corridor passenger trains from their track and also minimizes passenger use of freight rail right-of-way.

For minimizing wetland impacts, Exhibit 5-3 shows that Alternative 3 is also the best alternative. It should be noted that all the alignment options share substantial common mileage, for example from Rose Quarter to Vancouver and from Centralia to Nisqually, all options have similar impacts in the common stretches. These common stretches account for nearly 10 miles of wetland impact. Even where existing rail rights of way is shared, the existing embankment would likely need to be widened for adding tracks. As a result, there would still be wetland impacts even if existing rail right-of-way were used. For example, Alternatives 1 and 2 would have wetland impacts by easing curves along the river between Vancouver, WA and Longview/Kelso, WA. Along the same stretch, Alternative 3 tunnels through the bluffs and thereby avoids these areas.

Elsewhere where the alignments diverge, because of its use of extensive tunneling and flyovers, Alternative 3 avoids the need for widening existing rail rights of way, or for building new surface alignment with potential wetland impacts. Because of this, Alternative 3 has the least overall wetland impacts.

Exhibit 5-3: Wetland Impacts Comparison

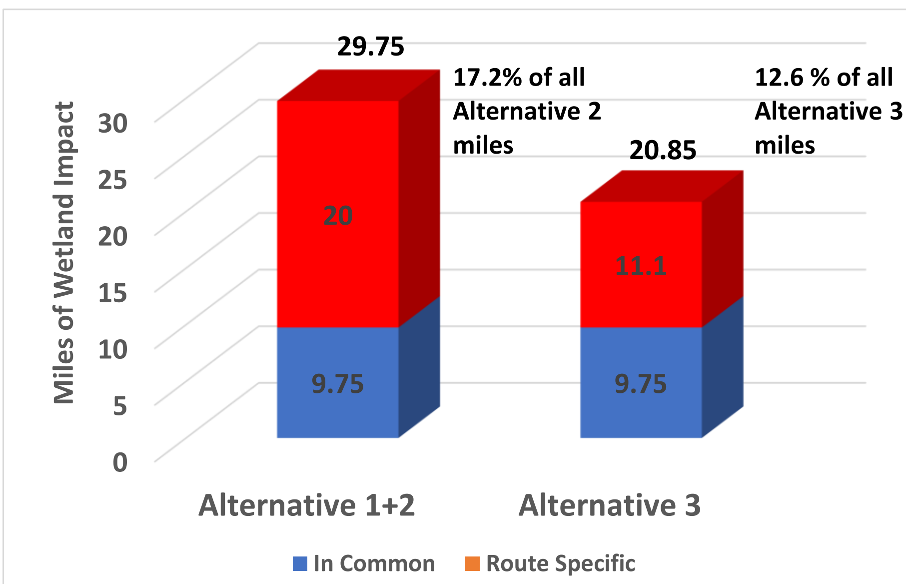
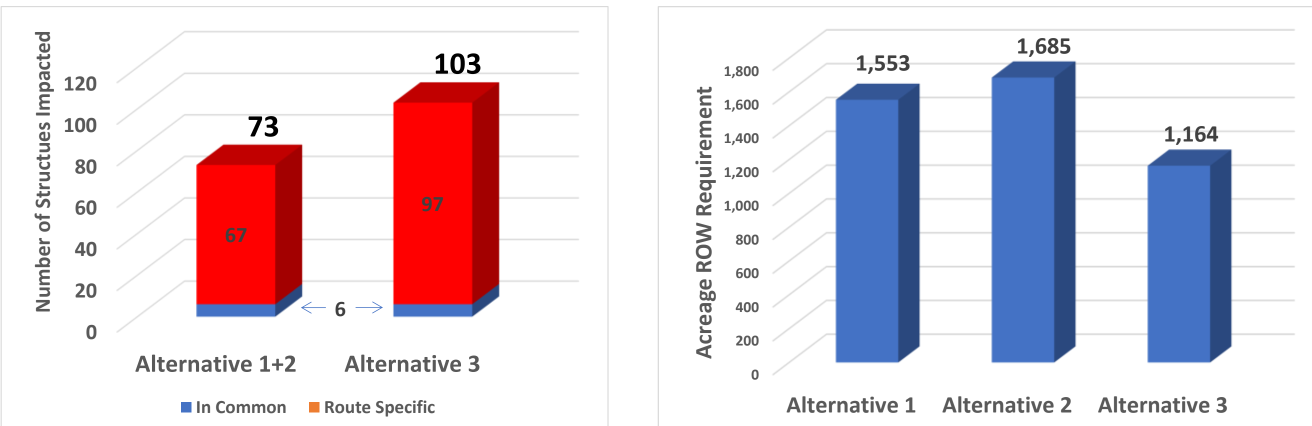


Exhibit 5-4 shows the number of structure impacts associated with each option. Most of the structure impacts were associated with elevated segments away from the existing rail right-of-way. At this preliminary level of assessment, an impact was noted if the alignment passes close enough to potentially impact a structure. This does not mean that the structure will necessarily have to be taken, demolished or even modified; in many cases the flyover might be high enough to even be able to pass over top the structure. A typical structural impact due to the use of an overhead flyover structure is shown in Exhibit 3-7.

The right-of-way acreage requirement was assessed based on the length of the surface alignment, excluding tunnels. Alternative 3 has the smallest overall acreage requirement due to its heavier reliance on tunnel easements; however, it also makes the least use of existing rail right-of-way. Alternative 2 needs the most land because it has a longer route than does Alternative 3. Alternative 1 needs slightly less land because it is only a single tracked option.

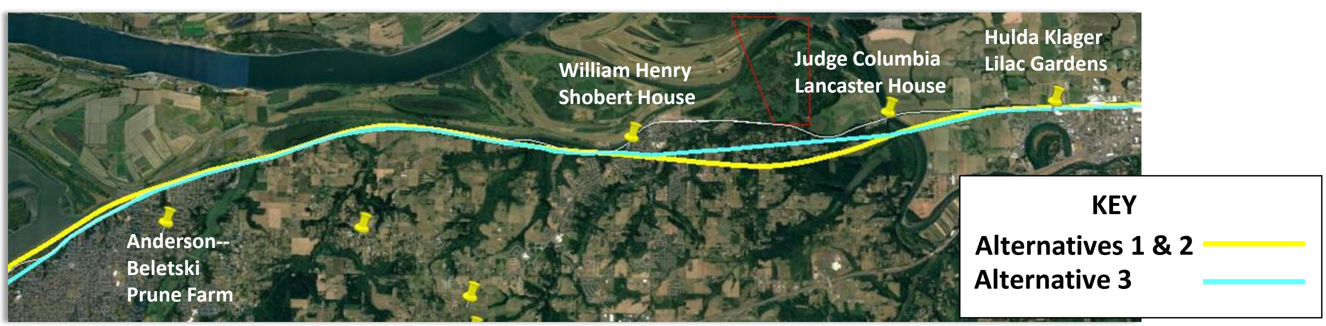
Exhibit 5-4: Structure Impacts and Land Taking Comparison

Structures Potentially Impacted | **Acreage Right-of-Way Requirement**



As shown in Exhibit 5-5, no direct impacts on historic structures (US Register of Historic Places) were found. Most properties were several blocks away from the alignment. However, the Tenino Depot, Centralia Union Depot, Olympic Club Saloon and Hulda Klager Lilac Gardens, are close enough to the track to be potentially impacted by the project. These locations will need extra attention in the Tier 2 EIS for avoiding impacts.

Exhibit 5-5: Historic Properties close to the Alignments



To summarize, all the direct environmental metrics except one, structure impacts, favor the selection of Alternative 3. Overall, the differences in the environmental profiles of the alternatives are minor and no fatal flaws have been identified with any of the alternatives, so any of the three options could reasonably be selected based on costs, benefits, and other environmental considerations.

5.3 Regional Transportation Impacts

Regional Impacts are the environmental effects of the Alternatives that manifest themselves on a corridor wide basis, not as site-specific impacts. These include the significant benefits of energy savings, emissions and traffic congestion reduction. When dollarized, these benefits make an important contribution to the Benefit Cost ratio for the project. However, this section will consider the value of those regional benefits from an environmental, rather than economic perspective.

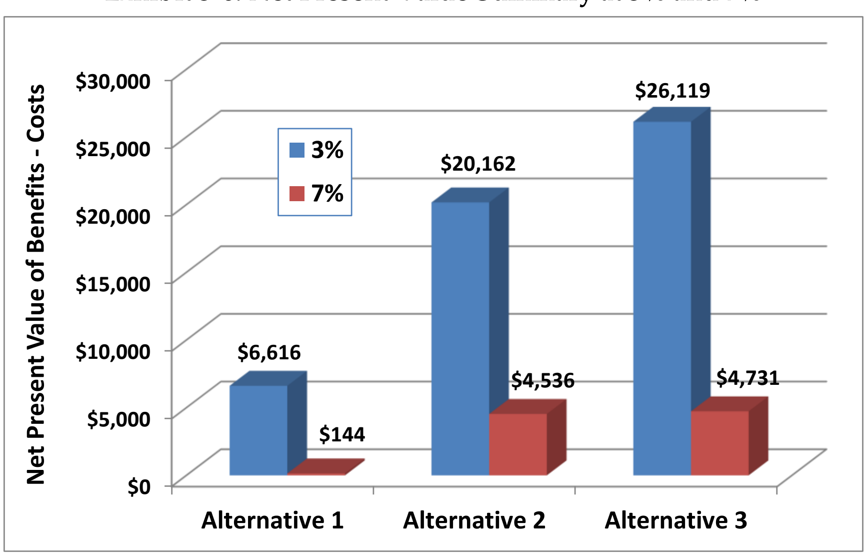
The level of regional impacts is almost directly proportional to the usage of the passenger rail system, since most of the ridership is diverted from automobile. The highest speed alternatives such as Alternative 3 also have an ability to reduce short-haul air trips, which are even more energy intensive than use of the automobile. Exhibit 5-2 shows three categories of environmental benefit: highway traffic congestion, energy savings and emissions reduction all of which rise in almost direct proportion to the amount of vehicle miles diverted away from the highway system. Some additional benefits not shown, such as highway safety benefits also rise in relation to diverted vehicle miles.

