# Amtrak Cascades
# Fleet Management Plan

**November 2017**

Washington State Department of Transportation

Oregon Department of Transportation

Funding support from U.S. Department of Transportation Federal Railroad Administration

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# Amtrak Cascades
# Fleet Management Plan


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This material is based upon work supported by the Federal Railroad Administration under Grant/Cooperative Agreement FR-HSR-0017-11-01 dated February 26, 2011 and subsequent amendments.

Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the FRA and/or U.S. DOT

Washington State Department of Transportation

Oregon Department of Transportation

November 7, 2017

The Washington State Department of Transportation (WSDOT) and the Oregon Department of Transportation (ODOT) are committed to providing safe, reliable and cost-effective transportation options for our citizens and businesses. The Amtrak Cascades passenger rail service, owned by the two states, plays a key role in fulfilling this commitment.

Amtrak Cascades utilizes a fleet of locomotives, non-powered cab units and trainsets that operate on our 467-mile corridor between Vancouver, British Columbia and Eugene, Oregon. This Fleet Management Plan evaluates passenger rail service goals from an equipment perspective. It will help WSDOT and ODOT manage their current fleet, as well as plan for acquisition of new equipment and maintenance facilities needed to support the fleet in the future.

The Fleet Management Plan is a collaborative effort of WSDOT, ODOT, railroads, Amtrak, state and local agencies, the Federal Railroad Administration, and other rail stakeholders. Funding for this effort was part of the nearly $800 million in high-speed rail grants provided by the Federal Railroad Administration to improve the corridor in Washington state.

Building on our collaborative approach, we look forward to the growth of the Amtrak Cascades service in the future and the successful implementation of the plan's recommendations to support that effort.

Ron Pate
Director, WSDOT Rail, Freight, and Ports Division

H.A. (Hal) Gard
Administrator, ODOT Rail and Public Transit Division

The planning and management of fleet issues has to be a “living” process in order to ensure fleet-strategy decision making relates to current and planned service. As such, the Fleet Management Plan should be reviewed and revised accordingly on a biennial basis. Periodic review and updates would reflect the latest development in planned services, the status of the existing fleet, the status of equipment acquisitions and any changes to stakeholder relationships.

**Revision History**

| Rev. No. | Rev. Date | Sections Affected | Comments |
|---|---|---|---|
| 1 | December 2011 | All | Final: Draft Deliverable – ARRA Program |
| 2 | June 2015 | All | Draft: Final Deliverable – ARRA Program |
| 3 | June 2017 | All | Final Deliverable – ARRA Program |
| 4 | November 2017 | Chapter 3, Section 3.7 | Minor updates per August 2017 comments from FRA |
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# Executive Summary

Intercity passenger rail is a critical component of the Pacific Northwest region's multimodal transportation system. Both Washington and Oregon's respective State Rail Plans (SRPs) define their vision, goals and objectives for passenger rail service. Both SRPs, identify the importance of having a plan in place that outlines future equipment needs and identifies investment strategies for the Amtrak Cascades corridor. Therefore, this Fleet Management Plan (FMP) represents a collaborative effort between Washington State Department of Transportation (WSDOT) and Oregon Department of Transportation (ODOT) to address that need. It documents how demands for Amtrak Cascades equipment and maintenance facilities are met today; as well as how they will be addressed once major federally-funded infrastructure improvements are completed in 2017, and what equipment and maintenance needs must be met through 2037 to ensure the continued growth of the Pacific Northwest's intercity passenger rail system.

The Federal Railroad Administration (FRA), in cooperation with various states and other partners, is developing standards for "next generation," high-speed passenger train equipment. To be eligible for the funds, future equipment for the Amtrak Cascades service must demonstrate a consistency with these federal standards. Expanded upon below, one of the objectives of the FMP is to assess present and future ridership demand in order to establish an approach for fleet support and to ensure compliance with federal standards.

### Purpose of the Plan

The primary purpose of the FMP is to evaluate passenger rail service goals of increasing service, improving reliability, and reducing journey times from an equipment perspective. The objective is to develop an approach that informs strategic investments and optimizes business operations. The FMP aligns with WSDOT's and ODOT's strategic goals, including:

- Strategic investment for preserving and sustaining the current equipment and infrastructure.
- A more "connected system" that further integrates transit modes throughout the region.
- Environmental stewardship with the intent of preserving and enhancing the quality of life for riders, the community and the environment
- Organizational strength and community engagement that promotes partnership, collaboration and communication.
- Technological advancement that promotes system safety, economic development and passenger convenience and customer satisfaction.

> The objective of the FMP is to develop an approach that informs strategic investments and optimizes business operations from an equipment perspective.

The FMP answers key questions that help assess fleet demand within the Amtrak Cascades corridor, including:

- How much equipment is required to deliver passenger rail service over the next 20 years?
- What resources are required to sustain equipment currently and in the future?

- What is the capacity of the passenger rail maintenance facilities to ensure the equipment fleet is efficiently maintained for reliability and longevity over the next 20 years?

Broadly speaking, the FMP defines fleet management through three unifying pillars:

1. ***Sustaining and enhancing the current fleet:*** Sustaining the longevity and reliability of a fleet will achieve the broadest benefits to the system through a variety of actions that include regular maintenance, overhauls for preservation and modernization or updates to the current fleet.
2. ***Acquiring new equipment and additional service expansion:*** Equipment acquisition is necessary to ensure there is the right amount of equipment to meet the customer demands. Ridership growth often triggers a demand for more equipment to fill the capacity needs and equipment nearing the end of its lifespan must be strategically replaced so as to ensure continued service and maximize purchase power.
3. ***Providing maintenance capacity and resources:*** Infrastructure, personnel, and maintenance schedules for both the current and projected fleet must be well-planned to best support maintenance, overhaul and modernization efforts.

## Process of the Plan

WSDOT and ODOT staff engaged in a colloaborative process to develop the FMP. Input from various operations, maintenance and infrastructure stakeholders, who understand the history and goals of the Amtrak Cascades service, was collected. This included building on outreach conducted in other planning efforts and interviewing representatives from FRA, Amtrak, Talgo and host railroads[1] to inform development of the FMP.

In addition to input from stakeholders, data and information about existing conditions, challenges and service demand across the corridor was reviewed and included the following:

- Future ridership and planned equipment rotations and usage.
- Current equipment condition and support requirements.
- The cost of ownership and projections for the fleet's commercial life.
- The funding requirements to meet the investment required for the service.
- The requirements for new equipment.
- The primary maintenance facility's current capacity and proposed enhancements.
- The effect of future service on the current maintenance facility and layover locations, as well as the demand for new or expanded locations.

The FMP summarizes key findings and outlines proposed strategies and considerations when assessing service growth, corridor management, and equipment and support facility investment over the 20 years following the completion of the 2017 service improvements.

### Detailed Service Scenarios

Amtrak Cascades operates on the Pacific Northwest Rail Corridor (PNWRC). WSDOT's SRP identified long-term goals for service frequency and journey times for the Washington segment

[1] Host railroads are track owners and operators for Amtrak Cascades. For this plan, outreach was conducted with BNSF Railway, Union Pacific and Sound Transit.

of the PNWRC and ODOT identified similar objectives for service south of Portland. The FMP includes four service scenarios based on each state's goals and ridership demands for the corridor over the next 20 years. A baseline scenario (Scenario 1) was established using 2017 service levels: two roundtrips between Seattle and Vancouver, British Columbia, six roundtrips between Seattle and Portland, and two round trips between Portland and Eugene. To project future equipment demand, three additional scenarios were developed. The four scenarios offer a more rounded picture of growth under different service levels, including how ridership growth could affect the corridor, fleet and maintenance requirements. Appendix D provides more detail on the approach to scenario planning.

### Developing Realistic Ridership Growth Projections (demand) / Applying an Equipment Lifespan

The FMP initially used base operations ridership data from 2013 for the Amtrak Cascades corridor. Ridership projections were then developed through modeling that used data from each state. Over the last three years, these models have shown a strong correlation between the projections and the actual performance. Chapter 6 details outputs from that model.

The projected lifespan of equipment also was evaluated from a planning perspective in order to determine when equipment would need to be replaced. In addition, a cost-model was developed to define the optimal lifespan of the equipment from a cost perspective.

### Reconciling the Technical Analysis with Existing and Future Conditions

The makeup of the Amtrak Cascades fleet will evolve as new equipment is added and old equipment ages or is retired. Changes also will occur as service goals identified within each state's SRP evolve. Therefore, the FMP is designed to be a living document updated on at least a biennial basis The expectation is that with each revision, the FMP's long-term outlook be refined, while WSDOT and ODOT uses the most recent version to implement near-term strategies.

