## Washington State

# East-West Passenger Rail Feasibility Study: A Preliminary Analysis

Washington State
Department of Transportation

June 2001

## Acknowledgements

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**BURLINGTON NORTHERN AND SANTA FE RAILWAY COMPANY**
DJ Mitchell Larry Woodley RL Depler Harry Zachau
Jack Ellstrom JW Ellstrom Chuck Christ J Espinosa Dennis Jackson

**WASHINGTON STATE DEPARTMENT OF TRANSPORTATION**
Leonard Pittman Donald S. Senn Jerry C. Lenzi

**LINK TRANSIT**
Tom Green

**SPOKANE REGIONAL TRANSPORTATION COUNCIL**
Glenn Miles

**CITY OF AUBURN**
Joseph Welsh

**WASHARP MEMBERS**
Jim Neal John Aylmer Charles Kilbury

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Prepared by the Public Transportation and Rail Division
Washington State Department of Transportation

June 2001

# East-West Passenger Rail Feasibility Study: A Preliminary Analysis

Prepared for the

**Washington State**
**Department of Transportation**

By

**HDR Engineering, Inc**
**The Resource Group**
**Transit Safety Management**

**June 2001**

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# Executive Summary

In 1993, the Washington State Legislature established the goal of introducing high-speed ground transportation between Seattle and Spokane by the year 2030 (RCW 47.79.020).

Currently, there is passenger rail service between these cities. Amtrak provides passenger rail service via its *Empire Builder*, which connects Seattle and Portland with Chicago, Illinois. While traveling within the state of Washington, however, the *Empire Builder* operates during late evening and early morning hours. Local communities across eastern Washington support this service, but they also believe there is a need for a new, intrastate passenger train that travels during daylight hours.

This strong local support, combined with the legislature's mandate, has led to the development of this preliminary feasibility study.

## What is the purpose of this preliminary feasibility study?

An in-depth study of the feasibility of introducing new Amtrak service on all three potential east-west rail corridors was slated to begin in Winter 2000. However, passage of Initiative 695 in November 1999 resulted in a 90 percent decrease in funding for this study. As a result, a comprehensive analysis was not possible. In an effort to begin the study process, however, this limited feasibility study was completed.

The purpose of this study is twofold:

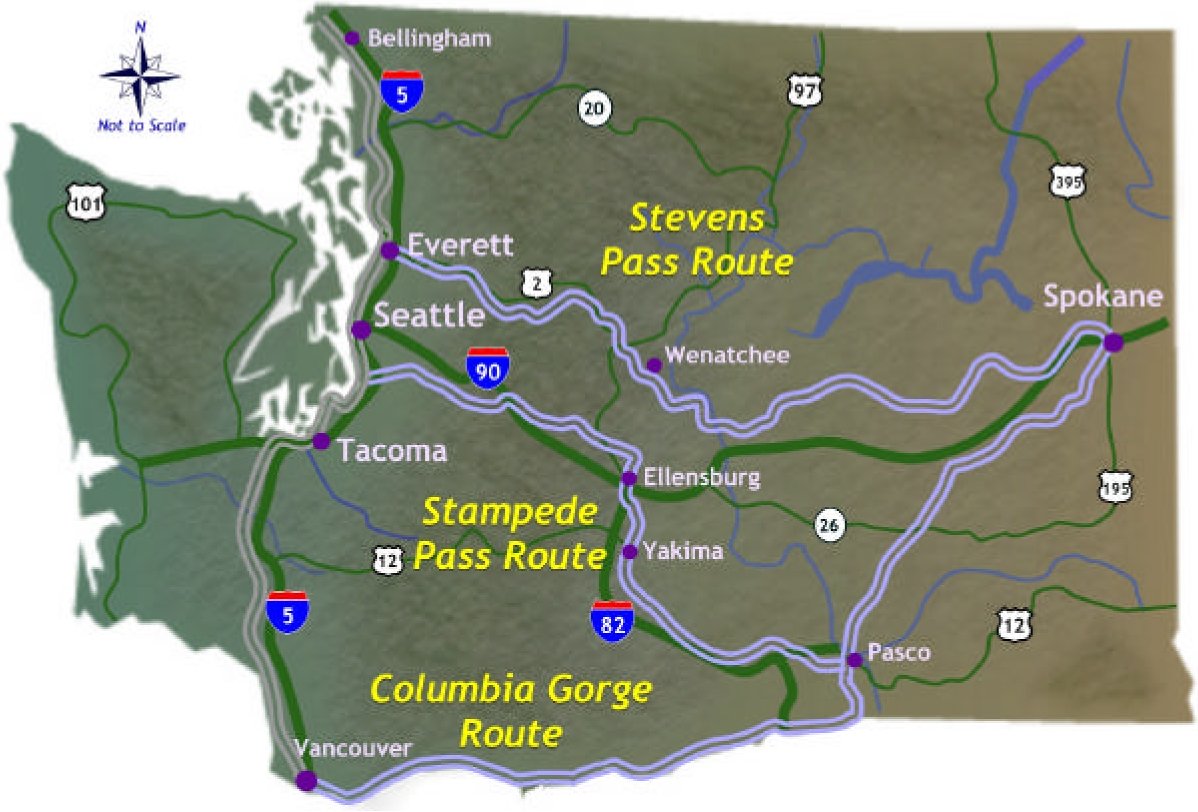
- This study provides a preliminary assessment of the feasibility of Amtrak service on the Stampede Pass rail corridor. The Stampede Pass rail corridor was chosen for analysis because it is the only east-west rail line that currently does not have passenger rail service; and
- This study also provides a baseline review of existing east-west rail corridors in Washington State. This review discusses the general existing conditions along the rail routes and potential obstacles to passenger rail expansion. This baseline assessment was designed as a foundation for further analysis of the east-west rail corridors and can be found in **Appendix A.**

## What did the East-West Rail Feasibility Study find?

The Stampede Pass route preliminary assessment provides a limited analysis of the operational and physical requirements necessary to implement daily, daylight passenger rail service along the Stampede Pass route.

Based on this preliminary feasibility study, as well the team's general knowledge of the east-west rail corridors, a number of conclusions were developed:

**Exhibit ES.1**
**Existing East-West Rail Corridors**



## The introduction of daylight passenger rail service along the Stampede Pass route is physically and operationally feasible.

This analysis indicates that Amtrak service along Stampede Pass is physically and operationally feasible, but further analysis of this route should be performed in the years ahead to obtain accurate ridership, scheduling, and cost information.

## Significant infrastructure improvements will be needed.

In order to provide safe and reliable Amtrak service on the Stampede Pass route, more than $350 million in infrastructure improvements will be needed. This estimate assumes at least one daily Seattle-Spokane round-trip. For example, this could be a single daily morning departure from Seattle and a single daily morning departure from Spokane.

Minimum infrastructure improvements to implement this daylight passenger rail service over the Stampede Pass route would include:

- Six or 16 miles of new track (second main track or sidings) between Auburn and Pasco (depending on the type of service and vehicle used);
- Centralized Traffic Control between Auburn and Pasco;
- Station improvements;
- Grade crossing improvements; and
- Purchase or lease of train equipment.

These improvements will cost more than $350 million. However, these improvements would also provide for more efficient freight movement along the Stampede Pass line, as well as additional frequencies of passenger service beyond the minimum service discussed in this report.

### The scheduled travel time between Seattle and Spokane would be at least 7 hours and 21 minutes.

Depending on the type of train equipment used along the route, total travel time between Seattle and Spokane would range from 7 hours and 21 minutes to 7 hours and 43 minutes. The use of conventional equipment, in conjunction with express service, accounts for the longer travel time. These travel times also assume that all recommended improvements, as well as changes in speed limits, are in place.

### Additional study will be required to estimate whether ticket sales will offset operating costs.

It is estimated that it would cost $14 million per year for one daily Seattle - Spokane round trip. These operating costs would be at least partially offset by ticket sales. Due to limited funding, this study was not able to estimate ridership or ticket sales. As a result, it is not possible to estimate the degree to which ticket sales will offset operating costs associated with this new service. Therefore, additional analysis is recommended.

### Express freight service along the route appears feasible and could help offset operating costs.

Amtrak often provides express freight service as a means to offset the cost of passenger rail service. Time sensitive shipments are placed in freight cars that are then coupled to passenger trains. The Washington Fruit Express program, currently in development, will carry Washington State produce to east coast markets via Amtrak's *Empire Builder*. New Seattle-Spokane Amtrak service would provide exceptional opportunities to transport more Washington produce to east coast markets. In combination with ticket sales, revenues from this freight express service could help offset operating costs.

### It is not yet possible to accurately assess the Stevens Pass route or the Columbia River Gorge route.

More analysis in the years ahead would be required to determine if these routes could handle additional passenger rail service. The preliminary analysis included in **Appendix A** of this report indicates that there is currently extensive rail traffic on both of these routes.

### It will take many years to make new East-West passenger rail service a reality.

This preliminary analysis indicates that the service along the Stampeded Pass rail corridor is physically and operationally feasible. However, costs identified for the introduction of the service are very expensive, and it is unlikely that partnership funding of this magnitude could be obtained under the state's current transportation funding mechanisms and the backlog of transportation projects already identified.

## What next steps are recommended over the next several years?

In light of the findings of this preliminary assessment, the study team recommends that Washington State undertake a detailed study of the feasibility of east-west passenger rail service on all three east-west rail corridors. This detailed study should include:

- Refined capital and operation cost estimates;
- Origin and destination analysis and ridership projections; and
- A thorough assessment of east-west freight rail traffic data and growth projections.

This information, when considered in its entirety, will be the foundation upon which full analysis of the costs and benefits of such a service can be based.

# Chapter One: Introduction

The Washington State Department of Transportation (WSDOT) is responsible for planning and implementing a multi-modal transportation system that meets the needs of the state's growing population and economy. Over the past decade, the interest in improving rail transportation in Washington has grown. In response to requests from policymakers and the public, WSDOT proposed to study new intercity passenger rail service between the cities of eastern and western Washington. An in-depth feasibility study was slated to begin in Winter 2000; however, passage of Initiative 695 in November 1999 resulted in a 90 percent decrease in funding for this feasibility study. As a result, a comprehensive study of all potential east-west rail corridors was not possible.

## Why was this feasibility study initiated at this time?

In 1993 the Washington State Legislature established the goal of introducing high-speed ground transportation between Seattle and Spokane by the year 2030 (RCW 47.79.020).

Amtrak currently provides passenger rail service between eastern and western Washington via its *Empire Builder* service. This daily passenger rail service operates during late evening and early

**Exhibit 1.1**
**Location of Cities Supporting Passenger Rail Services**

morning hours. Although local communities along the *Empire Builder's* route are very supportive of this service, they also believe there is a need for a passenger train that travels during daylight hours.

In late 1998 and early 1999, a grassroots effort by citizens and elected officials in eastern and central Washington inspired support for a study of the feasibility of daylight passenger rail service between eastern and western Washington. During this time, numerous cities adopted formal resolutions to support the study and the implementation of east-west daylight passenger rail service.

Formal resolutions were adopted in Cle Elum, Ellensburg, Yakima, Toppenish, Prosser, Kennewick, Pasco, Connell, Ritzville, Cheney, Harrington, Ephrata, Quincy, East Wenatchee, Wenatchee, and Leavenworth. In addition, Chambers of Commerce in some of these communities also supported and adopted their own resolutions (Cheney, Ephrata, East Wenatchee, Wenatchee, and Leavenworth). The city of Spokane's Regional Transportation Council issued a letter of support for a feasibility study of east-west daylight passenger rail service. **Exhibit 1.1 on the previous page** shows the locations of these communities.

Year 2000 Census information indicates population increased along the north-south passenger rail corridor, as well as throughout eastern and central Washington. U.S. Census data indicates that some counties have grown by over 20 percent. **Exhibits 1.2 and 1.3 on the following page** present county growth over the past ten years. It can be assumed that population growth of this magnitude increases pressure on the transportation infrastructure. As indicated in **Exhibit 1.4 (Page 4)**, traffic patterns over Snoqualmie Pass have substantially increased over a ten-year period. Providing alternative means of travel could alleviate growing physical pressure on our existing highway infrastructure, while also alleviating the environmental impacts resulting from increased motor vehicle travel.

**Exhibit 1.2**
**Growth in Western Washington Counties Located Along the *Amtrak Cascades* Route: 1990–2000**

| COUNTY | POPULATION | | PERCENTAGE |
|---|---|---|---|
| | 1990 | 2000 | CHANGE |
| **Whatcom** | 127,780 | 166,814 | 30.5% |
| **Skagit** | 79,545 | 102,979 | 29.5% |
| **Snohomish** | 465,628 | 606,024 | 30.0% |
| **King** | 1,507,305 | 1,737,034 | 15.0% |
| **Pierce** | 586,203 | 700,820 | 19.6% |
| **Thurston** | 161,238 | 207,355 | 28.6% |
| **Lewis** | 59,358 | 68,600 | 15.6% |
| **Cowlitz** | 82,119 | 92,948 | 13.2% |
| **Clark** | 238,053 | 345,238 | 45.0% |

*Source: Washington State Office of Financial Management and the 2000 U.S. Census*

An example of service that achieves these goals can be found in western Washington. *Amtrak Cascades* service, which operates between Eugene, Oregon and Vancouver, British Columbia via Portland and Seattle, diverted more than 40 million vehicle miles of traffic from regional highways and prevented more than 900 tons of air pollution in 2000.

Strong local support, as well as the recognition that our east-west transportation network is becoming more congested, led to the development of this feasibility study.

## What is the purpose of this study?

The purpose of the East-West Passenger Rail Feasibility Study is to provide policymakers and the public with objective information regarding the potential for daylight passenger rail service between eastern and western Washington communities. Based on discussions with key stakeholders—and recognizing the limited funding provided for the preliminary assessment—it was concluded that this feasibility study would have the greatest value if it:

1. Focused on the east-west rail route that currently does not provide passenger rail service to its surrounding communities (Stampede Pass); and
2. Provided a preliminary baseline analysis of the existing east-west rail corridors to serve as a foundation for east-west potential studies in the years ahead.

As such, this report is presented in two parts: first, the study itself, contained in these chapters, provides a preliminary assessment of the Stampede Pass rail corridor. This discussion is designed to provide a limited analysis of the operational and physical requirements necessary to implement daily, daylight passenger rail service between Seattle, Pasco, and Spokane.

Secondly, **Appendix A** of this document is a stand-alone analysis that provides a baseline review of the existing east-west rail corridors in Washington State. This appendix discusses the general existing conditions along the rail routes, as well as potential obstacles to passenger rail expansion. This baseline assessment was designed as a foundation for further analysis of the east-west rail corridors.

**Exhibit 1.3**
**Growth in Eastern and Central Washington Counties: 1990–2000**

| County | Population | | Percentage |
|---|---|---|---|
| | 1990 | 2000 | Change |
| Adams | 13,603 | 16,428 | 17% |
| Asotin | 17,605 | 20,551 | 14% |
| Benton | 112,560 | 142,475 | 21% |
| Chelan | 52,250 | 66,166 | 21% |
| Columbia | 4,024 | 4,064 | 1% |
| Douglas | 26,205 | 32,603 | 20% |
| Ferry | 6,295 | 7,260 | 13% |
| Franklin | 37,473 | 49,347 | 24% |
| Garfield | 2,248 | 2,397 | 6% |
| Grant | 54,798 | 74,698 | 27% |
| Kittitas | 26,725 | 33,362 | 20% |
| Klickitat | 16,616 | 19,161 | 13% |
| Lincoln | 8,864 | 10,184 | 13% |
| Okanogan | 33,350 | 39,564 | 16% |
| Pend Oreille | 8,915 | 11,732 | 24% |
| Spokane | 361,333 | 417,939 | 14% |
| Stevens | 30,948 | 40,066 | 23% |
| Walla Walla | 48,439 | 55,180 | 12% |
| Whitman | 38,775 | 40,740 | 5% |
| Yakima | 188,823 | 222,581 | 15% |

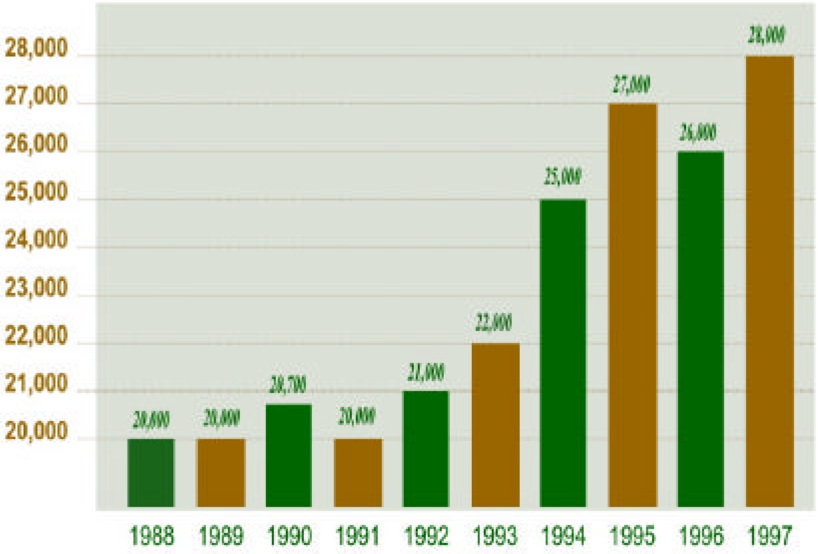
*Source: Washington State Office of Financial Management and the 2000 U.S. Census.*

If the legislature approves additional funding for east-west passenger rail assessment in the years ahead, the baseline analysis presented in **Appendix A** will help guide an in-depth corridor review.

## Why can’t passenger rail service just be added to the rail lines today?

Rail freight is shipped across Washington State via the three Burlington Northern and Santa Fe Railway Company’s (BNSF) main lines. In addition, Amtrak’s *Empire Builder* passenger rail service uses capacity on two of these main lines—Stevens Pass and the Columbia River Gorge. Railroads, who own the rail infrastructure, will typically consider adding passenger trains only if there’s unused capacity on their tracks. Given current levels of freight rail traffic on both Stevens Pass and the Columbia River Gorge main lines, more frequent passenger service could not be added without severely disrupting freight rail service. While some capacity may be available on the Stampede Pass route, this route would need to be upgraded to adequately serve passenger trains.

**Exhibit 1.4**
**Average Annual Daily Traffic at Snoqualmie Pass**



*Source: Washington State Department of Transportation.*

Current BNSF projections indicate that annual freight growth along the east-west main lines could range from two to five percent. As freight traffic grows, the ability of the existing BNSF main lines to accommodate other trains in addition to their freight trains will diminish. Therefore, it may be difficult for these main lines to handle additional passenger rail traffic. Future feasibility studies are needed to determine if it is reasonable to expect that service could be added.

## How will these findings be used?

This study will be presented to the Washington State Legislature and the Washington Transportation Commission. It will be up to these entities to decide whether to fund a more detailed analysis of the potential for east-west passenger rail service in the years ahead. Funding decisions will be based on a number of factors, including the state’s current transportation funding mechanisms and the backlog of transportation projects in the pipeline at that time.

## How is this report organized?

This feasibility study begins with a general overview of east-west passenger rail service in Washington State (Chapter Two). Chapters Three through Six focus on the Stampede Pass route, discuss potential service and infrastructure needs along this route, and provide information on potential costs of new passenger service. The report concludes (Chapter Seven) with recommendations and next steps. In addition, **Appendix A** provides a baseline analysis of the existing east-west rail lines in Washington State. Additional appendices provide backup for the Stampede Pass analysis.

# Chapter Two: Passenger Rail Service — Past and Present

East-west passenger rail service has been provided to communities east of the Cascade Mountains for over 100 years. Travelers first had direct access between Puget Sound and the Tri-Cities area when the Northern Pacific Railroad completed their main line and tunnel over Stampede Pass in the late 1880s. Passenger rail service continued on three cross-state routes until the early 1970s. In 1979, following the advent of Amtrak and its route consolidation program, the existing east-west passenger service trips were reduced to one daily round trip on two routes.

Today, Amtrak continues to operate east-west passenger rail service along two of the Burlington Northern and Santa Fe Railway's (BNSF) three east-west routes. BNSF's third east-west route, Stampede Pass, does not carry passenger rail service at this time. **Exhibit 2.1** presents the general location of these routes.

**Exhibit 2.1**
**East-West Rail Corridors**

## Which two east-west main line routes provide passenger rail service?

The two active east-west rail lines that currently provide passenger rail service are the Stevens Pass route and the Columbia River Gorge route. Both east-west routes travel westerly from Spokane, across the Cascade Mountains, and eventually connect with the BNSF north-south main line in western Washington. This north-south main line carries the current *Amtrak Cascades* passenger rail service, and serves passengers between Eugene, Oregon and Vancouver, British Columbia via Portland and Seattle. Amtrak's *Coast Starlight* also travels along this north-south main line. It is a long-distance train traveling between Los Angeles, California and Seattle, Washington.

### Where are these routes located?

The Stevens Pass main line leaves Spokane and travels west, across the Columbia River into Wenatchee. From this point, the rail line extends over the Cascade Range via the historic 8-mile long Cascade Tunnel. The line continues west into Everett where it joins the BNSF north-south main line.

The Columbia River Gorge route has two segments: from Spokane to Pasco[1] and from Pasco to Vancouver, Washington (Columbia River Gorge main line). To reach the Columbia River Gorge main line from Spokane, the route follows the former Northern Pacific Railroad (NP) main line out of Spokane through Cheney, Ritzville, and Connell to Pasco. The old NP main line then connects with the Columbia River Gorge main line in Pasco, following the north bank of the Columbia River from Pasco into Vancouver, Washington. At Vancouver, this route also connects with the BNSF north-south main line, where it extends north towards Seattle and south into Portland, Oregon.

### What type of passenger rail service is provided along these two routes?

Amtrak operates a section of the daily, round-trip *Empire Builder* service along both routes. From the north-south main line, the two trains travel east, over the Cascade Mountains, to meet in Spokane. In Spokane the trains are coupled together, whereupon they continue east to Chicago. When traveling west from Chicago, the procedure is reversed.

The Seattle section of the *Empire Builder* operating on the northern route begins service from Seattle's King Street Station. It travels north, with stops in Edmonds and Everett. At Everett, the route leaves the north-south main line and heads eastward through Snohomish County over Stevens Pass. Once through the Cascade Mountains, the *Empire Builder* makes stops in Wenatchee and Ephrata. The train's final stop in Washington State is in Spokane. The total trip between Seattle and Spokane takes about 7½ hours.

The Portland section of the *Empire Builder* over the southern route begins in Portland, Oregon and travels north across the Columbia River to Vancouver, Washington. From Vancouver, the train leaves the north-south main line and travels easterly along the Columbia River Gorge. The train makes stops in Bingen-White Salmon, Wishram, and Pasco. It then travels northeast to Spokane, its last station stop in Washington State. The

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[1] Throughout this report, this line segment is also referred to as the Pasco East main line or route.

total trip between Portland, Oregon and Spokane takes about 7½ hours.

From Spokane, the *Empire Builder* continues on to Idaho, Montana, North Dakota, Minnesota, Wisconsin, and eventually terminates the second afternoon in Chicago, Illinois. The return trip originates in Chicago in early afternoon and returns via the same route. Chicago arrivals and departures are timed to connect with east coast Amtrak trains. It is because of these long-distance destinations and scheduled arrival and departure times in the Midwest that the *Empire Builder's* stops in Washington State are at inconvenient times for local travel.

**Exhibit 2.2** provides a current timetable for the *Empire Builder* for both its northern and southern route.

**Exhibit 2.2**
**Amtrak *Empire Builder* Timetable**
**May 2001**

**Portland Section via Southern Route**

| TIME | CITY | TIME |
|---|---|---|
| 2:45 am | Spokane | 12:13 am |
| 5:35 am | Pasco | 8:57 pm |
| 7:30 am | Wishram | 6:55 pm |
| 8:04 am | Bingen-White Salmon | 6:21 pm |
| 9:20 am | Vancouver | 5:07 pm |
| 10:10 am | Portland, Oregon | 4:40 pm |

**Seattle Section via Northern Route**

| TIME | CITY | TIME |
|---|---|---|
| 2:15 am | Spokane | 12:32 am |
| 4:38 am | Ephrata | 9:42 pm |
| 5:43 am | Wenatchee | 8:42 pm |
| 8:43 am | Everett | 5:42 pm |
| 9:08 am | Edmonds | 5:17 pm |
| 10:20 am | Seattle | 4:45 pm |

## Was there ever passenger rail service over Stampede Pass?

Prior to the formation of Amtrak, the NP provided passenger rail service over Stampede Pass. These trains were designed to carry passengers from Washington State to and from areas in the Midwestern United States.

The premier westbound long distance train, the *North Coast Limited*, was scheduled to pass through Spokane late in the evening, with a morning arrival in Seattle. The return train left Seattle in mid-afternoon, again passing through Spokane late in the evening. Stops were made only in the larger cities like Ellensburg, Yakima, and Pasco.

The *Mainstreeter* was a second long distance train. It stopped at medium-sized cities like Prosser and Connell, as well as the larger ones (**Exhibit 2.3 on the following page**). The westbound train left Spokane in early evening with a very early Seattle arrival the next morning. The return train departed Seattle in the evening, traveling eastbound, with a late night/early morning arrival in Spokane.

In addition, until the late 1950s, the NP operated a pair of daytime trains on the Seattle-Spokane route specifically to handle local business. These trains stopped at numerous smaller towns that were not served by the transcontinental trains. The railroad actively promoted this local passenger train as a way to view the spectacular mountain scenery during daylight hours.

**Exhibit 2.3**
**Stampede Pass Passenger Rail Service**
**Local Business Route**
**(via the *Mainstreeter*) 1963 Timetable**

| TIME | CITY | TIME |
|---|---|---|
| 7:50 pm | **Spokane** | 6:46 am |
| 8:11 pm | **Cheney** | 6:15 am |
| 8:59 pm | **Ritzville** | 5:24 am |
| 10:05 pm | **Connell** | 4:23 am |
| 11:20 pm | **Pasco** | 3:16 am |
| 11:30 pm | **Kennewick** | 3:04 am |
| 12:17 am | **Prosser** | 2:12 am |
| 12:51 am | **Toppenish** | 1:39 am |
| 1:20 am | **Yakima** | 1:00 am |
| 2:32 am | **Ellensburg** | 11:51 pm |
| 3:04 am | **Cle Elum** | 11:21 pm |
| 3:20 am | **Easton** | 11:05 pm |
| 4:10 am | **Lester** | 10:19 pm |
| 4:45 am | **Kanaskat** | 9:42 pm |
| 5:15 am | **East Auburn** | 8:59 pm |
| 6:20 am | **Seattle** | 8:30 pm |

*Source: The Official Guide of the Railways and Steam Navigation Lines of the United States, Puerto Rico, Canada, Mexico and Cuba. National Railway Publication Company, June 1963.*

## Where is the Stampede Pass main line located?

To reach the Stampede Pass line from Spokane, it is necessary to follow the Pasco East main line to Pasco (this is the same line used to access the Columbia River Gorge main line from Spokane). The Pasco East main line connects with the Stampede Pass main line in Pasco, continuing northwestward up the Yakima Valley (**see Exhibit 2.4 on the following page**). A number of communities are located along this route, including Kennewick, Prosser, Toppenish, Yakima, Ellensburg, and Cle Elum. From Ellensburg the line continues towards the Cascade Mountains where it rises to 2,840 feet and crosses the mountains at Stampede Pass via the 1.8-mile long Stampede Tunnel. The rail line continues west into Auburn where it joins the BNSF north-south main line. From here, the main line continues north towards Seattle and south towards Tacoma (and Portland, Oregon). The Stampede Pass main line is currently used by BNSF freight trains.

## Why isn't there passenger rail service over Stampede Pass today?

Beginning in 1971, when Amtrak took over operation of passenger rail, some passenger service routes in Washington State were eliminated. However, the Stampede Pass route, servicing Seattle-Yakima-Pasco-Spokane, was one of the few routes in Washington that was continued by Amtrak. In the early 1970s, service was provided via the *Empire Builder* and the *North Coast Hiawatha.*[2]

The 1970 merger between the NP and the Burlington Northern (BN) Railroad changed the status of the Stampede Pass main line. In 1983, the Stampede Pass route was determined to be a redundant asset. At that time, it was

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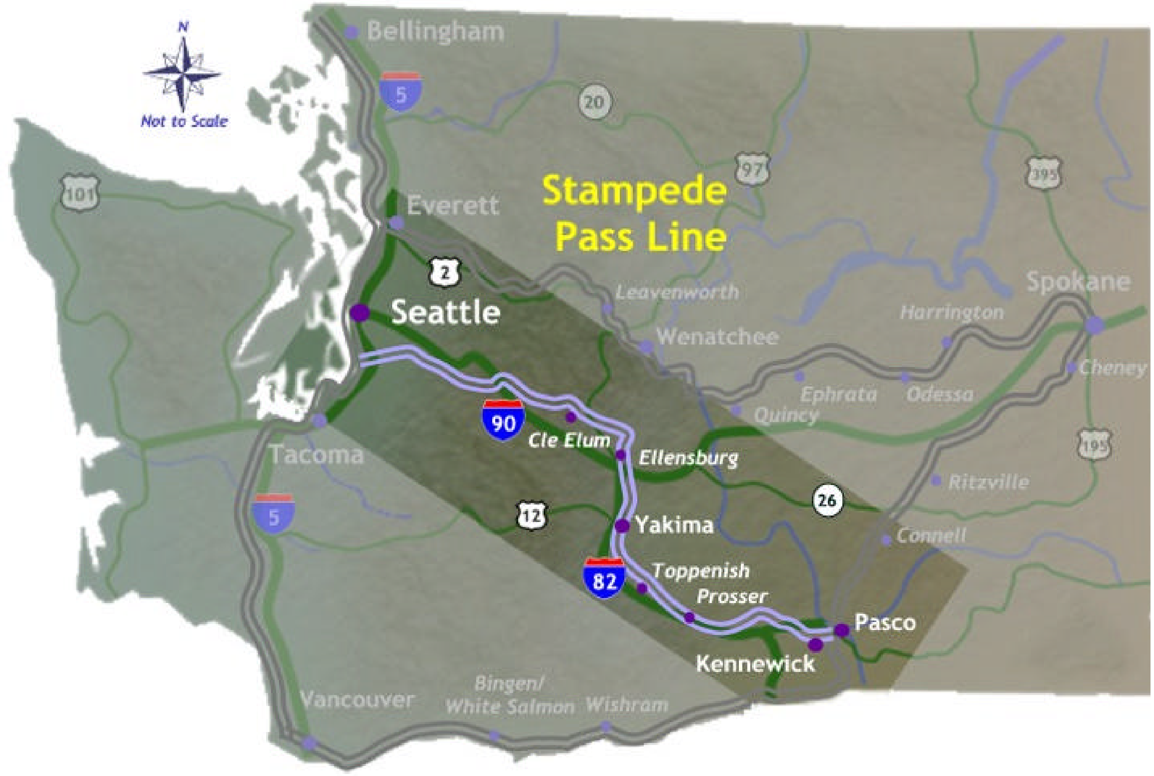
[2] The name of this train was derived from a combination of the Northern Pacific's *North Coast Limited*, and the Chicago, Milwaukee, St. Paul, and Pacific's *Olympian Hiawatha*.