As a result, it is clear that Alternative 3 is able to attract the most riders both from automobile and air flights, and therefore this option will have the greatest level of environmental benefit in terms of regional impacts. In fact, the level of benefit of Alternative 3 is more than three times greater than that of Alternative 1, making Alternative 3 the clear winner in terms of promoting goals like greenhouse gas reduction, air quality and a shift away from carbon-based fuels to clean electricity.

5.4 Summary Results of the Tier 1 Environmental Scan

From an environmental perspective, it is clear that the most effective alternative is Alternative 3. However, it's also important to understand that this mirrors the results of the economic analysis. Exhibit 5-6 confirms that although Alternative 3 is more costly than other options, it produces the highest Net Present Values in terms of Benefit Cost performance at both a 3% and 7% interest rate. Moving from Alternative 1 to Alternative 2 and finally up to Alternative 3, the Net Present Values of the project continue to increase at both the 3% and 7% interest rates.

Exhibit 5-6: Net Present Value Summary at 3% and 7%



The result shown in Exhibit 5-6 means that the additional capital cost for improving the option from Alternative 1 to 2 to 3 are ***incrementally*** justified at both 3% and 7% interest rates, since the NPV values continues to increase for the higher investment options. This shows that Alternative 3 not only meets the required investment criteria as a whole, but that the capital is also justified on an ***incremental*** basis moving up from Alternative 1 to 2, and from Alternative 2 to 3. Therefore, Alternative 3 is the best performing option from an economic perspective.

In terms of direct environmental impacts, Alternative 3's extensive use of tunnels and flyovers reduces all of the environmental metrics except that of structure conflicts. In terms of impacts on wetlands and all the other direct impact metrics, Alternative 3 is clearly the most effective option.

Finally in terms of regional impacts, Alternative 3's ability to divert high levels of ridership from the automobile and short-haul air flights means that Alternative 3 will be the most effective option. Alternative 3 is more than three times more effective than Alternative 1 in terms of its ridership attractiveness. This means that Alternative 3 will be the most effective alternative for promoting region-wide transportation goals, such as for reducing carbon emissions and reducing dependency on fossil fuels. Alternative 3 will have an additional benefit in terms of promoting strong transit-oriented development and more compact forms of urban development near the rail stations which has not been quantified here, because it is not a direct transportation benefit. However, it is clear that Alternative 3 will tend to concentrate development patterns rather than encouraging urban sprawl. Rail's tendency to promote walkable cities and attractive urban forms of development will tend to further amplify the environmental advantages of Alternative 3.

All three metrics: Economic, Direct Impacts and Regional Transportation Impacts, favor selection of Alternative 3 as the preferred alternative.

As a result, Alternative 3 should be selected as the preferred alternative and this is the option that should be carried forward for further development in Tier 2 EIS studies. Efforts should now begin to focus on how best to implement ultra high-speed rail in the Cascadia region and to begin its development.

6. Stakeholder, Public Involvement and Agency Coordination

For the CHSR Tier 1 EIS a Stakeholder and Public Outreach program was developed in order to obtain input to the study process as the study of the proposed Route and Technology Alternatives for the Tier 1 Service NEPA study were progressed.

6.1 Introduction

Ultra high-speed rail (UHSR) is a new technology, which has landuse, performance and infrastructure requirements that are outside the normal range of ground transportation systems. As such, ultra high-speed rail will generate different reactions from public and private sector stakeholders. Ultra high-speed rail is distinctly different from Amtrak or limited access interstate highways. Ultra high-speed rail operates at very high-speeds between cities and can generate a new level of connectivity that will change the dynamics, economics and social relationships that today are largely framed by the interstate highway systems and air travel.

Ultra high-speed rail will create affordable and efficient ways of moving both people and express cargo between major cities. Changes in the physical plant needed to support ultra high-speed rail, as well as the new dynamics of passenger and express freight movement, will impact both the users of the system and the general public, and the way communities are designed and connected in the future. Input from stakeholders and users will provide a mechanism for how ultra high-speed rail can best be integrated into the existing landuse and transport infrastructure of the Portland-Seattle corridor. The stakeholder and public outreach activities outlined in the program were designed to share information about the analysis process, the business case, alternatives analysis results, and environmental overview of the route, technology, and mitigation measures. The approach was designed to allow both stakeholders and general public to assess how it might impact them, and to understand their perceptions of the overall value and impact of the ultra high-speed rail system.

6.2 Stakeholder and Public Engagement Process

For the CHSR Tier 1 and 2 EIS a Stakeholder and Public Outreach program was developed in order to obtain input to the study process as the study moved from Alternatives Analysis to Preferred Option and its environmental assessment process.

6.2.1 Approach

The purpose of the CHSR Outreach Program is to inform and identify stakeholders and the general public about ultra high-speed rail in the Portland-Seattle corridor. The approach used CHSR website and IT to deliver cost effective education and public interface process to describe and explain the ultra high-speed rail project to stakeholders and the general public. This included sharing information on the proposed routes, alternative technologies, and financial, economic and environmental results and impacts, as well as showing what mitigation measures would be possible where any negative impacts are incurred by any alternative. In return the outreach process for each audience would obtain feedback and learn about design and user preferences in terms of any given option.

The following approaches were adopted for the Tier 1 and Tier 2 studies, see Exhibit 6-1:

- In Tier 1 three webinar presentations and discussions were held with key stakeholders. This provided feedback on the methodology and analysis. This provided feedback on the methodology and analysis and ensured it was sensitive to local issues and concerns. The feedback and the Alternatives Analysis were used to develop the Preferred Alternative to be taken into Tier 2.

- The Tier 2 analysis the Preferred Alternative will be taken to local communities in the form of public meetings in each community. Again, feedback will be sough on the evaluation process and study findings.
- Throughout the process newsletters, video, presentations will be used to inform the public and develop feedback on key issues.

Exhibit 6-1: Public Outreach and Communications Plan Process

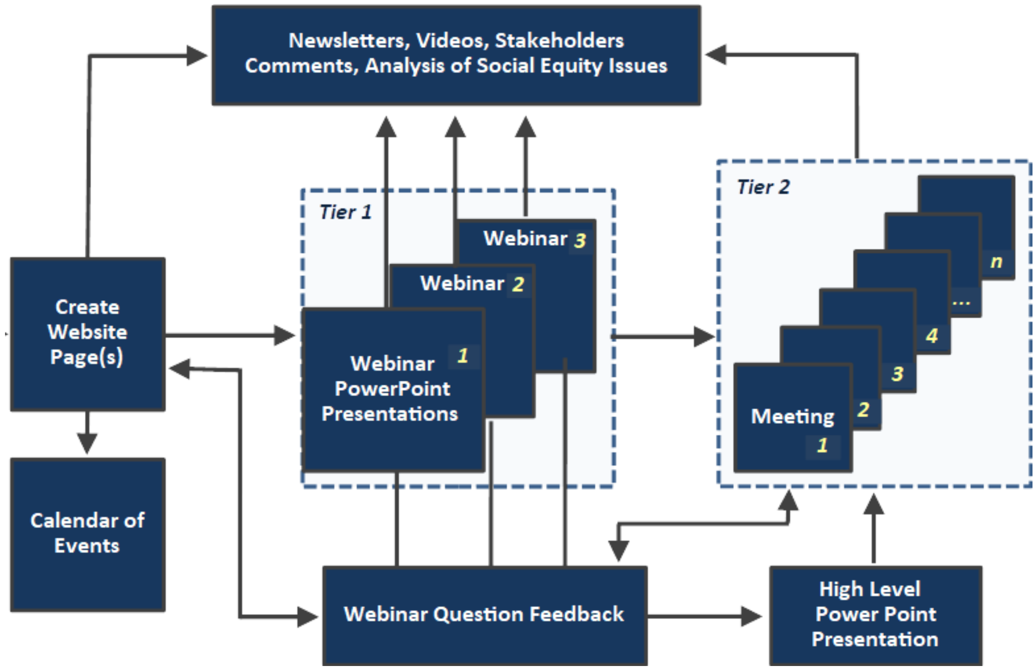


Exhibit 6-1 illustrates the strategic design of the Public Outreach Engagement Plan. As the diagram shows, the website will be the hub for engagement, webinars, newsletters, videos, media and social media interviews, meetings, discussions, and PowerPoint presentations.

The CHSR website, webinars, presentations, newsletters, media materials will be available to both stakeholders and the general public.