### Applying Core Principles

Equipment strengths and challenges are best understood in terms of four core principles that guide how WSDOT and ODOT evaluate the current Amtrak Cascades fleet and ultimately determine an equipment acquisition approach that responds to ridership demand and service expansion. Each agency applies a four-fold fleet management approach:

- **Pooling fleet equipment**–For two decades, WSDOT, ODOT and Amtrak have shared equipment across the corridor, regardless of ownership. This practice is affirmed by the FMP.
- **Partnering to streamline acquisitions**–Leverage multi-state procurements, such as the production of Siemens Charger locomotives.
- **Business case value**–Maintains performance-based investment and asset management strategies to maximize benefits and minimize costs of existing and new/replacement equipment.
- **Flexible and scalable fleet**–Both agencies understand the importance of passenger vehicles that can meet operational surges in demand and be easily rotated in/out of service.

## Supporting Service Development

Current service expansion is predicated on the 2017 completion of an extensive FRA-funded capital improvement program in Washington. In addition to infrastructure improvements, as part of this program, WSDOT is procuring eight Siemens Charger locomotives. The new locomotives are designed per specifications developed by the Next Generation Equipment Committee (NGEC) and will be more reliable, fuel efficient, and produce lower emissions than equipment currently in service. Upon completion of the capital program, WSDOT will be able to increase the roundtrips from four to six and reduce the scheduled run time between Seattle and Portland, and improve on-time performance to 88 percent.

## Reconciling Supply and Demand

This plan outlines an approach for addressing present-day and future Amtrak Cascades service demand and long-term expansion goals. This approach presents a series of options expressed as *strategies* and *considerations* to guide the process when assessing service growth, managing the corridor, and investing in equipment and support facilities over the next 20 years. These options are summarized in Table ES.1

**Table ES-1-1: FMP Strategies and Considerations Overview**

| Element | Description |
|---|---|
| **Strategy 1:** Managing demand (short-term) | Manage demand (for example, tailoring ticket pricing) on current services to address short-term ridership growth. |
| | Evaluate the potential to increase capacity in the existing trainsets. |
| **Strategy 2:** Modifying operations (short-term) | Modify operations through acquiring additional passenger vehicles/cars to increase trainset seating capacity to address short-term ridership growth. |
| **Strategy 3:** Investing in equipment (long-term) | **Consideration 3a:** Apply a set of established criteria for developing a compelling business case for all future acquisition programs. |
| | **Consideration 3b:** Tie replacement equipment to service-level increases (whenever possible). |
| | **Consideration 3c:** Improve fleet flexibility to simplify operations. |
| | **Consideration 3d:** Tie future acquisitions to service-level increases (whenever possible). |
| | **Consideration 3e:** Confirm that replacement dates are flexible enough to meet the timeframe for additional acquisition and to maximize order quantities. |
| **Strategy 4:** Maintenance facility investments (long-term) | When replacing or adding equipment, also consider maintenance facility, track, storage and work area capacity. |
| **Strategy 5:** Ensuring the FMP is a living document | Revise the FMP on a biennial basis to reflect the latest development in planned services, the status of the existing fleet, the status of equipment acquisitions and any changes to stakeholder relationships. |

## Equipment Needs and future Investment

Ensuring a reliable fleet with sufficient capacity to accommodate ridership growth, and to provide an appealing customer environment and service level, requires careful consideration and significant financial investment.

The FMP developed a 20-year equipment outlook for the currently funded 2017 service and three other potential future service scenarios. While the FMP analyzes four different service scenarios, this version of the plan primarily focuses on the equipment needs of the currently funded 2017 service (Scenario 1) based on current forecasts of ridership growth and the projected out of service date for existing equipment.

Under the current modeled growth for Scenario 1, seating capacity would need to increase from about 1,800 seats currently to approximately 2,300 seats by 2037. In addition, five of the seven trainsets that serve the Amtrak Cascades corridor are nearing their life-span planning goal of 25 years.

In addition, five of the seven trainsets that serve the Amtrak Cascades corridor are nearing their life-span planning goal of 25 years. Based on the life-cycle cost/benefit analysis contained in this report, the optimal replacement date for the Series 6 trainsets is in 2025. The existing equipment could continue in service beyond the proposed replacement date, however a delayed retirement would require further investment in the aging fleet for overhauls and modifications.

Through evaluation and modeling, the FMP proposes procuring passenger vehicles/cars by 2025. To meet a 2025 in-service date, an equipment acquisition program should be initiated by 2019. The actual replacement date, along with the detailed requirements for the new equipment, will be determined based on a final business case evaluation using key performance parameters outlined in this FMP and would be subject to funding availability.

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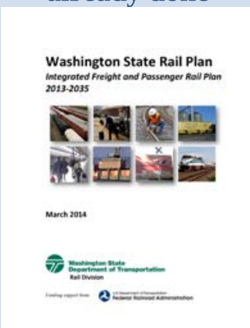
# Chapter 1. Introduction

**Building on what we have already done**


Washington State Rail Plan
*Integrated Freight and Passenger Rail Plan*
*2013-2035*

March 2014

**Washington State Rail Plan Vision Statement:**

As an integral part of Washington's multimodal transportation network, the rail system provides for the safe, reliable and environmentally responsible movement of freight and passengers to ensure the state's economic vitality and quality of life.


Oregon State Rail Plan

Adopted September 18, 2014

Oregon Department of Transportation

**Oregon State Rail Plan Vision Statement:**

Oregon will have a safe, efficient, and commercially viable rail system that serves its businesses, travelers and communities through private resources leveraged, as needed, by strategic public investments.

This chapter:

- Describes the assumptions and constraints for both current and future service and concludes in listing the necessary changes in service for each scenario from present day to 2037.
- Describes potential service scenarios, which include progressively higher levels of service.
- Lists the projected equipment order quantities under each of the four scenarios.
- Outlines some guidelines for planning purposes, which will be appropriate for any changes considered in the State Rail Plan (SRP) and will relate to the rolling stock investments proposed as part of the Fleet Management Plan (FMP).
- Explains the different contractual relationships used to deliver the Amtrak Cascades corridor services.

Intercity passenger rail is a critical component of the Pacific Northwest region's multimodal transportation system that serves to keep people and the economy moving. Both Washington and Oregon have prepared plans that establish policy, priorities and implementation strategies for each state's passenger rail transportation system. Washington and Oregon's respective SRPs are the guiding documents behind development of this FMP. It outlines a number of strategies and considerations for the equipment and support facilities needed to most effectively accommodate the traveling public and manage local and regional transportation demand over a 20-year period from 2017 to 2037.

As described in Washington's SRP, the region's rail transportation system faces significant near- and long-term challenges that include:

- Economic and demographic growth within the major urban centers and the larger region will increase demand for passenger rail services, challenging the capacity of the private rail network over which passenger and freight trains operate.
- Federal passenger rail policy has provided capital funding to expand the frequency and reliability of intercity passenger rail, but this requires each state to bear more costs for operating these services.

This FMP analyzes current and future challenges in terms of strategies and considerations tailored to meet these challenges.

## 1.1 What is the Amtrak Cascades Service?

The Amtrak Cascades service connects communities from Vancouver, British Columbia to Eugene, Oregon via Seattle and Portland on a 467-mile rail corridor. Listed as one of 11 federally designated, highspeed rail corridors in the nation, the Pacific Northwest Rail Corridor (PNWRC) primarily parallels Interstate 5 (I-5) and is a critical north-south line for local, regional and statewide passenger and freight rail operations. Amtrak Cascades is a state-supported service jointly administered by the Washington State Department of Transportation and Oregon Department of Transportation in contractual collaboration with Amtrak, host railroads (Sound Transit, Union Pacific Railroad, BNSF Railway Company), and equipment manufacturers (Talgo and Siemens). To ensure on-time performance, train designers and operators have worked to safely maximize speeds along the corridor's many curves and varied topography. The Amtrak Cascades service was first introduced in 1994 and has become increasingly popular for both business travelers and tourists, with service connecting major metropolitan and urban centers throughout the Northwest. Currently, the Amtrak Cascades service runs 4,000 trains per year with stops in 18 cities. This consists of 11 trains offering two daily round trips between Seattle and Vancouver, BC, four daily round trips between Seattle and Portland, and two daily round trips between Portland and Eugene. The service runs on track owned by the BNSF Railway Company, Sound Transit and the Union Pacific Railroad.