### Exhibit 2.4
### Stampede Pass Route



thought that the Stevens Pass line and the Columbia River Gorge line would be able to provide sufficient east-west capacity over the Cascade Mountains well into the twenty-first century. As a result, approximately 153 miles of the Stampede Pass line were sold to the Washington Central Railroad, an independent short line operating between Pasco and Cle Elum. The BN retained the remaining 97-mile segment but removed it from active service.

As a result, Amtrak's *North Coast Hiawatha* service was terminated, and the *Empire Builder* service was moved to the Stevens Pass route. To provide a general comparison (as well as a historic perspective), **Exhibit 2.5** presents a 1979 timetable for Amtrak's transcontinental *Empire Builder* route (over Stampede Pass).

### Exhibit 2.5
### Stampede Pass Passenger Rail Service
### Amtrak *Empire Builder* 1979 Timetable

| TIME | CITY | TIME |
|---|---|---|
| 11:15 pm | Spokane | 1:50 am |
| 2:15 am | Pasco | 10:55 pm |
| 4:05 am | Yakima | 9:15 pm |
| 5:10 am | Ellensburg | 8:11 pm |
| 8:00 am | East Auburn | 5:38 pm |
| 8:55 am | Seattle | 5:00 pm |

*Source: Burlington Northern Railroad Timetable*

In 1979 it took approximately 9½ hours to travel between Seattle and Spokane via Stampede Pass's *Empire Builder*.

Ten years later, BN reevaluated this decision. Traffic on the remaining east-west routes was at or near capacity. That fact, plus the booming Pacific Rim import-export trade, forced the decision to resurrect the Stampede Pass line, thus easing the congestion in the region and allowing the railroad greater flexibility in freight handling.

### Could passenger rail be re-instated over Stampede Pass?

Adding additional trains—either freight or passenger—requires an assessment of existing conditions (both physical and operational) along the rail line. This feasibility study provides a preliminary assessment of all active east-west rail lines to determine the feasibility of additional passenger rail service.

### What other potential east-west routes exist?

Two abandoned east-west rail corridors also exist, but are not included as part of this preliminary feasibility study.

The first is the eastern half of the former Spokane, Portland, and Seattle Railroad line between the Tri-Cities and Spokane.

The second corridor, also known as the John Wayne Trail, (formerly owned and operated by the Chicago, Milwaukee, St. Paul, and Pacific Railroad), extends between the Seattle area and the Idaho border near Tekoa in Whitman County.

A significant common feature of the two abandoned lines is that they generally extend through sparsely populated areas, and therefore are not conducive to passenger train service. However, further study may show significant usefulness of the Ellensburg – Lind portion of the Chicago, Milwaukee, St. Paul, and Pacific right-of-way for direct passenger train service between Seattle and Spokane.

# Chapter Three: Stampede Pass — General Railroad Characteristics

The review and assessment of a rail corridor requires an understanding of the current physical and operational characteristics of the existing rail line. It can then be determined if the rail line can physically handle additional trains at the desired times.

This chapter presents a brief discussion of railroad characteristics and operations as well as the current conditions on the Stampede Pass route.

## What are general railroad characteristics?

While there are fundamental distinctions between the operations of a railroad and a highway network, some of the basic characteristics are similar. Certain design standards (that dictate physical characteristics) are applied to rail construction, just as there are standards applied to highway construction.

**Exhibit 3.1**
**Types of Railroad Capacity**

| | |
|---|---|
| **THEORETICAL CAPACITY** | The number of trains per day that could run over a route in a strictly perfect, mathematically generated environment. This number is useful because it is relatively easy to generate. For example, if the longest running time between two sidings is one hour, that implies that it would take at least two hours between trains to travel in each direction. This would imply a capacity of 12 trains traveling east and 12 trains traveling west, each day (or 24 trains per day). |
| **PRACTICAL CAPACITY** | It's not possible to actually run the number of trains you work out mathematically. Things will happen—one train doesn't have enough locomotive power, the rail is slippery, there is wind or fog, or the engineer is a little slow on his train handling. A reasonable and regularly used figure for what the real world might produce is 75 percent of the theoretical capacity. Using this relationship for practical capacity makes it possible to produce a reasonable estimate fairly easily. |
| **COMMERCIAL CAPACITY** | Commercial capacity is simply the practical capacity available during the times when business needs would actually want shipments to move. Practical capacity is the number of trains you could reasonably expect to run in a day, but using all of it would require you to run trains when you don't need them. Suppose that the Seattle area could practically accept one train an hour and send out one train per hour. However, shippers want to receive their shipments before 6 a.m. so they can be ready for the day's business, and they want to send shipments after a day of loading cars (say, after 6 p.m.).<br>In effect, the commercial capacity in this very simple example is six trains per day outbound from 6 p.m. to midnight and six trains per day inbound from midnight to 6 a.m. Shippers might want to increase their rail business to a level that would need ten trains, but since their businesses only accept or send out shipments at certain times, the commercial capacity is much less than the practical capacity. |

In both cases, the design standards are derived directly from the characteristics of the vehicles and the intended operation of the facility.

## How do these characteristics affect the ability to add more trains?

In order to add more trains to a rail line, the tracks need to have the necessary capacity to handle the additional traffic. Capacity is simply the number of trains per day that a given rail line can safely move while meeting a particular schedule.[3]

The rail characteristics presented in **Exhibit 3.2 on the following pages** explain how each element contributes to the operation of the rail line, thus contributing to its capacity. Therefore, a review of current conditions along each route will provide enough information for a general feasibility assessment for new passenger service.

## How was information about rail characteristics collected?

The analysis of the Stampede Pass route entailed three steps:

1. General review of the Stampede Pass route's railroad characteristics;
2. In-depth review and simulation of Stampede Pass's operational and physical conditions; and
3. Development and identification of operational and physical needs for potential passenger rail service along the Stampede Pass route.

This chapter focuses on the first step of this analysis: general review of Stampede Pass's railroad characteristics. This task entailed:

- Reviewing existing reports and documents pertaining to freight and passenger rail in Washington State;
- Reviewing maps and rail plans, including highway maps, railroad track charts, and topographic maps; and
- Collecting train information (average number of trains per day on the Stampede Pass route) from Burlington Northern and Santa Fe Railway (BNSF).

## What assumptions were made as part of this review?

This review of current rail characteristics along the Stampede Pass route is based on four critical assumptions. These assumptions are:

1. Freight rail traffic will continue to increase in future years on each of the east-west routes;
2. The proposed daylight service will provide one train—during daylight hours—each day, in each direction;
3. The two endpoints for the proposed passenger rail service will be Seattle and Spokane; and
4. The proposed new east-west service schedule would be adjusted to integrate with the *Amtrak Cascades* service schedule that runs along the north-south BNSF route.[4]

---

[3] There are different types of capacity. Three types of capacity referred to in this study are presented in **Exhibit 3.1.**

[4] This assumption is based on projections of hourly *Amtrak Cascades* service by the year 2018 (between Seattle and Portland). A detailed analysis will be required to review the potential to integrate east-west service into the *Amtrak Cascades* plan. This separate analysis will require detailed ridership studies, cost comparisons, and required infrastructure along the north-south main line.

## Exhibit 3.2
## Railroad Characteristics and Their Relevance

| CHARACTERISTIC | WHY IS IT IMPORTANT? |
|---|---|
| **Track Structure** | Track structure has three elements: rails, ties, and ballast. **Rails** are made of steel. Even though the steel is very hard, the rail wears out, just as highway pavement wears out. The **ties**, typically made of wood or concrete, support the rails. **Ballast** is crushed rock used to support the ties and keep the track in correct alignment while draining off precipitation. The condition of each of these elements dictates the weight and type of equipment that can be used on the line, as well as the speeds allowed on the line. |
| **Number of Tracks** | The number of tracks affects the capacity of the line. Two tracks (also called **double track**) have more capacity (the number of trains that can move through the area) than one track (**single track**).<br>**Sidings** also increase the capacity of a single track. A single track line has auxiliary tracks known as sidings. Sidings located along the line allow trains moving in opposite directions to pass each other and allow faster trains to overtake slower trains. The capacity of the rail line and the reliability of operation are affected by the time required to move between sidings. |
| **Grade (the steepness of the tracks at various locations)** | The steepness of the track dictates the types of trains that can use the rail line. Typical grades for freight trains do not exceed 2 percent, while grades for passenger trains can be as high as 4 percent. **Ruling grade** is the predominant slope along the rail line. The ruling grade determines how many cars a locomotive can pull over that route. |
| **Curves (often presented in degrees of curvature)** | The tightness of the **curve** dictates the speed that a train can travel through it. The higher the degree, the tighter the curve, the slower the speed. *Amtrak Cascades* trains that are used on the north-south main line in western Washington can travel faster through tight curves than standard trains because they use tilt technology. |
| **Speed Limits** | Train **speed limits** are derived by considering physics, safety, and regulations. They are generally regulated by the Federal Railroad Administration (FRA). The Code of Federal Regulations (49 CFR 213, Track Safety Standards) establishes classes of track with associated speed limits and detailed physical requirements for tracks in a given class. Speeds may also be restricted by the Washington Utilities and Transportation Commission (WUTC). |
| **Traffic (Number and type of Trains)** | The **number and type of trains** that can operate on a rail line relate directly to capacity. The more trains that are put on a track, the more the need for additional track, signals, and improved traffic control. |

## Exhibit 3.2—Continued
## Railroad Characteristics and Their Relevance

| CHARACTERISTIC | WHY IS IT IMPORTANT? |
|---|---|
| **Signals and Traffic Control: Definition** | **Signals** help extend the engineer's sight distance and therefore allow greater speeds. **Traffic control** determines which train can use which tracks to improve safety and ease of movement of trains. |

### Types of Signals and Traffic Control

| TYPE | DEFINITION AND USE |
|---|---|
| **Centralized Traffic Control (CTC)** | Traffic control generally consists of an electronic system, usually associated with Automated Block Signals (ABS), or a manual block type system such the Track Warrant Control (TWC) system.<br>Under CTC, the signal system lets a dispatcher at a central location see the location of all trains on a diagram of the tracks. The dispatcher can remotely arrange for one train to safely pass another. The logic built into the CTC system ensures that local wayside signals and track switches are properly set so that locomotive engineers know what the dispatcher intends for them to do in a safe manner. |

| CHARACTERISTIC | WHY IS IT IMPORTANT? |
|---|---|
| **Yard Limit Operation (Yard Limit)** | Yard limit operation is a mostly manual traffic control system used in yards and terminals. Trains must generally be prepared to stop within half the range of vision. Because of the great stopping distance of trains, yard limit operation generally requires movement at 20 mph or less. |
| **Occupancy Control System (OCS)** | A traffic control system using a combination of Yard Limit operation and verbal instructions from the train dispatcher. OCS is generally limited to terminal areas where trains move at low to moderate speeds. |
| **Restricted Limits** | A traffic control system generally allowing trains to use the main track and move as the way is seen to be clear. Similar, except in some details, to yard limit operation. |

These assumptions were the foundation for analysis of current rail characteristics along the Stampede Pass route.

## What are the characteristics of the Stampede Pass route?

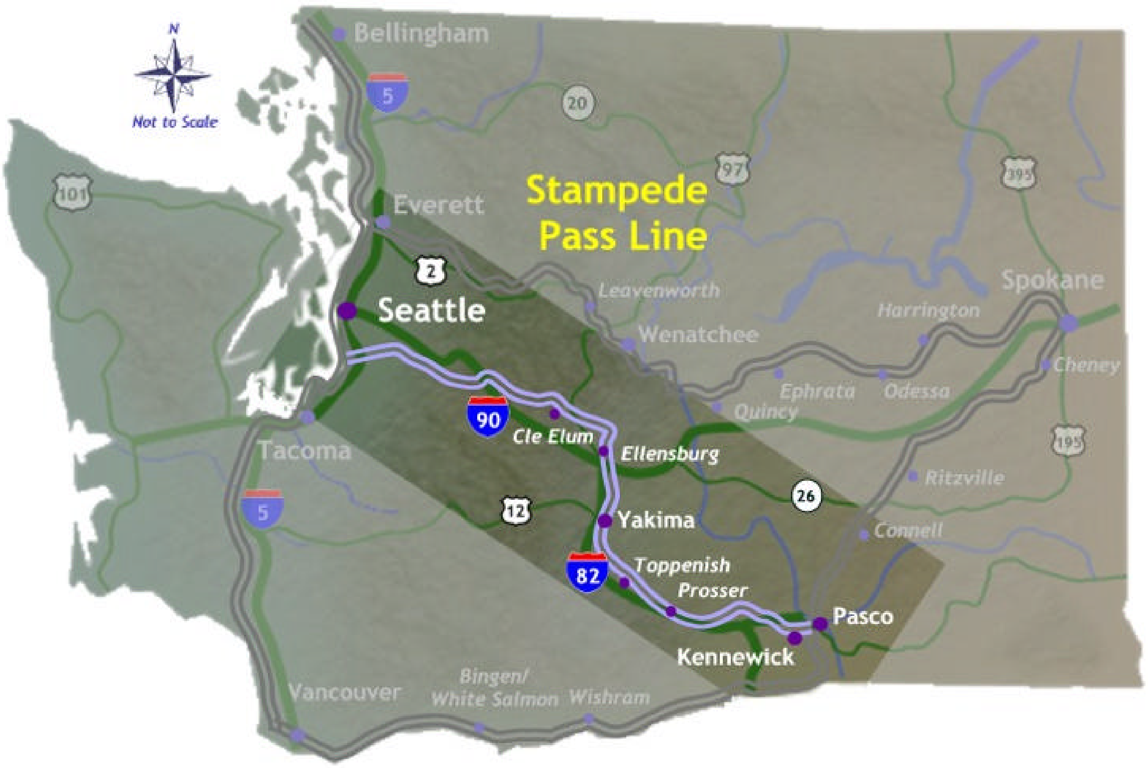
The former Northern Pacific Railroad main line through Stampede Pass is BNSF's central main line route. **Exhibit 3.3** presents the location of this route. The Stampede Pass route extends between Auburn and Pasco via Stampede Pass. From Pasco, the route travels north to Spokane via the Pasco East main line. The distance between Seattle and Spokane via this route is approximately 400 miles.

This line laid dormant for 14 years, but was rebuilt and reopened in December 1996. General freight traffic is transported over this route; however, the Stampede Tunnel does not currently have sufficient clearance to accommodate double-stack containers, tri-level auto cars, and certain trailer-on-flatcar loads.

### Stampede Pass Main Line

The Stampede Pass main line is all single track between Auburn and Pasco. There is a very short section of second main track at Easton, in Kittitas County. The entire line is controlled by Track Warrant Control, with short sections of Centralized Traffic Control (CTC) and Restricted Limits. The sections of CTC are only located between the switches of sidings.

**Exhibit 3.3**
**Stampede Pass Route**



The single tracks between these sidings operate by Track Warrant Control (TWC). There are no Automatic Block Signals (ABS) on this route. The Stampede Pass route is used only by BNSF freight trains.

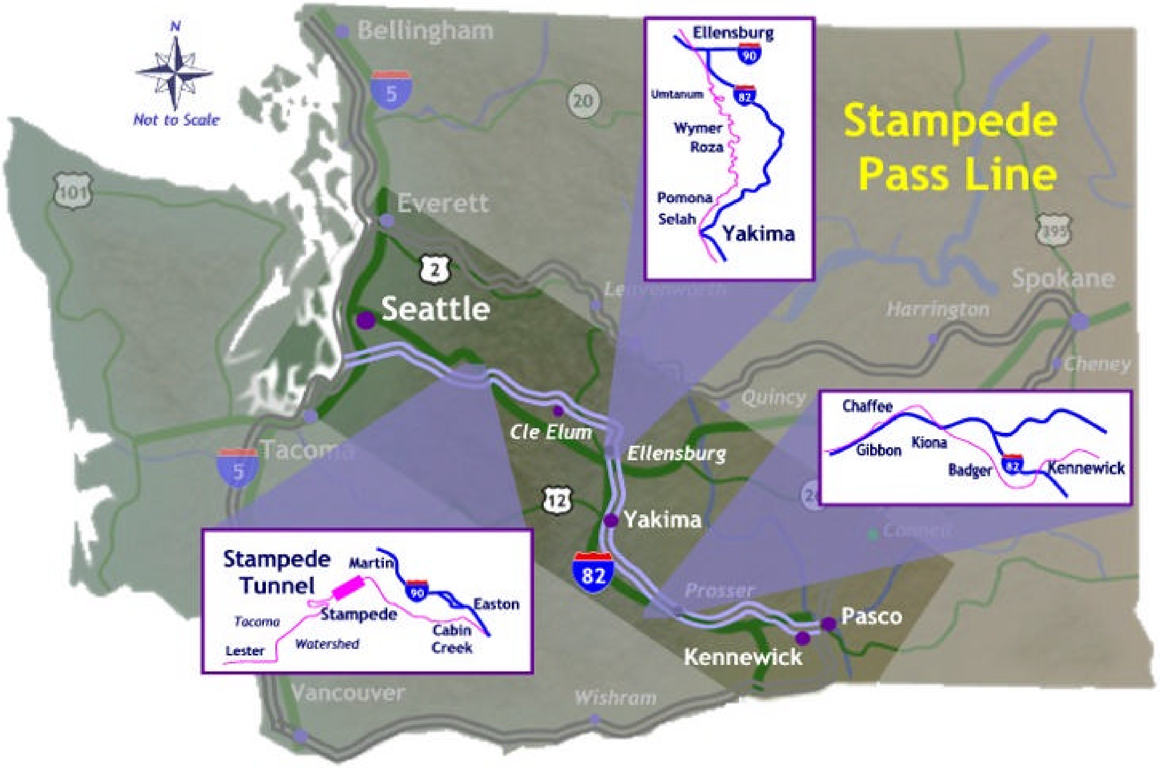
There are several short segments of 0.8 to 1.1 percent grade. The ruling grade on this route is 2.2 percent, near the upper limit for typical main line freight operations nationally. The absence of a signal system limits freight trains to 49 mph and passenger trains to 59 mph. There are numerous curves on this line that also restrict the speed of trains. **Exhibit 3.4** shows details of this route.

The Auburn – Pasco route is used by only a small number of trains. Some of the trains, such as empty grain trains, are not necessarily scheduled to operate normally on this line but are run on an as-needed basis.

## Pasco East Main Line

The Pasco East main line (between Pasco and Spokane) passes through Connell in Franklin County, Ritzville in Adams County, and Sprague in Lincoln County. For the most part, the line runs parallel to US 395 and Interstate 90 (see **Exhibit 3.5 on the following page**). There is a short section of double track near Spokane and another between Cunningham and Sand. Centralized Traffic Control is used on the entire line. The maximum speed for passenger trains is 79 mph. The maximum speed for freight trains is 60 mph. Curves

**Exhibit 3.4**
**Stampede Pass Detail Map**



restrict passenger and freight train speed at numerous locations.

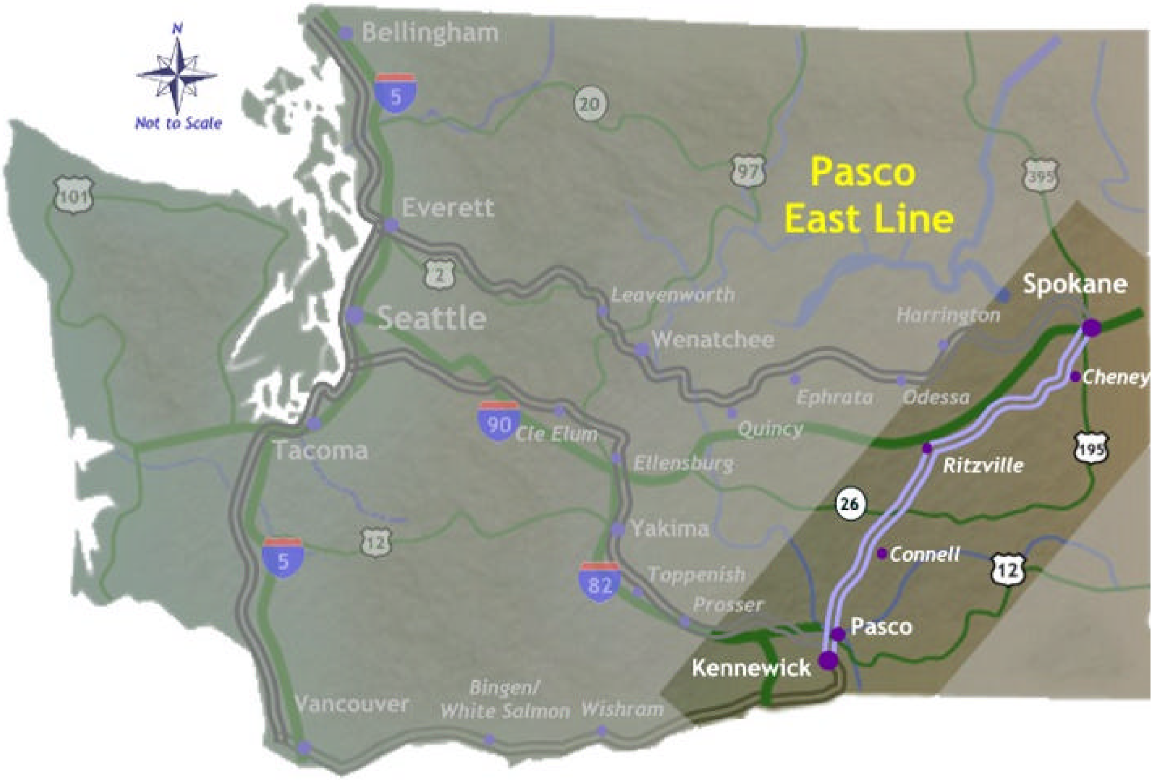
Moderate grades in two areas affect the capacity of the line. **Exhibits 3.6 and 3.7 on the following page** show the general locations of this main line's characteristics.

### Does the addition of passenger rail service over the Stampede Pass Route appear feasible?

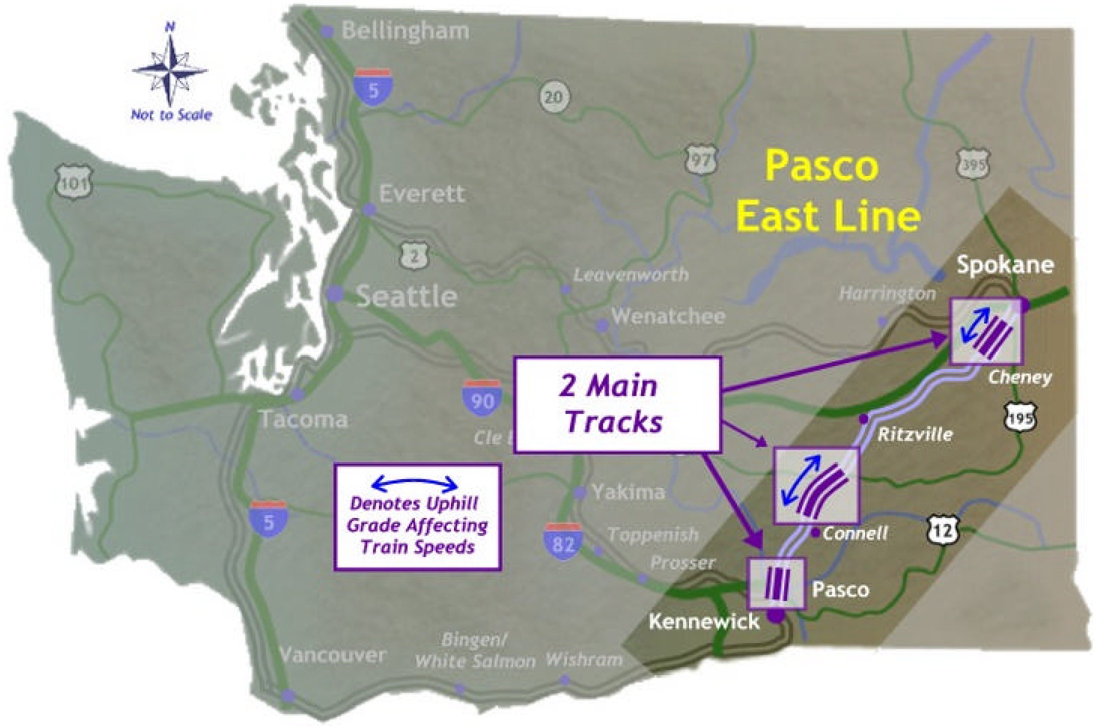
Preliminary review of the Stampede Pass route indicates that the current traffic on the route is extremely light. In addition, this preliminary review indicates that there are no major physical constraints that would limit expansion of the existing infrastructure.

Based on the physical and operational conditions of the Stampede Pass route, it was concluded that a preliminary assessment of this route could result in significant and meaningful findings. As such, the following chapter provides the results of detailed analysis and rail simulation of this route.

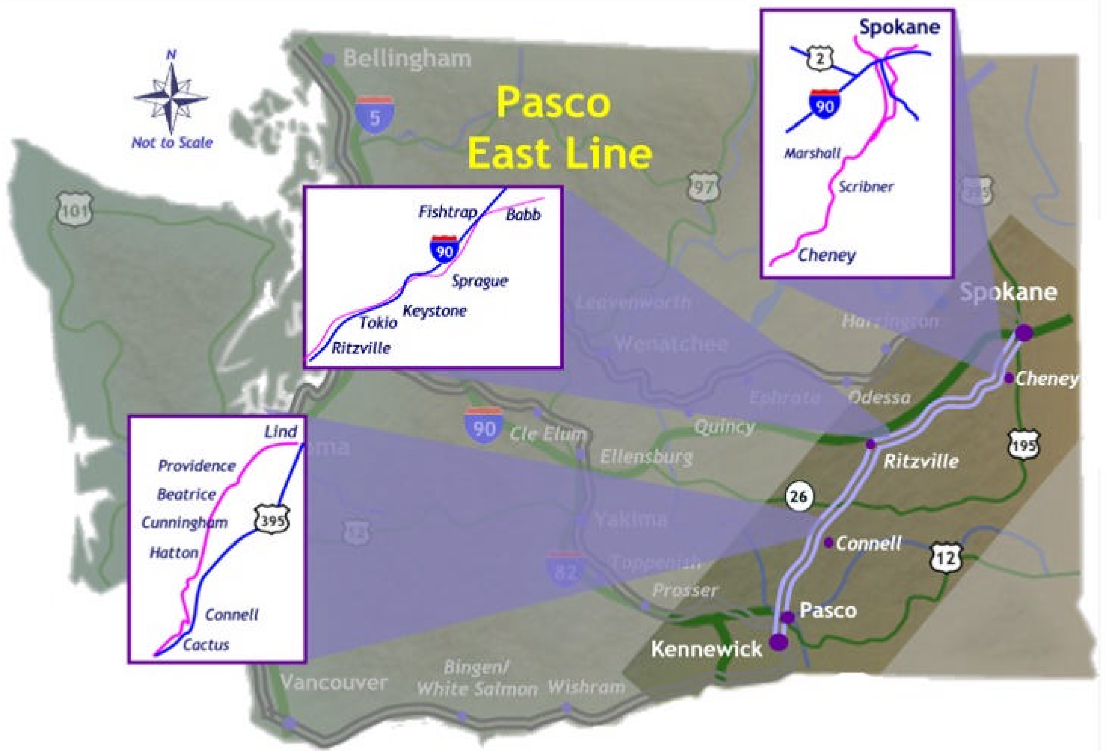
**Exhibit 3.5**
**Pasco East Route**



## Exhibit 3.6
## Pasco East Details: Grades



## Exhibit 3.7
## Pasco East Details: Curves



# Chapter Four: Simulation Analysis for Passenger Rail Service Over Stampede Pass

The preliminary review of railroad characteristics along the Stampede Pass route indicates that the introduction of passenger rail service may be feasible. Therefore, a simple simulation modeling exercise was performed to analyze the scheduled and typical traffic patterns for the Stampede Pass route.

The purpose of this simulation was to verify the ability of the route to support one daily daylight passenger train (in each direction). In addition, this simulation and analysis identified physical and operational improvements that may be necessary for this new service.

This simulation analysis and its findings also provide the foundation for future detailed analysis of east-west passenger rail service.