6.2.2 Key Messages

Using the approach described above, the key messages for the Cascadia Ultra High Speed Rail (CUHSR) Stakeholder and Public Engagement Plan are:

- Why Cascadia Ultra High Speed Rail (CUHSR)?
- What role will CUHSR plan in revitalizing passenger transportation?
- How will CUHSR stimulate economic development and new landuses?
- How will CUHSR provide service for airport integration by charging air passenger, air cargo, and express parcel freight markets?
- How will CUSHR integrate communities along the corridor?
- How will CUSHR generate new economic opportunities for business?
- How will CUHSR support new economy businesses of logistics, financial, IT, software, legal and transportation options?

- How will CUHSR change long-term infrastructure and landuse needs?
- How will CUHSR improve safety, environmental and energy use benefits?

These key messages were presented during the webinar discussions and input was provided to the study team.

6.2.3 Stakeholder Presentations

Stakeholder presentations were designed to show the details of the study including:

- Database Development
- Alternatives Analysis Methodology
- Preliminary Financial and Economic Results
- Environmental Overview of Alternatives
- Selection of Preferred Option

6.2.4 Stakeholder Webinars

The following Stakeholder Webinars were given and can be found in Appendix 2 of the CHSR Service NEPA Report Appendices:

- Cascadia High Speed Rail Corridor: Tier 1 EIS Public Outreach Webinar #1: Methodology and Study Approach
- Cascadia High Speed Rail Corridor: Tier 1 EIS Public Outreach Webinar #2: Alternative Analysis Preliminary Results
- Cascadia High Speed Rail Corridor: Tier 1 EIS Public Outreach Webinar #3: Environmental Analysis Results
- Cascadia High Speed Rail Corridor: Tier 1 EIS Public Outreach Webinar #4: The Preferred Alternative (TBT)

6.2.5 Stakeholder Questions and Answers

The following stakeholder questions were asked at the Webinar briefings provided to states, Departments of Transportation, municipalities, Metropolitan Planning Organization (MPO), and other transport agencies with an interest in the development of transportation options in the I-5 corridor between Eugene and Seattle.

The questions raised on the study by stakeholders were as follows:

TECHNOLOGY

1. How safe are the new high-speed trains?

Response: The new trains will be very safe especially with the addition of new Positive Train Control systems that will operate to prevent overspeed train accidents like the one that occurred in Dupont, WA or train collisions like the one that occurred in Chatsworth, CA.

However, as a dedicated high-speed system, CHSR will be even safer than Amtrak's (very safe) operations, since CHSR will operate on its own dedicated tracks which will have no interaction with either freight trains or highway automobile and truck traffic. This separation eliminates additional major categories of risk due to the characteristic of the right-of-way. In its 53 years of operations, the Shinkansen in Japan has maintained an impeccable safety record hauling over 10 billion passengers with zero passenger fatalities and injuries.

However, the characteristics of the trains themselves also contribute to the safety of the system. CHSR will employ FRA "Tier III" crashworthiness trains which afford the highest degree of safety of any type of train. Rather than relying only on brute strength, these trains employ crashworthiness features engineered into their design that have been shown to provide even higher levels of occupant protection than conventional trains do. As FRA certified trains, the CHSR equipment would have sufficient crashworthiness features to be able to operate anywhere, including in or alongside freight railroad rights of way although it is not anticipated that they will do so.

As such the CHSR will provide multiple layers of safety protection including state of the art traffic management and control systems, dedicated tracks free of freight train and highway traffic conflicts, and the highest degree of FRA safety certification for the trains themselves. This combination of dedicated right-of-way along with robust vehicles will provide a level of safety that's unparalleled anywhere in the world.

2. How does the new CHSR line differ from conventional rail lines?

Response: When the existing railroads were first built in the 19th century, the sizes of the trains were strictly limited by the small locomotives available at the time. In order to carry any reasonable tonnage or passenger load, the rail lines had to be built as flat and level as possible. At the same time the early locomotives were not powerful enough to be able to achieve high speeds. As a result, the standard railroad design would utilize curves for following the contour of the terrain, for avoiding obstacles and for obtaining the flattest possible alignment with the minimal amount of cut and fill.

By the 1950's these old, curvy alignments were already hamstringing the railroads to the extent that their trains, for the most part were not fast enough to be able to compete with auto travel times. This was exacerbated by the development of government subsidized interstate highway alignments, which, combined with powerful automobiles were able to travel much faster than the trains could on their 19th century alignments. In the 1950's and 1960's, there were no government programs in the United States comparable to those in Europe that could enable the railroads to update their alignments and passenger systems to be able to remain competitive with the new highway systems. As a result, the railroads were forced to practically abandon their passenger systems based on outdated alignments and technologies and focus on freight movement.

By the 1970's however the railroads in Europe and Japan were pioneering the development of new ultra high-speed trains having a capability of reaching first 150 mph, then 186 and 220 mph. These new train systems were powerful electric trains that were operating on new rail lines that were built to a fundamentally different principle. In development of high-speed rail lines, it is essential to keep curves to a minimum, but the powerful trains are able to handle much steeper gradients (standard up to 4%, exceptional up to 7%.) Accordingly, new high-speed lines have to be arrow-straight, but they can go up and down to follow the contours of the terrain much more than a conventional rail line could. As such:

- Conventional rail lines for low-powered trains, are built to minimize gradients but can have curves because the speeds aren't very high.
- New high-speed rail lines for high-powered trains and built to minimize curves but can have grades.

This is the key distinction between conventional rail lines and new high-speed rail lines. Because of the difference in train technology and the capabilities of the rail equipment, the geometric requirements for the alignments are completely different. This also explains the reason why new lines are usually needed for high-speed trains. Most certainly in the Pacific Northwest where the existing lines are both curvy and congested with freight trains, the development of new infrastructure for high-speed passenger rail is going to be needed.

Routes and Operations Analysis

3. What percentage of the alternatives are at grade, in tunnel, or elevated?

Response:

Infrastructure Type	Alternatives 1 and 2	Alternative 3
	Miles	Miles
Cut and Fill	16.40	31.16
On Grade	103.80	30.11
Flyover	34.70	60.94
Tunnel	18.40	43.49
TOTAL	**173.30**	**165.70**

4. Right-of-way acquisition is a critical factor; how will this be achieved?

Response: For elevated and tunnel sections, right-of-way requirements will mostly be addressed by acquiring easements rather than by outright land purchase. The price paid for easements is intended to compensate landowners for the costs of any direct impacts, loss of property value, use or development

rights. For elevated or shallow tunnel easements, usually surface development within the easement ROW is not allowed. Deep tunnels usually do not impose any surface use restrictions.
(See https://www.ccj.com/blog/2020/02/19/what-is-a-fair-payment-for-a-pipeline-easement)

Overall, the right-of-way is expected to cost $64-$254 thousand per mile, which is less than 1% of the construction cost.

Deep tunnel easements cost even less due to the lack of surface impact. A recent appraisal of residential property values in the Seattle area found no measurable impact on property values due to the presence of a deep tunnel underneath the property. Sound Transit has been paying 0.1¢ per cubic foot of acquired easement area for residentially zoned property, and 1.0¢ per cubic foot for properties with less restrictive zoning. A twin-bore high-speed rail tunnel has a volume of 2.84 million cubic feet per mile, so the cost of the deep tunnel easements would range between $2,800 and $28,000 per mile. As a result, tunnel easement costs have a negligible impact on system costs.
(See: http://www.msreal.com/sites/msreal/files/research/impact_of_deep_tunnels_on_property_value.pdf
and
http://www.millernash.com/files/Uploads/Documents/Z%20201.1%20%20smith_beaver_white_hiatt_dec2005.pdf

5. How will the station locations be decided? Is this still subject to further work and field surveys? Will Stated Preference Surveys be completed in further work?

Response: For the purpose of the Tier 1 EIS study, all the major free-standing urban areas in the corridor were connected to improve regional accessibility and to create economic growth in as many urban centers as possible. As proposed, airport and suburban stops are recommended for both Portland and Seattle. This offers much more significant ridership and freight potential. However, in the Preliminary Engineering phase, the stations and route selections will all be revisited and analyzed in much greater detail.

6. How deep will tunnels be in urban areas?

Response: Deep bored tunnels will be deep enough to avoid impacts on building foundations and on shallow utilities. They would be engineered to miss water, sewage and drainage tunnels and other existing deep underground utilities. The intent of deep boring the tunnels would specifically be to avoid surface and subsurface impacts on urban structures and the costs for utility relocation that would be needed if a shallow cut and cover approach were recommended.

7. How will land use patterns be impacted by the CHSR corridor and what will happen to commuter patterns?

Response: It should be noted that the general impact of high-speed rail and fixed guideway modes is to promote high-density development around its stations, whereas highway investment tends to promote low density “sprawl” development. High-speed rail will provide very fast connection time between smaller urban areas like Olympia, Kelso, Centralia, to and from the major cities of Portland, Tacoma, and Seattle. The improved access time will result in increased growth in both the smaller communities and the major urban areas. The regional economy will become more integrated, and the improved accessibility will generate growth in urban areas of all sizes when they are connected to the CHSR system. Travel patterns will be extended between the city centers, and as with high-speed rail, new social and commuter flows will develop from small urban communities with stations to the larger cities.

8. How will Covid-19 impact the demand between cities?

Response: Some components of ridership may lower with the preference for telecommuting, but other components (particularly social travel) are likely to increase. However, the changes in commuter travel are likely to affect urban transit systems and commuter rail much more than intercity, and in particular high-speed rail which caters much more to business and social travel than it does to commuter travel. Freight demand, however, is sure to increase with the preference for home delivery. Air cargo and less-than-truckload express trucking demand along the corridor has been growing at 4 to 5% per year and the effect of COVID has only been to accelerate the adoption of e-commerce. With lower costs and significantly shorter travel times, high-speed rail can not only transform the freight industry but absorb the estimated growth in the line-haul segments of freight movements. An investment-grade ridership, freight and financial projection will be developed as part of the planned Tier 2 environmental review process of the corridor. By that time, it will be possible to more fully reflect on the impact of this variable.