**Figure 1-1: Corridor Limits**

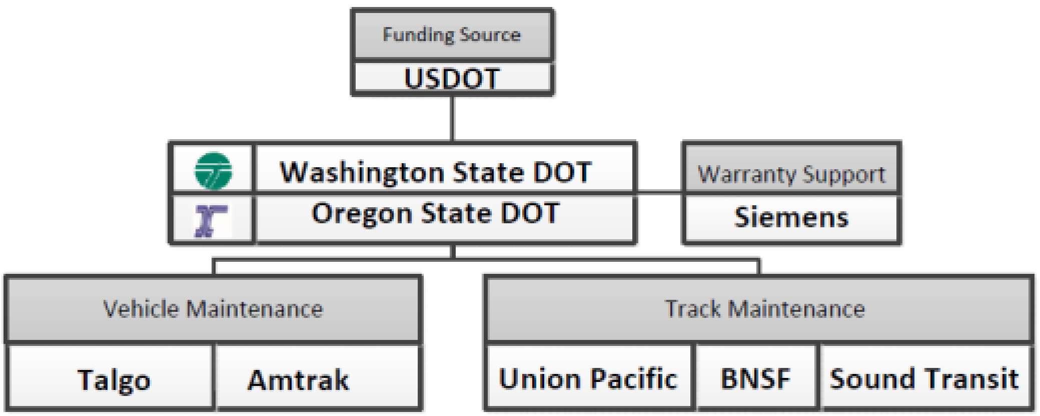

Ridership on the corridor has increased from roughly 180,000 riders in 1994 to more than 744,000 in 2015. The highest level of ridership during this period occurred in 2011, at 848,000 passengers, with levels decreasing in subsequent years, primarily due to construction activities related to the Federal Railroad Administration (FRA)-funded infrastructure improvement program in Washington. A majority of riders travel between Seattle and Portland, making these the two most popular station stops on the corridor. Many stations integrate with commuter rail, light rail, bus and pedestrian facilities to enhance multimodal connections, optimize throughput capacity, and promote seamless system operations.

To accommodate current ridership demand, Washington State Department of Transportation (WSDOT) and Oregon Department of Transportation (ODOT) provide daily service through a train fleet consisting of seven trainsets (sets of passenger train cars) with a capacity of about 250 passengers each. WSDOT owns three trainsets and ODOT and Amtrak own two each. All of the trainsets are scheduled into service each day. Six of the trainsets serve the entire corridor starting and ending in Seattle. This cycle is completed every six days. One trainset serves one of the daily routes between Seattle and Vancouver, B.C. Details of the trainset configurations and equipment ownership can be found in Chapter 3.

## 1.2 Roles and Responsibilities

Providing intercity passenger rail service on the PNWRC requires functional partnerships from public and private entities including, but not limited to, Washington, Oregon, British Columbia, Amtrak, host railroads, and equipment manufacturers. These partnerships are managed through constant collaboration, service contracts and agreements with varying levels of roles and responsibilities in terms of acquiring, operating and maintaining the equipment and facilities that support the service. This section highlights these entities. A more detailed discussion of the activities involved in fulfilling the obligations of the various parties is provided in Chapter 4.

**Figure 1-2: Maintenance Diagram Describing Roles/Responsibilities**




### WSDOT

WSDOT is a cabinet agency led by the secretary of transportation appointed by the governor. WSDOT is funded through a biennial transportation budget that is separate from the state's general operating and capital budgets. WSDOT not only manages the state highway system, but also owns assets including ferry boats and terminals, public-use airports, freight rail cars, short-line rail lines, passenger rail trainsets and stations. The Rail, Freight, and Ports Division (formally State Rail and Marine) is responsible for the following:

- Administering the operation of Amtrak Cascades service.
- Developing plans and programs for passenger rail service.
- Managing three WSDOT-owned trainsets.
- Procuring passenger rail equipment.
- Managing station assets and leases.
- Completing projects from federal high-speed rail funds.
- Administering local freight rail projects through grant and loan programs.

### ODOT

ODOT is led by a governor-appointed director. Oregon has one biennial budget for all state government agencies. ODOT manages the state highway system and also owns rail assets, system roads, bridges, railways, public transportation services, transportation safety programs, Department of Motor Vehicles and motor carrier regulations. The Rail and Public Transit Division is responsible for the following:

- Administering the operation of Amtrak Cascades service.
- Freight and passenger rail planning and operations, including contracting for train and motor coach services and supervising rail improvement projects between Eugene and Portland.
- Safety of the state's rail system and certified by FRA to inspect track, railroad equipment and cars, hazardous materials, and operating practices.
- Managing 155 miles of right-of-way (150 miles with tracks).
- Managing ODOT-owned passenger rail assets including: two trainsets, three cab cars, and one station.
- Completing projects from federal high-speed rail funds.
- Developing an SRP.
- Corridor Investment Plan Environmental Impact Statement project.
- Crossing safety authority over all public highway railroad crossings.

### Amtrak

Amtrak (National Railroad Passenger Corporation) was created in 1971 by the federal Rail Passenger Service Act of 1970 to assume the common carrier obligations of the private railroads. In exchange, Amtrak has the right to priority access of Class I tracks for incremental cost. Amtrak is a private for-profit corporation with the federal government as its majority stockholder.

ODOT and WSDOT have separate agreements contracting with Amtrak to operate Amtrak Cascades Intercity Passenger Rail Service in their respective states. These agreements address service objectives including schedules (frequency, travel times, and station stops), equipment, and onboard passenger amenities. Additionally, Amtrak will be leasing the new Charger locomotives from WSDOT upon their delivery to use in provision of Amtrak Cascades passenger services.

Amtrak has agreements with BNSF Railway Company (BNSF) and Union Pacific Railroad (UPRR) that address track usage, train dispatching, maintenance of track and structures, on-time performance, locomotive fuel, and supply of spare locomotives.

Amtrak also owns and operates a maintance facility in Seattle that serves as the primary maintenance facility supporting all seven Amtrak Cascades trainsets. Facility personnel provide daily upkeep, restock consumables, clean the interior and exterior of the trainsets, replenish fluids and conduct preventive maintenance and major or minor repairs as needed for each trainset.

### British Columbia Ministry of Transportation and Infrastructure (BCMoTI)

BCMoTI does not currently contribute operating funds for Amtrak Cascades, but supports the program through coordination with WSDOT and ODOT. For example, BCMoTI staff participate in on task forces and advisory committees related to the service. The states and province collaborate on cross-border passenger rail issues and have a history of success in many areas.

### Talgo

Talgo is the Original Equipment Manufacturer (OEM) of trains used in Amtrak Cascades service and has separate maintenance contracts with each of the three equipment owners–WSDOT (three trainsets), Amtrak (two trainsets), and ODOT (two trainsets). The maintenance contracts with WSDOT and Amtrak are for 20 years and expire in 2019. ODOT currently has an Interim Agreement that was drafted with the introduction of their trainsets.

### Siemens

Siemens is the OEM for the Charger locomotives currently being acquired by WSDOT for use in the Amtrak Cascades service. They will provide warranty support and reliability monitoring as part of the acquisition contract.

### Federal Railroad Administration (FRA)

The FRA is the U.S. Department of Transportation’s agency responsible for the oversight of the nation’s freight and passenger rail service. FRA’s passenger rail activities include:

- Administering federal grants to Amtrak.
- Supporting the U.S. Secretary of Transportation membership on Amtrak’s board of directors.
- Providing guidance and analysis of intercity passenger rail services and high-speed rail (HSR).
- Administering federal grants to states for intercity passenger rail capital improvement projects and HSR development—including those along the Pacific Northwest Rail Corridor (PNWRC).
- Overseeing safety and security of freight and passenger train service.

### Union Pacific Railroad (UPRR)

UPRR is a private railroad company that owns the rail lines Amtrak Cascades uses between Eugene and Portland, Oregon. UPRR is required by federal law to provide access for incremental cost to Amtrak in exchange for being relieved of common carrier obligations to carry passengers. Amtrak Cascades services operate on their infrastructure. However, they do not have a direct role in equipment issues beyond approving the use of equipment on their tracks.

### BNSF Railway Company (BNSF)

BNSF is a private railroad company that owns rail lines Amtrak Cascades uses between Portland, Oregon and Vancouver, British Columbia. BNSF is required by federal law to provide for incremental cost to Amtrak in exchange for being relieved of its common carrier obligations to carry passengers. Amtrak Cascades services operate on their infrastructure. However, they do not have a direct role in equipment issues beyond approving the use of equipment on their tracks.

### Sound Transit

Sound Transit (ST) is a regional transit and taxing authority established to provide transit service, and includes regional bus, light rail and commuter train service. Amtrak Cascades services operate on a short portion of rail line (between Tacoma and Nisqually Wash.) owned by ST. As is the case with other host railroads, ST does not have a direct role in equipment issues beyond approving the use of equipment on their infrastructure.

## 1.3 Consistency with Transportation and Rail Plans and Policy

An important component of a corridor's operating environment entails how current and future service fits with previous planning efforts and policy directives. The FMP is only one component of a broader transportation program for both states. As such, the plan's integration within the larger program is paramount for incorporating practical strategies and considerations that enhance mobility and service along the corridor. Table 1-1 lists the plans and policies that have relevance to this FMP and the current operating environment.