## What steps were taken for the simulation analysis?

During the month of August 2000, an interdisciplinary team of engineers and planners participated in an inspection trip along the Stampede Pass route. Where feasible, the team inspected the physical tracks and current rail operations.

In addition to this field review, existing data was collected from state and federal agencies, the Burlington Northern and Santa Fe Railway (BNSF), and Amtrak. Data collection included:

- Typical scheduled traffic;
- Typical actual traffic;
- Track geometry data;
- Track construction data;
- Track right-of-way data;
- Grade crossing data; and
- Station criteria used by Amtrak.

Following data collection, the study team compiled and analyzed information in three steps:

1. Various important elements were analyzed for physical track arrangement, traffic, speed/time, signals, traffic control, and road crossings;
2. A simulation model using some basic manual stringline analysis was used to analyze the scheduled and typical traffic patterns.[5] A stringline analysis is a graphic representation of the movement of trains on a rail line. The purpose of this simulation was to determine the ability of the route to support new/additional passenger service; and
3. Physical and operational elements that may be necessary for new service were identified. The study team then applied some basic unit-cost estimates to these elements.

This chapter presents a discussion of steps one and two of this process. Chapters Five and Six discuss the potential for passenger rail service and probable basic unit-costs for such a service.

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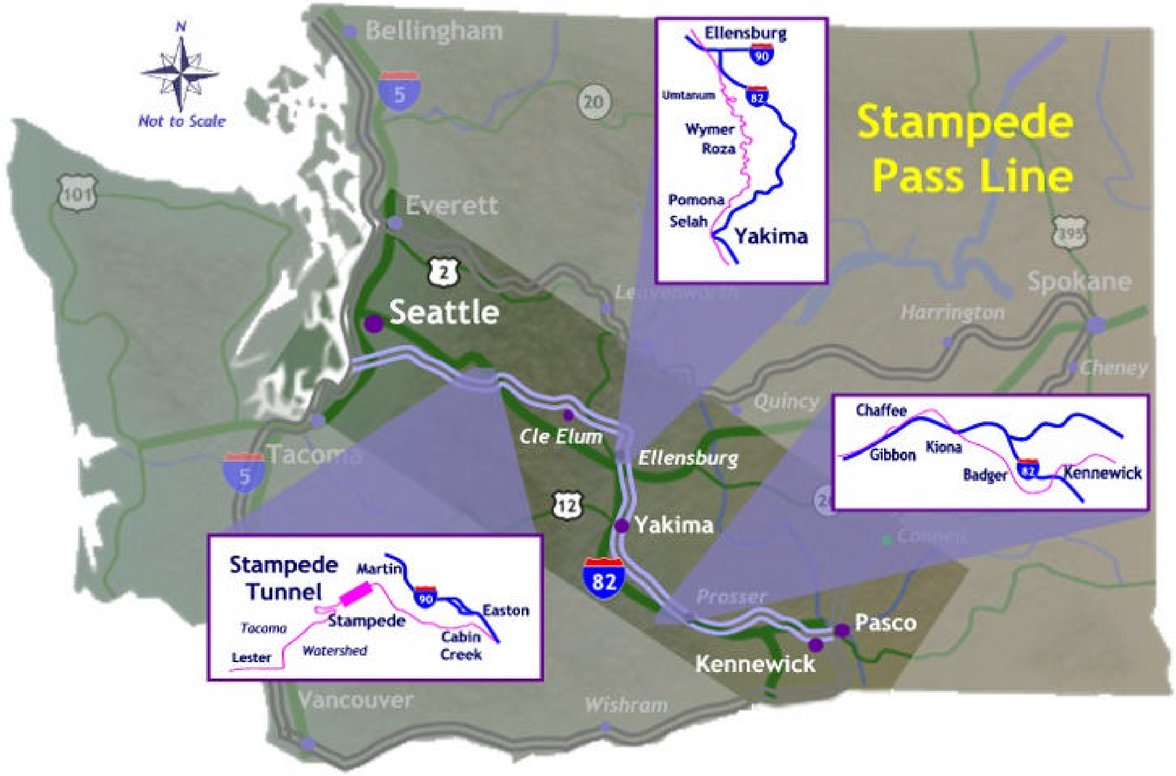
[5] Go to www.wsdot.wa.gov/pubtran to review these stringlines.

**Exhibit 4.1**
**Stampede Pass Detail Map**



## What are the important existing elements along the Stampede Pass route?

The first step in identifying feasibility of a particular route and then simulating potential service is to identify the important existing elements along the rail line. This discussion focuses on Stampede Pass current conditions as they relate to capacity, physical infrastructure, and existing regulations.

### Track Arrangement

The following discussion presents track arrangement information for the two segments of the Stampede Pass route: the Stampede Pass (Auburn to Pasco) main line and the Pasco East (Pasco to Spokane) main line.

### Auburn to Pasco

The entire route from Auburn to Pasco is single track with the exception of a short section of two main tracks between Cabin Creek and Easton (see **Exhibit 4.1** for general location). Running time between sidings under current conditions is generally 45 minutes to an hour. That translates into a capacity of roughly 18 trains per day under ideal circumstances. The traffic control system erodes that figure considerably.[6] When sidings are 45 minutes to an hour apart, the delay for meeting opposing trains can easily range from 45 minutes to over two hours per meet.[7]

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[6] See discussion about traffic control on page 27.
[7] A meet is a railroad term that describes when one train encounters a train moving in the opposite direction.

Increasing the speed of trains can make a significant improvement in the capacity of the line. But even with higher train speed increasing capacity, the running time between sidings still limits recoverability and reliability. The extent of the limitation is reasonable given the nature of the traffic currently using this route.

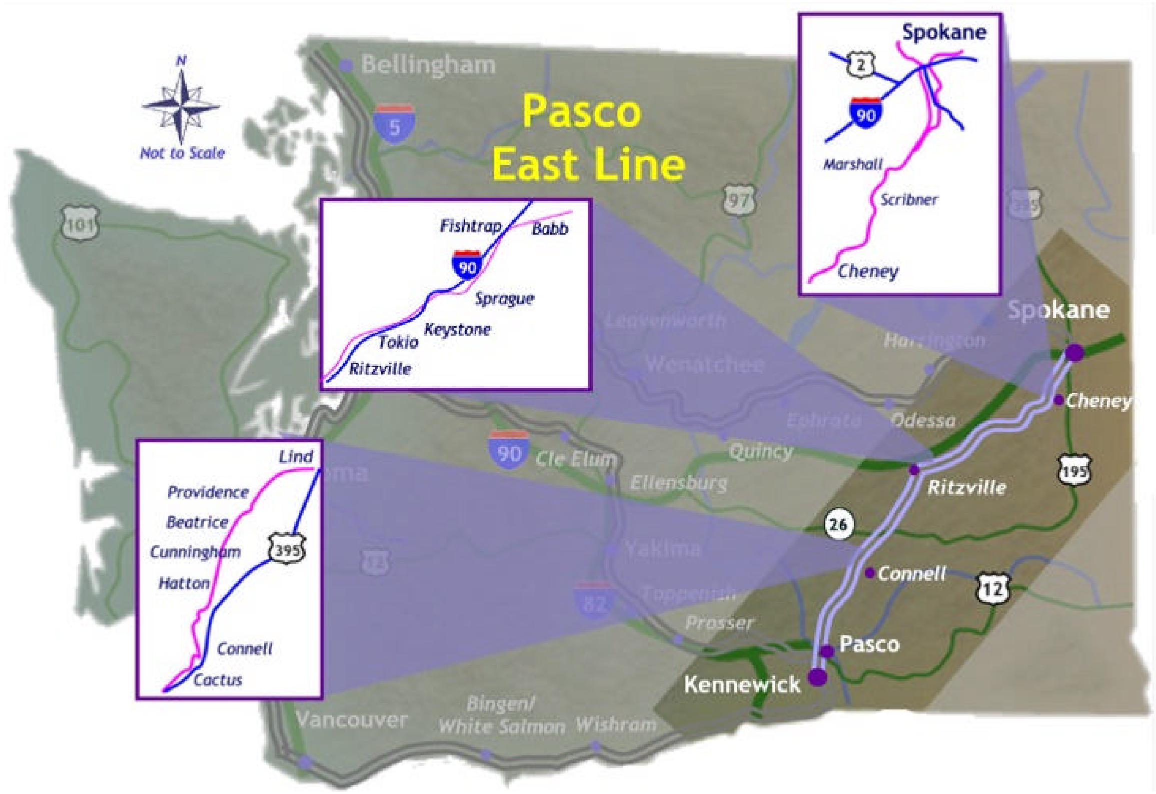
## Pasco to Spokane

The track arrangement between Pasco and Spokane (Pasco East) is suited to the high volume of traffic on the line. Of the approximately 146 miles between Pasco and Spokane, about 34 miles is double track. Although there are a variety of train types and train speeds along the line, the numerous curves on the line tend to make freight train speeds sufficiently uniform to generally avoid the need for one freight train to pass another. **Exhibit 4.2** illustrates the general locations of these curves. The significant exception is westward grain trains, which are limited to 45 mph at all times.

The maximum running time between sidings for a typical freight train is approximately 20 minutes. That translates to a capacity of about 54 trains per day, or generally a rather great reliability of operation, for a single-track line, at the current volume.

The Pasco to Spokane route is subject to periods of heavy congestion and significant delays. This congestion is not due as much to the capacity limitation of

**Exhibit 4.2**
**Pasco East Details: Curves**



the line as it is to the commercial capacity limitation of the line.

There are five sections of this segment where freight train running time between sidings is 15 minutes or more. The running time through two of these sections may be 20 minutes or more for some trains. The effect of this is that simply meeting two trains can result in a delay of 40 minutes for one of the trains.

If a second train is following closely behind a train that must wait 40 minutes for a meet, the second train will generally have to wait at the previous siding because the length of a siding is usually only sufficient to hold one train. Therefore, the delay to the second train will be almost an hour. A third train in close succession will also be delayed over an hour.

The physical characteristics of the Pasco East main line force the general daily capacity limitation to occur during times of heavy traffic regardless of the ability of the line to handle more traffic during the course of an entire day.

The mixture of traffic on the main line aggravates this condition. Several time-sensitive intermodal trains and two passenger trains cannot sustain the significant delays described. They must be considered first when allocating track to train movements. The otherwise appropriate siding for a meet between two freight trains may not be the appropriate siding for a meet between one of the freight trains and a passenger or intermodal train following the opposing freight train.

## Traffic

The following discussion presents traffic information for the two segments of the Stampede Pass route: the Stampede Pass (Auburn to Pasco) main line and the Pasco East (Pasco to Spokane) main line.

### Auburn to Pasco

The Auburn – Pasco route is used by only a small number of trains. Some of the trains, such as empty grain trains, are not necessarily scheduled to operate normally on this line but are run as needed.

### Pasco to Spokane

The Pasco East main line is the primary BNSF route between western Washington and the eastern United States.[8] There are typically 25 or more trains per day on this line. The traffic on this line includes very time-sensitive intermodal trains, merchandise trains that are time-sensitive to varying degrees, bulk commodity unit trains, and returning empty trains. The southern route of the *Empire Builder* also operates on this line.

Eastbound freight trains tend to leave Pasco at approximately the same time each day. They also tend to operate on a consistent headway[9] of one to two hours. There are generally few eastbound trains between midnight and 9:00 a.m.

Westbound trains tend to be less regular in leaving Spokane. However, a closely-spaced group of three to five westbound trains leaving Spokane is not unusual.

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[8] Except for intermodal traffic originating or terminating in Seattle or Tacoma.

[9] Headway refers to the time interval between two trains traveling along the same route.

Traffic flow is somewhat directional. BNSF's rail yard at Pasco generally processes trains in a single direction, concentrating upon eastbound trains for half a day then westbound trains for the remainder of the day. This results in a visible pattern of westbound trains from late night through mid-morning and eastbound trains from early afternoon to late evening. Portland is roughly five hours west of Pasco. Intermodal trains leaving Portland for the east tend to leave in the late evening, passing Pasco in mid-morning, typically before the trains that have been processed at Pasco begin to leave. Intermodal trains for Portland tend to arrive in early evening and early morning, passing Pasco in late afternoon and late night. Intermodal trains are often moving in the opposite direction of the flow of traffic to and from Pasco. Grain and coal loads and empty trains are operated when they will least interfere with scheduled freight traffic. Overall, traffic may vary from a few trains on the main line to heavy congestion and delay.

**Exhibit 4.3**
**Washington Utilities and Transportation Commission (WUTC) Orders: Auburn to Pasco**

| JURISDICTION | ORDER |
|---|---|
| **Ellensburg** | 50 mph for "streamline and passenger trains" 35 mph for freight trains operating within city limits (September 23, 1952) |
| **Selah** | 40 mph for all trains operating within the corporate limits (January 12, 1973) |
| **Wapato** | 30 mph for all trains operating within corporate limits (July 30, 1952) |
| **Toppenish** | 35 mph for all trains operating within corporate limits (July 30, 1952) |
| **Mabton** | 50 mph for all trains operating within corporate limits (June 25, 1952) |
| **Prosser** | 45 mph for all trains operating within corporate limits as they were located on the date of the order (July 16, 1975) |
| **Kennewick** | 35 mph for all trains within corporate limits (February 6, 1952) |
| **Kennewick** | 40 mph instead of 35 mph only for passenger trains on the Burlington Northern main line track within corporate limits (September 27, 1989) |

## Speeds

The existing speed limit for freight trains is generally 49 mph between Auburn and Pasco except where restricted by curves. The maximum allowable speed for this type of track is 60 mph for freight trains and 80 mph for passenger trains. Since the speed limit is generally above 40 mph, the track must be maintained to federal standards for these speeds.

The Washington Utilities and Transportation Commission (WUTC) has the authority[10] to set speed limits at all grade crossings in unincorporated areas and in all cities (except first-class cities).[11] However, federal regulations[12] preempt the state from setting speed limits except where unique local safety conditions exist. Between Auburn and Pasco, there are several WUTC orders in effect. These orders are presented in **Exhibit 4.3.**

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[10] Per Revised Code of Washington 81.48.030.

[11] A first-class city is a city with a population of 10,000 or more.

[12] Federal regulations provide guidance regarding train speeds at grade crossings. Generally these regulations can be found in the Code of Federal Regulations (CFR): 49 CFR 213 and 49 CFR 236.

Between Pasco and Spokane, two WUTC orders are in effect:

1. The WUTC order limiting train speed through Cheney to 35 mph was abrogated in September 1997. BNSF has not yet changed posted speed limits; and
2. The speed limit through Ritzville is 50 mph for passenger trains and 40 mph for freight trains.

## Signal System

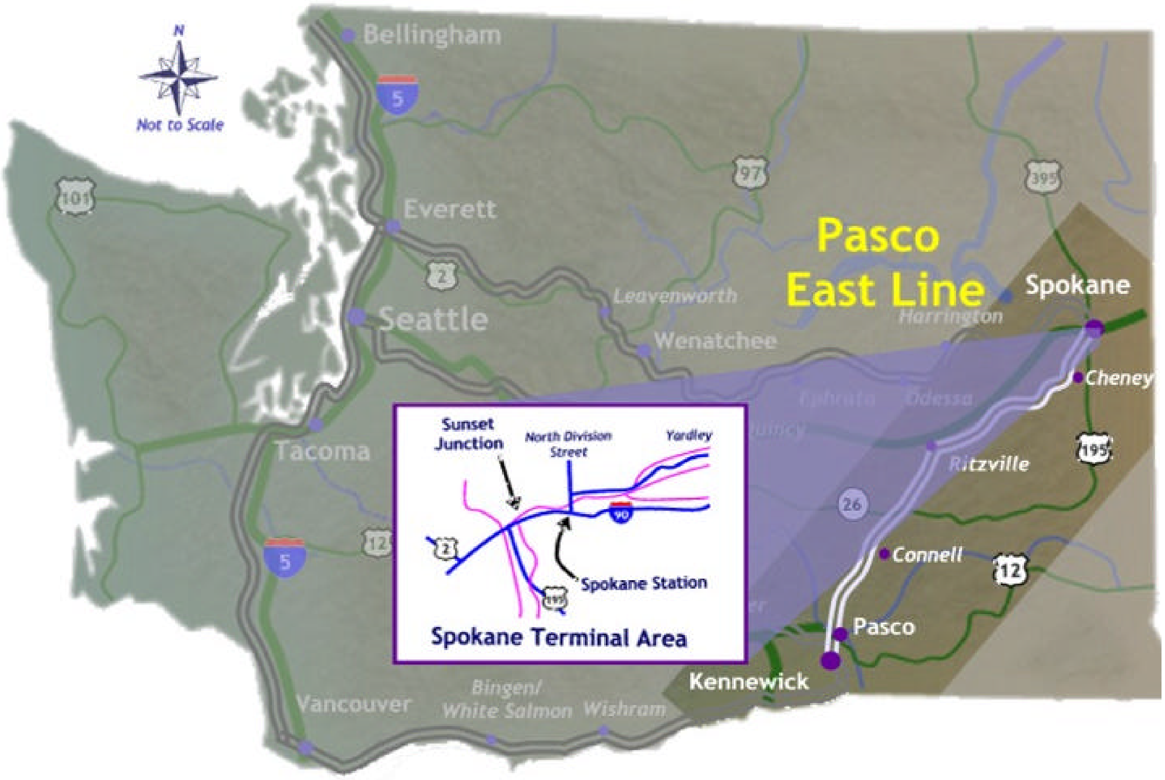
The following discussion presents signal system information for the two segments of the Stampede Pass route: the Stampede Pass (Auburn to Pasco) main line and the Pasco East (Pasco to Spokane) main line.

### Auburn to Pasco

Except for several isolated areas, there is no signal system between Auburn and Pasco. Both the federal track and signal regulations are in effect, so even though track regulations would let trains operate on this type of track at up to 80 mph, the signal regulations limit passenger trains to 59 mph and freight trains to 49 mph.

There are no Automatic Block Signals (ABS) between Auburn and Pasco. Track Warrant Control (TWC) provides rear end protection for trains except between the switches of each siding, where Centralized Traffic Control (CTC) is the traffic control method.

**Exhibit 4.4**
**Sunset Junction to Yardley Yard**



The absence of a block signal system limits the capacity of the line in two ways:

1. Lower speeds reduce capacity; and
2. The inability for a second train to follow closely behind the preceding train further limits capacity.

### Pasco to Spokane

The entire Pasco-Spokane route is equipped with Automatic Block Signals (ABS).

The Spokane terminal area east of Sunset Junction is double track with ABS. A third, unsignaled, track extends from Sunset Junction to Yardley Yard, east of Spokane. The Spokane passenger station tracks connect to this track. **Exhibit 4.4 on the previous page** presents these general locations.

## Traffic Control

The following discussion presents traffic control information for the two segments of the Stampede Pass route: the Stampede Pass (Auburn to Pasco) main line and the Pasco East (Pasco to Spokane) main line.

### Auburn to Pasco

A hybrid traffic control system is used along the main line. The entire line is controlled by Traffic Warrant Control except that Centralized Traffic Control (CTC) is in use between the east and west switch of each siding. In this application, the CTC provides little benefit except to allow the train dispatcher to remotely handle the switch, at each end for the siding or the main track, as required. Without that capability, each train would be required to stop for a significant time to handle the switch then change it back to the normal position after crossing over it.

The rudimentary traffic control system adds to the capacity limitation brought about by the lack of ABS. The required procedures are so time-consuming and so limiting that the main line can be entirely tied up with far fewer trains than can be theoretically accommodated.

### Pasco to Spokane

Traffic control is generally CTC (or a similar electronic system) except for a short segment of Automatic Block Signals/Yard Limit/Occupancy Control System (OSC) in Spokane. Traffic control in the Spokane terminal area is OCS.

## How was the simulation performed?

Simulation is a method of predicting the interaction between trains within a given infrastructure plan. Simulation commonly refers to the use of very sophisticated computer software, which can replicate the minutest elements of operation. For the purpose of an initial feasibility study, such sophistication was not necessary, nor feasible.

The simulation for this report was performed using some basic manual stringline analysis. A stringline analysis is a graphic representation of the movement of trains on a rail line. The stringline consists of an x-y coordinate system, one axis represents time and the other axis represents distance. The movement of trains are described by connecting plotted points of the location at various times.[13]

The stringline analysis for this Stampede Pass feasibility study was designed around three criteria:

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[13] Go to www.wsdot.wa.gov/pubtran to review these stringlines.

### Criterion One: Passenger trains must not interfere with each other.

On a single-track railroad like Stampede Pass, a siding must be available where the opposing passenger trains will meet. If one or both of the trains will be required to reduce speed when meeting, the additional time should be included in the schedule. The amount of time to allow for the meet will depend upon two factors:

1. How long must the first train that arrives wait until the other train arrives? If both trains are scheduled to arrive at the same time, is the siding long enough to allow both trains to continue moving, and if so, can they continue moving at normal speed?[14]
2. What arrangement can be made if one of the trains is not on time, but within a five-minute acceptable tolerance?[15]

### Criterion Two: Freight trains must not interfere with passenger trains.

Passenger trains are typically more time-sensitive than freight trains. The difference between actual running time and scheduled running time is generally much less for passenger trains than for freight trains. In addition, the speed of passenger trains is typically much greater than that of freight trains. These two differences require careful consideration when introducing or adding passenger service.

When two trains meet on a single-track line, there generally will be a delay to one of the two trains. Because passenger trains are more time-sensitive than freight trains, it is necessary to ensure the ability of freight trains to clear the track without stopping the passenger train. Sidings must accommodate the entire length of any freight train operating on the line. There must be a sufficient number of sidings to accommodate all freight trains that will be on the line at the same time as the passenger train. These sidings must be located as close as possible to where the passenger trains will meet or pass the freight train. At a location normally used for two freight trains to meet, two sidings are required to allow both freight trains to clear the passenger train, and then meet each other.[16]

### Criterion Three: Passenger trains must not interfere with freight trains.

This is often not entirely practical or possible; however, the interference must not exceed a level that is acceptable to the railroad. When interference by passenger trains cannot be eliminated, the agency sponsoring the passenger trains and the railroad will negotiate the required infrastructure changes.[17]

Transit time and reliability are just as important to freight service as they are to passenger service. Interference with

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[14] If the speed limit is 79 mph and the center of the siding is located at the point where the two trains would meet if their running times were considered independently, the length of siding required for a no-delay meet would be between two and three miles depending upon the terrain and track geometry at the location and the configuration of the signal system.

[15] If neither train is to be delayed, the siding must be about 16 miles long to accommodate the five-minute variation in time.

[16] On a multiple track railroad, the interference will generally be in the form of passenger trains overtaking freight trains because of the difference in speed between freight and passenger trains.

[17] A level of mitigation that is too aggressive can affect the viability of a passenger service because of high capital cost. A level of mitigation that is not aggressive enough may result in continuing reliability problems and a resistance to additional passenger services. This mitigation would provide the desired result only when traffic conditions are perfect and all trains are precisely on time.

freight service is the greatest concern railroads have about providing passenger service along their lines. The basic principle of preventing freight train interference with passenger trains is simple:

*The requirement is met as long as sufficient places are provided to clear the main track sufficiently ahead of the passenger train*.

But clearing the path for passenger trains can have a negative effect on freight. Where the rail line is not properly configured for the amount and nature of traffic, the delays to freight trains can be substantial.

Depending upon the topography, the signal system, and the speed limit, a freight train must be clear of the main track at least three minutes before a passenger train will pass if the passenger train is to incur no delay. If the freight train is clear of the main track at the last minute and the siding is just long enough to accommodate the freight train, the delay to the freight train will be about two minutes.

Freight trains, for a number of reasons, generally do not follow a schedule as closely as a passenger train. The most carefully scheduled freight trains may have an acceptable deviation of an hour from schedule. Freight trains, unlike passenger trains, also do not perform similarly from day to day. Passenger trains are relatively small and typically made up of similar—if not identical—cars from day to day. Freight trains may vary in size by over five times from one day to the next. Depending upon terrain and other conditions, the variation in time required for a freight train to move from one siding to the next may vary by over five minutes.

The pattern of existing and future freight service must be examined closely to determine exactly what track facilities must be built to accommodate passenger trains. In order to examine this closely, vehicles must be selected and speeds and travel times must be developed.

### What assumptions were made about train equipment?

Based on the three criteria for this simulation model, four assumptions were used in the analysis. These assumptions were:

1. More than one passenger vehicle type would be tested for potential passenger rail service. **Exhibit 4.5 on the following page** presents these vehicle options.
2. The new passenger service could potentially provide express[18] service for Washington State produce. The potential volume of express service alone could be an important economic driver for new passenger service.
3. Freight and passenger speeds would be increased and tested. **Appendix B** provides details of this speed analysis.
4. Service would be designed to require the least amount of new infrastructure.

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[18] Amtrak often provides express service as a means to offset the cost of passenger rail service. Time sensitive shipments (in special high-speed freight cars) are coupled with passenger rail cars. East-west service would provide exceptional opportunities to transport Washington produce to eastern and southeastern consumers. The Washington Fruit Express, a state-sponsored freight program, could benefit from express service on an east-west passenger rail route.

These assumptions were integral parts of the simulation model. Following the simulation, physical and geographic characteristics of the route were reviewed to identify areas where potential infrastructure improvements could be made to support the operational findings of the simulation.

A scenario for daylight passenger rail service along the Stampede Pass route was then developed.

### Exhibit 4.5
### Potential Vehicle Types for Passenger Rail Service in Washington State

| VEHICLE | DESCRIPTION |
|---|---|
| **Talgo Equipment** | This is the equipment currently being used for *Amtrak Cascades* service. Talgo trains are capable of traveling at higher speeds than conventional trains because of their use of passive tilt technology.* Because of this design, sharp curves on the route will not have to be eliminated, thus resulting in fewer costly construction projects. |
| **Conventional Equipment** | Amtrak's conventional car fleet generally includes the Superliner, Horizon and Amfleet cars. Superliner cars are bi-level cars especially suited to use on Amtrak's long distance routes. Amtrak's Horizon and Amfleet cars are similar. They are typically used for short distance trains in the Midwest and eastern parts of the country.<br>Another possibility would be a set of new, modified commuter cars. The Chicago and Northwestern Railway operated a set of upgraded bi-level commuter rail cars as their Peninsula 400 service for many years. The cars had been modified so that their level of comfort and amenities (like food service) equaled or exceeded conventional passengers cars of the time (1960). In today's market where used passenger cars are very scarce and expensive, such a train would give the highest passenger comfort with the least cost while being able to carry express cars. |

**Note: The tilt system has air springs in the main suspension that allows the train to tilt naturally. The train tilts towards the curve while maintaining passenger comfort and safety. The system is considered passive because motors do not operate it; the passive tilt system functions with no energy consumption and requires less maintenance.*

# Chapter Five: Potential Daylight Passenger Rail Service Along Stampede Pass

The railroad characteristics review and simulation analysis that was performed for this study indicates that the introduction of daylight passenger rail service along the Stampede Pass route appears feasible. A scenario for daylight passenger rail service was developed based upon the study team's findings.

This scenario was then used to identify potential infrastructure needs along the route. This process was performed a number of times until the most feasible, least-cost scenario was developed and identified.

## Is daylight passenger service feasible for the Stampede Pass route?

This preliminary analysis indicates that daylight passenger rail service (in each direction) along the Stampede Pass route is feasible.

Based on the simulation model, the findings indicate that daylight passenger service could be provided between Spokane and Seattle. A preliminary, sample schedule[19] for service is presented in **Exhibit 5.1 on the following page.**

Accurate and detailed schedule information cannot be established without detailed ridership information. In addition, station stops need to be determined before accurate schedules can be developed. However, examples of schedules were prepared using different combinations of station stops.[20]

### Where would the train stop?

For the purposes of this preliminary feasibility study, the travel time was calculated with stops in: Spokane, Cheney, Ritzville, Connell, Pasco, Kennewick, Prosser, Toppenish, Yakima, Ellensburg, Cle Elum, and Seattle.

However, it must be noted that these stops were for illustrative purposes only and do not attempt to suggest that a station stop be located in each of these cities. Amtrak utilizes specific criteria to evaluate the location of potential passenger rail stations.

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[19] Actual running time is dependent on the number and duration of station stops. Station stops for a short-distance intrastate service such as that between Seattle and Spokane should average two minutes. If service includes picking up or leaving express cars in Yakima, the stop will be 15 to 30 minutes. These station stop durations are reflected in the example schedules.

[20] The example schedules demonstrate some possible arrangements of Seattle – Pasco – Spokane service. These schedules are intended to demonstrate travel time and do not reflect the final schedules of any service. The examples include different combinations of stops for illustrative purposes only. Actual stops of the service must be determined by the appropriate examination procedure.