9. Will urban sprawl be increased by high-speed rail?

Response: The impact of high-speed rail will be to integrate urban areas and give smaller urban areas improved access to larger cities. As a result, it will provide increased opportunity, income, job accessibility, and social mobility through expanded and improved access to larger urban areas. Since fixed guideway transportation systems are well known for promoting densification around their stations, rather than sprawl, it is unlikely that high-speed rail will promote sprawl patterns of development. Further work will be required as the project progresses on the extent and size of the development potential in large and small cities where stations are proposed.

10. What is the acceleration and stopping distance of the CHSR trains?

Response: Acceleration curves for various types of high-speed trains are shown in Exhibit 2-17 of the SDP. These show that typical acceleration up to 150 mph requires 5-7 miles, and up to 220 mph requires 10-15 miles. The optimal braking regimen utilizes the electric motors on the train to recapture braking energy as the train slows down. Although in an emergency the stopping distances can be cut in half or less, normal braking curves would be a mirror image of the acceleration curves in order to maximize the percentage of electric energy that can be recovered in braking. As a result, normal braking from 150 mph also requires 5-7 miles, and from 220 mph requires 10-15 miles.

11. What is the level of service for the CHSR system?

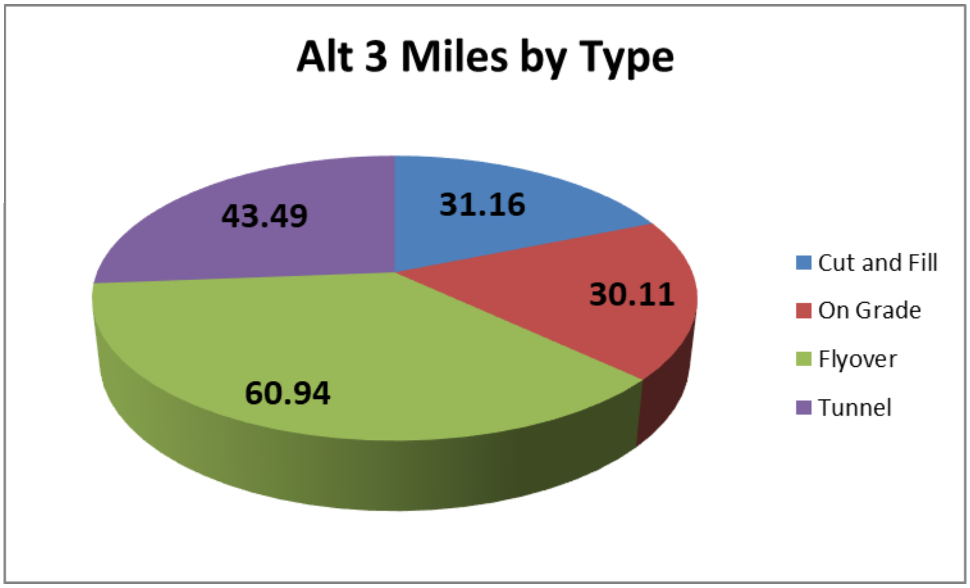
Response: High-speed Super Express trains traveling directly between major cities will make no intermediate stops. Local stopping trains will serve travel needs between intermediate smaller locations. Proposed schedules are shown in Exhibit 5-8 of the SDP.

Capital Costs

12. Can a map be produced showing the percent of infrastructure by each type (i.e., elevated, cut and cover, deep tunnel)?

Response: The breakdown for Alternative 3 is shown below:

Mileage by Type of Construction Portland to Seattle for Alternative 3



13. What is the contingency for the capital costs? How does it relate to other high-speed rail projects?

Response: The capital costs for high-speed rail in the Portland-Seattle corridor are similar in character to those for a high-speed rail project. The bulk of these costs are for infrastructure that is well understood, e.g., tunnels, bridges, guideways. As a result, we were able to use the capital cost experience associated with 40 years of building high-speed rail systems. The same contingency was adopted for this corridor's infrastructure as for other high-speed rail projects. The typical contingency for high-speed rail infrastructure is 30% contingency and 28% soft costs. TEMS expects to do considerable sensitivity analysis as part of the next stage of work, such as in the Tier 2 EIS study.

14. Were the tunneling costs estimated based on any actual tunnel projects?

Response: Infrastructure costs are mid-range costs that were sourced directly from the engineering review, previous studies and USDOT FRA benchmark costs. The resulting unit costs were almost identical to those used in Washington State's Ultra-High-Speed Rail study.[21] However, these tunneling, elevated and at-grade costs were reduced for development of a single-tracked, non-electrified alignment in Alternative 1.

15. Is the nine-year implementation period for building the system long enough?

Response: Yes, this is sufficient for construction once the environmental review process has been completed. Construction of California High-Speed Rail was started as an economic stimulus measure before all the right-of-way had been secured, partially mitigated by the ability to operate on the existing rail network as the high-speed core is built out (like the French LGV network). As a result, many of the delays to that project have been attributed to difficulties in buying property and legal challenges. For tunnel cut-and-cover construction, however, high-speed rail will not need to permanently bisect property parcels (the main complaint of landowners) and for many miles, it will have no surface impacts at all. It is important to secure the easements to a substantial share of the right-of-way before starting construction. If this is done, there is no reason why the nine-year implementation cannot be achieved. A detailed Implementation Plan will be developed in the Tier 2 environmental review process of the project.

16. What is the life cycle of the infrastructure equipment?

Response: The estimated design life of high-speed rail technology is approximately 30 years considering a structured maintenance, repair and replacement program. The estimated design life of the track structure, pylons and foundations is approximately 100 years. The estimated design life of tunnels and underground infrastructure is approximately 100 years. In addition, TEMS followed the standard economic framework of the 1997 Commercial Feasibility Study for High-Speed Ground Transportation (CFS) and which does not include inclusion of scrap/salvage value although US TIGER/BUILD Grant criteria may have allowed the inclusion of such values. As such, TEMS assessment of the economic results could be considered conservative, but we wanted to remain consistent with the established framework for assessing rail projects.

OPERATING COSTS

17. What is the difference between Operating and Capital Costs? What is the cyclical maintenance cost? Should cyclical maintenance be in Capital Costs?

Response: Operating costs are for day-to-day operations of the high-speed rail system. Capital costs are for construction of the system and initial acquisition of trains. According to Generally Accepted Accounting Principles (GAAP) certain types of maintenance activities that have a life expectancy greater than one year, such as periodical infrastructure renewals and replacements, are to be capitalized rather than expensed. These types of maintenance expenditures are identified as cyclic maintenance. All three types of expenses

[21] See Table 5-10 on page 5-13 of the *Ultra-High-Speed Ground Transportation Study*, Prepared for Washington State Department of Transportation by CH2MHill in February 2018.
Weblink: https://wsdot.wa.gov/sites/default/files/2018/07/26/ultra-high-speed-ground-transportation-study.pdf

are treated on a cash-flow basis in the Net Present Value (NPV) discounting analysis for estimation of the Cost Benefit ratios.

18. Are taxes included?

Response: Taxes are not included in the USDOT Benefit-Cost Analysis because taxes are considered a transfer payment and not a real cost or benefit of the project. They are an economic impact to the communities rather than a benefit, and this has been assessed separately from the Benefit-Cost Analysis.

19. How reliable is the electric power supply? What if the grid goes down? What happens to the operation? Do trains just stop?

Response: The Tier 1 EIS Study assumes that the electric power supply is reliable and will have appropriate back-up capacity, with utility interconnections sufficient to provide continuous electric service redundancy.

20. When would the system become operational? Is it after six years of construction?

Response: It is considered that following the completion of the environmental review process and acquisition of a substantial share of the necessary right-of-way access, there would be a six-year construction and training period. The operation of the system could then occur. A more detailed development schedule will be prepared during the Tier 2 environmental review process.

PASSENGER MARKETS

21. The model calibration is very good, in terms of coefficients and statistical measures, but there should be more explanation of the model and its performance.

Response: See detailed model description below.

(A) Database: The current model was developed using existing data sources (see pages 4-2 to 4-21 and Appendix 3 in the Service Development Report). These vary in quality.

- Socioeconomic Data – This was developed using a variety of data sources including US Census Bureau, MPO data, Woods & Poole data, and American Community 5-year Estimates. This data is regarded as being very good in providing population, income and employment data at a zone (TAZ) level.

- Network Data – This is derived from base year schedules for in-vehicle time, frequency, fares, terminal times, access-egress time, and so reflect actual performance in the base year. For forecast years, transport strategy assumptions are made for oil prices (US EIA forecasts), congestion (MPO forecasts), auto efficiency (Oakridge forecast). These forecasts are based on US government and local MPO forecasts and need to be tested in sensitivity forecasts at the next stage of work.
    - This data is regarded as being a very good description of base and forecast year travel times and costs, and typically accepted by USDOT.

- Origin/Destination (O/D) Data – This is derived for the base year from state and MPO data for auto travel, Amtrak passenger statistics for rail, FAA airline 10 percent survey, Bus line schedules and counts, and US Bureau of Transport Statistics. This data is regarded as good at a feasibility level but must be reinforced with direct survey and counts for Investment Grade work. The analysis is done on a zone-to-zone basis with local access and egress time being estimated for each zone.