**Table 1-1: Relationship To Transportation Plans, Policies and Studies**

| Year | Title/Agency | Consistency |
|---|---|---|
| **Underway** | Oregon Passenger Rail Study<br>ODOT | Evaluates options for improved passenger rail service between Eugene-Springfield and Portland, Ore. |
| **2015** | USDOT Planning Efforts<br>FRA | PRIIA and MAP-21 include provisions to develop strategies, guidance and or plans for passenger rail. Both federal policies guide and inform how each state plans, develops and funds its transportation system. |
| **2014** | Washington SRP<br>WSDOT | The Washington SRP established goals, needs and recommendations for passenger rail throughout the state. The FMP defines equipment and maintenance strategies and considerations to deliver service consistent with the SRP. |
| **2014** | Oregon SRP<br>ODOT | Oregon published its SRP to document issues, opportunities and the overall vision of its rail system. The FMP defines equipment and maintenance strategies and considerations to deliver service consistent with the SRP. |
| **2013** | Corridor Intergovernmental Agreement<br>WSDOT and ODOT | Superseding the 2012 MOU, this agreement formally documents joint funding and oversight responsibilities for the Amtrak Cascades service. The FMP carries this vision forward with a corridor approach to fleet pooling. |
| **2013** | Cascades Rail Corridor Management Workplan<br>WSDOT and ODOT | The FMP's framework for agency collaboration is consistent with how Washington and Oregon jointly manage the corridor in accordance with this management workplan. |
| **2012** | Memorandum of Understanding<br>WSDOT and ODOT | This MOU committed WSDOT and ODOT to the concept of a joint operation of the service as a single corridor. The FMP carries this vision forward with a corridor approach to fleet pooling. |
| **2008** | Amtrak Cascades Mid-Range Plan<br>WSDOT | This mid-range plan evaluates specific steps identifying and developing options that outline how to achieve incremental Amtrak Cascades service increases. WSDOT's capital program resulted from this effort. |
| **2006** | Long-Range Plan for Amtrak Cascades<br>WSDOT | The detailed operating and capital strategies within the long-range plan were the basis for developing the equipment and maintenance details in this FMP. Fleet requirements were evaluated against established and projected travel times and train frequencies. |

Sources: Washington SRP, Oregon SRP and Consultant Analysis.

Notes: The Passenger Rail Investment and Improvement Act of 2008 (PRIIA) mandated a transition of the control of services and financial responsibility for intercity services from Amtrak to the states. Section 1.5 provides more information on the contractual arrangements created because of PRIIA.

## 1.4 Projected Future Service and Equipment Demand

Currently there are four round trips per day between Seattle and Portland. Two round trips operate between Portland and Eugene and two round trips operate between Seattle and Vancouver BC. This level of service has been operated since 2009. With the completion of the capital improvement program in Washington, two additional round trips will be introduced between Seattle and Portland in 2017. This will be achieved with the current equipment although the current locomotives will be replaced with new Charger locomotives being procured under the FRA-funded ARRA program.

### Assumptions for Future Service

In order to evaluate future equipment needs, it is necessary to consider what possible scenarios for future service there could be. These scenarios would cover differing levels of service for different segments of the corridor. Given the uncertainties about future service levels, these scenarios would not be the definitive future service but would provide a good approximation across the potential range of cases that have been identified within each state's SRP.

The train frequencies directly inform growth of corridor ridership. In determining future passenger demand, several service growth patterns were developed based on service goals identified in WSDOT's and ODOT's SRPs. These scenarios were evaluated using each of the three route segments on the corridor and provide a range of options, starting with a baseline level of the funded service in Scenario 1, with increasing service levels up to Scenario 4, to achieve the goals set by each SRP. The analysis leads to a listing of the necessary changes needed for the service under each scenario from present day to 2037.

The future levels of service are contingent on a number of factors, including funding from the legislatures and agreements with host railroads, service operators and maintenance entities. Table 1-2 details the number of daily roundtrips for each segment under the four scenarios and highlights the changes in service for each scenario from present day to 2037 (interim years are not listed because no change in service is projected in those years), allowing WSDOT and ODOT to make meaningful decisions about future service that take into account these factors.

**Table 1-2: Modeled Scenarios Showing Number of Daily Round Trips by Segment and Year**

| Scenario 1[a] | 2016 | 2017 | 2019 | 2021 | 2023 | 2025 | 2027 | 2029 | 2030 | 2031 | 2035 | 2037 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seattle – Vancouver, B.C. | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Seattle - Portland | 4 | **6** | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Portland - Eugene | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **Scenario 2[a]** | **2016** | **2017** | **2019** | **2021** | **2023** | **2025** | **2027** | **2029** | **2030** | **2031** | **2035** | **2037** |
| Seattle – Vancouver, B.C. | 2 | 2 | 2 | 2 | 2 | 2 | **3** | 3 | 3 | 3 | 3 | 3 |
| Seattle - Portland | 4 | **6** | 6 | 6 | 6 | 6 | **8** | 8 | 8 | 8 | 8 | 8 |
| Portland – Eugene | 2 | 2 | 2 | 2 | 2 | **3** | 3 | 3 | 3 | 3 | **4** | 4 |
| **Scenario 3[a]** | **2016** | **2017** | **2019** | **2021** | **2023** | **2025** | **2027** | **2029** | **2030** | **2031** | **2035** | **2037** |
| Seattle – Vancouver, B.C. | 2 | 2 | 2 | 2 | 2 | **3** | 3 | 3 | 3 | 3 | 3 | 3 |
| Seattle - Portland | 4 | **6** | 6 | 6 | 6 | **8** | 8 | 8 | 8 | **10** | 10 | 10 |
| Portland - Eugene | 2 | 2 | 2 | **3** | 3 | 3 | 3 | **4** | 4 | 4 | 4 | 4 |
| **Scenario 4[a]** | **2016** | **2017** | **2019** | **2021** | **2023** | **2025** | **2027** | **2029** | **2030** | **2031** | **2035** | **2037** |
| Seattle – Vancouver, B.C. | 2 | 2 | 2 | 2 | **3** | 3 | 3 | 3 | **4** | 4 | 4 | 4 |
| Seattle - Portland | 4 | **6** | 6 | 6 | **8** | 8 | **10** | 10 | **13** | 13 | 13 | 13 |
| Portland - Eugene | 2 | 2 | **3** | 3 | 3 | **4** | 4 | 4 | **5** | 5 | **6** | 6 |

[a] *Future service is contingent on future funding and other factors. Because of that uncertainty, a range of scenarios was used to evaluate fleet needs under a range of circumstances. Scenarios range in growth from (low) funded service levels in Scenario 1 to (high) meeting the highest level of service discussed in the State Rail Plans for Oregon and Washington by 2035 in Scenario 4. Scenarios 2 and 3 provide intermediate service growth.*

### Estimated Future Equipment Demand

In order to determine the level of demand for equipment, the model functions on a seating basis, that is then translated into number of cars to provide a tangible understanding of the potential equipment purchases needed.[2] This section lists the projected equipment order quantities under each of the four scenarios (including an additonal option under Scenario 1) and also discusses:

- Consideration for order size and timing, including the rationale for grouping purchases.
- Mixed equipment operations, including considerations to evaluate when to consider operations with different equipment types.
- Alternatives for managing seating capacity, including ways for managing the fleet when seating demand exceeds capacity: delaying retirements, reducing spare ratios, demand management, reconfiguring vehicles to increase seating and accepting a ridership limitation.
- Establishing a business case for fleet composition that would include considerations and performance parameters.

The development of each scenario for future service and the analysis of planned equipment life ultimately support a projection of rolling stock demand for future years. Future demand depends on the scenario and becomes the basis for all planning related to maintenance, operations and the associated funding. At the appropriate time, WSDOT and ODOT will evaluate the demand against actual ridership levels, availability of equipment and funding for service, to determine the recommended course of action.

Based on the four scenarios, equipment acquisition was modeled for future years based on the 20-year planning horizon. It should be noted that the equipment projections are for planning purposes only. The levels of service are not necessarily funded, and operations and maintenance contract modifications are not in place nor are the issues associated with track access and infrastructure improvements agreed upon with host railroads. Adding service would require that WSDOT and ODOT finalize these issues before proceeding. The equipment projections discussed in this section assume that WSDOT and ODOT have resolved these issues in advance of, or in parallel with, the acquisition of any additional equipment.

> Equipment acquisition projections are for planning purposes only. Ultimately, the quantity and type of equipment to be acquired will be identified after a business case evaluation using criteria described in this FMP.

The following tables illustrate the modeled equipment order quantities for the future years under each of the four scenarios based on demand. The tables indicate the years in which new equipment would be acquired. Interim years are not listed because no equipment is projected to be acquired in those years. Although the model included both bi-level and single-level/trainset equipment,[3] for illustrative purposes, only the single-level/trainset modeled equipment acquisitions are shown.

[2] The total number of cars includes all of the equipment required to configure a complete train.
[3] See Table D-1 in Appendix D for modeled quantities of all three types of equipment.