## Exhibit 5.1
## Sample Stampede Pass Route Schedule

**TALGO**

Read Down ↓ / Read Up ↑

| Example 3 | Example 2 | Example 1 |  | *Stop* | Example 1 | Example 2 | Example 3 |
|---|---|---|---|---|---|---|---|
| 7:00 AM | 7:00 AM | 7:00 AM | **Spokane** |  | 2:21 PM | 2:27 PM | 2:39 PM |
| 7:21 AM | 7:21 AM |  | **Cheney** | 0:01 |  | 1:56 PM | 2:08 PM |
| 8:03 AM |  |  | **Ritzville** | 0:01 |  |  | 1:26 PM |
| 8:52 AM |  |  | **Connell** | 0:01 |  |  | 12:37 PM |
| 9:35 AM | 9:31 AM | 9:29 AM | **Pasco** | 0:02 | 11:54 AM | 11:58 AM | 12:06 PM |
| 9:45 AM | 9:41 AM |  | **Kennewick** | 0:02 |  | 11:43 AM | 11:51 AM |
| 10:22 AM |  |  | **Prosser** | 0:01 |  |  | 11:13 AM |
| 10:47 AM |  |  | **Toppenish** | 0:01 |  |  | 10:48 AM |
| 11:09 AM | 11:01 AM | 10:55 AM | **Yakima** | 0:03 | 10:29 AM | 10:29 AM | 10:33 AM |
| 11:57 AM | 11:49 AM | 11:43 AM | **Ellensburg** | 0:03 | 9:31 AM | 9:31 AM | 9:35 AM |
| 12:24 PM |  |  | **Cle Elum** | 0:01 |  |  | 9:06 AM |
| 2:39 PM | 2:27 PM | 2:21 PM | **Seattle** |  | 7:00 AM | 7:00 AM | 7:00 AM |

**CONVENTIONAL**
**carrying express**

Read Down ↓ / Read Up ↑

| Example 6 | Example 5 | Example 4 |  | *Stop* | Example 4 | Example 5 | Example 6 |
|---|---|---|---|---|---|---|---|
| 7:00 AM | 7:00 AM | 7:00 AM | **Spokane** |  | 9:26 PM | 9:29 PM | 9:44 PM |
| 7:23 AM | 7:23 AM |  | **Cheney** | 0:01 |  | 8:56 PM | 9:09 PM |
| 8:10 AM |  |  | **Ritzville** | 0:01 |  |  | 8:22 PM |
| 9:07 AM |  |  | **Connell** | 0:01 |  |  | 7:25 PM |
| 9:56 AM | 9:33 AM | 9:29 AM | **Pasco** | 0:02 | 6:37 PM | 6:40 PM | 6:50 PM |
| 10:06 AM | 9:43 AM |  | **Kennewick** | 0:02 |  | 6:25 PM | 6:35 PM |
| 10:48 AM |  |  | **Prosser** | 0:01 |  |  | 5:52 PM |
| 11:14 AM |  |  | **Toppenish** | 0:01 |  |  | 5:26 PM |
| 11:30 AM | 10:55 AM | 10:52 AM | **Yakima** | 0:15 | 5:07 PM | 5:07 PM | 5:09 PM |
| 11:36 AM | 11:16 AM | 11:13 AM |  |  | 4:37 PM | 4:37 PM | 4:39 PM |
| 12:28 PM | 12:08 PM | 12:05 PM | **Ellensburg** | 0:03 | 3:48 PM | 3:48 PM | 3:50 PM |
| 12:54 PM |  |  | **Cle Elum** | 0:01 |  |  | 3:22 PM |
| 3:34 PM | 3:14 PM | 3:11 PM | **Seattle** |  | 1:00 PM | 1:00 PM | 1:00 PM |

### What criteria does Amtrak use to evaluate potential station locations?

In order to make passenger rail competitive with other modes of transportation, travel times need to be competitive. Stopping in every community (whether it has riders or not), greatly increases the travel time of the train. In addition, the cost of the passenger rail service needs to be reasonable (building and maintaining a station could potentially increase the cost of a ticket). It is because of these two factors that a station stop cannot be arbitrarily built just because the train travels through a particular community.

As such, Amtrak developed specific criteria that are applied to each potential station location. **Appendix C** presents these criteria.

### What type of equipment would be used?

There appears to be two possible types of intrastate service between Seattle and Spokane. There may be a significant number of cars of apples and other express shipments to be handled by passenger trains between Yakima and Pasco (or Spokane) for connection with the through train to Chicago. A train handling these express cars would perform much like other conventional passenger trains, although with perhaps fewer passenger-carrying cars than the long-distance trains.

Express cars are limited to the same speeds as conventional passenger trains. They are not allowed to operate at the higher speeds in curves that the second train type (Talgo trainsets) can achieve. Using Talgo train equipment on a train handling express cars would involve the higher cost of a Talgo trainset without the associated running time advantage. A train intended to handle express traffic between Yakima and Pasco would most likely use conventional passenger train cars. The cars would probably be captive[21] to the Seattle – Spokane route.

For a train not handling express traffic, Talgo trains provide a significantly shorter running time. Talgo trains operating between Seattle and Spokane can also be integrated into the *Amtrak Cascades* service equipment rotation. Because of the *Amtrak Cascades* service, the Seattle – Spokane service equipment could be much better utilized.

Talgo equipment presents several advantages[22] over conventional vehicles. However, this type of equipment cannot be used to its capabilities between Yakima and Pasco if cars of express shipments must be handled on the train. In fact, the Federal Railroad Administration (FRA) regulations might prevent mixing the two types of equipment.

### Would new equipment need to be purchased?

Depending upon the schedule and the type of service, new equipment could either be leased or purchased. A detailed operations

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[21] Referring to passenger rail, captive means cars would be used exclusively on the east-west route.

[22] The tilting feature allows for faster speeds on existing curves and also eliminates the need to flatten existing curves along the route. In addition, Talgo equipment accelerates faster than conventional equipment. Also, experience on the north-south corridor—where Talgo equipment is used—indicates that riders are attracted to Talgo's style and comfort.

**Exhibit 5.2**
**Travel Times Between Seattle and Spokane***
**(in hours and minutes)**

| ROUTE | TALGO EQUIPMENT | CONVENTIONAL EQUIPMENT |
|---|---|---|
| **Seattle to Auburn** | 0 hours, 25 minutes | 0 hours, 30 minutes |
| **Auburn to Pasco** | 4 hours, 04 minutes | 4 hours, 26 minutes |
| **Pasco to Spokane** | 2 hours, 16 minutes | 2 hours, 36 minutes |
| **TOTAL TRIP** | **6 hours, 45 minutes** | **7 hours, 32 minutes** |

** This travel time does not include station stops or extra schedule recovery time. For these additions, see Exhibit 5.1.*

plan and analysis could provide an answer to this question.

## How fast would the trains travel?

Travel time[23] is an essential element of determining the feasibility of a proposed service. Travel time is also essential to scheduling service, planning equipment and crews, and determining the infrastructure requirements of a service.

In order to be effective, passenger train travel times must be competitive with those of alternative modes. The travel time is dependent on the speed limits along the main line. Speed limits are dependent on several conditions including the degree of track maintenance, the alignment of the track, and the signal system. The equipment used on the passenger train is as important to travel time as the condition of the track and the signal system.

Because of the extreme amount and degree of curves, very little of the Stampede Pass route is suitable for train speeds in excess of the 79 mph allowed by federal regulation for a conventional signal system. The speed analysis[24] performed for this study also suggests that the introduction of advanced train control systems to allow operation of passenger trains in excess of 90 mph would allow no significant reduction in travel time without some significant changes in alignment to reduce curves.

## How long would the trip take?

As expected—regardless of the scenario—the travel time for Talgo equipment is shorter than the travel time for conventional equipment. **Exhibit 5.2** presents a comparison of travel time between Seattle and Spokane for each potential vehicle type. **Exhibit 5.3**

**Exhibit 5.3**
**Travel Time Difference Between Auburn and Pasco Based on Vehicle Type**

|  | CONVENTIONAL | TALGO | DIFFERENCE (IN MINUTES) |
|---|---|---|---|
| **Existing Conditions** | 5:53 | 5:21 | **32** |
| **Change in Speed Limits** | 4:26 | 4:04 | **22** |

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[23] Also referred to as transit time and running time.

[24] **Appendix B** in the back of this report, provides detailed technical information regarding the speed analysis on this corridor.

presents these comparisons for the line between Auburn and Pasco. Depending on the speed scenario, travel time between Talgo equipment and conventional equipment ranges from approximately 20 to 30 minutes. Proposed speed limit increases can only be made if the additional infrastructure improvements recommended in this report are also implemented.

The Pasco-Spokane travel time does not vary as significantly because of the smaller proportion of slow speed, curved track on this part of the route.

Conventional passenger train travel time between Pasco and Spokane is 2 hours 36 minutes. The travel time for the Talgo train (because of the higher speeds around curves) is 2 hours 16 minutes, 20 minutes faster than the conventional passenger train running time.

### How would express service affect travel time?

As discussed earlier in this report, the use of Talgo trains for express service would not be cost-effective and may be prohibited by FRA regulations. Therefore, conventional equipment would be the most appropriate choice. As presented in the previous section, the use of conventional equipment would add approximately 30 minutes to the estimated travel time between Seattle and Spokane.

## Would additional infrastructure be needed for this new service?

Specific, detailed infrastructure requirements for new passenger train service are dependent upon the exact schedule of the proposed service. If the commercial requirements for the service impose a very limited range of departure times from the initial stations, the infrastructure must be fixed to that schedule regardless of cost. If the commercial requirements allow flexibility, schedules and infrastructure plans may be explored repeatedly until the best combination of infrastructure cost and desirable schedule is reached.[25]

The following provides a preliminary assessment of the potential infrastructure needs for new service along the Stampede Pass route. Infrastructure requirements are discussed in the following order:

1. Tracks (and associated facilities)
2. Signals and Traffic Control
3. Speeds
4. Grade Crossings
5. Stations

Following discussion of infrastructure needs, other findings resulting from this feasibility study are presented.

### Tracks and Associated Facilities: Auburn to Pasco

The feasibility analysis indicated that the new passenger trains would have to meet (and pass each other) somewhere along the route. The much greater volume of freight traffic between Pasco and Spokane increases the possibility that two passenger trains will meet in close proximity to where two freight trains will be overtaken.

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[25] More detailed train movement information is required for developing an infrastructure plan to support additional trains. BNSF provided general information on train movements on the Stampede Pass route. Such information is not sufficient for a definitive infrastructure plan, but for the purposes of this preliminary feasibility study, can provide a foundation for potential infrastructure needs.

Initial review indicates that a siding[26] may be needed between Auburn and Pasco.

Analysis indicates that if minimum travel time is of great importance and the schedule is similar to the example using Talgo trains, this siding may be significantly longer than those typically used for meeting freight trains. It may be constructed and maintained to allow greater speed. In addition, it may be in the form of two main tracks of sufficient length to accommodate the five minute schedule tolerance of the passenger trains; or be in the form of three moderate-length sidings, one each at the scheduled meeting point and five minutes from the scheduled meeting point in either direction.

Commercial sensitivity to travel times between Seattle and Pasco will determine which of these two arrangements is appropriate. However, it is estimated that regardless of the track arrangement, a total of approximately 16 miles of new trackage would be needed for the Talgo service example.

If the schedule of the new service is similar to the example of conventional equipment and express service, the siding requirement may be significantly less because the loss of running time while meeting would not be as important. In this case, the siding requirement could be only six miles of new track in two sidings of about three miles each.

### Where should this new trackage be constructed?

The choice of location for construction of trackage for meeting passenger trains should be carefully integrated with service and schedule planning. This is to ensure that the required facilities are correctly located and that more than one passenger train meeting point is constructed only if necessary. Infrastructure planning must be carefully integrated with service planning. Initial review indicates that this new trackage should be located somewhere between Pasco and Yakima, if the schedule example using Talgo trains is to be used. If conventional equipment is used on an express-friendly schedule, the new trackage needs to be on the west side of Stampede Pass.

In addition to this siding, ridership and station planning will dictate when trains must operate, which in turn, may dictate the location and nature of additional infrastructure requirements.

### Tracks and Associated Facilities: Pasco to Spokane

It appears possible that a single pair of daylight Seattle – Spokane trains may be possible without significant capital improvements between Pasco and Spokane. The daylight trains may leave Spokane and Pasco respectively before the beginning of the day’s significant traffic flow. If that is the case, then interaction with other traffic may be generally limited to opposing trains and the existing track arrangement may prove acceptable. This can be determined only upon very close examination of a substantial amount of actual train movement information from Burlington Northern and Santa Fe Railway Company (BNSF).

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[26] Depending upon the time-sensitivity of the passenger trains, the track arrangement required for meeting opposing trains may be somewhat specialized.

### Signals and Traffic Control: Auburn to Pasco

It is possible to operate passenger trains between Auburn and Pasco using the current signal and traffic control arrangement; however, it is not practical. The lack of block signals and the rudimentary traffic control system are significant problems.

### Signals and Traffic Control: Pasco to Spokane

Traffic control between Pasco and Spokane has Centralized Traffic Control (CTC) and does not need to be improved.

## Why isn't the current signal system sufficient between Auburn and Pasco?

The lack of block signals limits train speed to 59 mph. A block signal system would allow speeds up to 79 mph. This speed difference alone could reduce travel time by 34 minutes.

The lack of block signals also limits capacity. Twenty years ago when there were two or more people on the caboose of a freight train, the duty of one of the crewmembers on the caboose was to protect the rear of the train against collision. Freight trains no longer have a crewmember on the rear of the train and no longer have a place for such a crewmember to ride. All trains not in Automated Block Signal (ABS) territory must now have an absolute block behind them. This method is not practical when handling a passenger train with only the engineer in the locomotive cab. The locomotive engineer is not permitted to receive mandatory directives[27] while at the controls of a moving locomotive. A second person would be required to receive and relinquish authority as the train was moving in order to reduce the capacity limitation to the extent possible.[28]

The rudimentary control system, based on written instructions issued to trains by radio, also limits capacity.[29]

## Why isn't the current traffic control system sufficient between Auburn and Pasco?

The current traffic control system includes what are known as "islands of CTC." This situation performs only one of the necessary traffic control functions. The dispatcher handles the switches at the ends of the sidings electronically. Without these power switches, trains would need to stop at the switch to a siding, throw the switch, and pull into the siding. Because there is no employee on the rear of a freight train, the switch would be left aligned for the siding and the train approaching on the main track would need to stop and handle the switch for the main track. The train in the siding would need to align the switch from the siding to the main track. Again, with no crewmember on the rear of the train, the switch would be left for the next train to stop and restore it to the main track route. These delays limit capacity and lengthen travel time

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[27] Instructions relating to the movement and safety of a train.

[28] The second person in the cab for this purpose increases the operating cost of the train.

[29] Each train must possess absolute authority for a section of the line. A train moving from A to B that is to meet a train moving from B to A has only authority to move from A to the meeting point. The other train has only authority to move from B to the meeting point. When the trains have arrived at the meeting point, each must relinquish its authority and receive new movement authority from the dispatcher. This process may take several, perhaps 10 or more, minutes.

beyond the delays already caused by the absence of a signal system and by the written order traffic control system.

### What signal and traffic control improvements are recommended between Auburn and Pasco?

For the reasons just discussed, the operation of passenger trains should not be considered without Centralized Traffic Control for the entire distance between Auburn and Pasco.

#### Speeds

Freight and passenger rail speeds along the Stampede Pass main line must be increased in order to accommodate new passenger rail service. An in-depth analysis is presented in **Appendix B**.

#### Grade Crossings

With the potential for higher speeds, safety along the Stampede Pass route will be an important issue.

Grade crossings are designated places where cars, trucks, bicyclists, and pedestrians cross the railroad tracks. At grade-separated crossings, the roadway goes over the railroad tracks or the tracks go over the roadway. The majority of the crossings along the corridor are at-grade.

Depending upon the speed of the train and the amount of vehicular traffic that crosses the tracks, federal guidelines recommend certain types of warnings at the crossings.

### What are the types of grade crossing warning signs?

Upgrading crossings can help improve safety and increase train speeds. Warning devices are designed on a site-specific basis, taking into account rail traffic, vehicular traffic, and accident history.

Warning devices can range from simple markings on the roadway alerting drivers and pedestrians of railroad tracks, to complete grade separation. Grade-separated crossings are expensive and often not warranted for low volume or low speed intersections. All at-grade crossings have some form of warning, from signs to active warning devices that include flashing lights and gates. Active warning is used at virtually all at-grade crossings in urban areas. **Exhibit 5.4 on the following page** illustrates the types of grade crossing warning signs.

### What is recommended for the grade crossings along the route?

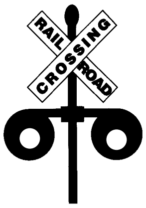
There are 85 grade crossings between Auburn and Pasco. Forty-nine of the at-grade crossings along the route are equipped with automatic crossing signals. These signals must have the activation time adjusted for the proposed higher train speeds. Given the preliminary assessment for this study, it was not determined which of these signals had newer equipment. The task of adjusting the signal on newer equipment is fairly simple. However, it is assumed that a number of the older signal equipment (or at least the control equipment) may require complete replacement.

**Exhibit 5.4**
**Types of Railroad Grade Crossing Warning Signs**

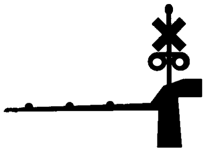
**Advance Warning Signs:** Means a roadway-rail grade crossing is ahead.

**Pavement Markings:** Painted on the pavement in front of a crossing.

**Railroad Crossbuck Signs:** Found at all public crossings. Should be treated as yield signs.



**Flashing Light Signals:** Used with crossbuck signs and roadway-railroad crossings. You must always stop when the lights are flashing.



**Gates:** Used with flashing signals at certain crossings to indicate that a train is coming.

Eight of the crossings with automatic signals have only flashing lights and do not have gates. These crossings should be investigated for the need for gates with the introduction of higher rail traffic speed and traffic density. In addition, the 36 public crossings that do not have automatic crossing signals should be examined for the need for these devices, given the potential higher speeds and increased traffic along the route.

### Passenger Rail Stations

A number of cities along the proposed Stampede Pass route already have passenger rail service. As such, facilities are sufficient to meet the needs of an additional train. These cities are: Seattle, Auburn (this station currently provides service for Sounder commuter rail service), Pasco, and Spokane.

For the remaining cities along the route, an in-depth evaluation will be required. In some cases, existing rail depots could potentially be converted to passenger rail stations. The minimum facilities needed are: station platform, sufficient lighting, and appropriate parking.

**Appendix D** provides an overview of the potential station locations along the route.

## Did this feasibility study identify other possibilities along the Stampede Pass route?

After the initial service plan for daylight passenger rail service along the Stampede Pass route was developed, other possibilities for rail service became evident. With the implementation of the recommended infrastructure for the proposed service (as well as some additional infrastructure in certain cases), other passenger rail service along the route appeared to be feasible.

### What other service appears feasible?

If a detailed ridership and economic study in the years ahead indicates a sufficient market for other service, the following possibilities seem feasible:

1. Identified improvements will allow for not only one additional passenger train, but for added capacity throughout the route.  It is anticipated that implementation of the suggested improvements could result in the capacity to add more passenger and freight service along the Stampede Pass route.
2. Daylight service between the Tri-Cities area and Spokane may be possible with minimal, if any, infrastructure construction. Simulations indicated that service could leave Pasco in the early morning, and leave Spokane in the late afternoon.  With the completion of a second main track between Pasco and Spokane, as well as some sidings and/or third main track, additional trains could be added to this service.
3. An additional train service between Seattle and Yakima (or Pasco), operating at times that the Seattle – Spokane trains do not provide service locally, may be possible. To accommodate such a train, significant infrastructure construction beyond that recommended in this preliminary analysis would not be required.
4. It may be necessary for the service described above to originate/terminate at Kennewick instead of Pasco.  This would avoid significant construction in Pasco yet accommodate the additional traffic.
5. The Yakima Valley produce express market requires some careful consideration.  This preliminary analysis indicates express service may be possible with minimal infrastructure improvements beyond those identified in this preliminary analysis.  The type of passenger rail vehicle, as well as the passenger service schedule, will dictate the feasibility of express service.

# Chapter Six: Operating and Capital Costs

Existing intercity passenger rail service in the state of Washington utilizes rail infrastructure owned by the Burlington Northern and Santa Fe Railway Company (BNSF). The potential service along the Stampede Pass route would also run along tracks owned by BNSF. Preliminary analysis reveals potential infrastructure improvements will be needed to implement daily, daylight east-west passenger rail service while maintaining freight capacity needs. To meet service and capacity demands, the Washington State Department of Transportation will need to work with its partners to identify projects, their costs, and financing.

## What types of costs will be required to implement passenger rail service on Stampede Pass?

The implementation of passenger rail service will require different types of investments. These investments are categorized as operational costs and capital costs.

### What are operating costs?

Operational costs are a direct function of operating the train service every year. Costs include fuel, labor, maintenance of trains and facilities, insurance, marketing and sales, and general administrative costs.

A passenger rail system not only incurs operating costs but also collects revenue from tickets purchased by passengers. Therefore, some costs are offset by revenue.

### What are capital costs?

Capital costs generally represent investment for improvements to railroad infrastructure and facilities. They normally result from a long-range plan that identifies the need for certain expenditures in certain years. Track and signal improvements along the route are considered capital costs. Station improvements and land acquisition, along with the purchase of new trainsets, are also a capital cost.

## What would the operating costs be for new passenger rail service over the Stampede Pass route?

Using existing operational costs from the *Amtrak Cascades* service (1999 and 2000), it is estimated that the total cost of operating two Talgo trains per day between Spokane and Seattle would be approximately $14 million annually. This number is based on a general cost-per-mile for *Amtrak Cascades* service, and includes all costs associated with operating the service, including fuel, on-board and station staffing, regular maintenance and repair, insurance, cleaning, a national reservation system, and a number of other associated costs. However, it must be emphasized that this $14 million estimate does not include passenger revenue and potential express service revenue. Income from both of these sources would offset the expense of passenger service operations.

## What capital costs would be required to implement passenger rail service over the Stampede Pass route?

The minimum capital costs to implement daylight passenger rail service (in both directions) over the Stampede Pass route would include:

- Six or 16-miles of new track (second main track or sidings) between Auburn and Pasco;[30]
- Centralized Traffic Control between Auburn and Pasco;
- Station improvements;
- Grade crossing improvements; and
- Purchase or leasing of equipment.

**Exhibit 6.1** presents general approximations of these potential capital costs.

**Exhibit 6.1**
**Conceptual Estimate of Capital Costs for Implementation of Passenger Rail Service on the Stampede Pass Route (in 2001 Dollars)**

| IMPROVEMENT | ESTIMATED COST |
|---|---|
| Six or 16-miles of New Double Track | $30 M** |
| CTC – Auburn to Pasco | $180 M |
| Station Improvements | $10 M |
| Grade Crossing Signals | $25 M |
| Train Equipment Purchase/Lease* | $30 M |
| Replace Jointed Rail with Continuously-Welded Rail | $75 M |
| Total Estimated Capital Cost | $350 M |

**Assumes two Talgo trainsets, including locomotives*

***Depending upon the type of service and equipment, either six or 16-miles of new track would be needed. For the purpose of this cost estimate, the cost of the 16-mile improvement was calculated.*

## Who would pay for this new passenger rail service?

If new passenger rail service were to be implemented over the Stampede Pass route, WSDOT would work with their partners to identify areas for cost sharing and negotiations. Partners would likely include BNSF, Amtrak, Sound Transit, and local partnerships.[31]

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[30] Depending upon the types of service and equipment, either six or 16-miles of new track would be needed.

[31] Sound Transit could be a potential partner for providing service connections along the north-south corridor.

# Chapter Seven: Conclusions and Next Steps

The overall goals of this preliminary feasibility study were to answer the following questions:

- Is the introduction of daylight, passenger rail service feasible over the Stampede Pass route?
- Would additional infrastructure be needed?
- How much would it cost?
- What would be the next steps?

This chapter concludes with recommendations to meet these goals.

## What are the conclusions of this preliminary feasibility study?

Based on this preliminary feasibility study, as well the team's general knowledge of the east-west rail corridors, a number of conclusions were developed:

- Daylight passenger rail service is physically and operationally feasible along the Stampede Pass route.
- Implementation of service would require, at a minimum, significant infrastructure improvements to the current traffic control system and grade crossings. In addition, six or16-miles of new trackage between Pasco and Auburn would be needed—depending upon the type of service (Talgo or express service). Increased speeds along the entire route—for both passenger and freight—would also be required.
- A detailed analysis of the Stampede Pass route should be performed in the years ahead to obtain accurate ridership, scheduling, and cost information.
- Express service along the route could offset costs of additional passenger rail service, but would result in longer travel times for these trains.
- Initial analysis indicates that the identified infrastructure improvements would allow additional expansion beyond the one daily (each direction) daylight train.
- It is possible that if infrastructure improvements are made to the Stampede Pass route (as suggested), more freight could then be potentially diverted from the other east-west routes, thus affecting their ability to operate more passenger trains. This concept could be investigated by a detailed study.
- Accurate and detailed schedule information cannot be established without detailed ridership information. In addition, station stops need to be determined before accurate schedules can be developed.
- Funding decisions for future east-west passenger rail studies and service will be made by the Washington State Legislature and the Washington Transportation Commission. These decisions will be based on a number of factors, including the state's current transportation funding mechanisms and the backlog of transportation projects in the pipeline at that time.

## What next steps are recommended over the next several years?

In light of the findings of this preliminary assessment, the study team recommends that Washington State undertake a detailed study of the feasibility of east-west passenger rail service on all three east-west rail corridors.  This detailed study should include:

- Refined capital and operation cost estimates;
- Origin and destination analysis and ridership projections; and
- A thorough assessment of east-west freight rail traffic data and growth projections.

This information, when considered in its entirety, will be the foundation upon which full analysis of the costs and benefits of such a service can be based.

# Glossary

**112-Pound** Rail is generally described by the weight per yard. 112 lb. Rail is very light for main tracks. 132 lb. Rail is used for typical heavy tonnage, relatively high-speed main tracks.

**Centralized Traffic Control** Electronic means of controlling rail traffic through the use of controlled signals and switches.

**Consist** The cars ("Train Consist" or "Consist") or the locomotives ("Engine Consist") of a train.

**Cross-Level** Determination of level when checked across the rails, perpendicular to the track.

**Distributed Power** Additional locomotives located at some point in the train or behind the train, controlled remotely by the engineer in the lead locomotive.

**Double Track** Two main tracks, each generally assigned to opposite directions of travel similarly to a 2-lane roadway. Tracks may be used in the direction opposite to the assigned direction of travel under specifically controlled conditions and usually at reduced speed.

**Grade** Technically, the compacted and graded earthwork upon which track is constructed. However, in typical usage, the word usually means the tilt or steepness of the track up or down hills and mountains, as in "a two percent grade" (see definition of Percent).

**Helper** Extra locomotives added only for the portion of a trip that has very steep grades.

**Intermodal** When describing freight service, generally the transportation of containers or highway trailers on a train. Also applies to the transportation of automobiles and small trucks in specially designed rail cars.

**Jointed Rail** 39-foot or 72-foot lengths of rail joined by bolts and steel bars to form continuous rails.

**Main Track** Track used by trains for travel between stations. Other tracks may extend between stations but are not normally used for through travel.

**Meet** A train encountering a train moving in the opposite direction.

**Multiple Track** Two or more main tracks usually arranged to allow movement in either direction with equal facility, like the reversible lanes of a highway.

**Occupancy Control System** A traffic control system using a combination of Yard Limit operation and verbal instructions from the train dispatcher. OCS is generally limited to terminal areas where trains move at low to moderate speeds.

**Pass** A train overtaking a slower train.

**Percent** The unit of measurement for the tilt of railroad grades. One percent is a rise of one foot over a length of 100 feet (1:100).

**Recovery Time** Time added to a schedule, above the required travel time, to mitigate the effects of unpredictable events occurring during the course of a trip.

**Restricted Limits** A traffic control system generally allowing trains to use the main track and move as the way is seen to be clear. Similar, except in some details, to yard limit operation.

**Ruling Grade** The grade that determines the limitation of the pulling ability of locomotives on a route. The ruling grade is generally the steepest grade on the route, however there may be very short stretches of steeper grade that do not limit the performance of locomotives.

**Siding** A secondary track, usually adjacent to a main track, that allows a train to clear the main track to meet an opposing train or to be passed by a following train.

**Signal** An arrangement of lights, similar to a highway traffic signal, used to convey information to the locomotive engineer of a train.

**Single Track** A single main track used for the movement of trains in both directions.

**Stringline** A graphic representation of the movement of trains on a rail line. The stringline consists of an x-y coordinate system, one axis time and the other distance, with the movement of trains described by connecting plotted points of the location at various times.

**Superelevation** "Banking" of curves

**Switch** A special track arrangement that allows a train to remain upon the same route or change route.

**Track Geometry** The curve, grade, and cross-level condition of the track.

**Track Warrant Control** A traffic control system allowing trains and maintenance work to occupy main tracks only on written authority from the train dispatcher. A very strict set of procedures is applied to train crews or maintenance workers obtaining the authority verbally from the dispatcher, writing on the prescribed form only as each word is spoken, and repeating the entire content to the dispatcher before it can be acted upon. Track Warrant Control imposes no speed limit of its own on train movement. The procedure required for the transmission of authority by radio or telephone is time-consuming.

**Train Dispatcher** The traffic controller for a railroad, sometimes also known as Rail Traffic Controller.

**Yard Limit Operation** A traffic control system generally allowing trains to use the main track and move as the way is seen to be clear. Trains must generally be prepared to stop within half the range of vision. Because of the great stopping distance of trains, yard limit operation generally requires movement at 20 mph or less.

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# Appendices

- **Appendix A:** Preliminary Assessment of the East-West Routes
- **Appendix B:** Speed Analysis
- **Appendix C:** Amtrak Station Criteria
- **Appendix D:** Potential Station Locations

# Appendix A: Preliminary Assessment of the East-West Routes

The purpose of this preliminary assessment is to provide a foundation and baseline for an in-depth review of east-west rail corridors in Washington State. This baseline is designed to be the first step in a much larger study of passenger rail service. It is anticipated that once legislative funding for a larger study is available, this preliminary assessment will help guide development for the in-depth east-west corridor review.

This preliminary assessment presents a brief discussion of railroad characteristics and operations as well as the current conditions on the three existing Burlington Northern and Santa Fe Railway Company's (BNSF) main lines. This appendix also provides a general assessment of each route's ability to handle additional passenger rail service.

The review and assessment of a rail corridor requires an understanding of the current physical and operational characteristics of the existing rail line. It can then be determined if the rail line can physically handle additional trains at the desired times.