- Stated Preference (SP) Data – The data for the study was derived from various high-speed rail studies completed in the Chicago-Detroit, Chicago-St. Louis, Chicago-Milwaukee, Houston-Dallas, Los Angeles-Vegas corridors. As such, for the Cascadia corridors, high-speed rail values of time data were estimated. It was assumed to be equivalent to air values of time. At the next stage of work a full Stated Preference Survey will be completed specific to high-speed rail. This will give local Cascadia corridor high-speed rail values of time.

    - **A Full SP Survey will be needed for Investment Grade Study**

(B) Model: The forecasting model is a Discrete Choice model as recommended by academics MIT, US Transportation Research Center, Volpe, and USDOT. The model is based on three components –

- Total Demand. This forecast is based on growth in the total travel market due to growth in socioeconomic factors, population, income and employment.

- Induced Demand. This forecast is based on the change in traffic volume due to improved or worsening quality of travel as measured by the time and cost of travel. The quality of travel is measured in a single metric that includes all aspects of an origin to destination trip in terms of time and cost. See Appendix 3 of the Service Development Report. The assumption of the model is that the demand for travel expands, or contracts based on the quality of travel available for a specific trip. As such, travel is being treated as a normal good subject to normal economic price theory, lower price more demand, higher price less demand.

- Modal Choice. This forecast is based on the relative quality of travel provided by each mode considering the time and cost of travel, which are turned into a single value by converting time to money using values of time. Values of time estimates used in the study are given on a mode and purpose basis in Appendix 3 of the Service Development Plan.

(C) Calibration: Each of the three model components are calibrated using the data gathered in the development of the database.

- The Total Demand is regressed against the socioeconomics using combinations of population, income, and employment. See Appendix 3 of the Service Development Plan.

- The Total Demand is also impacted by the quality of travel service offered between zones, so the impact of the improvement is estimated for each year once high-speed rail is put into service. Since CHSR is offering competitive fares with Amtrak, while saving significant amounts of time and a much higher level of reliability, the quality of service is significantly improved. At the same time, the highway network is facing increased gas prices and congestion over time according to the USDOT EIA forecasts for gas, and MPO forecasts for highway delays. Bus travel is impacted by oil and congestion forecasts, while air faces capacity issues, terminal access issues, and rising oil prices. As such, the quality of service is falling for the competitive modes.

- The Modal Split model merely compares the quality of service offered by the different modes and estimates the changing market shares, using logistic regression analysis calibration as shown in Appendix 3. The modal split form, hierarchy, and structure is the Degenerate nested logit that is recommended by academics and USDOT, Volpe Center. See “Stated Choice Methods: Analysis and Applications” JJ. Louviere, D. Hensher, and J. Swait, Cambridge 2000.

22. The model should provide an explanation of the importance of different variables and the role of the variables in explaining the growth of Total Demand and the Mode Choice selection.

Response: The role of the different variables is defined in the component models. For the Total Demand model, the two key factors are Socioeconomic growth and the Quality of the Transportation network. See Appendix 3 of the CHSR Service Development Plan.

The Total Demand model is behavioral and so considers different socioeconomic factors and different Quality of Service elements for each purpose of travel. This is because different factors and elements motivate different behavior, i.e., an individual’s rational changes for the different types of trips made. The socioeconomic factors used for increased travel demand are shown in Appendix 2 of the Service Development Plan. For Business Travel, Employment and Income factors are used. As a result, the proposition is that higher levels of Employment and Income generate increased business travel and are the drivers of Business Travel. Analysis shows that Commuting is driven by Population, Employment, and Income, while Social Travel is driven by Population and Income.

For each purpose of travel, different combinations of variables are tested to see which set gives the most reasonable and statistically stable relationship. See Appendix 3 of the CHSR Service Development Plan.

For Quality of Transportation of Service, Travel Utility (as defined by travel times and costs and defined by Equation 3 in Appendix 3) is used. If Travel Utility improves i.e., travel time and costs are reduced, so the volume of travel increases. As Travel Utility diminishes, so the volume of travel diminishes.

The regression model for Total Travel Demand is shown in Equation 4 on page 3 of Appendix 3 of the Service Development Plan. This calibrates the trips between corridor zones for each of the three purposes of travel. The equations derived are shown in Appendix 3 of the Service Development Plan. It can be seen that Business Travel is the most sensitive to Socioeconomic Growth (0.4230) while Social Travel (0.2430) is half as sensitive, and Commuting is the least sensitive (0.1055). In terms of the Quality of Travel Service, Commuting (0.8786) is the most sensitive, while Business and Social Travel are somewhat less sensitive at (60 to 70 percent). See Appendix 3, page 4.

The Mode Split Analysis compares the Quality of Service offered by each mode in a bi-modal analysis that compares Auto with Public Modes, Air and Guideway (Rail) with initially Bus, then Air and high-speed rail. The equations are all statistically valid for each purpose of travel with high-speed rail being highly competitive with air, rail, and bus, but less competitive with auto, particularly for business and social trips with short distance movements. For longer trips over 200 miles high-speed rail becomes very competitive and is dominant over 300 miles. See Appendix 3 of the CHSR Service Development Plan.

23. What is the interaction between smaller communities such as Olympia and the large cities like Portland and Seattle? Can the Origin/Destination (O/D) flows between cities be shown to support the concept of the interaction between the different cities?

Response: See O/D Matrix

OD MATRIX From Station	To Station	2030 Alternative 1 CHSR 110-mph Diesel (thousand trips)	2030 Alternative 2 CHSR 220-mph Low Investment (thousand trips)	2030 Alternative 3 CHSR 250-mph High Investment (thousand trips)
Seattle, WA	SEA-TAC, WA	87.70	116.13	133.58
Seattle, WA	Tacoma, WA	284.83	376.05	431.65
Seattle, WA	Olympia/Lacey, WA	171.05	225.17	257.97
Seattle, WA	Centralia, WA	65.13	85.49	97.76
Seattle, WA	Kelso-Longview, WA	75.96	99.41	113.45
Seattle, WA	Vancouver, WA	260.31	341.59	390.53
Seattle, WA	Portland, OR	2,266.86	3,450.48	4,326.52
SEA-TAC, WA	Tacoma, WA	6.39	8.33	9.49
SEA-TAC, WA	Olympia/Lacey, WA	3.84	4.99	5.67
SEA-TAC, WA	Centralia, WA	1.46	1.89	2.15
SEA-TAC, WA	Kelso-Longview, WA	14.40	18.61	21.09
SEA-TAC, WA	Vancouver, WA	49.34	63.96	72.60
SEA-TAC, WA	Portland, OR	421.25	545.22	618.72
Tacoma, WA	Olympia/Lacey, WA	12.46	16.15	18.34
Tacoma, WA	Centralia, WA	4.74	6.13	6.95
Tacoma, WA	Kelso-Longview, WA	5.53	7.13	8.06
Tacoma, WA	Vancouver, WA	18.96	24.50	27.76
Tacoma, WA	Portland, OR	161.88	208.88	236.56
Olympia/Lacey, WA	Centralia, WA	2.85	3.67	4.15
Olympia/Lacey, WA	Kelso-Longview, WA	3.32	4.27	4.82
Olympia/Lacey, WA	Vancouver, WA	11.39	14.67	16.59
Olympia/Lacey, WA	Portland, OR	97.21	125.07	141.38
Centralia, WA	Kelso-Longview, WA	1.27	1.62	1.83
Centralia, WA	Vancouver, WA	4.34	5.57	6.29
Centralia, WA	Portland, OR	37.01	47.49	53.58
Kelso-Longview, WA	Vancouver, WA	5.06	6.48	7.30
Kelso-Longview, WA	Portland, OR	43.17	55.22	62.18
Vancouver, WA	Portland, OR	147.94	189.74	214.02

It can be seen from the matrix that the very largest flows are between the major cities of the corridor such as Seattle to Portland. However, there are significant flows between the commuter cities such as Vancouver, WA and Portland, OR where substantial flows occur on a daily basis. For the smaller cities like Olympia, the flows to Seattle and Portland are significant as business and commuter traffic uses the ultra high-speed train to connect with the largest cities.

24. How does the model measure Induced Demand, and how does it estimate diversion from existing modes to high-speed rail?

Response: Induced Demand is the change in demand as a result of the travel between cities becoming cheaper in terms of time and cost. Travel, like any other normal product, responds to price (in this case the generalized costs of travel.) See Appendix 3 of the CHSR Service Development Plan.

25. Value of Frequency?

Response: The Stated Preference (SP) Surveys offer choices between options of waiting more time for a train or paying more money. This will be an element of the SP Survey to be done as part of the next stage of work. Current values used in the Feasibility Study were derived from previous SP Surveys done for higher speed passenger rail surveys in other corridors (e.g., Los Angeles-Las Vegas, Chicago-Detroit).