**Table 1-3: Modeled Equipment Acquisitions for Scenario 1**

| Year | Locomotives | Cab/Baggage/Power | Food Service | Coach | Business |
|---|---|---|---|---|---|
| 2025 | - | 9 cars | 8 cars | 29 cars | 8 cars |
| 2031 | - | - | - | 1 car | - |

**Table 1-4: Modeled Equipment Acquisitions for Scenario 1A**

| Year | Locomotives | Cab/Baggage/Power | Food Service | Coach | Business |
|---|---|---|---|---|---|
| 2017[a] | 3 locos | - | - | 14 cars | 6 cars |
| 2025 | - | 9 cars | 8 cars | 29 cars | 8 cars |
| 2031 | - | - | - | 1 car | - |

*[a] Assumed to be additional passenger vehicles/cars for the existing trainsets.*

*Note: Scenario 1A is the same as Scenario 1 but it includes the addition of locomotives and additional vehicles to meet fleet sizing needs rather than maintaining the current fleet size.*

**Table 1-5: Modeled Equipment Acquisitions for Scenario 2**

| Year | Locomotives | Cab/Baggage/Power | Food Service | Coach | Business |
|---|---|---|---|---|---|
| 2017 | 3 locos | - | - | - | - |
| 2025 | 1 loco | 10 cars | 9 cars | 34 cars | 9 cars |
| 2027 | 1 loco | 1 car | 1 car | 3 cars | 1 car |
| 2028 | - | - | - | 2 cars | - |
| 2029 | - | - | - | 2 cars | - |
| 2032 | - | - | - | 2 cars | - |
| 2036 | - | - | - | 2 cars | - |
| 2037 | - | - | - | 2 cars | - |

**Table 1-6: Modeled Equipment Acquisitions for Scenario 3**

| Year | Locomotives | Cab/Baggage/Power | Food Service | Coach | Business |
|---|---|---|---|---|---|
| 2017 | 3 locos | - | - | - | - |
| 2021 | 1 loco | 5 cars | 4 cars | 8 cars | 4 cars |
| 2025 | 1 loco | 6 car | 6 car | 29 cars | 6 car |
| 2026 | - | - | - | 2 cars | - |
| 2027 | - | - | - | 4 cars | - |
| 2031 | 1 loco | 1 car | 1 car | 7 cars | 1 car |
| 2033 | - | - | - | 2 cars | - |

**Table 1-7: Modeled Equipment Acquisitions for Scenario 4**

| Year | Locomotives | Cab/Baggage/Power | Food Service | Coach | Business |
|---|---|---|---|---|---|
| 2017 | 3 locos | - | - | - | - |
| 2019 | 1 loco | 5 cars | 4 cars | 8 cars | 4 cars |
| 2023 | 1 loco | 1 car | 1 car | 4 cars | 1 car |
| 2024 | - | - | - | 1 car | - |
| 2025 | - | 5 cars | 5 cars | 28 cars | 5 cars |
| 2027 | 1 loco | 1 car | 1 car | 9 cars | 1 car |
| 2029 | - | - | - | 3 car | - |
| 2030 | 4 locos | 4 cars | 4 cars | 10 cars | 4 cars |
| 2031 | - | - | - | 10 cars | - |
| 2032 | - | - | - | 6 car | - |
| 2036 | - | - | - | 1 car | - |

The level of vehicle demand reflects significant order quantities when WSDOT and ODOT anticipate equipment replacement and when additional services will result in an increase in equipment demand. The modeling also shows small incremental requirements that result from ridership growth and the requirement for additional seating capacity on existing services. From a practical perspective, the procurement of individual or small quantities of passenger vehicles/cars would not be financially prudent unless WSDOT and ODOT are able to participate in a procurement already being undertaken by a different agency.

Therefore, a wise business case can be made to consolidate orders for upcoming years in order to provide economies of scale and to make the acquisition practical (i.e., ordering in bulk to achieve a lower per unit cost). These additional vehicles then will allow for growth in ridership as it develops. Such an approach may result in consolidating equipment orders for each scenario in the identified years, as shown in Table 1-8 to Table 1-12.

**Table 1-8: Consolidated Modeled Equipment Acquisitions for Scenario 1**

| Year | Locomotives | Cab/Baggage/Power | Food Service | Coach | Business |
|---|---|---|---|---|---|
| 2025 | - | 9 cars | 8 cars | 30 cars | 8 cars |

**Table 1-9: Consolidated Modeled Equipment Acquisitions for Scenario 1A**

| Year | Locomotives | Cab/Baggage/Power | Food Service | Coach | Business |
|---|---|---|---|---|---|
| 2017[a] | 3 locos | - | - | 14 cars | 6 cars |
| 2025 | - | 9 cars | 8 cars | 30 cars | 8 cars |

[a] *Assumed to be additional passenger vehicles/cars for the existing trainsets.*

**Table 1-10: Consolidated Modeled Equipment Acquisitions for Scenario 2**

| Year | Locomotives | Cab/Baggage/Power | Food Service | Coach | Business |
|---|---|---|---|---|---|
| 2017 | 3 locos | - | - | - | - |
| 2025 | 2 locos | 11 cars | 10 cars | 46 cars | 10 cars |

**Table 1-11: Consolidated Modeled Equipment Acquisitions for Scenario 3**

| Year | Locomotives | Cab/Baggage/Power | Food Service | Coach | Business |
|---|---|---|---|---|---|
| 2017 | 3 locos | - | - | - | - |
| 2021 | 2 locos | 5 cars | 4 cars | 16 cars | 4 cars |
| 2025 | - | 7 cars | 7 cars | 36 cars | 7 cars |

**Table 1-12: Consolidated Modeled Equipment Acquisitions for Scenario 4**

| Year | Locomotives | Cab/Baggage/Power | Food Service | Coach | Business |
|---|---|---|---|---|---|
| 2017 | 4 locos | - | - | - | - |
| 2019 | - | 6 cars | 5 cars | 24 cars | 5 cars |
| 2023 | 2 locos | - | - | - | - |
| 2025 | 4 locos | 10 cars | 10 cars | 55 cars | 10 cars |

## Considerations for Order Timing and Sizing

Three main factors drive the schedule for the acquisition of equipment:

- Equipment needs for enhanced levels of service.
- New equipment to replace retiring equipment.
- Additional cars to lengthen trains based on increased ridership demands.

It is important to note that these three factors do not result in equal levels of demand. Replacement of existing equipment requires larger quantities, while new service requires less equipment, and incremental ridership growth has the smallest equipment demand of the three. However, the economics of equipment ordering mean that acquiring larger quantities of equipment at one time is easier to manage because the volume of production is most attractive to potential car builders, as such it could be the most cost effective approach for WSDOT and ODOT. Competitive pricing and willingness to bid are at their highest in this case.

When service growth is required, the increase in equipment to achieve service might only be a single new trainset. This smaller quantity is harder to source from the market. If WSDOT and ODOT require equipment to be common with existing equipment, this may limit the competitiveness of the acquisition process. Moreover, finding a manufacturer willing to build a smaller quantity may be problematic unless they already have an active production line.

Likewise, acquiring additional vehicles to grow capacity on existing trainsets are the hardest situation to accommodate. Vehicle manufacturers are not typically interested in individual vehicle orders unless they are already have orders for the same vehicle type in production. Therefore, it is not practical to acquire individual vehicles on a reliable basis, and WSDOT and ODOT should combine any future growth requirements with acquisitions planned for preceding years in order to increase the size of the orders. This would make the orders more attractive and build the fleet's equipment in advance of when it would be necessary to deliver service.

It should be noted that all individual passenger vehicles/cars procured under the Next Generation Equipment Committee (NGEC) specifications will be interoperable. Consequently, tying these acquisitions with other procurement programs will accommodate fleet growth that is more cost-effective.

### Mixed Equipment Operations

WSDOT and ODOT based projections of equipment demand on current expectations for the types being added. Section 3.8 details the different options for equipment types in the future. Transitioning to different equipment will have two major impacts on fleet sizing. It will introduce a different type of equipment mix, and the number of each type of vehicle needed for future growth will be affected. In addition, the spare capacity for maintenance and operations will require optimization. If the equipment is not interoperable, WSDOT and ODOT will have to manage the spare ratios for each type individually. This may result in a higher number of spare cars than would be required for a homogenous fleet.

### Alternatives for Managing Seating Capacity

The projected equipment demand is based on what is necessary to deliver service reliably and to accommodate service growth. If WSDOT and ODOT choose not to make this level of investment, it is necessary to consider the consequences of the potential shortfall. The approaches listed below outline the possible options if WSDOT and ODOT are not being able to optimize the service.