## What are the three east-west main line routes?

The two active[A.1] east-west rail lines that currently provide passenger rail service are the Stevens Pass route and the Columbia River Gorge route. Both east-west routes travel westerly from Spokane, across the Cascade Mountains, and eventually connect with the BNSF north-south main line in western Washington. This north-south main line carries the current *Amtrak Cascades* passenger rail service, and serves passengers between Eugene, Oregon and Vancouver, British Columbia via Portland and Seattle. Amtrak's *Coast Starlight* also travels along this north-south main line. It is a long-distance train traveling between Los Angeles, California and Seattle, Washington.

In addition to these two routes, BNSF also has an east-west main line over Stampede Pass. **Exhibit A.1 on the following page** provides a general vicinity map of each of the routes.

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[A.1] Two abandoned east-west rail corridors also exist, but are not included as part of this preliminary feasibility study. One rail line is located between Pasco and Spokane, and was formerly owned and operated by Burlington Northern Railroad. This route is the old SP&S route that travels via East Pasco, Kahlotus, Washtucna, Hooper, Lamont, and South Cheney.

An additional abandoned rail corridor, also known as the John Wayne Trail, (formerly owned and operated by the Chicago Milwaukee St. Paul and Pacific Railroad), extends between the Seattle area and the Idaho border near Tekoa, in Whitman County. A significant common feature of the two abandoned lines is that they generally extend through sparsely populated areas, and therefore are not conducive to passenger train service. However, further study may show significant usefulness of the Ellensburg – Lind portion of the Chicago, Milwaukee, St. Paul and Pacific Railroad right-of-way for direct passenger train service between Seattle and Spokane.

**Exhibit A.1**
**East-West Rail Corridors**

## Where is the Stevens Pass route located?

The Stevens Pass main line leaves Spokane and travels west, across the Columbia River into Wenatchee. From this point, the rail line extends over the Cascade Range via the historic 8-mile long Cascade Tunnel. The line continues west into Everett where it joins the BNSF north-south main line.

**Exhibit A.2 on the following page** provides a general vicinity map of the Stevens Pass route.

## Where is the Columbia River Gorge route located?

The Columbia River Gorge route has two segments: from Spokane to Pasco[A.2] and from Pasco to Vancouver, Washington (Columbia River Gorge main line). To reach the Columbia River Gorge main line from Spokane, the route follows the former Northern Pacific (NP) main line out of Spokane through Cheney, Ritzville, and Connell to Pasco. The old NP main line then connects with the Columbia River Gorge main line in Pasco, following

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[A.2] Throughout this report, this line segment is also referred to as the Pasco East main line or route.

**Exhibit A.2**
**Stevens Pass Route**

the north bank of the Columbia River from Pasco into Vancouver, Washington.
At Vancouver, this route also connects with the BNSF north-south main line, where it extends north towards Seattle and south into Portland, Oregon. **Exhibit A.3** on the following page provides a general vicinity map of the Columbia River Gorge route.

## Where is the Stampede Pass route located?

To reach the Stampede Pass line from Spokane, it is necessary to follow the Pasco East main line to Pasco (this is the same line used to access the Columbia River Gorge main line from Spokane).

The Pasco East main line connects with the Stampede Pass main line in Pasco, continuing northwestward up the Yakima Valley (**see Exhibit A.4**). A number of communities are located along this route, including Kennewick, Prosser, Toppenish**,** Yakima, Ellensburg, and Cle Elum.

From Ellensburg the line continues towards the Cascade Mountains where it rises to 2,840 feet and crosses the mountains at Stampede Pass via the 1.8-mile long Stampede Tunnel. The rail line continues west into Auburn where it joins the BNSF north-south main line. From here the main line continues north towards Seattle and south towards Tacoma (and Portland, Oregon). The Stampede Pass main line is currently used by BNSF freight trains.

## Exhibit A.3

## Exhibit A.4
## Stampede Pass Route

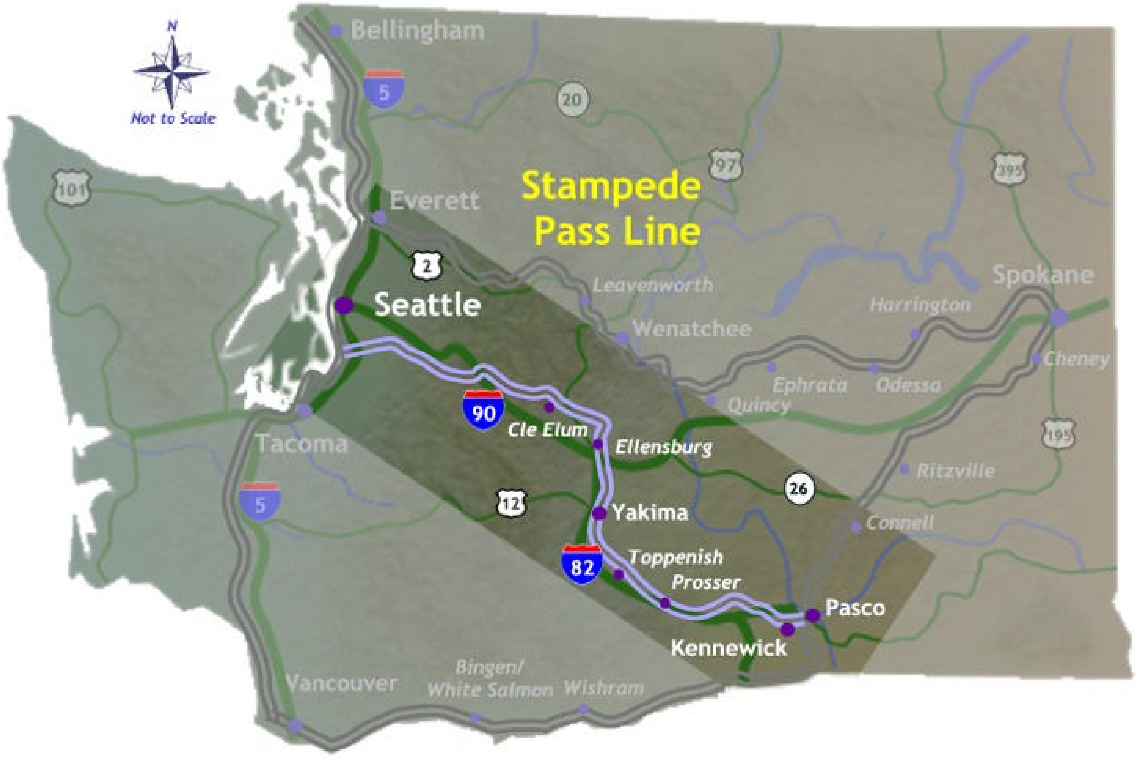

**Exhibit A.5**
**Types of Railroad Capacity**

| | |
|---|---|
| **THEORETICAL CAPACITY** | The number of trains per day that could run over a route in a strictly perfect, mathematically generated environment. This number is useful because it is relatively easy to generate. For example, if the longest running time between two sidings is one hour, that implies that it would take at least two hours between trains to travel in each direction. This would imply a capacity of 12 trains traveling east and 12 trains traveling west, each day (or 24 trains per day). |
| **PRACTICAL CAPACITY** | It's not possible to actually run the number of trains you work out mathematically. Things will happen—one train doesn't have enough locomotive power, the rail is slippery, there is wind or fog, or the engineer is a little slow on his train handling. A reasonable and regularly used figure for what the real world might produce is 75 percent of the theoretical capacity. Using this relationship for practical capacity makes it possible to produce a reasonable estimate fairly easily. |
| **COMMERCIAL CAPACITY** | Commercial capacity is simply the practical capacity available during the times when business needs would actually want shipments to move. Practical capacity is the number of trains you could reasonably expect to run in a day, but using all of it would require you to run trains when you don't need them. Suppose that the Seattle area could practically accept one train an hour and send out one train per hour. However, shippers want to receive their shipments before 6 a.m. so they can be ready for the day's business, and they want to send shipments after a day of loading cars (say, after 6 p.m.).<br>In effect, the commercial capacity in this very simple example is six trains per day outbound from 6 p.m. to midnight and six trains per day inbound from midnight to 6 a.m. Shippers might want to increase their rail business to a level that would need ten trains, but since their businesses only accept or send out shipments at certain times, the commercial capacity is much less than the practical capacity. |

## How were these routes compared?

A review of general railroad characteristics along each of these routes compared current operations and physical conditions.

## What are general railroad characteristics?

While there are fundamental distinctions between the operations of a railroad and a highway network, some of the basic characteristics are similar. Certain design standards (that dictate physical characteristics) are applied to rail construction, just as there are standards applied to highway construction. In both cases, the design standards are derived directly from the characteristics of the vehicles and the intended operation of the facility.

## How do these characteristics affect the ability to add more trains?

In order to add more trains to a rail line, the tracks need to have the necessary capacity to handle the additional traffic. Capacity is simply the number of trains per day that a given rail line can safely move while meeting a particular schedule.[A.3]

The rail characteristics presented in **Exhibit A.6 on the following pages** explain how each element contributes to the operation of the rail line, thus contributing to its capacity. Therefore, a review of current conditions along each route will provide enough information for a general feasibility assessment for new passenger service.

## How was data collected for this preliminary assessment?

In order to carry out this preliminary assessment, the study team performed the following steps:

- Reviewed existing reports and documents pertaining to freight and passenger rail in Washington State;
- Reviewed maps and rail plans, including highway maps, railroad track charts, and topographic maps;
- Collected train information (average number of trains per day on the three routes) from BNSF; and
- Performed a general analysis of rail characteristics of the three routes for capacity.

Specifically, the study team evaluated each route based on:

1. Current rail traffic;
2. Capacity based on existing infrastructure; and
3. Need for new infrastructure.

## What assumptions were made as part of this review?

This review of current rail characteristics along the three east-west routes is based on four critical assumptions. These assumptions are:

1. Freight rail traffic will continue to increase in future years on each of the east-west routes;
2. The proposed daylight service will provide one train—during daylight hours—each day, in each direction;
3. The endpoints for the proposed passenger rail service will be Seattle and Spokane; and Vancouver, WA and Spokane; and
4. The proposed new east-west service schedule would be adjusted to integrate with the *Amtrak Cascades* service schedule that runs along the north-south BNSF route.[A.4]

These assumptions were the foundation for comparison of current rail characteristics along the three east-west routes.

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[A.3] There are different types of capacity. Three types of capacity referred to in this study are presented in **Exhibit A.5 on the previous page.**

[A.4] This assumption is based on projections of hourly *Amtrak Cascades* service by the year 2018 (between Seattle and Portland). A detailed analysis will be required to review the potential to integrate east-west service into the *Amtrak Cascades* plan. This separate analysis will require detailed ridership studies, cost comparisons, and required infrastructure along the north-south main line.

## Exhibit A.6
## Railroad Characteristics and Their Relevance

| CHARACTERISTIC | WHY IS IT IMPORTANT? |
|---|---|
| **Track Structure** | Track structure has three elements: rails, ties, and ballast. **Rails** are made of steel. Even though the steel is very hard, the rail wears out, just as highway pavement wears out. The **ties**, typically made of wood or concrete, support the rails. **Ballast** is crushed rock used to support the ties and keep the track in correct alignment while draining off precipitation. The condition of each of these elements dictates the weight and type of equipment that can be used on the line, as well as the speeds allowed on the line. |
| **Number of Tracks** | The number of tracks affects the capacity of the line. Two tracks (also called **double track**) have more capacity (the number of trains that can move through the area) than one track (**single track**).<br>**Sidings** also increase the capacity of a single track. A single track line has auxiliary tracks known as sidings. Sidings located along the line allow trains moving in opposite directions to pass each other and allow faster trains to overtake slower trains. The capacity of the rail line and the reliability of operation are affected by the time required to move between sidings. |
| **Grade (the steepness of the tracks at various locations)** | The steepness of the track dictates the types of trains that can use the rail line. Typical grades for freight trains do not exceed 2 percent, while grades for passenger trains can be as high as 4 percent. **Ruling grade** is the predominant slope along the rail line. The ruling grade determines how many cars a locomotive can pull over that route. |
| **Curves (often presented in degrees of curvature)** | The tightness of the **curve** dictates the speed that a train can travel through it. The higher the degree, the tighter the curve, the slower the speed. Amtrak *Cascades* trains that are used on the north-south main line in western Washington can travel faster through tight curves than standard trains because they use tilt technology. |
| **Speed Limits** | Train **speed limits** are derived by considering physics, safety, and regulations. They are generally regulated by the Federal Railroad Administration (FRA). The Code of Federal Regulations (49 CFR 213, Track Safety Standards) establishes classes of track with associated speed limits and detailed physical requirements for tracks in a given class. Speeds may also be restricted by the Washington Utilities and Transportation Commission (WUTC). |
| **Traffic (Number and type of Trains)** | The **number and type of trains** that can operate on a rail line relate directly to capacity. The more trains that are put on a track, the more the need for additional track, signals, and improved traffic control. |

## Exhibit A.6—Continued
## Railroad Characteristics and Their Relevance

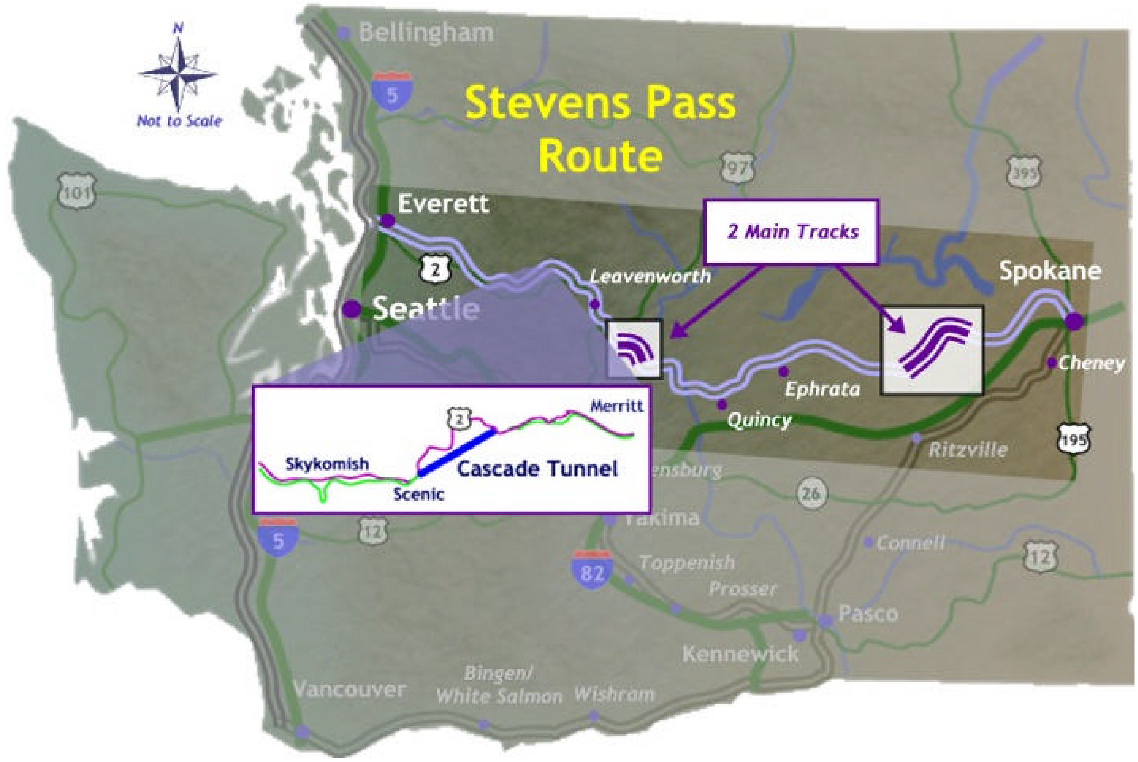
| CHARACTERISTIC | WHY IS IT IMPORTANT? |
|---|---|
| **Signals and Traffic Control: Definition** | **Signals** help extend the engineer's sight distance and therefore allow greater speeds. **Traffic control** determines which train can use which tracks to improve safety and ease of movement of trains. |

### Types of Signals and Traffic Control

| TYPE | DEFINITION AND USE |
|---|---|
| **Centralized Traffic Control (CTC)** | Traffic control generally consists of an electronic system, usually associated with Automated Block Signals (ABS), or a manual block type system such the Track Warrant Control (TWC) system.<br>Under CTC, the signal system lets a dispatcher at a central location see the location of all trains on a diagram of the tracks. The dispatcher can remotely arrange for one train to safely pass another. The logic built into the CTC system ensures that local wayside signals and track switches are properly set so that locomotive engineers know what the dispatcher intends for them to do in a safe manner. |

| CHARACTERISTIC | WHY IS IT IMPORTANT? |
|---|---|
| **Yard Limit Operation (Yard Limit)** | Yard limit operation is a mostly manual traffic control system used in yards and terminals. Trains must generally be prepared to stop within half the range of vision. Because of the great stopping distance of trains, yard limit operation generally requires movement at 20 mph or less. |
| **Occupancy Control System (OCS)** | A traffic control system using a combination of Yard Limit operation and verbal instructions from the train dispatcher. OCS is generally limited to terminal areas where trains move at low to moderate speeds. |
| **Restricted Limits** | A traffic control system generally allowing trains to use the main track and move as the way is seen to be clear. Similar, except in some details, to yard limit operation. |

**Exhibit A.7**
**Stevens Pass Route: Detail Map**



## What are the current rail characteristics along the Stevens Pass Route?

BNSF northern east-west main line is the former Great Northern route over Stevens Pass. A predominant amount of intermodal[A.6] traffic to and from the Ports of Seattle and Tacoma is handled over the Stevens Pass route. The Stevens Pass main line extends from Everett to Spokane via Wenatchee. The distance between Seattle and Spokane via the Stevens Pass route is approximately 330 miles.

The main line is single track for most of the distance and is known for the 7.79-mile Cascade Tunnel that passes below the summit of the Cascades between Scenic and Berne. There is a short stretch of second main track in Wenatchee. About 22 miles of second main track is also located between Lamona and Bluestem in Lincoln County. Centralized Traffic Control is used for almost the entire length of the line. **Exhibit A.7** identifies these locations.

East of Wenatchee, the maximum allowed speed is 79 mph for passenger trains and 60 mph for freight trains. West of Wenatchee, the maximum allowed speed is 79 mph for passenger trains and 50 mph for freight trains. The speed of passenger and freight trains is restricted by curves at numerous locations along the entire route. The average number of trains along this route is 18 trains per day. The highest

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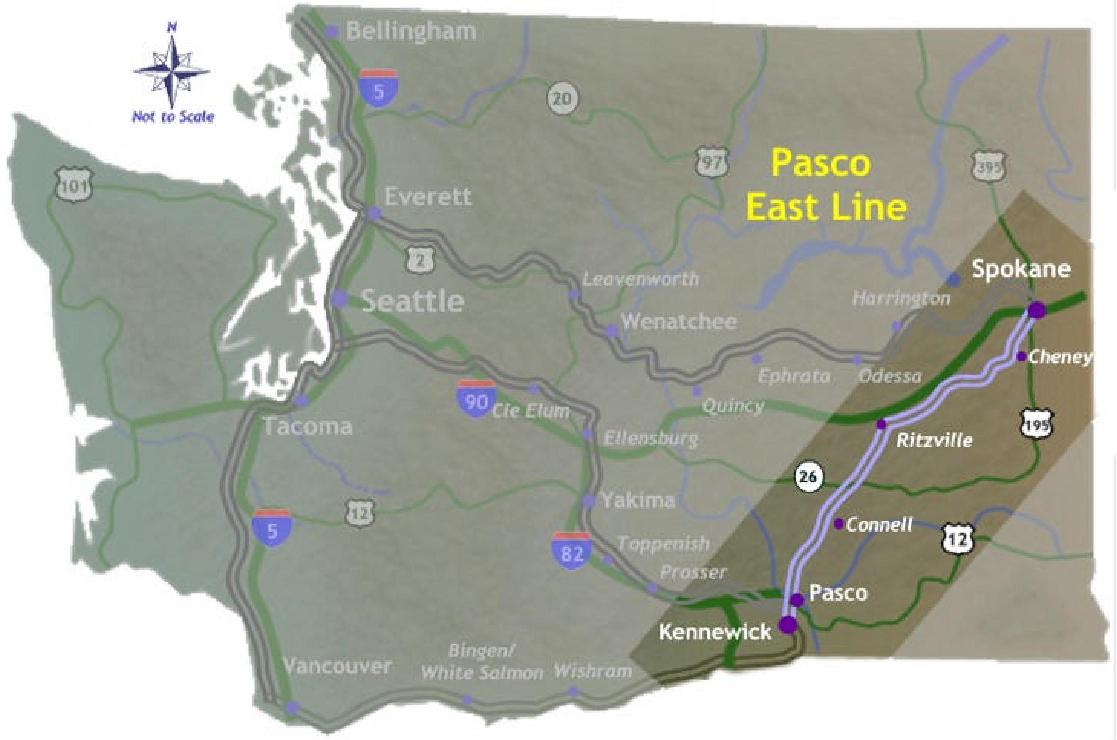
[A.6] Freight delivered via truck or ship, and then moved to another destination via rail, is considered intermodal traffic.

**Exhibit A.8**
**Pasco East Route**



daily train count is 23. Amtrak's daily *Empire Builder* operates on this route, traveling from Spokane to Seattle. Because of the clearance of the Cascade Tunnel, the Stevens Pass main line provides a cross-state passage for all types of trains.

The ruling grade on this route is 2.2 percent. Significant portions of this main line have a grade of 1.6 percent. There are also long segments of track with grades that range from 0.8 percent to 1.0 percent.

## What are the characteristics of the Columbia River Gorge Route?

The southern route extends through the scenic Columbia River Gorge on the former Spokane, Portland & Seattle (SP&S) main line. The Columbia River Gorge main line travels from Vancouver, Washington to Pasco. From Pasco, the route travels north to Spokane along the Pasco East main line. The Columbia River Gorge route is the only water level crossing of the Cascade Range. Much of the grain and other transcontinental traffic to and from the Portland/Vancouver area is transported over this line because of the amount of locomotive energy that would be needed to travel over the Cascade Mountains. The distance between Seattle and Spokane via the Columbia River Gorge route is approximately 530 miles.

The daily average number of trains is 30; the highest daily train count is 37. The Amtrak *Empire Builder* operates on this route daily between Spokane and Portland, Oregon. The remaining traffic is BNSF freight trains.

### What are the characteristics of the Columbia River Gorge Main Line?

The entire main line is single track except for a short section east of Vancouver and a short section west of Wishram. Centralized Traffic Control is used for the entire route.

East of Wishram, in Klickitat County, the maximum passenger train speed is 79 mph. West of Wishram the maximum passenger train speed is 70 mph. The maximum freight train speed for the entire route is 60 mph. There are numerous curves along the entire route that restrict passenger train speed and numerous curves west of Wishram that restrict freight train speed.

### What are the characteristics of the Pasco East Main Line?

The Pasco East main line (between Pasco and Spokane) passes through Connell in Franklin County, Ritzville in Adams County, and Sprague in Lincoln County. For the most part, the line runs parallel to US 395 and Interstate 90 (see **Exhibit A.8 on the previous page**). There is a short section of double track near Spokane and another between Cunningham and Sand. Centralized Traffic Control is used on the entire line. The maximum speed for passenger trains is 79 mph. The maximum speed for freight trains is 60 mph. Curves restrict passenger and freight train speed at numerous locations.

Moderate grades in two areas affect the capacity of the line. **Exhibits A.9 and A.10 on the following page** show the general locations of this main line's characteristics.

## What are the characteristics of the Stampede Pass Route?

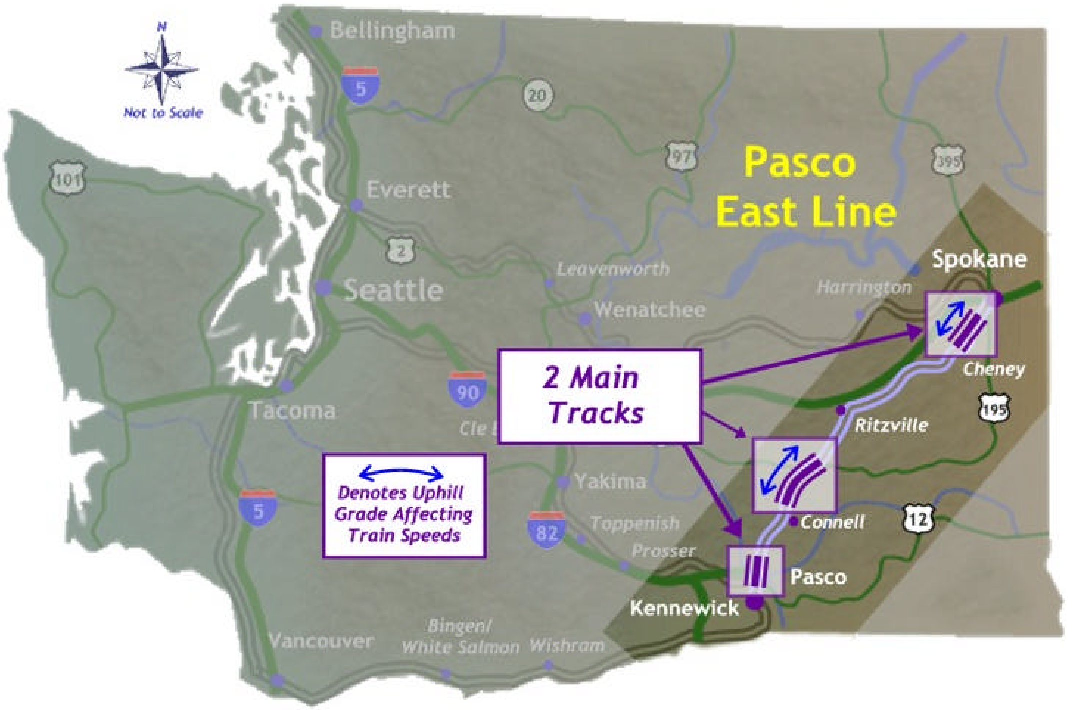
The former Northern Pacific main line through Stampede Pass is BNSF's central main line route. **Exhibit A.11 on Page A-13** presents the location of this route. The Stampede Pass route extends between Auburn and Pasco via Stampede Pass. From Pasco, the route travels north to Spokane via the Pasco East main line. The distance between Seattle and Spokane via this route is approximately 400 miles.

This line laid dormant for 14 years, but was rebuilt and reopened in December 1996. General freight traffic is transported over this route; however, the Stampede Tunnel does not currently have sufficient clearance to accommodate double-stack containers, tri-level auto cars, and certain trailer-on-flatcar loads.

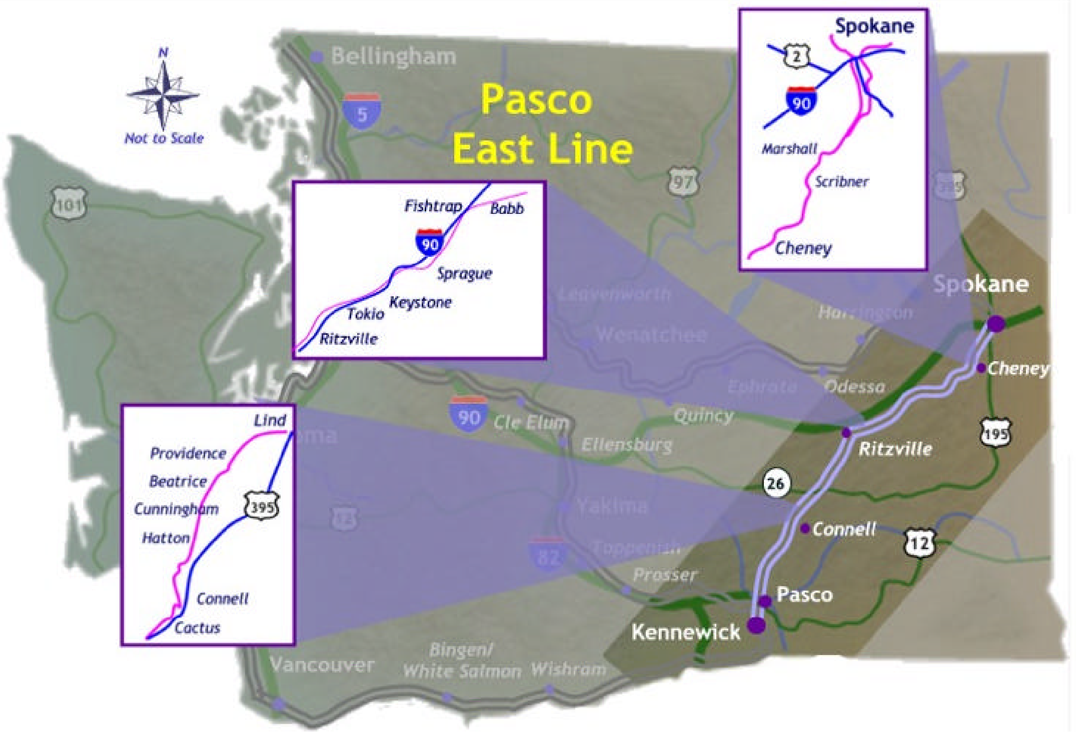
### Stampede Pass Main Line

The Stampede Pass main line is all single track between Auburn and Pasco. There is a very short section of second main track at Easton, in Kittitas County. The entire line is controlled by Track Warrant Control (TWC), with short sections of Centralized Traffic Control (CTC) and Restricted Limits. The sections of CTC are only located between the switches of sidings. The single tracks between these sidings operate by Track Warrant Control (TWC). There are no Automatic Block Signals (ABS) on this route. The Stampede Pass route is used only by BNSF freight trains.