26. Economist view of Values of Time?

Response: The November 2013 Economist raised concerns about the Values of Time being applied to Business Travel and whether or not it took into account the ability of business travelers to work on trains. The Ministry of Transport in the United Kingdom (UK MOT) had used old data collected before

Wi-Fi and laptops/smartphones. The UK MOT then did Stated Preference (SP) surveys and modified the Values of Time for Business to a lower level. The Values of Time were still regarded as a benefit in the Benefit-Cost Analysis, it was just the relative level of value that was slightly reduced. The Economist view did not challenge the use of Values of Time as a benefit, which is the current “practice” of Transport Economics. The same approach is used by USDOT procedures and of course, the UK Ministry of Transport procedures. Working on a train is productive, but that is not to say it is as productive as being in the office, and it is worth noting that the time to and from business meetings is frequently personal time. The personal time can often mean getting up early in the morning and going to bed late at night. Since the 1960’s when SP Surveys were introduced, they have consistently shown that individuals value time, and business travelers’ value it more than commuters and social travelers. In the February 2020 edition, Economist changed its view to support the HS2 high speed project. This included accepting significant business traveler Values of Time savings associated with the project.

27. Travel time value for different modes.

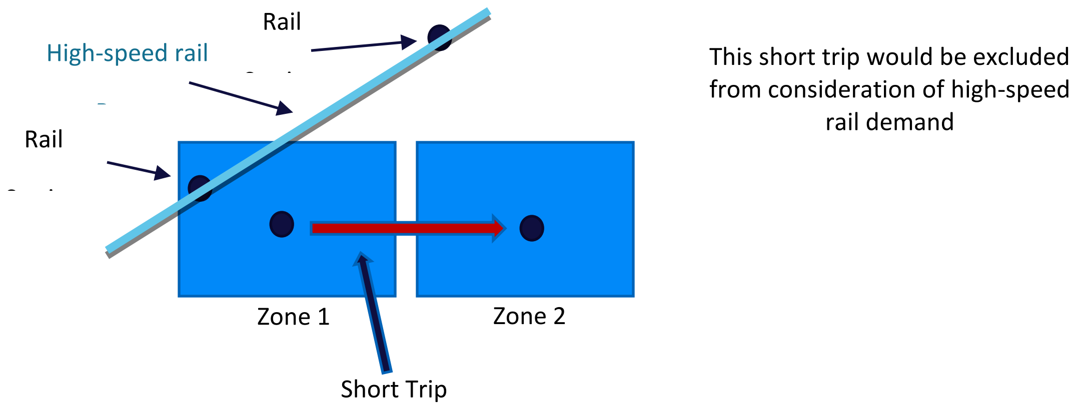
Response: Stated Preference (SP) Surveys consistently show that travelers on different modes and purposes have different time values. Business Air travelers have the highest Values of Time, Social Bus travelers (often students) have the lowest.

28. COMPASS™ modeling of traffic flows.

Response: The COMPASS™ model will review the character of a trip and consider if the trip should be included. Trips are excluded if –

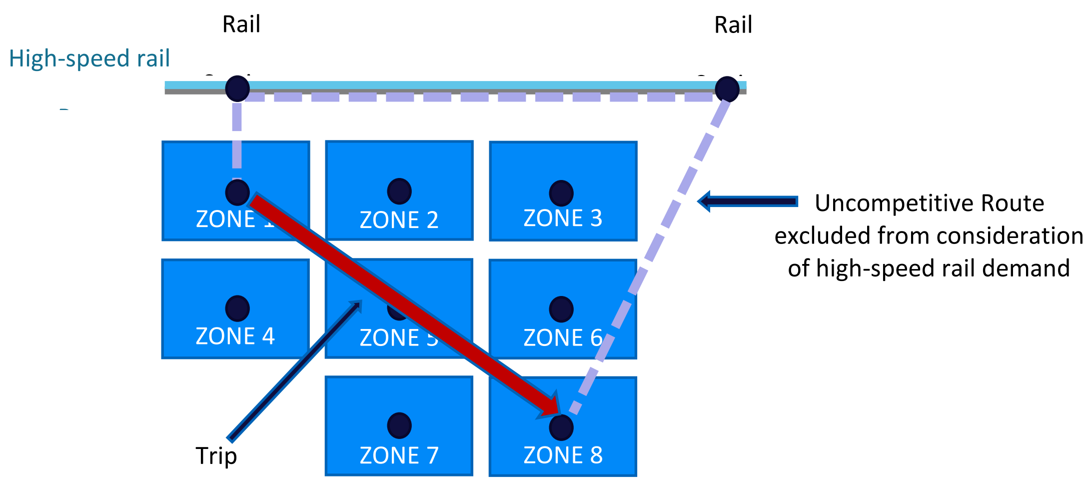
- The trip is too short to be made by high-speed rail. Trip excluded. See Diagram 1

Diagram 1: Excluded Short Trip



- The trip can be made by high-speed rail but is not economically competitive. In this case the trip is excluded. See Diagram 2.

Diagram 2: Excluded Uncompetitive Trip



COMPASS™ eliminates trips that are unreasonable.

29. What will be the impact of Driverless cars in the future?

Response: At this time, the analysis has not addressed Driverless Cars. This is an evolving technology and in future studies consideration can be given to how it might impact the competitiveness of auto versus high-speed rail. However, it should be noted that one of the initial applications of driverless technology has been to serve as a "last mile" connection for transit riders between the transit or rail stations, and their homes, shopping centers or places of business. As such, driverless technologies can serve to enhance and connect with transit systems, they should not be viewed as strictly a competitive technology.

30. What is the potential for "onboard marketing" by video system?

Response: There is considerable potential for using onboard video system for marketing. Should this technology mature as intended, it would allow a different financial model to be developed. However, further research is needed to allow such financing to be considered in developing a funding program.

31. How will the Stated Preference (SP) Surveys be incorporated in the modelling process?

Response: SP Surveys for high-speed rail are needed as the project progresses to Investment Grade Analysis. A Stated Preference Survey would be completed in the Portland-Seattle corridor. The SP data would be used to derive Values of Time, Frequency, Wait Time, Access and Egress Times, on a purpose basis. The derived Values of Time would be used directly in the modeling process. See Appendix 3 and page 4-17 of the Service Development Plan.

32. Can Benchmarking be used to compare results?

Response: TEMS typically uses Benchmarking to compare forecast results in its Investment Grade Studies. In developing benchmarks, TEMS will identify similar projects, infrastructure, technology, and operations, and landuse impacts. The nearest benchmarks are the Northeast Corridor, European HSR routes, and Japanese HSR routes. This includes routes with ultra high-speed rail as well as high-speed routes.

33. Have the COMPASS™ model forecasts been compared to the actual performance of high-speed rail?

Response: Yes, COMPASS™ model forecasts have been extensively tested in 34 Before and After studies for High-Speed Rail. The error range on the 34 studies is less than ±20 percent. TEMS promises a plus or minus 20 percent range for Investment Grade Studies.

TEMS' Forecasts

Exhibit 1 provides a validation of the 34 Investment Grade "Before and After" forecasts that TEMS has completed.

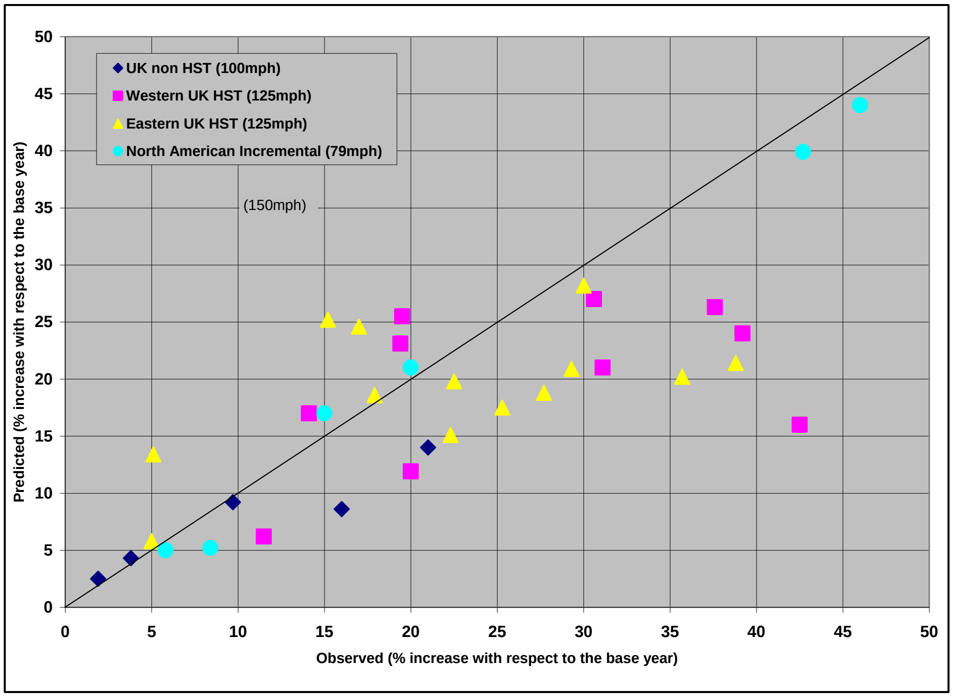


EXHIBIT 1: Observed vs. Predicted in TEMS' Rail Projects

Exhibit 2 shows the "Distribution of Forecast Error", all of which are within the 20 percent error range allowed by Investment Grade Forecasts.