- **Delaying retirements:** This approach is feasible if WSDOT and ODOT are not able to fund replacement equipment. The existing equipment could continue in service beyond the scheduled out-of-service date. The projections indicate this approach could negatively impact operating costs and reliability. However, a careful analysis should be done to determine the effect on total cost and reliability. Revenue and further investment in the fleet for overhauls and modifications would be needed in order to allow the equipment to continue to provide the level of service required. WSDOT and ODOT would need to revise their budgets to accommodate both the overhaul investment and the potential increase in maintenance costs.
- **Reducing spare ratios:** The modeling assumed spare vehicles to support maintenance and overhaul and to include operating spares. The current fleet operates with no spare trainsets. All maintenance is done at night, while the trainsets are not in service. Although WSDOT and ODOT can continue this model, without any operating spares, it is necessary to have all trains in service every day. (An intensive preventive maintenance approach is necessary to ensure the availability of the equipment.) Operating with reduced spare ratios is, therefore, possible. However, it brings additional pressures on the

maintenance system and provides a reduced ability to deal with unforeseen events. Previously, Amtrak has provided replacement trains or bus services when one of the Talgo-manufactured trainsets is out of service for any reason. Whether Amtrak is able to continue to do this in the future is unclear at this time.

- **Implementing demand management:** If ridership levels are higher than trainset seating capacity can accommodate, then WSDOT and ODOT could consider possible enhancements to ticketing policy that further encourage a redistribution of riders to less heavily used trains. Whether this can be effective is a function of the type of riders using the service and their flexibility to travel at different times of day or on other services.
- **Reconfigure vehicles to increase seating:** Reconfiguring the interior of the passenger cars/vehicles to have a higher density of seating would improve capacity. However, this could affect the perceived value of the service and, potentially, revenue generation. However, if alternatives are required for additional equipment, WSDOT and ODOT could consider a higher-density seating configuration, which would entail additional capital costs for the conversion work required.
- **Accepting a ridership impact:** If capacity cannot grow to meet ridership demand, there is an option that riders would turn away from the system to use alternative modes. This will cap revenues and may secondarily influence ridership at other times, if riders perceive the system as being crowded or unavailable.

### Business Case for Fleet Composition Changes

The projections contained within this FMP identify when WSDOT and ODOT may need new equipment and the lead-times associated with the procurement of that equipment. These two elements combine to determine when a procurement process should commence. Ahead of this date, WSDOT and/or ODOT would compile a business case to justify any acquisition program.

As discussed in Section 3.6, the time for new equipment procurement is based on planning goals. Actual equipment replacement will require an evaluation of service requirements and the condition and performance of the current equipment at the time of the replacement. That analysis should establish whether the equipment is performing as expected by the FMP, is suffering a higher cost of operation and reduced reliability, or is exceeding expectations and has capacity to be operated for longer than anticipated.

WSDOT and ODOT can combine this information with any additional equipment requirements that might be concurrent to determine whether the acquisition of new equipment is cost effective, whether it needs to be accelerated or whether it can be deferred in lieu of alternative support strategies allowing the equipment to continue to provide cost-effective service.

The business case that WSDOT and ODOT would develop will include the performance parameters, customer requirements and costs of sustaining the equipment going forward. The case will also account for any necessary overhauls, the costs of the new equipment and the revenue benefits that can be achieved by introducing additional capacity, customer amenities and reduced costs associated with the new equipment. In addition, the business case will examine the cost effectiveness of the size of the procurement versus alternative procurement batches, if WSDOT or ODOT were to change the timing of the acquisitions.

## 1.5 Lead-times for Equipment and Service Changes

Planning for service changes requires an understanding of the lead-time associated with the introduction of new services. WSDOT and ODOT should account for a significant amount of lead-time to make good business decisions when acquiring new rail rolling stock. The supporting changes for infrastructure are similarly time consuming. This Section outlines some guidelines for planning purposes, which will be appropriate for any changes considered in the SRPs and will relate to the rolling stock investments proposed as part of the FMP.

Preparation of technical specifications for new equipment has historically been a key part of the procurement process. However, the creation of the NGEC, under the auspices of Section 305 of the Passenger Railroad Improvement and Investment Act of 2008 (PRIIA), resulted in a number of specifications being developed at a national level. These specifications cover all types of intercity passenger rail equipment and are available for use by the whole industry. Future federal grants will likely require the use of these specifications. However, even if state money is being used for equipment acquisitions, there are still benefits to using these specifications. The specifications were intended to provide interoperability and supportability benefits related to working with other states using the same types of equipment. In addition, an agency can leverage the reduction in the lead-time resulting from the use of the existing specifications.

Even with a specification already available, the lead-time for equipment is significant. Unless the equipment is already in production and the order can be optioned from an existing contract, the time from placement of an order to the first vehicles being delivered can range of 30 to 48 months. Longer lead-times would exist for equipment not previously designed or built. The rate of production will then determine how quickly the supplier can produce the vehicles.

The entire process, from the initial preparation of the Request for Proposal (RFP) documents through the delivery of the first vehicle, can take several years. If all the various steps in the process are totaled, a potential 5- to 6-year timetable exists (Table 1-13).

**Table 1-13: Timeline for a typical acquisition program**

| Activity | Estimated Time to Complete[a] | Estimated Total Elapsed Time |
|---|---|---|
| Preparation of RFP documentation | 6 months | 6 months |
| RFP submission, review and selection | 6 months | 12 months |
| Negotiation to NTP | 3 months | 15 months |
| Development, commissioning, testing and production start up | 48 months | 63 months |
| Balance of Production | Quantity dependent | - |

Notes: A production rate of approximately four vehicles per month is typical. Production length depends on the final production rate and number of vehicles ordered.

[a] *Times are estimates of the typical time it takes to complete the task.*

The lead-time for equipment delivery is not the only element to be included in the planning process. Infrastructure upgrades, such as track changes to allow increased service or modifications to maintenance facilities and/or stations to accommodate the new equipment, are relevant considerations. Moreover, if service is being added, host railroads would need to develop and approve new schedules for track time availability. WSDOT and ODOT should consider all of these associated elements in the overall planning process.

Additionally, WSDOT and ODOT would need to complete the associated commercial negotiations to introduce new equipment into the fleet. These negotiations are not necessarily a critical path item, but may be complex enough to require WSDOT and ODOT to program the negotiations at an early opportunity and concurrently with the equipment procurement process. WSDOT and ODOT would have to develop or update the following agreements:

- **Operations agreement updates:** An amendment to the existing operating contract would outline the changes that would result from new equipment acquisition, any changes to work practices, crew requirements, costs of operation and scheduling/performance. Depending on how significant the change in equipment is, it may require a substantial update to the contract. This can conceivably take from 6 months to 1 year to complete.
- **Maintenance agreement updates:** The changes in the volume and type of equipment will determine the required modifications to the existing maintenance agreement. WSDOT and ODOT will need to address access to facilities and timing of access, parts consumed, labor and skill level changes, training updates and availability levels. WSDOT and ODOT could commence negotiations with the same contractor as the operations agreement and conduct the two negotiations together. However, the negotiations may involve a different contractor, which would require a similar six month to one-year timeframe.
- **Warranty support:** Introducing new equipment into the fleet will come with warranty provisions from the manufacturer. These may require provision of additional staff and space for a warranty team, storage of warranty spares and a process to resolve warranty defects on the equipment, as part of the ongoing maintenance process. WSDOT and ODOT will need to enter into an agreement with the maintenance provider for these warranty activities, the use of the facilities and management of the warranty processes. This can conceivably take six months to complete.
- **Training:** Training for the maintenance personnel and the operations staff will be part of the equipment procurement contract. It can conceivably take six months for WSDOT and ODOT to enter into agreements with respective maintenance and operation organizations to allow for training of staff.
- **Commissioning and testing:** WSDOT and ODOT will test the equipment for technical compliance as part of the development program. However, the equipment will have to undergo an FRA-type testing program on the corridor. No testing would be required if equipment of the current type is added to the fleet because all FRA testing would have been completed. WSDOT and ODOT will need to enter into two main agreements to cover this process. First, the FRA and the host railroads will have to approve the operation of the equipment for the test program. Second is an operations agreement with the operator to allow them to proceed with the test program. Concluding these agreements can take up to six months.
- **Track access agreement:** The host railroads will have to approve the equipment for commercial operation on their right of ways. The testing and commissioning program provides the necessary information for the host railroad to be satisfied with the acceptability of the equipment. An agreement from each host railroad will be required to recognize what data are required to allow ongoing operation and to confirm that data

requirements have been adequately satisfied. This can conceivably take from six months to one year to complete.

## 1.6 Contractual Arrangements Supporting Service

Beginning in 2013, the business relationship between Amtrak and states with intercity passenger rail service changed significantly as a result of implementation of PRIIA. Prior to this change, Amtrak operated services for many states, and the framework for the agreement(s) under which Amtrak provided services depended on when Amtrak initiated the services. The level of funding and equipment support provided by Amtrak to each state greatly varied. PRIIA required that the control of services and financial responsibility for intercity passenger rail move from Amtrak to the states. This applied to all routes shorter than 750 miles (the Pacific Northwest Rail Corridor is 467 miles). PRIIA also equalized the arrangements under which the states receive service, most specifically with regard to financial support. PRIIA Section 209 mandated the creation and implementation of a common funding methodology across all states. Under this methodology, Amtrak must break even financially on the provision of services for state-supported corridors. Amtrak can no longer provide a subsidy to the service. Therefore, the states are responsible for the operations and maintenance costs, less any revenue that the service generates.