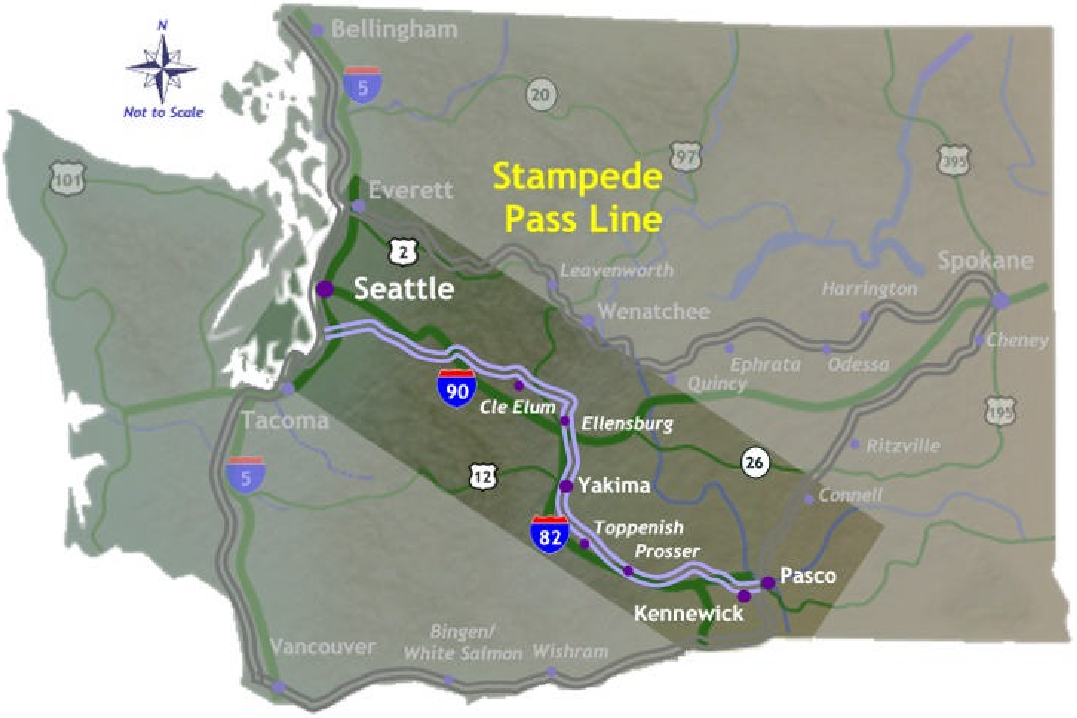
## Exhibit A.9
## Pasco East Route: Grades



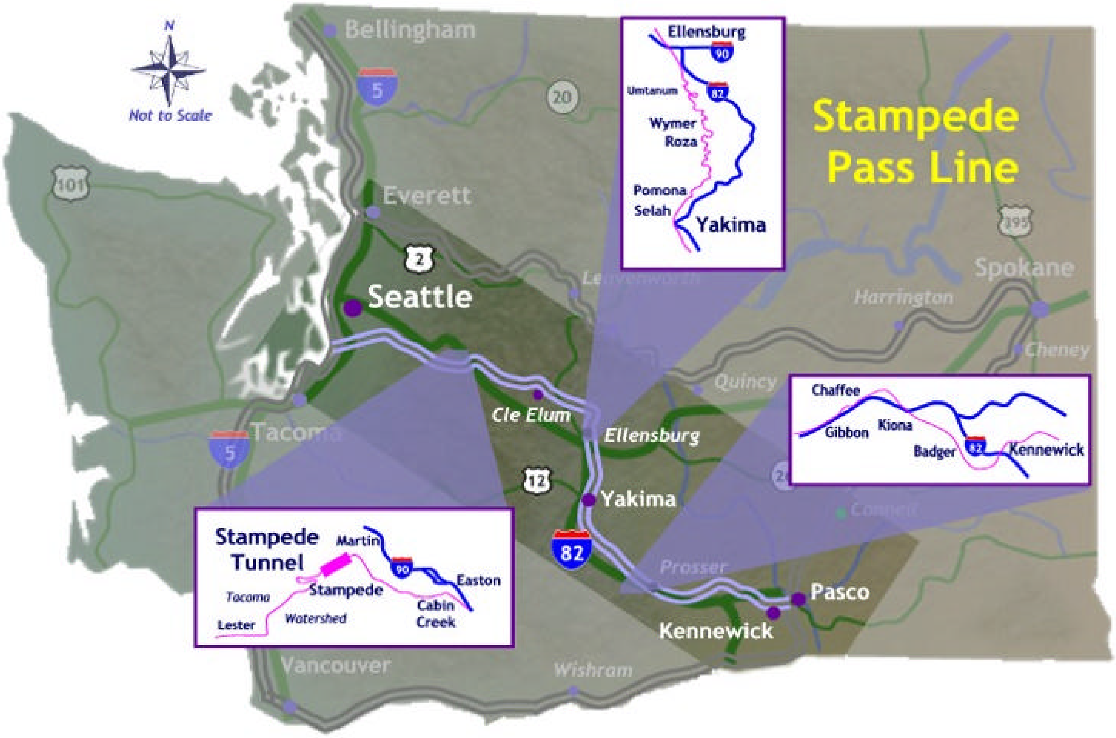
## Exhibit A.10
## Pasco East Route: Curves



### Exhibit A.11
### Stampede Pass Route



### Exhibit A.12
### Stampede Pass Route: Detail Map



There are several short segments of 0.8 to 1.1 percent grade. The ruling grade on this route is 2.2 percent, near the upper limit for typical main line freight operations nationally. The absence of a signal system limits freight trains to 49 mph and passenger trains to 59 mph. There are numerous curves on this line that also restrict the speed of trains. **Exhibit A.12 on the previous page** shows details of this route.

The Auburn – Pasco route is used by only a small number of trains. Some of the trains, such as empty grain trains, are not necessarily scheduled to operate normally on this line but are run on an as-needed basis.

### Pasco East Main Line

The Pasco East main line is the same line used by freight and passenger trains traveling from the Columbia River Gorge line en route to Spokane.

## Which of these routes can accommodate new passenger trains?

For the purposes of this preliminary analysis, a rough approximation of the capacity of the lines, their ability to operate additional trains, and their ability to operate reliably, was made. The following discusses the major constraints of each of the routes.

### Stevens Pass Route

This preliminary review indicates that the Stevens Pass route has capacity constraints that are not easily solved. The Cascade Tunnel is popularly known as a major capacity constraint because of the need to ventilate the tunnel between trains. Heat and locomotive exhaust gas accumulates in the tunnel. This is not a significant problem in most railroad tunnels. The movement of the train pulls the exhaust gas while also drawing fresh air into the tunnel. The great length of the Cascade Tunnel makes ventilation with high horsepower fans necessary because the normal movement of air is insufficient to clear the exhaust gas from the tunnel. **Exhibit A.13 at the end of this section** provides an explanation about tunnel ventilation and its relationship to the sidings along the route.

However, the limiting capacity constraint actually is the running time between sidings. Because sidings are often used by slower trains to get out of the way of faster trains, the distance between sidings on this line contributes to the speed and time of day that a passenger train can travel along the route. The limitation imposed by the running time between sidings at Skykomish and Scenic and between Scenic and Berne is approximately 75 minutes in each direction.

Preliminary calculations indicate that running time between sidings is 75 minutes. Allowing six hours per day for track maintenance,[A.7] the capacity of the line is about 28 trains per day. Theoretically, the main line could then support an average count of 22 trains per day. However, these calculations also assume that traffic is evenly distributed throughout the day, which, as stated earlier, would be unusual for a typical rail line and is probably not the case. Because

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[A.7] Track maintenance crew shifts are eight hours per day. It is assumed that approximately six of these hours are productive, working hours for the crew.

of that, some periods of congestion and delays can be expected.

Reducing the running time between Skykomish, Scenic, and Berne is actually more important than reducing the ventilation time in the Cascade Tunnel. This is not a simple undertaking. Running time reduction may be accomplished by raising train speed or reducing the distance between sidings. The former is not practical because of sharp curves and steep grades. The latter may be practical between Skykomish and Scenic but is not practical to an effective degree between Scenic and Berne through the tunnel.

### Columbia River Gorge Route

The capacity limitation on the Columbia River Gorge route is imposed by siding-to-siding running time of 20 minutes in at least two places west of Wishram. East of Wishram, the sidings are about ten minutes apart, but five of the sidings (located between two longer sidings), are much shorter than most sidings along the line. These short sidings either limit train length (thus, limiting capacity), or double the running time between sidings that can be used (also limiting capacity).

Preliminary calculations indicate that running time between sidings is 20 minutes. Allowing six hours per day for track maintenance, the capacity of the line is about 40 trains per day. Theoretically, the main line could then support an average count of 30 trains per day. However, these calculations also assume that traffic is evenly distributed throughout the day, which, as stated earlier, would be unusual for a typical rail line and is probably not the case. Because of that, some periods of congestion and delays can be expected.

### Stampede Pass Route

Preliminary review of the Stampede Pass route indicates that the current traffic on the route is extremely light. In addition, this preliminary review indicates that there are no major physical constraints that would limit expansion of the existing infrastructure.

Based on the physical and operational conditions of the Stampede Pass route, it was concluded that a preliminary assessment of this route could result in significant and meaningful findings.

### Which route shows the most promise for potential passenger rail service?

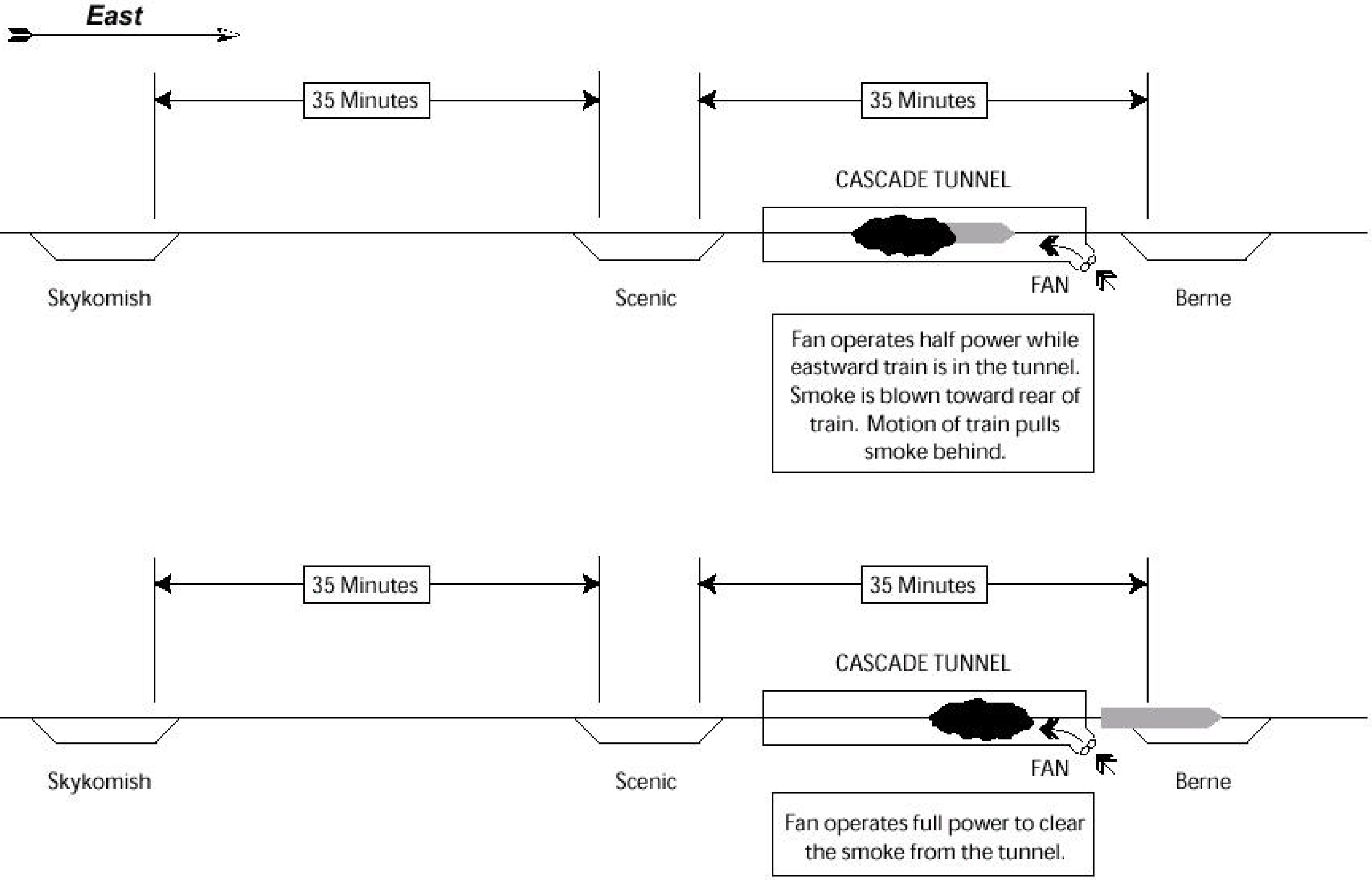
A comparison of the three east-west routes indicates that the Stampede Pass route may have the capability of handling additional traffic.

However, an in-depth study of the other two routes in the years ahead may indicate that additional daylight passenger service is feasible.

**Exhibit A.13**

# THE CASCADE TUNNEL AND CAPACITY LIMITATION - 1

## TUNNEL VENTILATION



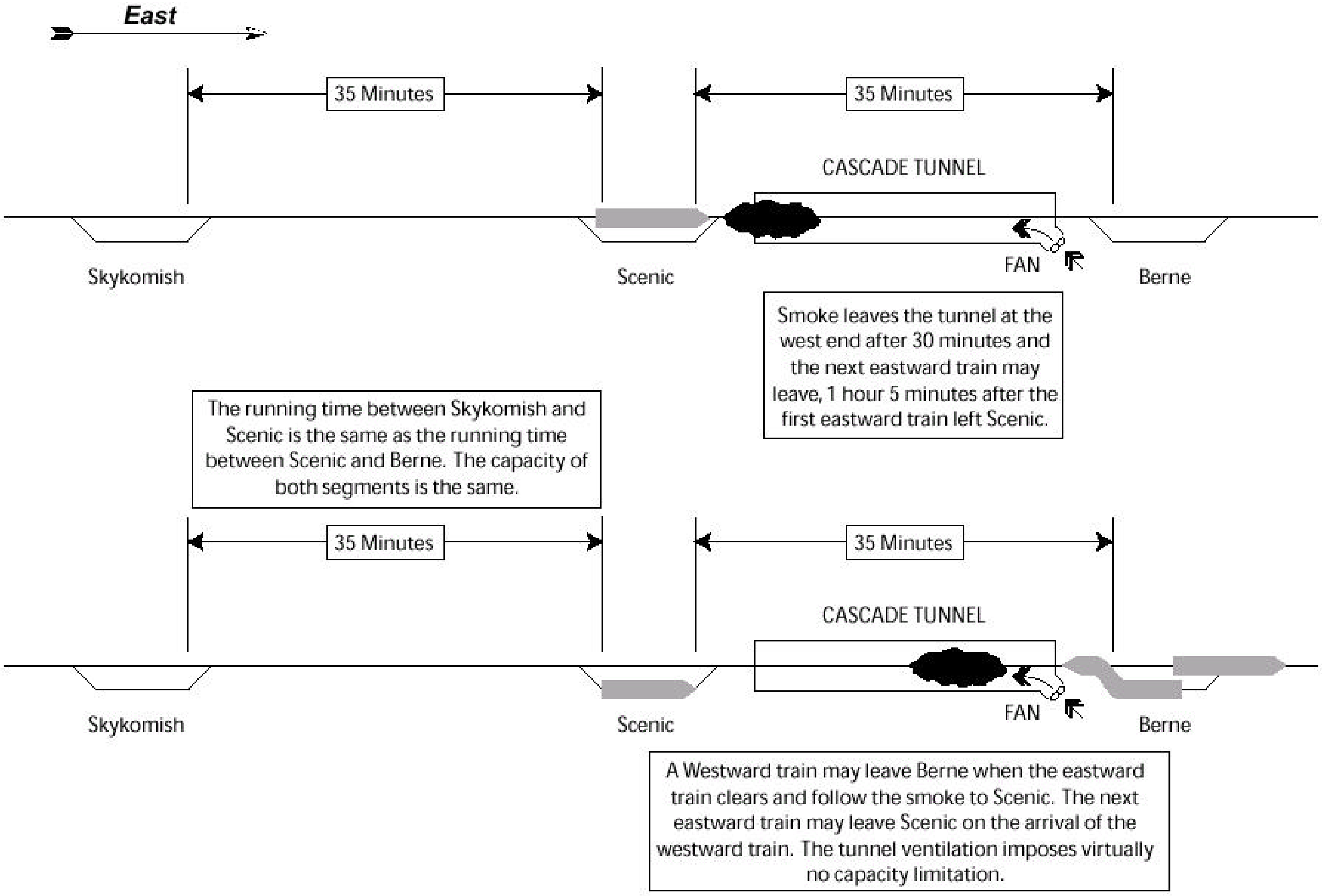
Fan operates half power while eastward train is in the tunnel. Smoke is blown toward rear of train. Motion of train pulls smoke behind.

Fan operates full power to clear the smoke from the tunnel.

**Exhibit A.13—Continued**

# THE CASCADE TUNNEL AND CAPACITY LIMITATION - 2

## *HOW TUNNEL VENTILATION AFFECTS CAPACITY*



Smoke leaves the tunnel at the west end after 30 minutes and the next eastward train may leave, 1 hour 5 minutes after the first eastward train left Scenic.

The running time between Skykomish and Scenic is the same as the running time between Scenic and Berne. The capacity of both segments is the same.

A Westward train may leave Berne when the eastward train clears and follow the smoke to Scenic. The next eastward train may leave Scenic on the arrival of the westward train. The tunnel ventilation imposes virtually no capacity limitation.

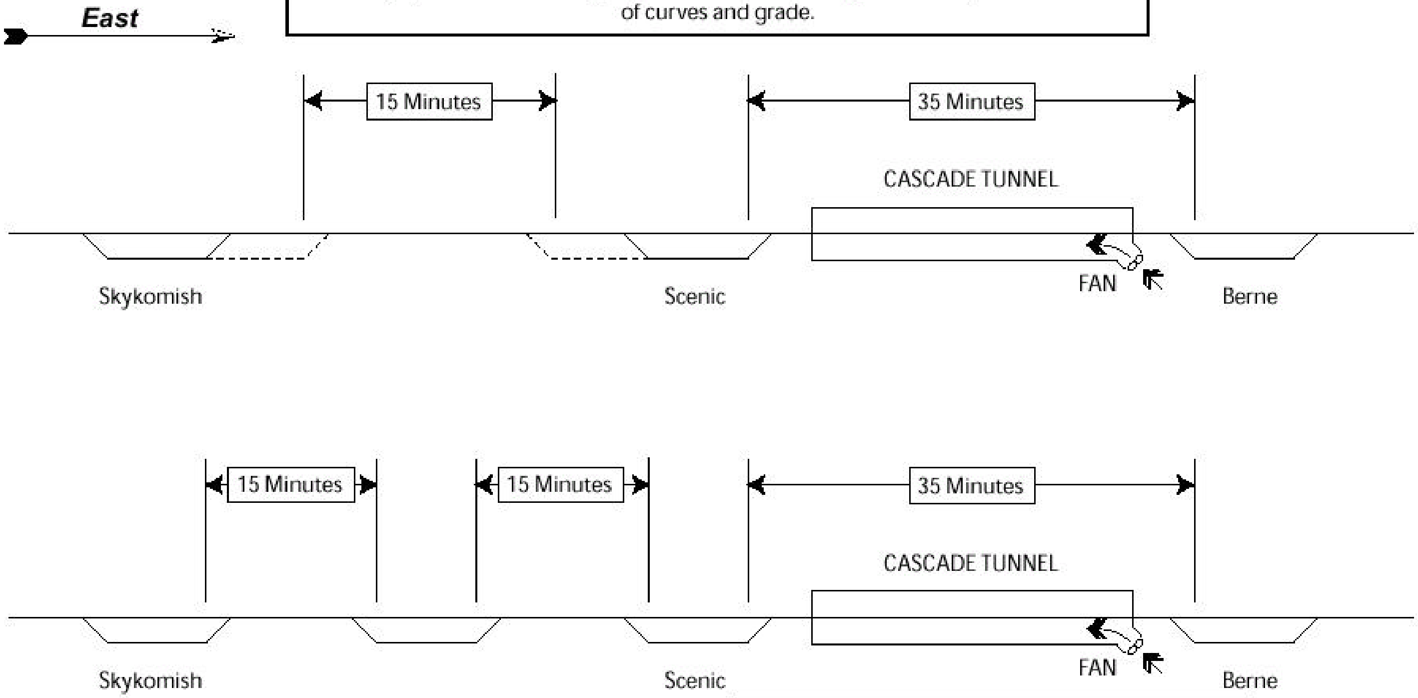
**Exhibit A.13—Continued**

# THE CASCADE TUNNEL AND CAPACITY LIMITATION - 3

## *INCREASING CAPACITY*

### RUNNING TIME BETWEEN SIDINGS MUST BE REDUCED TO INCREASE CAPACITY

Increasing speed to reduce a significant amount of running time is not practical because of curves and grade.



Running time between Skykomish and Scenic could be reduced by extending the Skykomish and Scenic sidings or by constructing a new siding between Skykomish and Scenic.

Running time between Scenic and Berne cannot be reduced by extending the Scenic and Berne sidings or by constructing a new siding between Scenic and Berne without a significant amount of tunneling

# Appendix B: Speed Analysis

After review and analysis of existing and future operational conditions on the Stampede Pass Route, the goal of establishing travel times and speed was identified. This was the first step in the process of developing a passenger rail operations plan.

## How were travel time and speed scenarios developed for the Stampede Pass Route?

Travel time (running time, transit time) is an essential element of determining the feasibility of a proposed service. Running time is also essential to scheduling service, planning equipment and crews, and determining the infrastructure requirements of a service. In order to calculate travel time between cities, speed limit zones must first be established. The first step in this analysis was to develop assumptions and develop a methodology for speeds.

## What were the assumptions for speed limit zones?

In order to be effective, passenger train travel times must be competitive with those of alternative modes. The travel time is dependent on the speed limits along the line. Speed limits are dependent on several conditions including the degree of track maintenance, the alignment of the track, and the signal system.

Three basic sets of assumptions were made for comparison of the Auburn – Pasco line:

- Track and signal conditions remain as they are;
- Track and signal improvements are made to return the line to approximate its 1979 state. The last passenger service operated over the line between Auburn and Pasco in the early 1980s. In order to provide an idea of the level of utility that existed at that time, the speed limits that existed in 1979 were used as a second base case. These speed limits actually demonstrate the former utility of the line that existed before the Automatic Block Signal system was removed; and
- Track and signal improvements are made within the existing track geometry to provide the best possible transit time for passenger trains.

The example speed limits for passenger train operation and the associated running times assume that all of the Washington Utilities and Transportation Commission (WUTC) speed restriction orders are no longer in effect. No assumption is made about any unique local hazards that come under the authority of the WUTC nor of what is required to mitigate or eliminate those hazards.

Two basic sets of assumptions were made for comparison of the Pasco – Spokane line:

- Track and signal conditions remain as they are except the WUTC order speed limit for Ritzville and the speed limit for the former WUTC order for Cheney are removed; and

- In each case (except for the current speed limits), passenger train speed limits were calculated to the nearest one (1) mph.[B.1]

For the examination of speed limit zones, the term “passenger trains” refers to the separate speed limits for conventional passenger trains and Talgo trains. Tests for running time include the following conditions:

- The current freight train speed limits and the passenger train speed limits that result from the track geometry that establishes the freight train speed limits.
- The freight and passenger train speed limits that were in effect in 1979 between Pasco and Auburn. This test is necessary on this line because the condition and capacity deteriorated significantly. The line was not restored to the condition and capacity existing when passenger trains were last operated.
- The freight and passenger train speed limits resulting from establishing speed limit zones suitable for passenger trains. The passenger trains are assumed to be the relatively short conventional passenger trains or Talgo trains that can be expected on the route.

## What speed limit scenarios were developed?

There are numerous factors involved in establishing train schedules. Speed limits are only one of them. **Exhibit B.1** shows the speed limit zone effects on running times for various trains. In each running time example, the described train is generally operated nonstop from one end of the route to the other. However, some of these trains would include a change in train and/or engine consist en route. For these trains, only the time that the train is moving is counted. No time is included for the change in trains and/or engine consist.

### Running Times: Passenger

The Auburn – Pasco running time for a conventional passenger train under the existing conditions is 5 hours 53 minutes. The passive tilt technology of Talgo trains, allows them to operate at a higher cant deficiency than conventional passenger trains. (Higher cant deficiency means they have the ability to negotiate sharper curves at higher speeds.) The Auburn – Pasco running time for a Talgo train operating at high cant deficiency speeds under the

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[B.1] Railroad speed limits, like highway speed limits, are generally specified in 5 mph increments. There is no regulation or other requirement that speed limits be in this format.

The nearest-one mph speed limits can allow a significant running time reduction where there are numerous curves that restrict train speed. The example speed limit zones for passenger and Talgo trains contain speeds rounded to the nearest 1 mph from the calculation rather than the nearest 5 mph. The example speed limit zones generate a trip time between Auburn and Pasco that is 9 minutes less than the same speed limits in 5 mph increments.

# Exhibit B.1
# Running Time Comparisons

| | | Auburn to Pasco | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Current Conditions | | | 1979 Conditions | | | Example Conditions | | |
| | Train Consist | Talgo | Conv. Passenger | Freight | Talgo | Conv. Passenger | Freight | Talgo | Conv. Passenger | Freight |
| Passenger | Talgo F59 Cab F40 | 5:21 | 5:54 | | 4:47 | 5:15 | | 4:04 | 4:24 | |
| | Talgo 2 F59 | 5:18 | 5:51 | | 4:40 | 5:09 | | 4:01 | 4:22 | |
| | Local Passenger | | 5:53 | | | 5:15 | | | 4:26 | |
| | Through Passenger | | 5:53 | | | 5:14 | | | 4:24 | |
| Freight | Grain Load 108 cars 12-3000 HP locomotives | | | 7:05 | | | 6:56 | | | 6:13 |
| | Grain Load 108 cars 6-3000 HP locomotives Pasco to Ellensburg<br>54 cars 6-3000 HP locomotives Ellensburg to Auburn | | | 7:08 | | | 6:58 | | | 6:21 |
| | Grain Empty 108 cars 3-3000 HP locomotives | | | 7:04 | | | 6:43 | | | 5:48 |
| | Grain Empty 108 cars 3-3000 HP locomotives Auburn - Ellensburg and 2-3000 HP locomotives Ellensburg to Pasco | | | 7:07 | | | 6:55 | | | 5:52 |
| | Regular Commercial Freight 60 cars 4800 tons 4-3000 HP locomotives Auburn-Pasco | | | 6:48 | | | 6:35 | | | 5:45 |
| | Regular Commercial Freight 87 cars 7000 tons 6-3000 HP locomotives Auburn-Pasco | | | 7:08 | | | 6:41 | | | 5:47 |
| | Regular Commercial Freight 87 cars 7000 tons 6-3000 HP locomotives Auburn-Ellensburg and 3-3000 HP locomotives Ellensburg - Pasco | | | 7:10 | | | 6:48 | | | 5:53 |
| | Intermodal 64 cars 4800 tons 4-3000 HP locomotives | | | 7:02 | | | 6:40 | | | 5:45 |
| | Intermodal 93 cars 7000 tons 6-3000 HP locomotives | | | 7:11 | | | 6:54 | | | 5:45 |
| | Intermodal 93 cars 7000 tons 6-3000 HP locomotives Auburn - Ellensburg 3-3000 HP locomotives Ellensburg - Pasco | | | 7:22 | | | 7:01 | | | 5:54 |

| | | Pasco to Spokane | | | | | |
|---|---|---|---|---|---|---|---|
| | | Current Conditions | | | Example Conditions | | |
| | Train Consist | Talgo | Conv. Passenger | Freight | Talgo | Conv. Passenger | Freight |
| Passenger | Talgo F59 Cab F40 | 2:20 | 2:34 | | 2:16 | 2:27 | |
| | Talgo 2 F59 | 2:17 | 2:32 | | 2:13 | 2:25 | |
| | Local Passenger | | 2:44 | | | 2:36 | |
| | Through Passenger | | 2:33 | | | 2:26 | |
| Freight | Grain Load 108 cars 5-3000 HP locomotives | | | 3:44 | | | 3:45 |
| | Grain Empty 3-3000 HP locomotives | | | 3:23 | | | 3:20 |
| | Grain Empty 2-3000 HP locomotives | | | 3:46 | | | 3:43 |
| | Regular Commercial Freight 60 cars 4800 tons 4-3000 HP locomotives | | | 3:33 | | | 3:31 |
| | Regular Commercial Freight 87 cars 7000 tons 6-3000 HP locomotives | | | 3:25 | | | 3:20 |
| | Intermodal 64 cars 4800 tons 4-3000 HP locomotives | | | 3:21 | | | 3:16 |
| | Intermodal 93 cars 7000 tons 6-3000 HP locomotives | | | 3:22 | | | 3:18 |

current conditions is 5 hours 21 minutes, 32 minutes less than for conventional passenger train equipment. The running times for the 1979 conditions are 5 hours 15 minutes for conventional passenger trains and 4 hours 47 minutes for Talgo trains operating at high cant deficiency speed. The example speed limits reduce conventional passenger train running time to 4 hours 26 minutes and Talgo train running time to 4 hours 4 minutes.