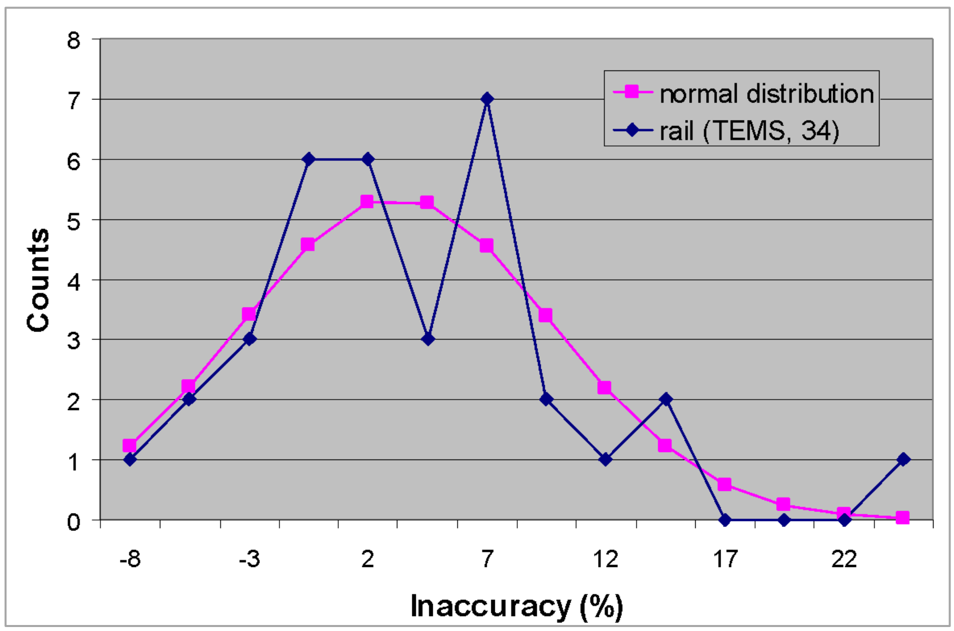


EXHIBIT 2: Distribution of TEMS' Forecast Error for 34 Passenger Rail Studies

34. How will CHSR address Covid-19 safety among passengers?

Response: CHSR has not yet decided on the layout of stations or vehicles. CHSR will follow federal and state guidelines. It is anticipated that by the time CHSR is up and running (estimated as 10 years) that Covid-19 vaccinations will be at a high level and that the travelling population is likely to be highly minimized from the pandemic.

35. How will CHSR address equity?

Response: CHSR will address equity in the following ways:

- Equal opportunity during construction and operation of the system. To meet Federal and state equal opportunity targets. This will include small and minority businesses, as well as different ethnic and minority employment opportunities.
- Fares. Fares will be developed that are designed to provide discounts and special fares for socially disadvantage groups (e.g., young people, students, unemployed, and senior citizens)
- Housing rents. The rents for the proposed developments near and at stations will include private and public housing with rents for the public houses structured to meet the medium 20 percent for lower income households.

FREIGHT MARKETS

36. How would the freight terminals be connected with the CHSR System?

Response: In the short-term, express parcel, LTL freight terminals are clustered at urban gateways and airports. For this reason, high-speed rail can provide short connections to major terminal centers. For the long term, additional site-specific planning will be required, but it is likely that major high-speed rail terminals will be co-located with the first and last mile delivery terminals of the express parcel carriers (e.g., FedEx, Amazon, UPS).

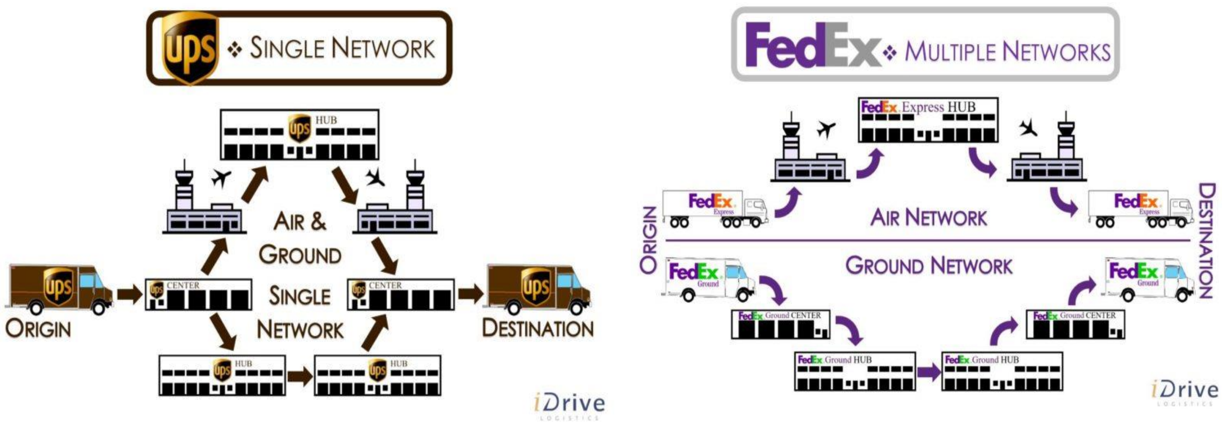
37. Characterize the Less than Truckload (LTL) and Air Cargo Markets.

Response: As shown in the Feasibility Study, LTL and Air Cargo operates through three distinct elements.

- Pick up – done by vans to bring goods to terminals
- Terminal to Terminal – movement done today by truck or air
- Delivery – done by vans from terminals

High-speed rail would compete for Terminal-to-Terminal movement only, not Door to Door Pick up or Delivery, which is done by vans. Terminals are clustered together at airports and urban gateways. The exhibit below shows the typical networks used by express parcel carriers (i.e., FedEx, UPS, XPO, YRC, and ABF). It can be seen that first and last mile delivery is by van, terminal to terminal movements by truck and air. It is truck and air that high-speed rail will compete against. High-speed rail is cost and time effective against air and truck competitors and will simply take market share from those modes in the express parcel markets.

UPS vs FedEx Network Structure



38. What is the Value of Time for Parcels and Packages?

Response: In the Express Parcel market, people are clearly willing to pay money to have parcels and packages moved faster and quicker. The "Just-In-Time" supply chains that drive the supply of goods have done away with local warehousing in favor of an overnight delivery system (e.g., car parts, computer equipment, pharmaceuticals) which are all supplied by supply chains that pay premiums for fast delivery from national and regional warehousing, and repackaging facilities. Recent estimates from Stated Preference Surveys for Finished Goods and Express Parcels is $0.50 per ton per hour. See Great Lakes and St. Lawrence Seaway New Cargoes/New Vessels Market Assessment for USDOT [22], TEMS, Inc. and Rand Corporation.

39. Are the freight and passenger services compatible?

Response: Freight and passengers use the same trains and can be run together. It may be that peak hours are largely passenger, with freight running at night, and both services offered during off-peak daytime.

40. What would be the impact of Driverless Trucks?

Response: The evaluation of future technology offerings such as driverless trucks was beyond the scope of the current studies. Research in this area has begun and should be completed so that a sensitivity analysis can be included in the Investment Grade Study.

[22] Reference: Great Lakes and St. Lawrence Seaway New Cargoes/New Vessels Market Assessment Report for USDOT, TEMS/RAND Corp, 2007 see: https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/PB2009106672.xhtml

41. What is the headway for freight?

Response: The headway for freight trains is potentially the same as for passenger trains. However, freight may largely move during off peak periods, while passengers move during peak periods, but both can operate any time during the day or night.

42. Trucking is heavily subsidized in terms of infrastructure. Could CHSR corridor be equally subsidized?

Response: While the trucking industry is heavily subsidized with regard to highway maintenance costs, the evaluation of the CHSR corridor indicates that revenues would be sufficient to not require any operating subsidy from the government.

FINANCIAL AND ECONOMIC BENEFIT-COST

43. What is Operating Ratio?

Response: The Operating Ratio is the Net Present Value of the Revenues divided by the Net Present Value of the Operating Costs. Alternatively, the same revenues and costs can be compared for any given calendar year. See Service Development Plan, Exhibit 9-2. It should be noted that this is the operating ratio used for transit and passenger rail, which is different to that used by freight rail.

44. What are the Revenue Sources?

Response: Revenues include passenger fare box, freight revenues and net real estate revenues. The role of onboard advertising has not yet been defined. This should be considered in the Investment Grade Study, but considerable research is needed to establish the level and types of advertising.

45. Is the Residual Value of the project considered?

Response: There is no need to exclude Residual Value from the analysis. However, it is still not yet defined exactly what the condition and materials would be after 25 years. This should be assessed and considered in the Investment Grade Study.

46. What is the required US Funding support?

Response: The project is proposed as a public/private partnership. The funding plan has not yet been developed but may seek to take advantage of USDOT funding programs like Build grants, Transportation Infrastructure Finance and Innovation Act (TIFIA), Railroad Rehabilitation and Improvement Finance (RRIF), and Grant Anticipation Notes (GANS). TEMS uses the term funding to describe the raising of money and financing to describe the overall approach to overall program of cost and revenues that pay for the system.

47. What are User and Non-User Benefits?

Response: USDOT has largely defined the User and Non-User benefits to be included in the Benefit-Cost Analysis e.g., Consumer Surplus Benefits includes benefits to users, but also benefits to highway and air users who face less traffic congestion and can drive faster. The SP Values of Time are used in the modeled Utility function (generalized cost) to identify the importance of time to different types of travelers.

48. Have Cash Flows been developed?

Response: Yes, the Cash Flows are developed. The sum of the cash flows appropriately discounted are given in Exhibits 9-4 and 9-5 of the Service Development Plan.