While Amtrak works with the states of Washington and Oregon to deliver service as an integrated corridor, the contractual frameworks are split between these three core partners. Amtrak has separate operating agreements with WSDOT and ODOT covering their respective responsibilities in the Pacific Northwest Rail Corridor.

The Amtrak operating agreements for the Amtrak Cascades service have two main elements. One is the operation of the trains in service to include those that Amtrak owns. The other is the provision of maintenance for the equipment used to deliver the service. The operating agreements cover the cost of train crews, as well as items such as fuel consumed and track access charges. The maintenance agreement covers the programmed maintenance for the trains, including any overhauls.

However, unlike some corridors, the maintenance framework for the Amtrak Cascades service has added complexity. Amtrak is solely responsible for the maintenance of the locomotives and non-powered control units, and Talgo is responsible for maintaining the Series 6 and Series 8 trainsets. Talgo has a contract with WSDOT for the WSDOT-owned Series 6 equipment (three trains), a contract with Amtrak for the Amtrak-owned Series 6 equipment (two trains) and a contract with ODOT for the Series 8 equipment (two trains). Talgo staff manages equipment maintenance, including technical support and materials. Talgo also provides onboard technicians for its trainsets while they are in service. Although Talgo uses Amtrak labor to conduct its maintenance activities, the cost of the direct labor is not included in the Talgo contracts. Instead, the Amtrak operating agreements with WSDOT and ODOT include a cost for this staff, even though they operate under the direction of Talgo. The Talgo maintenance agreements with Amtrak and WSDOT are long-term agreements (20 years) that will expire in 2019. ODOT currently has an Interim Agreement with Talgo that was drafted with the introduction of the Series 8 trainsets.

## History of passenger rail service and host railroads

Amtrak's creation in 1971 was part of a process that relieved host railroads of the obligations to operate passenger rail service. As part of their rights to operate rail services, the federal government mandated that railroads provide passenger services. The losses that the passenger services were incurring put the railroads in financial difficulty. Amtrak was created to take on the responsibility for running these services and to alleviate the financial burden passenger service imposes on the railroads. In return for being relieved of this burden, the railroads were required under the Rail Passenger Service Act of 1970 to provide track access to Amtrak in perpetuity on a marginal cost basis. Consequently, Amtrak is the only entity that has a legislative right to operate service across host railroad tracks in the United States. Any other operator wanting access has to negotiate for that access with the host railroads.

Consequently, train service changes can only be made with the agreement of the host railroads. Therefore, the development of intercity passenger rail service requires agreement with the applicable host railroads regarding the level of service to be provided, the on-time performance metrics and the investment required in the infrastructure to ensure that the host railroad's own service is not detrimentally impacted by the enhanced intercity passenger rail service. Therefore, public agencies often fund and develop railroad capacity enhancements to meet the needs of the increased level of passenger service.

Currently the Amtrak Cascades corridor uses right-of-way owned or controlled by four different entities:

- BNSF Railway owns the majority of the right-of-way between Portland, Ore. and Vancouver, British Columbia.
- Union Pacific owns the majority of the right-of-way in Oregon where the Amtrak Cascades service operates from Portland to Eugene, Ore.
- Sound Transit owns the right-of-way on the Point Defiance Bypass, which is scheduled to begin operations for Amtrak Cascades in 2017.
- Canadian National controls dispatching on BNSF-owned right-of-way north of the Frasier River Bridge in British Columbia.

**Figure 1-3: Point Defiance Bypass Alignment**

**Host railroad agreements required for Point Defiance Bypass**


Beginning in 2017, Amtrak Cascades will operate on the Point Defiance Bypass (shown above in orange). WSDOT and Amtrak must negotiate agreements with the host railroad to operate on this route, which is owned by Sound Transit. This FRA-funded project benefits Amtrak Cascades with improved reliability, faster, more frequent service and two additional round-trips between Seattle and Portland.

# Chapter 2. Core Principles for Assessment

A discussion of equipment strengths and challenges is best understood in terms of four core principles that guide how the Washington State Department of Transportation (WSDOT) and the Oregon Department of Transportation (ODOT) both evaluate the current Amtrak Cascades fleet (expanded upon in chapter 3) and ultimately determine an equipment acquisition approach that responds to ridership demand and service expansion. Each agency applies a four-fold fleet management approach that:

1. Maximizes equipment use and efficiency through pooling.
2. Partners with other states to streamline the equipment acquisition process.
3. Develops a compelling business case for each acquisition.
4. Procures flexible and scalable equipment moving forward.

## 2.1 Pooling Fleet Equipment

WSDOT, ODOT and Amtrak presently pool the Amtrak Cascades equipment in order to maximize use, enhance corridor service and eliminate any preference of one partner and/or its stake in the fleet. Each agency's desire is to leverage the existing equipment to enhance service along the entire corridor, as opposed to using the equipment to promote state-focused or agency-centric demands.


## 2.2 Partnering to Streamline Acquisitions

WSDOT and ODOT recognize that partnering with other states often expedites the acquisition process (depending on what phase the process is in) and ensures compliance with applicable grant requirements (for example, Buy America and Next Generation Equipment Committee (NGEC) specifications) or other funding terms and conditions. This process is being used with the acquisition of WSDOT's eight new Siemens locomotives. Partnering also streamlines the procurement process in response to ridership demand through modifying an existing order or working with other agencies to create an order for a larger quantity of equipment. Additionally, partnering within a larger acquisition program can accommodate combined growth demand, ensure the availability of equipment and simplify the process to increase an agency's spare parts inventory.

## 2.3 Developing a Compelling Business Case for Equipment Acquisition

The uniqueness of every acquisition program demands a thorough evaluation and creating a compelling business case that compares current equipment performance to future equipment cost and benefits. WSDOT and ODOT will continue their practice to document condition and performance data under three important areas:

- How the existing equipment has performed as anticipated within the FMP.
- Whether the existing equipment has had higher costs of operation and/or lower trends of reliability.
- Whether the equipment has exceeded expectations and can continue in service longer than expected.

For each new equipment acquisition, each agency will prepare individual business cases that compare the expense of keeping a current piece of equipment in service against the benefits of additional revenue from added seating capacity, increased customer amenities and/or reduced costs often associated with new equipment.

## 2.4 Procuring a Flexible and Scalable Fleet

Flexibility and scalability are critical elements to consider when expanding service and increasing ridership capacity to meet increased ridership demand. Flexibility means that equipment can be:

- Added or removed to meet seasonal operational surges in demand.
- Easily rotated in and out of service to streamline the maintenance process and preserve the overall schedule.

Adjusting the number of passenger cars and seating capacity in response to ridership demand provides rail operators with a level of flexibility and scalability that is critical for meeting maintenance requirements and controlling service delivery costs.

As such, any equipment acquisition strategy must balance fleet flexibility with operational simplicity to respond to long-term service goals and projected ridership demand.

While flexibility is the key for service expansion, WSDOT and ODOT also realize the value in creating a process that clearly defines core requirements and performance parameters regarding fleet sizing, as well as other features applicable to the operating environment for the next generation of equipment, including safety related requirements. These parameters will apply when procuring individual cars of single or bi-level equipment or flexible trainsets. Other elements applicable to passenger vehicles to consider when planning for service expansion are establishing the following:

- Seating capacities.
- Mix of seating.
- ADA access.
- Maximum speed capabilities to minimize journey times.
- Curve performance/passenger comfort.
- Clearances.
- Customer amenities.

# Chapter 3. Equipment Servicing the Amtrak Cascades

This chapter:

- Presents an overview of the current configuration of the Amtrak Cascades fleet and addresses the strengths and unique challenges in overseeing it.
- Summarizes the current and future relationship obligations among Washington State Department of Transportation (WSDOT), Oregon Department of Transportation (ODOT) and Amtrak to best manage and allocate equipment.
- Presents the basis for the planning goals and the resultant analysis
- Outlines the methodology and approach WSDOT/ODOT used to develop and interpret the modeling results.
- Details the different options for equipment types in the future.
- Expands upon each equipment type and presents both short-term and longer-term issues related to future equipment demand for the Amtrak Cascades corridor.
- Reviews federal grant funding requirements and their effect on WSDOT and ODOT's future equipment acquisition programs.