The Pasco – Spokane running time does not vary as significantly because of the smaller proportion of slow speed, curved track on this part of the route. Conventional passenger train time between Pasco and Spokane is 2 hours 33 minutes. However, a local passenger train with only one locomotive and 5 express cars will take 2 hours 44 minutes. The running time for the Talgo train at high cant deficiency speed is 2 hours 20 minutes, 13 minutes faster than the conventional passenger train running time. Using nearest 1-mph speed limits and eliminating the Ritzville and Cheney speed restrictions gains 4 to 6 minutes.

## Running Times: Freight

There is a wide range of freight train running times, because there is a wide variety of freight train configuration. In general, the Auburn – Pasco running time is just over 7 hours. Under the 1979 conditions it was 10 to 20 minutes less. The example speed limits generate a running time reduction of 45 minutes to an hour for freight trains between Auburn and Pasco.

The example freight train speeds for Pasco – Spokane change only the Ritzville and Cheney speed limits. These changes reduce running time by only about 3 minutes.

## Train Consists: Passenger

The equipment used on the passenger train is as important to transit time as the condition of the track and the signal system. The typical passenger train of 1979, the time of the base case speed zones, would have been similar to the current Seattle – Chicago trains. Such trains may weigh 1,000 tons or more. These trains can operate at normal passenger train speeds. Such trains regularly operated at over 100 mph in the 1960s and before, but they accelerate slowly. The performance limitation is apparent when numerous changes in speed must be made. They are suited to long distance trips with moderately relaxed schedules. Because the performance level of such trains is not extremely high, less is required of the track configuration and of the scheduling of the service.

Conventional cross-country passenger trains are not contemplated for new service over this route. The performance of this type of train is developed only as a comparison among the train configurations that may be used for the new service.

There appear to be two possible types of intrastate service between Seattle and Spokane. There may be a significant number of cars of apples and other express shipments to be handled in passenger trains between Yakima and Pasco or Spokane for connection with the through train to Chicago. A train handling these express cars would perform much like other conventional passenger trains, although with perhaps fewer passenger-carrying cars than the long-distance trains.

### Exhibit B.2
### Curve Restrictions: Auburn to Pasco

| Auburn (top) to Pasco (bottom) | |
|---|---|
| **Miles not restricted by curves** | **Miles restricted by curves** |
| | 64.7 |
| 1.9 | |
| | 0.3 |
| 4.7 | |
| | 1.3 |
| 4.8 | |
| | 0.4 |
| 6.1 | |
| | 0.8 |
| 2.8 | |
| | 5.7 |
| 2.7 | |
| | 0.8 |
| 5.7 | |
| | 0.1 |
| 6.1 | |
| | 24.8 |
| 3.4 | |
| | 1 |
| 6.6 | |
| | 1.5 |
| 46.4 | |
| | 15.5 |
| 1.8 | |
| | 1.3 |
| 11 | |
| | 0.3 |
| 1.4 | |
| | 0.4 |
| 1.4 | |
| | 0.5 |
| 1.9 | |

| Total Miles | Total Miles |
|---|---|
| 108.7 | 119.4 |

The daylight-trip market appears to be different from the express market. It is anticipated that the express cars will be made ready at the close of business in Yakima and moved in the evening for a connection with the train that currently leaves Pasco at 8:57 p.m. and Spokane at 1:15 a.m. In the reverse direction, the cars currently arrive at Spokane at 1:40 a.m. or Pasco at 5:35 a.m. from the east, to be delivered in Yakima in the morning for the day's loading. These times are not convenient for intrastate travel and may attract few riders. The schedule can be adjusted to better accommodate intrastate travel by delaying the Spokane departure until 7:00 a.m. and the Seattle departure until 1:00 p.m. as shown in the example schedules. This adjustment reduces the amount of time the cars are available for loading. A service possibly more desirable for intrastate passengers would probably leave Seattle and Spokane in the morning, arriving at the opposite end of the trip in the late afternoon. The goal of such a service would be to provide the most competitive possible transportation option for the traveling public.

The Auburn – Pasco – Spokane route examined in the following material is a difficult route for the operation of fast passenger trains. The climb from sea level to 2,837 feet is challenging for freight trains but is not challenging for passenger trains. The passenger trains considered can easily sustain the fastest allowable speeds on the grades involved. The challenge is curvature. In the approximately 230 miles between Auburn and Pasco, there are 320 individual curves totaling about 75 miles of track. Most of these are relatively sharp curves that restrict the speed of trains. The table in **Exhibit B.2** shows that the longest stretch of track without restricted curves is 46.4 miles east of Yakima. The remaining track without restrictive curves is divided among 15 separate locations, the longest of which is 11 miles. The longest stretch of the route that has no unrestricted curves is 64.7 miles from Auburn to the east. There are two stretches without unrestricted curves that are 24.8 and 15.5 miles long. The remaining track with restrictive curves is divided among 13 places. 119.4 miles of the line are affected by the speed limitation of curves.

In the approximately 146 miles between Pasco and Spokane, there are 209 individual curves totaling 46 miles of track. The table in **Exhibit B.3** shows that the longest stretch of track between Pasco and Spokane without restricted curves is 12.6 miles. The remaining track without restrictive curves is divided among 8 separate locations, the longest of which is 7 miles. 101.7 miles of the line are affected by the speed limitation of curves. Talgo trains, such as used between Vancouver BC and Portland on the *Cascades* service, are very well suited to this environment. There are several advantages to be had from using Talgo equipment. The train is much lighter than is conventional equipment, thus performing better and requiring less fuel. The Talgo trains may operate through curves faster than conventional equipment because the carbody tilts when passing through curves to compensate for the effects of the curve. The travel time of Talgo trains, because of the light weight and tilting, can be much shorter than travel time for conventional passenger trains on a line with numerous speed-restricted curves. The Talgo trains, however, cannot be operated in conjunction with conventional express cars.

**Exhibit B.3**
**Curve Restrictions:**
**Pasco to Spokane**

| Pasco (top) to Spokane (bottom) | |
|---|---|
| **Miles not restricted by curves** | **Miles restricted by curves** |
| | 7.3 |
| 7 | |
| | 1.2 |
| 4.3 | |
| | 0.3 |
| 4 | |
| | 2.5 |
| 2.6 | |
| | 0.4 |
| 1.1 | |
| | 50.5 |
| 3.1 | |
| | 0.2 |
| 12.6 | |
| | 16.6 |
| 3.5 | |
| | 5.9 |
| 5.7 | |
| | 16.8 |

| Total Miles | Total Miles |
|---|---|
| 43.9 | 101.7 |

The passenger trains tested for running time on this line for each of the various situations include:

- Conventional passenger train – 2 P40 locomotives, two single level baggage or express cars and eight Superliner passenger cars (coach, dining, lounge or sleeping cars).
- Conventional local passenger train – 1 F-40 locomotive with 3 Amfleet passenger cars (coach and lounge) between Seattle and Yakima and with the addition of 5 and 10 express cars between Yakima and Spokane.
- Talgo Passenger train – 1 F-59 and 1 unpowered F-40 cab car with 12 Talgo cars.
- Talgo passenger train – 2 F59's with 12 Talgo cars.

## Train Consists: Freight

The Stampede Tunnel has historically precluded tri-level automobile cars and some trailer or container cars. When regular service was operated on Stampede Pass before the 1997 re-opening of the line, double-stack cars were not in use. Even after the re-opening, these cars still cannot be operated through the Stampede tunnel. As was the case before 1997, the Stampede Pass line is generally the last choice for the railroad, except for some detour traffic because of service interruption on other lines, for grain load and empty trains that are not restricted by the tunnel dimensions, and some regular commercial freight.

The size of the trains may vary dramatically. Historically, significant use of helpers was made between Wenatchee and Skykomish, but not between Ellensburg and Lester. Helpers could once be added to a freight train or removed in 15 or 20 minutes. Changes in operating practices and in the number of crewmembers on a train have caused the process to take an hour or more. Thus, the use of helpers is avoided. The need for helpers on a train of more than about 5,000 tons is among the factors that limit the use BNSF makes of the Auburn – Pasco route. The use of additional locomotives located in the train like helpers, known as distributed power, is becoming increasingly common. Common use of distributed power may affect BNSF's opinion of the desirability of freight traffic over the Stampede Pass route.

Changing the characteristics of the line to allow much faster passenger service can change the locations at which track must be provided for meeting and passing trains. It may make the use of the line by BNSF for other traffic much more attractive. The running time for several types of freight trains, including types of traffic not normally seen on the line, have been tested for running time through each of the various speed limit situations.

The freight trains testing for running time for each of the various situations include:

- Grain loads of 108 cars, weighing 12,960 tons, using 10-3000 HP locomotives. In practice, these units would be located at the front and at two other locations in the train. There may be one or two engineers for the two sets of locomotives that are cut into the train.
- Grain loads of 108 cars, weighing 12,960 tons, between Pasco and Ellensburg, splitting into two trains of 6,480 tons for movement between Ellensburg and Auburn. The operating plan to provide the additional locomotives at Ellensburg for the movement of the second train will not be considered as the purpose of this study. This analysis is included merely to indicate possible benefits to freight operation that might occur because of the introduction of passenger trains.
- Grain empties of 108 cars, weighing 3,456 tons using 3-3000 HP locomotives between Auburn and Ellensburg.
- Grain empties of 108 cars, weighing 3,456 tons using 3-3000 HP locomotives between Auburn and Ellensburg and 2-3000 HP locomotives between Ellensburg and Pasco.

- Regular commercial freight trains with 60 cars, weighing 4,800 tons using 4-3000 HP locomotives between Auburn and Pasco.
- Regular commercial freight trains with 87 cars, weighing 7,000 tons using 6-3000 HP locomotives between Auburn and Pasco.
- Regular commercial freight trains using 6-3000 HP locomotives between Auburn and Ellensburg and 3-3000 HP locomotives between Ellensburg and Pasco.
- Trailers/single-level containers of intermodal freight with 64 cars, weighing 4,800 tons, using 4-3000 HP locomotives between Auburn and Pasco.
- Trailers/single-level containers of intermodal freight with 93 cars, weighing 7,000 tons, using 6-3000 HP locomotives between Auburn and Ellensburg and 3-3000 HP locomotives between Ellensburg and Pasco.

The comparison running times include only the actual running time. Time stopped at stations to change crew or locomotive or change the consist of the train is not included.

## Train Performance Calculation

A Train Performance Calculator (TPC) computer program was used to determine the running time for each of the types of trains examined. The TPC uses a detailed description of the alignment and profile of the track, a detailed description of the train itself, a detailed description of the braking power of the train, and a detailed description of the pulling power of the locomotive. The TPC uses several equations to generate speed and distance traveled from the power applied by the locomotive and the various resistances that the train has to movement (friction, air movement, acceleration and others). The set of equations is applied for each second of movement. The TPC examines the route ahead as the location changes, emulating the way in which the locomotive engineer would control the power and brakes.

The line between Auburn and Pasco has not seen regular passenger train operation for about 20 years. In the interim, the line has been either used as a shortline or left unused and almost abandoned.

As such, the current speed limits between Auburn and Pasco reflect the intention of operating only low-priority freight service. Freight trains, especially heavy-tonnage freight trains, accelerate slowly. Speed limit zones are set for trains with that characteristic. Passenger trains accelerate much more quickly and can benefit from much shorter speed zones than can heavy freight trains. There is little to be gained from indicating the running time for passenger trains using the current track geometry except as a base for the type of improvement that can be expected.

In 1979 the consist of passenger trains differed significantly from that of the proposed new passenger service. Scheduling practices were significantly different at that time. Much less importance was placed on station-to-station elapsed times. The schedules were established for a Chicago – Seattle through trip. The schedules demonstrated a more leisurely approach to passenger train operation than the current approach. The schedule of westward passenger trains between Auburn and Seattle also contained all of the eight percent recovery time for the entire trip between St. Paul and Seattle. The object of this procedure was that whatever happened between St. Paul and Auburn could be made up between Auburn and Seattle with a significant amount of extra time (eight percent of the entire trip) between those last two stations.

Historically, train speed limits have been set to the nearest 5 mph below a calculated speed limit that is not a multiple of 5 mph. Experience gained through planning and implementation of *Amtrak Cascades* service between Vancouver, WA and Blaine indicates that establishing the speed limit for passenger trains at the nearest 1 mph may save a significant amount of time. This same method has been explored for passenger trains between Auburn and Pasco and Spokane.

### Speed Limits for Current Conditions

**Exhibit B.4** shows the speed limit zones for Talgo, conventional passenger, and freight trains using the current conditions. Conventional passenger and Talgo train speed limits were calculated from the track geometry that supports the current freight train speed.

### Speed Limits for the Conditions that Existed in 1979

**Exhibit B.5** shows the speed limit zones for Talgo, conventional passenger, and freight trains using the conditions that existed in 1979. The significant differences between the 1979 and the 2000 conditions are the presence of passenger trains on the line in 1979 with the resultant higher speeds for freight and passenger trains, and the Automatic Block Signal system that also allowed higher speeds.

It should be noted that the Talgo trains were not in use in 1979 and at the time there were no speed zones for these trains. The Talgo speeds were calculated from the passenger train speeds, making the required adjustments in the calculation.

### Example of Speed Limits for Passenger Service

**Exhibit B.6** shows a complete set of Talgo, conventional passenger, and freight train speed limits. These speed limits were developed by noting the amount of superelevation required at various speeds for passenger and freight trains and choosing the highest achievable passenger train speed while keeping the freight train as uniform and achievable as possible.

#### Pasco to Spokane

The Pasco – Spokane portion of the route has both pre-existing passenger trains and high-importance high-speed intermodal trains. There is little to be done on this line to accommodate the shortest practical running time.

## Exhibit B.4
## Speed Limit for Current Conditions: Auburn to Pasco

| Starting Milepost | Ending Milepost | Talgo | Conventional Passenger | Freight | Maximum zone curvature |
|---|---|---|---|---|---|
| | | (mph) | (mph) | (mph) | (degrees) |
| 103 | 101.8 | 10 | 10 | 10 | R.L |
| 101.8 | 101 | 25 | 25 | 25 | 1-0 |
| 101 | 98.4 | 38 | 33 | 30 | 8-0 |
| 98.4 | 95.6 | 50 | 41 | 35 | 3-16 |
| 95.6 | 84.9 | 52 | 44 | 40 | 4-2 |
| 84.9 | 70.7 | 43 | 38 | 35 | 7-0 |
| 70.7 | 67.3 | 33 | 28 | 25 | 9-30 |
| 67.3 | 63.7 | 40 | 33 | 30 | 6-30 |
| 63.7 | 57.5 | 46 | 39 | 35 | 5-0 |
| 57.5 | 39.4 | 28 | 23 | 20 | 10-30 |
| 39.4 | 36.1 | 55 | 46 | 40 | 3-0 |
| 36.1 | 31.4 | 59 | 59 | 49 | 1-1 |
| 31.4 | 30.1 | 58 | 47 | 40 | 2-30 |
| 30.1 | 18.8 | 59 | 56 | 49 | 2-6 |
| 18.8 | 14.2 | 59 | 52 | 45 | 2-0 |
| 14.2 | 12.7 | 43 | 38 | 35 | 6-45 |
| 12.7 | 10.9 | 32 | 28 | 25 | 10-7 |
| 10.9 | 1.3 | 59 | 52 | 45 | 2-9 |
| 1.3 | 0 | 48 | 40 | 35 | 4-0 |
| 0 | 126 | 20 | 20 | 20 | T |
| 126 | 121.1 | 59 | 59 | 40 | 0-30 |
| 121.1 | 120.2 | 45 | 39 | 35 | 5-24 |
| 120.2 | 115.3 | 38 | 33 | 30 | 7-56 |
| 115.3 | 112.2 | 42 | 38 | 35 | 7-34 |
| 112.2 | 110.8 | 38 | 33 | 30 | 8-7 |
| 110.8 | 105.6 | 44 | 38 | 35 | 6-18 |
| 105.6 | 104.4 | 38 | 33 | 30 | 8-2 |
| 104.4 | 102.3 | 32 | 28 | 25 | 10-31 |
| 102.3 | 99.6 | 41 | 38 | 35 | 6-42 |
| 99.6 | 97 | 58 | 50 | 45 | 3-15 |
| 97 | 96.3 | 43 | 38 | 35 | 7-4 |
| 96.3 | 94.4 | 61 | 48 | 40 | |
| 94.4 | 92.1 | 40 | 40 | 40 | 2-0 |
| 92.1 | 91.5 | 50 | 40 | 35 | 3-30 |
| 91.5 | 87.4 | 20 | 20 | 20 | 0-30 |
| 87.4 | 79.2 | 59 | 54 | 49 | 3-5 |
| 79.2 | 78 | 30 | 30 | 30 | 0-40 |
| 78 | 71.6 | 59 | 59 | 49 | T |
| 71.6 | 70.4 | 20 | 20 | 20 | T |
| 70.4 | 41.7 | 59 | 59 | 49 | 1-0 |
| 41.7 | 39.2 | 45 | 45 | 45 | 1-30 |
| 39.2 | 36 | 59 | 53 | 49 | 3-30 |
| 36 | 32.9 | 56 | 49 | 45 | 4-5 |
| 32.9 | 32.1 | 38 | 33 | 30 | 7-55 |
| 32.1 | 27.9 | 54 | 48 | 45 | 5-0 |
| 27.9 | 27.7 | 49 | 43 | 40 | 5-15 |
| 27.7 | 22.7 | 55 | 48 | 45 | 4-30 |
| 22.7 | 20.9 | 49 | 43 | 40 | 5-30 |
| 20.9 | 4.3 | 59 | 55 | 49 | 2-30 |
| 4.3 | 1.9 | 40 | 39 | 35 | 4-30 |
| 229.7 | 230.4 | | 35 | 25 | |
| 230.4 | 231.4 | | 25 | 25 | |

## Exhibit B.5
## Speed Limit for 1979 Conditions: Auburn to Pasco

| Starting Milepost | Ending Milepost | Talgo | Conventional Passenger-not rounded to 5 mph | Conventional Passenger | Freight | Maximum zone curvature |
|---|---|---|---|---|---|---|
| | | (mph) | (mph) | (mph) | (mph) | (degrees |
| 103 | 102.2 | 10 | 10 | 10 | 10 | 10-15 |
| 102.2 | 101.3 | 70 | 70 | 70 | 50 | 1-0 |
| 101.3 | 99.3 | 44 | 38 | 35 | 35 | 5-58 |
| 99.3 | 98.4 | 38 | 33 | 30 | 30 | 8-0 |
| 98.4 | 97.5 | 78 | 70 | 70 | 50 | 2-18 |
| 97.5 | 96.1 | 44 | 38 | 35 | 35 | 5-58 |
| 96.1 | 93.1 | 79 | 70 | 70 | 50 | 1-59 |
| 93.1 | 91.5 | 69 | 60 | 60 | 50 | 2-30 |
| 91.5 | 90.2 | 79 | 70 | 70 | 50 | 1-40 |
| 90.2 | 89.2 | 56 | 49 | 45 | 45 | 4-2 |
| 89.2 | 86.2 | 79 | 70 | 70 | 50 | 2-10 |
| 86.2 | 84.9 | 56 | 49 | 45 | 45 | 3-52 |
| 84.9 | 83.3 | 44 | 38 | 35 | 35 | 6-0 |
| 83.3 | 81.9 | 79 | 79 | 70 | 50 | T |
| 81.9 | 80.2 | 43 | 38 | 35 | 35 | 7-0 |
| 80.2 | 79.3 | 52 | 49 | 45 | 45 | 4-0 |
| 79.3 | 78.2 | 44 | 38 | 35 | 35 | 6-0 |
| 78.2 | 77.1 | 68 | 57 | 50 | 50 | 2-0 |
| 77.1 | 74.6 | 44 | 38 | 35 | 35 | 6-0 |
| 74.6 | 73.7 | 60 | 60 | 60 | 50 | T |
| 73.7 | 71.7 | 44 | 38 | 35 | 35 | 6-0 |
| 71.7 | 70.6 | 33 | 28 | 25 | 25 | 9-0 |
| 70.6 | 68.2 | 38 | 33 | 30 | 30 | 8-30 |
| 68.2 | 67.2 | 33 | 28 | 25 | 25 | 9-30 |
| 67.2 | 65.1 | 62 | 55 | 55 | 50 | 3-25 |
| 65.1 | 64.2 | 43 | 38 | 35 | 35 | 6-30 |
| 64.2 | 63.7 | 33 | 28 | 25 | 25 | 9-24 |
| 63.7 | 62.6 | 50 | 43 | 40 | 40 | 5-0 |
| 62.6 | 60.5 | 71 | 60 | 60 | 50 | 2-5 |
| 60.5 | 39.3 | 30 | 30 | 30 | 20 | 10-30 |
| 39.3 | 38.3 | 58 | 50 | 45 | 45 | 3-0 |
| 38.3 | 36.4 | 79 | 75 | 75 | 50 | 0-51 |
| 36.4 | 36.1 | 79 | 70 | 70 | 50 | 2-8 |
| 36.1 | 31.4 | 79 | 75 | 75 | 50 | 1-1 |
| 31.4 | 30.1 | 69 | 60 | 60 | 50 | 2-30 |
| 30.1 | 25.3 | 25 | 25 | 25 | 25 | 2-6 |
| 25.3 | 18.8 | 79 | 75 | 75 | 50 | 1-1 |
| 18.8 | 18 | 71 | 60 | 60 | 50 | 2-0 |
| 18 | 16.3 | 79 | 75 | 75 | 50 | 1-15 |
| 16.3 | 14.2 | 79 | 70 | 70 | 50 | 2-0 |
| 14.2 | 12.8 | 43 | 38 | 35 | 35 | 7-0 |
| 12.8 | 10.9 | 32 | 28 | 25 | 25 | 10-10 |
| 10.9 | 1.3 | 79 | 70 | 70 | 50 | 2-9 |
| 1.3 | 0.3 | 50 | 35 | 50 | 35 | T |
| 0.3 | 0.2 | 48 | 40 | 35 | 35 | 4-0 |
| 0.2 | 124.8 | 50 | 35 | 50 | 35 | T |
| 124.8 | 121.1 | 79 | 79 | 70 | 50 | 0-30 |
| 121.1 | 120.2 | 45 | 39 | 35 | 35 | 5-24 |
| 120.2 | 119.9 | 35 | 29 | 25 | 25 | 7-0 |
| 119.9 | 118.7 | 43 | 38 | 35 | 35 | 7-0 |
| 118.7 | 117.7 | 49 | 43 | 40 | 40 | 5-4 |
| 117.7 | 115.3 | 42 | 38 | 35 | 35 | 7-56 |
| 115.3 | 112.5 | 48 | 43 | 40 | 40 | 6-12 |
| 112.5 | 110.8 | 34 | 28 | 25 | 25 | 8-40 |
| 110.8 | 109.2 | 48 | 43 | 40 | 40 | 6-18 |
| 109.2 | 107.7 | 54 | 48 | 45 | 45 | 4-57 |

# Exhibit B.5—Continued
# Speed Limit for 1979 Conditions: Auburn to Pasco

| Starting Milepost | Ending Milepost | Talgo | Conventional Passenger-not rounded to 5 mph | Conventional Passenger | Freight | Maximum zone curvature |
|---|---|---|---|---|---|---|
| 107.7 | 106.9 | 48 | 43 | 40 | 40 | 6-14 |
| 106.9 | 105.5 | 54 | 48 | 45 | 45 | 4-40 |
| 105.5 | 104.4 | 38 | 33 | 30 | 30 | 8-2 |
| 104.4 | 104.1 | 28 | 23 | 20 | 20 | 10-31 |
| 104.1 | 102.4 | 36 | 32 | 30 | 30 | 10-6 |
| 102.4 | 101.1 | 54 | 48 | 45 | 45 | 4-50 |
| 101.1 | 99.6 | 43 | 38 | 35 | 35 | 6-42 |
| 99.6 | 98.2 | 79 | 70 | 70 | 50 | 1-3 |
| 98.2 | 97 | 63 | 55 | 55 | 50 | 3-15 |
| 97 | 96.3 | 43 | 38 | 35 | 35 | 7-4 |
| 96.3 | 94.4 | 79 | 70 | 70 | 50 | 1-3 |
| 94.4 | 92 | 53 | 45 | 40 | 40 | 3-30 |
| 92 | 90.3 | 79 | 79 | 79 | 60 | 0-30 |
| 90.3 | 89.8 | 20 | 20 | 20 | 20 | T |
| 89.8 | 87.9 | 60 | 60 | 60 | 60 | T |
| 87.9 | 85.3 | 79 | 79 | 79 | 60 | 1-0 |
| 85.3 | 83.2 | 71 | 64 | 60 | 60 | 3-5 |
| 83.2 | 78.6 | 79 | 79 | 79 | 60 | 0-40 |
| 78.6 | 78.1 | 30 | 30 | 30 | 30 | T |
| 78.1 | 71.6 | 79 | 79 | 79 | 60 | T |
| 71.6 | 70.4 | 35 | 35 | 35 | 35 | T |
| 70.4 | 52.2 | 79 | 79 | 79 | 60 | 1-0 |
| 52.2 | 51.6 | 50 | 50 | 50 | 50 | T |
| 51.6 | 41.9 | 79 | 79 | 79 | 60 | 1-0 |
| 41.9 | 39.2 | 45 | 45 | 45 | 45 | 1-50 |
| 39.2 | 37.4 | 79 | 79 | 79 | 60 | 1-30 |
| 37.4 | 36.7 | 61 | 54 | 50 | 50 | 3-30 |
| 36.7 | 32.9 | 61 | 55 | 50 | 50 | 4-5 |
| 32.9 | 32.1 | 40 | 35 | 35 | 30 | 7-55 |
| 32.1 | 30.7 | 74 | 65 | 60 | 60 | 2-20 |
| 30.7 | 21.9 | 53 | 48 | 45 | 45 | 5-15 |
| 21.9 | 21 | 60 | 60 | 60 | 60 | 1-0 |
| 21 | 20.1 | 79 | 79 | 79 | 60 | T |
| 20.1 | 19.8 | 78 | 70 | 70 | 60 | 2-30 |
| 19.8 | 9.2 | 79 | 79 | 79 | 60 | 1-50 |
| 9.2 | 2.3 | 35 | 35 | 35 | 35 | 2-0 |
| 2.3 | 1.9 | 30 | 30 | 30 | 30 | T |
| 229.7 | 230.4 | 35 | 30 | 35 | 25 | |
| 230.4 | 231.4 | 35 | 30 | 25 | 25 | |

# Exhibit B.6
# Example of Speed Limits: Auburn to Pasco

| Starting Milepost | Ending Milepost | Talgo | Conventional Passenger | Freight | Maximum zone curvature | Maximum superelevation and actual freight speed |
|---|---|---|---|---|---|---|
| | | (mph) | (mph) | (mph) | (degrees) | |
| 103 | 102.6 | 29 | 23 | 20 | 10-15 | |
| 102.6 | 100.4 | 50 | 45 | 35 | 1-0 | |
| 100.4 | 98.6 | 46 | 41 | 35 | 5-58 | 4.0" F38 |
| 98.6 | 98.4 | 42 | 38 | 35 | 8-0 | 4.86" F35 |
| 98.4 | 96.1 | 54 | 45 | 40 | 3-16 | 1.66" F40 |
| 96.1 | 95.7 | 40 | 43 | 40 | 5-58 | 4.68" F40 |
| 95.7 | 90.2 | 70 | 60 | 50 | 2-30 | 3.48" F56 |
| 90.2 | 89.9 | 57 | 51 | 45 | 4-2 | 4.24" F47 |
| 89.9 | 86.1 | 64 | 53 | 45 | 2-21 | 1.63" F47 |
| 86.1 | 84.7 | 58 | 51 | 45 | 3-52 | 3.98" F47 |
| 84.7 | 81.5 | 48 | 43 | 40 | 6-0 | 4.72" F40 |
| 81.5 | 81.1 | 45 | 40 | 35 | 7-0 | 4.72" F37 |
| 81.1 | 70.4 | 48 | 43 | 40 | 6-0 | 4.72" F40 |
| 70.4 | 67.8 | 37 | 33 | 30 | 7-42 | 4.24" F31 |
| 67.8 | 63.9 | 40 | 33 | 30 | 6-30 | 2.09" F30 |
| 63.9 | 63.7 | 37 | 32 | 30 | 9-24 | 3.92" F30 |
| 63.7 | 62.5 | 50 | 43 | 40 | 5-0 | 3.6" F40 |
| 62.5 | 59.4 | 63 | 50 | 40 | 2-5 | |
| 59.4 | 57.7 | 59 | 48 | 40 | 2-21 | 0.75" F41 |
| 57.7 | 57.5 | 55 | 46 | 40 | 3-0 | 1.36" F40 |
| 57.5 | 43.5 | 34 | 30 | 25 | 10-30 | 3.46" F28 |
| 43.5 | 40.5 | 45 | 37 | 25 | 4-0 | 0.75" F31 |
| 40.5 | 39.4 | 34 | 30 | 25 | 10-8 | 3.30" F28 |
| 39.4 | 38.3 | 63 | 55 | 50 | 3-0 | 3.25" F50 |
| 38.3 | 36.4 | 79 | 79 | 60 | 0-51 | |
| 36.4 | 36.1 | 79 | 70 | 60 | 2-8 | 4.32" F65 |
| 36.1 | 31.4 | 79 | 79 | 60 | 1-1 | |
| 31.4 | 30.7 | 79 | 70 | 60 | 2-4 | 4.09" F65 |
| 30.7 | 30.1 | 75 | 67 | 60 | 2-30 | 4.88" F63 |
| 30.1 | 25.3 | 79 | 79 | 60 | 1-30 | |
| 25.3 | 24.9 | 79 | 70 | 60 | 2-6 | 4.17" F65 |
| 24.9 | 18.8 | 79 | 79 | 60 | 1-1 | |
| 18.8 | 18 | 79 | 75 | 60 | 2-0 | 4.88" F70 |
| 18 | 15.2 | 79 | 79 | 60 | 1-30 | |
| 15.2 | 14.2 | 79 | 75 | 60 | 2-0 | 4.88" F70 |
| 14.2 | 12.8 | 45 | 40 | 35 | 7-0 | 4.75" F37 |
| 12.8 | 10.9 | 37 | 33 | 30 | 10-10 | 4.59" F30 |
| 10.9 | 9.5 | 79 | 70 | 50 | 2-9 | 4.39" F65 |
| 9.5 | 6.8 | 79 | 79 | 50 | 1-1 | |
| 6.8 | 6 | 79 | 70 | 50 | 2-9 | 4.39" F65 |
| 6 | 0.3 | 79 | 79 | 50 | T | |
| 0.3 | 0.2 | 48 | 40 | 35 | 4-0 | |
| 0.2 | 121.1 | 79 | 79 | 50 | 0-30 | |
| 121.1 | 120.2 | 47 | 41 | 35 | 5-24 | 3.46" F38 |
| 120.2 | 119 | 45 | 40 | 35 | 7-0 | 4.7" F37 |
| 119 | 117.7 | 46 | 41 | 35 | 5-4 | 3.0" F38 |
| 117.7 | 116.2 | 46 | 41 | 35 | 6-6 | 3.83" F37 |
| 116.2 | 115.4 | 42 | 37 | 35 | 7-55 | 4.65" F35 |
| 115.4 | 112.4 | 46 | 40 | 35 | 6-12 | 4.0" F37 |
| 112.4 | 110.8 | 39 | 35 | 30 | 8-40 | 4.26" F32 |