49. Error Range

Response: For the Tier 1 EIS Study, we have an error range of ±30 to 40 percent and as such any benefit cost of greater than 1.3 – 1.4 is very significant and positive for the corridor and US economy. Our results show very significant net benefits at 3 percent discount (1.6 to 2.2) and at 7 percent discount (1.0 to 1.3). The 7 percent discount rate itself is discriminatory and punitive, designed to eliminate weak projects. The interpretation at USDOT is to have a greater than 1.0 Benefit-Cost ratio, at a 7 percent discount rate. This is less punitive. This project is one of the very few really large projects that reaches comfortably both hurdle rates.

The financial results for the Operating Ratio are positive for each Alternative at 2.13 for Alternative 1 and reaching 3.86 for Alternative 3. See Exhibit 9-2 on page 9-8 of the Service Development Plan.

SUPPLY-SIDE ECONOMIC ANALYSIS

50. Accessibility

Response: This is defined in the same way as it is in the Travel Demand models. The definition is given as Generalized Cost. See page 4-16 of the Service Development Plan.

51. Property Values

Response: The property values are provided by American Community Survey (ACS). The American Community Survey (ACS) is a continuous survey conducted by the U.S. Census Bureau which takes efforts in gathering information previously available only in the long form of the decennial census, such as income, employment, and property values. The U.S. Census Bureau sends surveys to almost 300,000 addresses monthly. TEMS used the ACS 2018 Data Releases that include the latest releases of the new 2014-2018 ACS 5-year Variance Replicate Estimates to get property values at census tract level. Then the property value data was aggregated to the TEMS zone level. Therefore, property value improvement can be estimated for each zone that is compatible with the COMPASS™ Ridership and Revenue Forecast Model.

52. Transit Oriented Development (TOD) Impact

Response: The TOD Impact Analysis for the corridor has been completed using the RENTS™ model. The model based on Prof. E. Mishan Cost Benefit book estimates the likely increase in economic wealth by assessing the likely increase in Economic Rent. Economic Rent is defined as the long-term increase in wealth (income, property values) due to the improvement in the economic productivity of the economy due to new investment in the factors of production. A key factor is transportation accessibility to markets. An investment in transportation systems improves market reach and accessibility. This results in increased economic performance and growth of regional and national gross domestic product (GDP). High-speed rail will provide such a transport improvement, particularly for the growth sectors of the New Economy such as Finance, Software, Health, Industry, Logistics, Consumer Products, Education, and Administration.

53. Station Property Values

Response: The values provided are theoretical and will vary with the proposed build out of the station. Perkins and Will proposals for the Portland and Seattle multimodal stations could well give higher values. This is because the values we provide are for high-speed rail alone and do not capture how the value can be impacted by local factors, amenities, location, and services (e.g., connecting transit). This local impact will be measured in future studies.

54. What percent of the tax base is for the station and lines themselves?

Response: The tax expansion identified is for the high-speed rail system impact on employment, which generates extra income and thus tax revenues.

55. Do the system operating costs include property tax?

Response: The system has not included tax payments as that is not a USDOT requirement. They would be included in a Financial Prospectus for the Private Sector Financial Analysis. Property tax (like all tax payments) is a transfer payment and would be included in a private sector financing plan.

55. Calculation of Economic Rent Impacts

Response: Economic Rent Impacts are calculated by assessing how improved accessibility will increase economic value of assets. The methodology is described in the Service Development Plan on pages 9-17 to 9-25. Essentially the process identifies how much increase occurs in employment, income, property values from measuring the elasticity of accessibility on the economic rent factors and then identifying how the improved transportation system reduces accessibility (generalized cost) to markets. Ideally future Economic Rent curves for 2030 to 2050 should be estimated, but that is complex as one moves from discussing 2019 dollars to 2030 or 2050 dollars that are not typically well understood. As such, the current estimate is conservative since it misses out on the economic growth from 2019 to 2030 and 2050.

57. Economic Rent of impacted industries (e.g., trucking)

Response: The Economic Rent analysis is an aggregate analysis showing overall level of benefit. As such, if there may be negative impacts (e.g., lost trucking jobs) which are made up by increased jobs in the high-speed rail freight business by a more positive impact that is greater to generate the increase in Economic Rent.

In this case high-speed rail is only absorbing the future growth of the express parcel markets so no existing jobs in trucking are lost. High-speed rail is absorbing the growth in the market and creating jobs (possibly with higher levels of productivity than existing trucking jobs) moving parcels and LTL by high-speed rail.

58. Social Equity

Response: Social Equity has not been measured to date, but high-speed rail serves both passenger and freight markets, so it creates benefits for high income and low-income workers. To measure Social Equity, an analysis of the distribution of benefits across different types of workers and the income ranges of workers will be completed in the Tier 2 EIS Analysis.

59. Loss of population, how does it get impacted by high-speed rail?

Response: The Economic Rent Analysis allows the estimation of the likely changes in population, as well as employment over and above current trends. This will allow the analysis to show how high-speed rail will improve the overall potential of population growth in the corridor cities. High-speed rail unlike highway development intensifies population and reduces sprawl to suburbs.

60. What are the critical Risk Factors?

Response: The key planning risk factors that will need to be assessed include –

- Socioeconomic growth rates
- Energy prices
- Highway congestion
- Highway vehicle technology – driverless cars and electric trucks
- First mile/last mile assumptions for freight competition
- Climate Change
- Market Volatility

Current scope of work did not include Risk Analysis, but this would be included in a Tier 2 Investment Grade Study.

61. How will high-speed rail change land use?

Response: High-speed rail will strengthen regional and city to city ties. It can energize downtown areas in cities and expand airport and urban gateway freight growth. It will support the New Economy industries of Finance, Administration, Software, Computer, Logistics, Transportation, Warehousing, Health and Education. It will also create greater social and economic integration of the region as smaller cities integrate with larger cities through different land use patterns.

62. What role can onboard advertising play?

Response: While the financial model has not yet been developed, the potential exists for high-speed rail to use its at seat video system to create a significant advertising revenue. This could be far greater than that currently used in high-speed trains, e.g., the London Heathrow Express service, which have video in each car. This is outside the existing scope of work for the Feasibility Study and requires direct research into the level and value of advertising that might be developed.

63. Induced Demand

Response: Induced demand is relatively new in transportation planning as the early forecasting models (developed largely by engineers) such as Bureau of Public Roads (BPR), which used a fixed demand matrix and so had no induced demand. The advent of high-speed rail produced large, induced demand impacts that were named "Nose Cone Effect", and the BPR model simply could not model the impact. The development of the Discrete Choice models like COMPASS™, allowed induced demand that is really associated with a significant reduction in the time or price of travel to be modeled. It has now been successfully modeled for the last 30-years.

6.2.6 PUBLIC OUTREACH

The Public Outreach process was developed to provide maximum coverage to all the communities of the Portland-Seattle corridor. The process was designed to provide by high level webinar PowerPoint presentations suitable for a public audience. As such, the program will be largely focused on Tier 2 local meetings (webinars) that specifically answers local issues, while also describing the overall UHSR concept, route and service proposals. It will describe both corridor and local-level financial, economic and environmental impacts and benefits.

It is anticipated that these outreach efforts would be continued and significantly expanded within the scope of the proposed Tier 2 EIS as shown in Exhibit 6-1. This will take the form of specific presentations, newspaper interviews, handout/leave behind materials, and townhall meetings.

6.2.7 AGENCY COORDINATION

As part of the Tier 1 process agency coordination has largely consisted of working with different environmental agencies to obtain the overview mapping required for the Environmental Scan. This included cultural resources conservation lands, historic resources, ecology, environmental justice, agricultural lands and soil values as described in Chapter 4. Further, more detailed Agency Coordination will be completed in Tier 2, including coordination with:

- US Army Corp of Engineers
- Washington and Oregon US Departments of Transportation
- US Fish and Wildlife Service
- US Environmental Protection Agency
- US Department of Transportation
- US Census Bureau
- US Department of Agriculture
- Washington and Oregon Departments of Natural Resources
- Washington and Oregon Departments of Agriculture
- UP, BNSF and Amtrak Railroads

7. Conclusion

Based on the information in this Service NEPA Tier 1 Environmental Scan, along with field reviews and coordination with agencies and the public, it is anticipated that the proposed improvements in the Cascadia rail corridor will have no long-term significant negative impacts on the environment, since the rail corridor will be developed in an environmentally sensitive way and mitigations are possible. It is important to note that ultra high-speed rail transportation is inherently a “green” mode of transportation since it is powered by electricity and does not use fossil fuels. Furthermore, it can provide equivalent transport capacity, with far fewer impacts and for less cost than would highway or air expansion.

The key finding of the study is that this corridor is one of the best in the country in terms of potential economic benefits and it has the potential to provide a modern Ultra High-Speed Passenger Rail System between Portland and Seattle, with future extensions south to Eugene and north to Vancouver, BC, which both now need to be assessed. This analysis has shown that the Portland to Seattle corridor would be able to meet USDOT FRA financial and economic criteria, allow the creation of a public/private partnership (P3), and have a strong positive impact on improving the quality of the regional environment. This is because much of the ultra high-speed rail route will be in tunnel significantly reducing its impact in urban and rural landscapes, that it uses electric power not fossil fuels, and that it avoids interaction with other modes improving safety from auto accidents and pedestrian conflicts. In transportation terms, it not only reduces congestion by diverting auto and air travelers to rail. This diversion reduces emissions and both highway and airport capacity requirements. Finally, it shows very strong financial and economic returns. In doing this it establishes the case needed for moving forward with further analysis and assessment as required to complete the Tier 2 Environmental and Preliminary Engineering work that will be needed for the continued development of the ultra high-speed corridor.