## Exhibit B.6—Continued
## Example of Speed Limits: Auburn to Pasco

| Starting Milepost | Ending Milepost | Talgo | Conventional Passenger | Freight | Maximum zone curvature | Maximum superelevation and actual freight speed |
|---|---|---|---|---|---|---|
| 110.8 | 109.4 | 47 | 42 | 40 | 4-53 | 3.47" F40 |
| 109.4 | 109.2 | 47 | 42 | 40 | 6-18 | 4.92" F40 |
| 109.2 | 107.7 | 48 | 42 | 40 | 4-57 | 3.54" F40 |
| 107.7 | 106.9 | 48 | 42 | 40 | 6-14 | 4.84" F40 |
| 106.9 | 105.5 | 48 | 42 | 40 | 4-40 | 3.23" F40 |
| 105.5 | 104.4 | 42 | 37 | 35 | 8-2 | 4.7" F35 |
| 104.4 | 104.1 | 37 | 33 | 30 | 10-31 | 4.82" F30 |
| 104.1 | 102.8 | 37 | 33 | 30 | 4-36 | 0.9" F30 |
| 102.8 | 102.4 | 37 | 33 | 30 | 10-6 | 4.47" F30 |
| 102.4 | 101.1 | 46 | 41 | 35 | 4-50 | 4.5" F37 |
| 101.1 | 100.3 | 46 | 41 | 35 | 6-42 | 4.7" F38 |
| 100.3 | 99.6 | 63 | 56 | 50 | 3-28 | 4.7" F52 |
| 99.6 | 98.2 | 65 | 58 | 50 | 1-3 | |
| 98.2 | 97 | 65 | 58 | 50 | 3-35 | 4.7" F54 |
| 97 | 96.7 | 44 | 40 | 35 | 7-4 | 4.7" F37 |
| 96.7 | 96.3 | 75 | 65 | 50 | 2-28 | 4.7" F62 |
| 96.3 | 92.9 | 79 | 79 | 50 | 1-23 | |
| 92.9 | 92.1 | 79 | 70 | 50 | 2-0 | 3.78" F64 |
| 92.1 | 91.9 | 62 | 55 | 50 | 3-30 | 4.41" F51 |
| 91.9 | 85.3 | 79 | 79 | 60 | 1-0 | |
| 85.3 | 83.8 | 67 | 60 | 55 | 3-5 | 4.67" F56 |
| 83.8 | 37.4 | 79 | 79 | 60 | 1-30 | |
| 37.4 | 36.8 | 73 | 65 | 60 | 2-30 | 4.30" F60 |
| 36.8 | 36 | 58 | 52 | 45 | 3-30 | 3.62" F48 |
| 36 | 35.9 | 58 | 52 | 45 | 4-5 | 4.62" F48 |
| 35.9 | 32.9 | 63 | 55 | 45 | 3-0 | |
| 32.9 | 32.5 | 58 | 50 | 45 | 3-30 | 3.13" F46 |
| 32.5 | 37.1 | 42 | 38 | 35 | 7-55 | 4.79" F35 |
| 37.1 | 30.8 | 53 | 50 | 60 | 2-20 | 3.88" F60 |
| 30.8 | 30.1 | 53 | 50 | 45 | 4-39 | 4.59" F45 |
| 30.1 | 27.9 | 53 | 48 | 45 | 5-0 | 4.96" F45 |
| 27.9 | 27.7 | 51 | 45 | 40 | 5-15 | 4.44" F42 |
| 27.7 | 26.1 | 56 | 50 | 45 | 2-21 | 1.33" F45 |
| 26.1 | 25.9 | 56 | 50 | 45 | 4-25 | 4.75" F47 |
| 25.9 | 24.9 | 56 | 50 | 45 | 3-30 | 3.03" F45 |
| 24.9 | 22.8 | 56 | 50 | 45 | 4-30 | 4.70" F46 |
| 22.8 | 21.9 | 50 | 45 | 40 | 5-30 | 4.66" F42 |
| 21.9 | 20.1 | 79 | 79 | 60 | 1-0 | |
| 20.1 | 19.8 | 73 | 65 | 60 | 2-30 | 4.3" F60 |
| 19.8 | 18.8 | 79 | 70 | 60 | 1-50 | 3.29" F64 |
| 18.8 | 7.8 | 79 | 79 | 60 | 1-20 | |
| 7.8 | 7.5 | 79 | 75 | 60 | 2-0 | 4.88" F70 |
| 7.5 | 6.1 | 79 | 79 | 60 | 1-0 | |
| 6.1 | 5.7 | 79 | 75 | 60 | 2-0 | 4.88" F70 |
| 5.7 | 4.3 | 79 | 79 | 60 | 1-0 | |
| 4.3 | 3.8 | 56 | 50 | 45 | 4-30 | 4.78" F46 |
| 3.8 | 1.9 | 79 | 79 | 45 | T | |
| 229.7 | 230.4 | 35 | 35 | 25 | | |
| 230.4 | 231.4 | 25 | 25 | 25 | | |

# Appendix C: Amtrak Station Criteria

In order to make passenger rail competitive with other modes of transportation, travel times need to be competitive. Stopping in every community (whether it has riders or not), greatly increases the travel time of the train. In addition, the cost of the passenger rail service needs to be reasonable (building and maintaining a station could potentially increase ticket costs). It is because of these two factors that a station stop cannot be arbitrarily built just because the train travels through a particular community. Amtrak developed the following criteria to evaluate potential station locations. *The following criteria are grouped by functional considerations and are not ranked as to relative importance. Not all criteria are applicable in every instance.*

## Criterion One: Rail Operations

A station has to provide a safe environment for passengers with respect to train operations along the adjacent trackage and be compatible with other passenger and freight operations on the line. As such, rail operations criteria include:

- Passenger safety;
- Compatibility with Amtrak rail operations;
- Compatibility with commuter rail operations;
- Compatibility with freight railroad operations;
- Flexibility to accommodate service changes;
- Impact on scheduled running times; and
- Accessibility to yard or service functions (if applicable).

## Criterion Two: Rail Service Patronage

Patronage (ridership) is a prime consideration in site selection. Stations need to be easily accessible to the residential and business customers. Convenient highway and transit access is important. Rail service patronage criteria include:

- Minimal impact on patronage of nearby stations;
- Ability to generate new ridership;
- Ability to encourage intermodal patronage;
- Impact on patronage of other modes;
- Accessibility to home-based trips;
- Accessibility to business trips; and
- Accessibility to special or unique trips (activity centers such as shopping, museums, universities).

## Criterion Three: Traffic Operations

Intercity rail stations require convenient access from all directions, by both highway and transit. Ideally, stations will be located where they minimize conflict to traffic caused by train operations, and where they create the least impacts on nearby residential or other sensitive areas. They should have sufficient land available for transit operations, parking, and circulation. As such, traffic operations criteria include:

- Access from freeways from all directions;
- Access from arterial streets from all directions;

- Minimal conflict to traffic caused by train operations;
- Anticipated congestion in the station vicinity;
- Traffic impacts in residential or other sensitive areas;
- Land available for sufficient parking and circulation in parking areas;
- Potential for easy drop-off and pick-up of rail passengers; and
- Direction of traffic flows.

## Criterion Four: Site Characteristics

Land availability and potential for expansion in accord with local land use plans is an important factor in site selection. In addition, the facility should have a minimum of environmental constraints. Because stations are usually funded with local contributions, joint development opportunities should be explored as a means of funding construction or maintenance. As such, site characteristic criteria include:

- Availability of parcels;
- Potential for future expansion;
- Allowable zoning and land use designations;
- Potential for joint development;
- Absence of environmental constraints; and
- Need for environmental cleanup.

## Criterion Five: Transit Operations

The ideal station location will have convenient transit access via routes serving the surrounding community as well as regional transit lines. As such, transit operations criteria include:

- Logical stop on current or proposed transit routes;
- Land available for transit route terminus and bus operations;
- Good access for express, regional, or intercity buses; and
- Relationship to commuter rail services.

## Criterion Six: Site Vicinity Characteristics

While a station along a rail line can function independently of its surroundings, its usage will be enhanced if it is compatible with surrounding uses. Sites near major employment centers or high-volume traffic generators are obviously desirable. Often, stations can serve to enhance nearby economic development, and, when integrated with local development plans, they can become community focal points. Stations that are integrated with adjoining uses often provide a superior station environment and benefit from high visibility and nearby activities. As such, site vicinity characteristics criteria include:

- Compatibility with existing and planned land uses;
- Proximity to population and employment centers or special generators;
- Avoidance of noise-sensitive land uses;
- Connected to bike and pedestrian amenities;
- Opportunities to enhance economic development;
- Opportunities for site design to enhance station area; and
- Security, site visibility, and site activity.

## Criterion Seven: Financial Factors

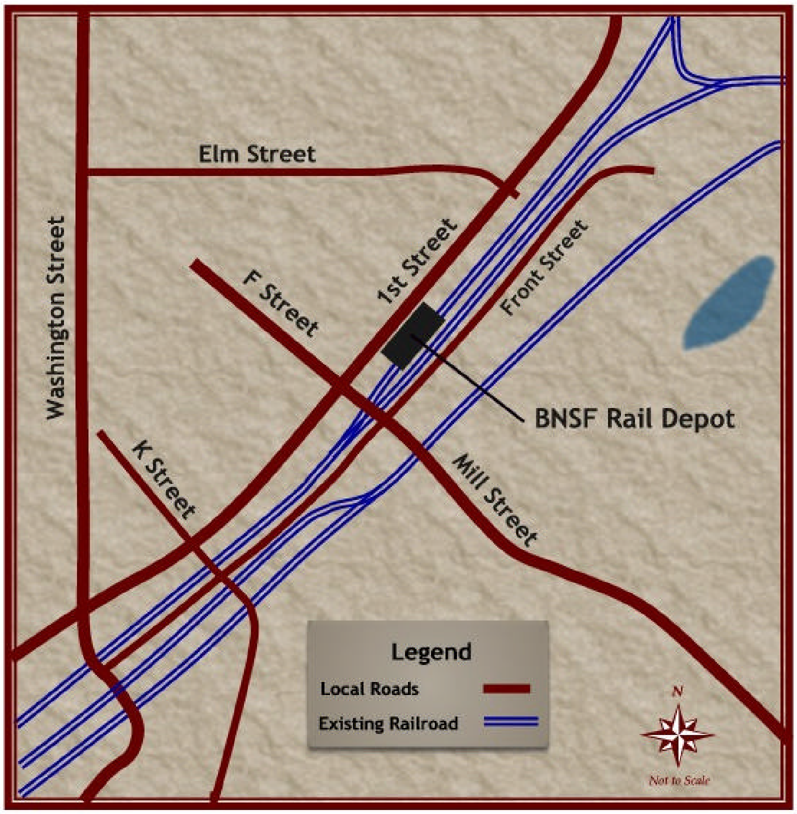
Acquisition and development costs are important considerations. Related concerns include costs of providing or revising adjacent trackage to the station or costs to mitigate station impacts. As such, financial factors criteria include:

- Acquisition costs;
- Development costs;
- Rail-related costs;
- Mitigation of other site-specific costs; and
- Ability to attract public or private financing.

# Appendix D: Potential Station Locations

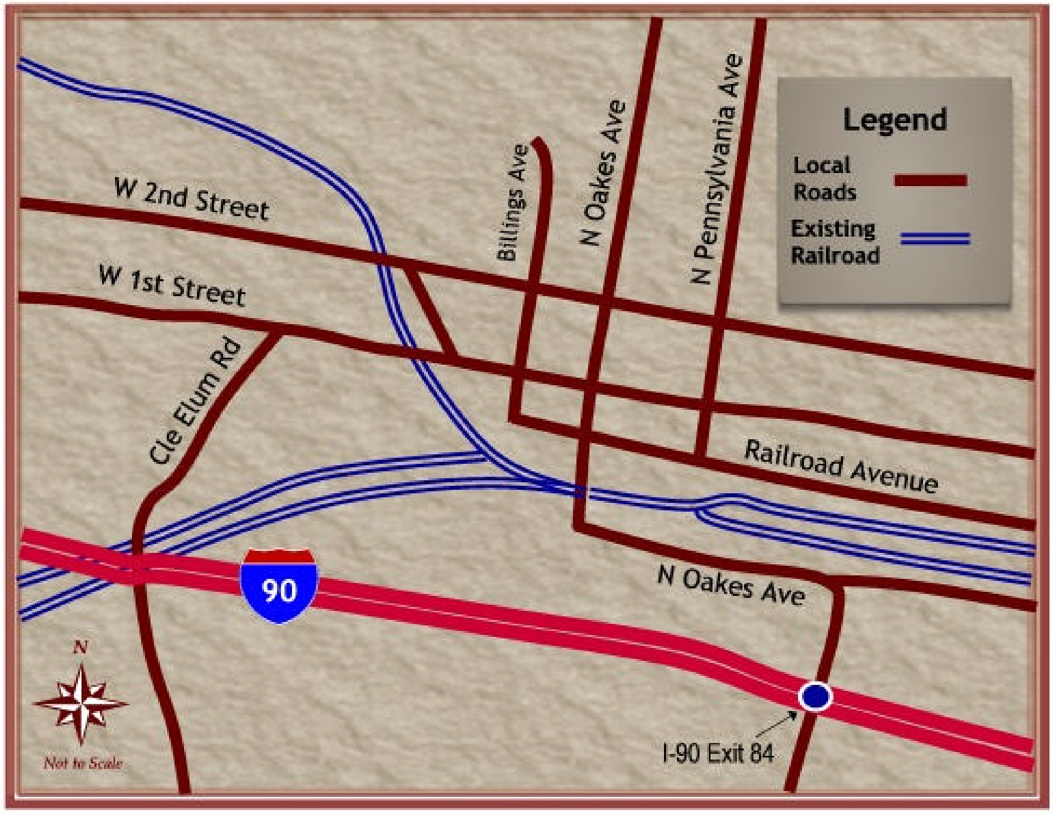
## Cheney

Cheney currently does not have a passenger rail facility. The Burlington Northern and Santa Fe Railway (BNSF) owns a small structure near the center of town that serves as a field office for BNSF staff. The community is served by Spokane Transit and Greyhound.



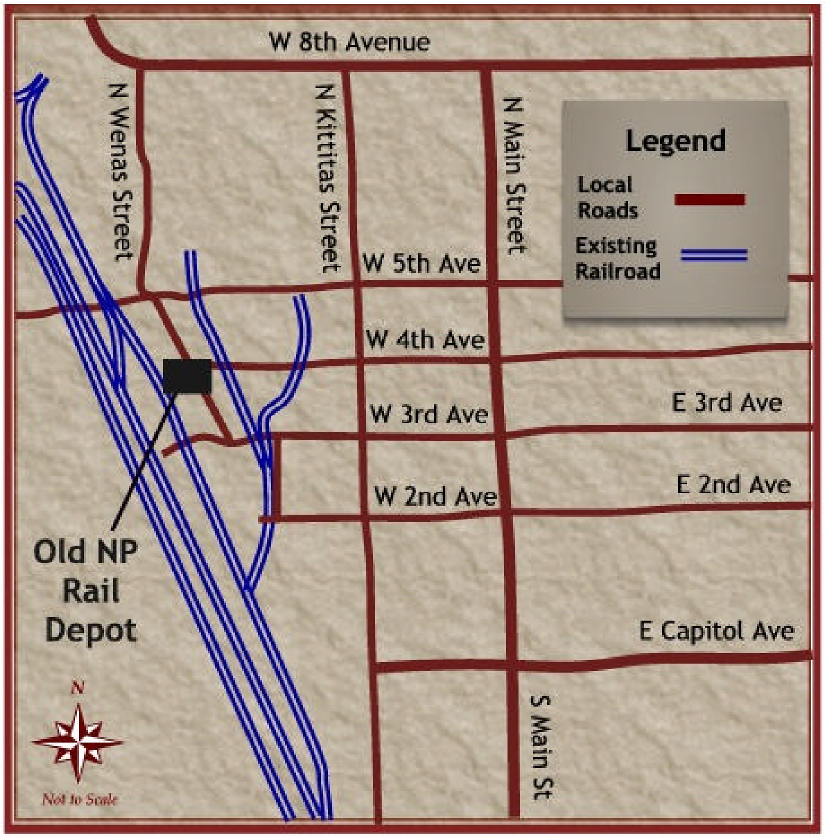
## Cle Elum

Currently, there is no passenger rail station on the BNSF main line. There is a proposal for a new facility adjacent to the central business district that would be part of a larger community development project. Cle Elum does not have a public transit system, but is served by Greyhound.



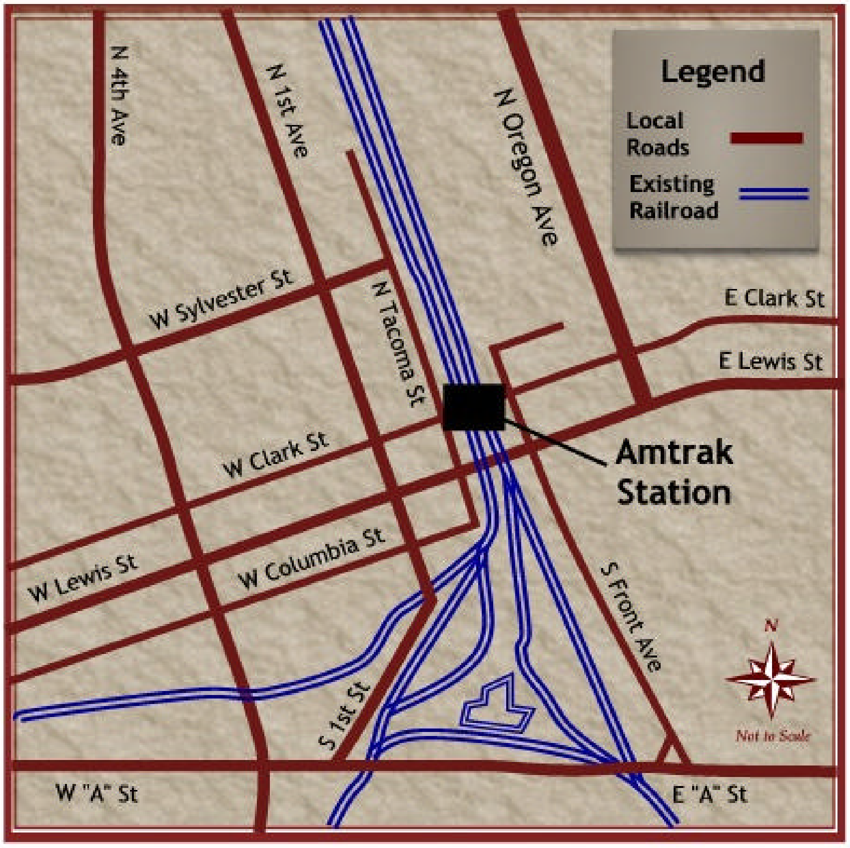
## Ellensburg

The station is located at 606 W. Third Avenue, and was constructed for the Northern Pacific Railway in 1910. Ellensburg currently does not have a public transit system, but the city is served by Greyhound. The facility is scheduled to undergo an extensive renovation in the near future.



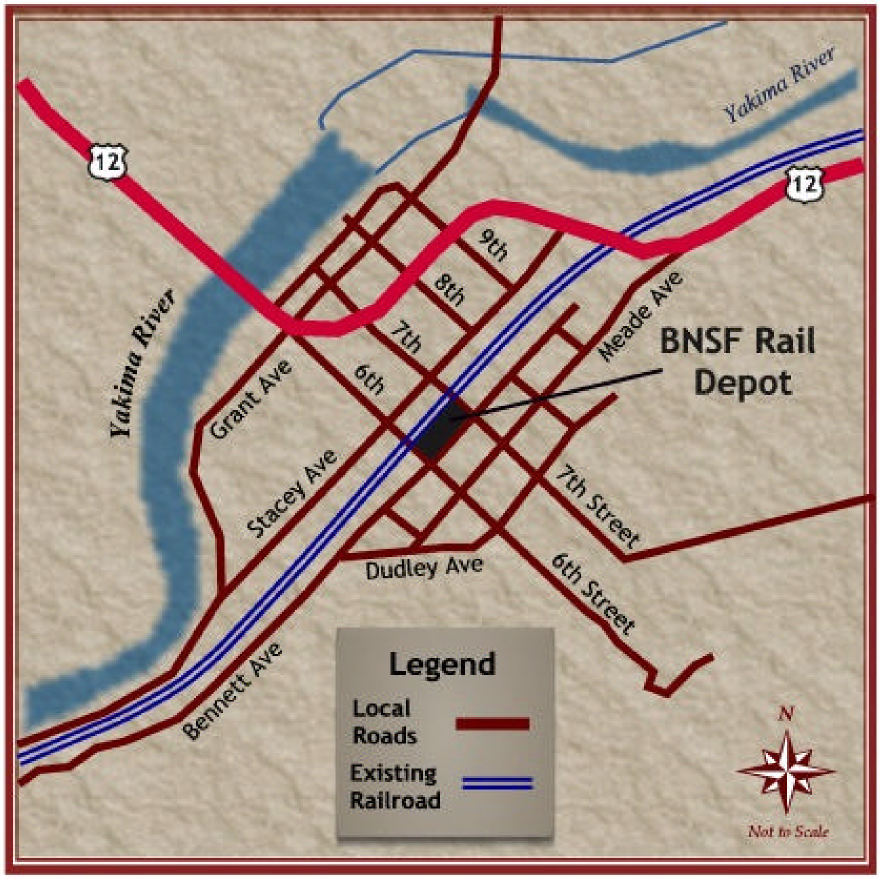
## Pasco

The Pasco Passenger Intermodal Facility is located at 535 First Avenue. The building was constructed in 1998 and is owned by the city of Pasco. It hosts Amtrak's *Empire Builder* and also serves as the city's Greyhound depot. Local bus service is provided by Ben Franklin Transit.



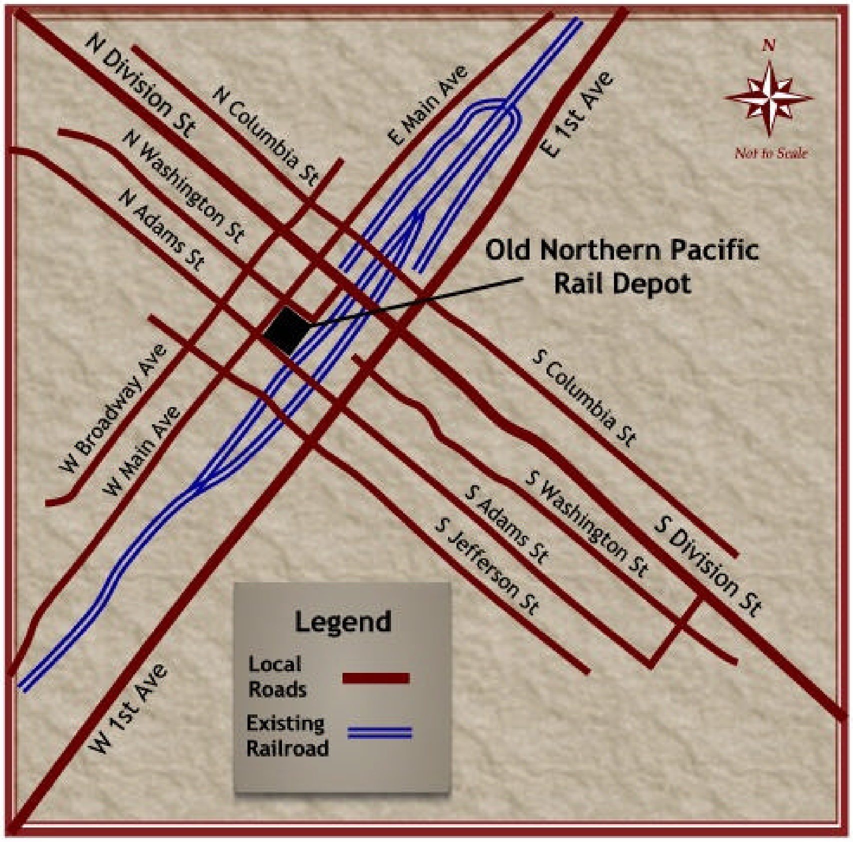
## Prosser

The former Northern Pacific depot is located at 1230 Bennett Avenue, and is currently owned by Depot, Inc. on property leased by BNSF. The building was constructed in 1950. The station is the site of the Prosser Chamber of Commerce and Prosser Economic Development Council. Prosser is served by Ben Franklin Transit.



## Ritzville

The Ritzville depot is located at 201 W. Railroad Avenue. It is owned by the city of Ritzville and is currently a museum. There is no public transportation in the community, but it is served by Greyhound.



## Seattle

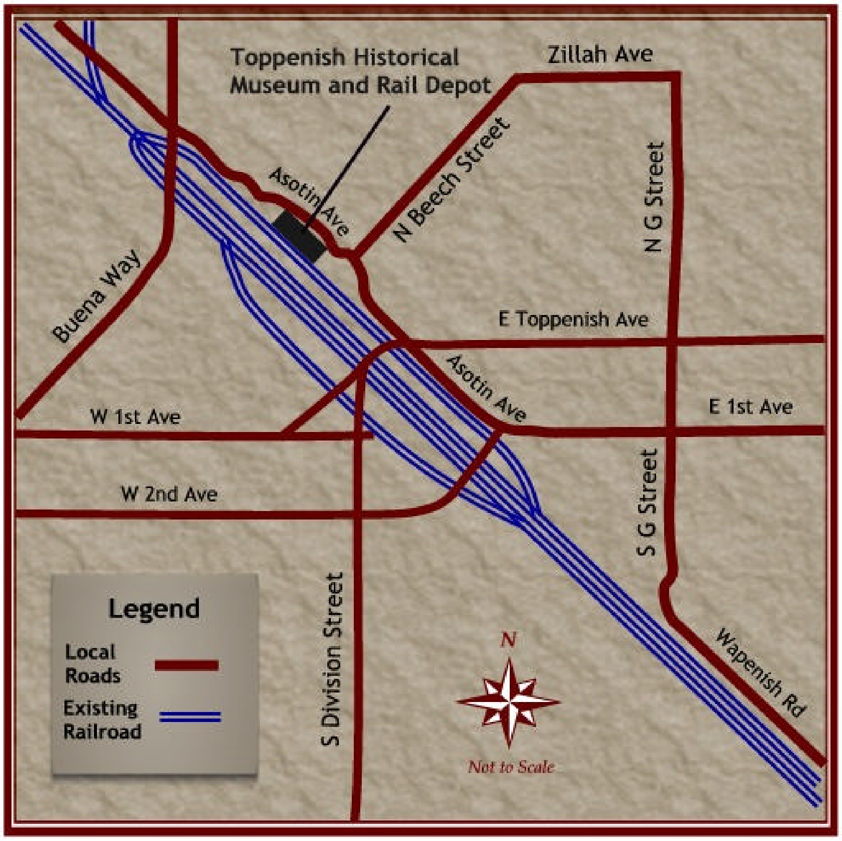
King Street Station, located at 303 South Jackson Street, was constructed in 1906. The station was renovated in 1950 and 1964, with a more extensive renovation slated for 2001. The facility hosts Amtrak's *Coast Starlight*, *Empire Builder*, and *Cascades* services, as well as Sound Transit commuter trains. The station is served by Metro, Community Transit, Pierce Transit, and Sound Transit.

## Spokane

The Spokane Intermodal Center is located at 221 West 1st Street. The building was originally constructed in 1890 for the Northern Pacific Railway. The facility was renovated in 1994 and is currently owned by the city of Spokane. The station hosts Amtrak's *Empire Builder*, as well as Greyhound and Northwest Trailways bus service. Spokane Transit provides service along Sprague Avenue, which is adjacent to the facility.

## Toppenish

Toppenish's former Northern Pacific depot, built in 1911, is located at 10 South Asotin Avenue. The facility is owned by the city and now serves as the home of the Yakima Valley Rail and Steam Museum. There is no local transit service.



## Yakima

The station is located at 32 North Front Street. It was constructed for the Northern Pacific Railway in 1910. The station is owned by BNSF, and currently hosts a small business and a restaurant. The facility is served by Yakima Transit.