## 3.1 Ownership of Equipment

WSDOT, ODOT, and Amtrak together operate the Amtrak Cascades equipment as one intercity passenger rail service that serves the entire Amtrak Cascades corridor. Each entity has an ownership stake in the equipment, which encourages the most efficient use of the equipment without favoring any one partner or its direct stake in the fleet. All three partners operationally pool and use the equipment as required. Consequently, irrespective of who owns a particular piece of equipment, Amtrak can operate that equipment anywhere on the corridor to optimize the service and best serve customers. Of the seven trainsets currently in use on the corridor, ownership is as follows:

- Amtrak: Two Talgo Series 6 trainsets.
- WSDOT: Three Talgo Series 6 trainsets.
- ODOT: Two Talgo Series 8 trainsets.

While Amtrak and WSDOT own each of their respective Series 6 trainsets, the two partners do not similarly own all the individual cars in their respective sets. Amtrak and WSDOT have reconfigured their trainsets over time so that some cars owned by WSDOT are part of an Amtrak trainset and vice versa. Additionally, WSDOT owns the three spare Series 6 cars in the fleet.

The Amtrak-owned Series 6 trainsets are the only Talgo equipment in Amtrak's fleet. Consequently, Amtrak does not have a national approach to Talgo maintenance and investment. Therefore, while there is a split of ownership, WSDOT and Amtrak's recent approach to modifications and overhauls for the Series 6 trainsets is to have all the Series 6 sets modified and/or overhauled at one time. This results in two separate contracts for the work, but it allows the five trainsets to be maintained as one fleet.

The costs associated with capital investment in the WSDOT-owned Series 6 trainsets are the responsibility of WSDOT. Similarly, ODOT is responsible for the capital investment of the ODOT-owned Series 8 trainsets. With regard to the two Amtrak-owned Series 6 trainsets, the situation is more flexible. WSDOT and ODOT split the capital costs for investment in Amtrak's trainsets based on a formula related to the use each state will have from their investment made. Since the implementation of the new costing mechanism developed in accordance with Section 209 of PRIIA, Amtrak is no longer responsible for any capital investment in equipment for state corridor services, which is why WSDOT and ODOT fund these investments.

Amtrak owns the current locomotive fleet of six F59PHIs, and Amtrak supplements these locomotives with six Amtrak-owned P42s. Amtrak provides a total of 12 locomotives to cover all of Amtrak's operations in the Pacific Northwest, including the Amtrak Cascades service that requires seven trains in service each day.

There are currently six non-powered control units (NPCUs) available to support the Amtrak Cascades service. Of the units, ODOT owns three, and Amtrak owns the other three. ODOT provides its NPCUs to Amtrak to operate under a lease arrangement. ODOT and Amtrak renewed the lease in August 2014, which will run for a 10-year period for a nominal rent. Either party can terminate the lease with mutual consent at any time within that period without penalty.

An order is currently outstanding for new locomotives. Led by the Illinois Department of Transportation, WSDOT is partnering in the contract as a Joint Purchasing Entity. WSDOT is acquiring eight of the Siemens Charger locomotives under this procurement and will own these locomotives when WSDOT accepts them into the Amtrak Cascades fleet in 2017.

There are no leases in place against the state-owned equipment, so no lease obligations have to be met when managing the fleet.

## 3.2 Management and Allocation of Equipment

Since the equipment in the Amtrak Cascades corridor originates from a number of owners, the method each owner uses to manage and allocate equipment for the benefit of the whole corridor is a strength of the Amtrak Cascades service. In addition to equipment dedicated to the corridor, WSDOT and ODOT leverage Amtrak's national pool of equipment to meet service requirements.

However, with the transition to PRIIA Section 209 funding of state corridor services, Amtrak's investment in the equipment is now the responsibility of the states. Therefore, while some equipment will remain Amtrak owned, WSDOT and ODOT will lead planning efforts for the future upgrades and modifications of the five Series 6 and two Series 8 trainsets as a whole.

The introduction of new locomotives will mean that ownership of locomotives used in this corridor will shift from Amtrak to WSDOT. However, from an operational perspective, no difference will be apparent since, as with the current locomotives, the new locomotives will be used across the corridor as required. However, Amtrak will still potentially need to provide additional locomotive support to supplement service when maintenance is being done.

WSDOT and ODOT have identified investment in future equipment on a corridor basis. Both agencies will need to determine the source for funding for those acquisition programs and establish those funds ahead of any procurement process. WSDOT and ODOT will negotiate the split, if any, between the two agencies, and the equipment will serve the corridor in the manner that best suits operational needs.

## 3.3 Fleet Sizing

While the State Rail Plans set the goals for service development and ridership enhancement, it is the role of the FMP to determine how to fulfill those goals. In order to do this, the FMP needs to evaluate the optimal size of the Amtrak Cascades fleet. This will be based on how many passengers will be carried on any given train and, therefore, what size that train should be. With the size of the trains established and the number and rotation of the trains set by the State Rail Plan, the overall equipment need to deliver service can be calculated.

To do this, WSDOT developed a model to assess current and future equipment needs. This model calculates seating requirements, which is converted into a number of passenger vehicles/cars to accommodate demand. This section presents the methodology and approach WSDOT and ODOT used to develop and interpret the modeling results.

Understanding equipment demand that is sufficent to deliver service as it grows and develops is fundamental. Additionally, more equipment is typically required beyond what is in daily use to support maintenance and operations, which in turn, dictates the overall size of the fleet. Currently, the Amtrak Cascades service does not have spare equipment for maintenance and operations (although individual spare, non-revenue cars are in storage at the Seattle Maintenance Facility). In the future, the service intends to improve flexibility by having additional spare equipment. This approach is independent of the type of equipment that is/will be used to deliver service.

A number of factors influence a fleet's size as service develops and grows. Projecting fleet requirements and the associated acquisitions and retirements during that time require an assessment of each of the following factors and their impact on the fleet going forward:

- The number of trains being operated.
- Use of the equipment to deliver the services.
- Levels of ridership.
- Distribution of ridership between the services.
- Optimization of the train sizes based on varying ridership demand along the corridor for a given service.
- The current fleet roster.
- Vehicle acquisitions and their integration with the pre-existing equipment.
- Plans for equipment retirement.
- Maintenance philosophy and the need for spare equipment.
- Planned overhauls and their effect on planned equipment retirements.
- Operating philosophy and the need for spare equipment.
- Capital funding availability.

Evaluating potential fleet demand starts by developing a baseline and subsequent scenarios from that baseline. WSDOT and ODOT defined the baseline level of service to be both current operations and future operations implemented in 2017, when the current federally-funded investment upgrades are completed. WSDOT, ODOT and Amtrak have already committed to this service level. Subsequently, Scenario 1 (and Scenario 1A) maintains this level of service throughout the period of consideration, which extends to 2037. Under this scenario, any additional equipment will then accommodate ridership growth as more people begin riding the existing trains over time.

WSDOT and ODOT also evaluated three other scenarios beyond the baseline Scenario 1. Section 1.4 describes each of the additional scenarios, which include progressively higher levels of service. As the most robust scenario, Scenario 4's 2037 level of service projects six round trips between Portland and Eugene, 13 round trips between Seattle and Portland and four round trips between Seattle and Vancouver, British Columbia, as recommended in WSDOT's *2006 Long-Range Plan*.

WSDOT previously modeled ridership growth for the corridor, applying this ridership model as the basis to further model service development. The previous model outlined an overall view of ridership growth across various segments, dependent on improved levels of service. However, the model did not look at individual trains. For the requirements of fleet planning, it is necessary to have ridership projections by train in order to understand fully fleet seating capacity requirements. Therefore, WSDOT and ODOT developed a more complex ridership model.

The more recent ridership model analyzed existing data at a more detailed level, evaluating ridership for a full year (calendar year 2013) to identify exactly how many people were daily riding each train between each station on the corridor. Since 2013 saw the highest level of ridership during implementation of the infrastructure improvement program on the corridor, it is considered a solid representative baseline for future planning purposes. WSDOT and ODOT used the data to provide a statistical analysis of the number of people on a given segment of the corridor based on the growth rates identified in WSDOT's previous modeling. From this, WSDOT and ODOT generated a required level of capacity based on an assumed number of days per year when the train is projected to be sold out. Since the model accepts a given number of sold out days, it avoids sizing the fleet for maximum condition and instead provides a train size that meets a broader range of requirements.

WSDOT and ODOT then added the proposed equipment schedules to the model to determine how many trainsets are required for daily service and how the equipment is rotated between services. These rotations were added to the model to establish which parts of the rotation have the highest passenger demand. They also identified the layover locations for the trains based on the potential rotations and then determined the size of the train based on the highest demand. Finally, the model was used to establish the level of ridership and compared it to the number of seats per vehicle, thus establishing the number of vehicles required in a trainset to provide the necessary seating capacity.

WSDOT and ODOT then compiled the total amount of equipment required for daily service, plus the projection of spare equipment needed to support program maintenance, operating spares, overhaul/modification programs, and repair of casualties/wrecks, This total reflects the entire fleet demand.

The modeling bases its results on a given level of seating capacity per vehicle. Since different vehicle types and vehicles from different manufacturers have varying seating capacities, WSDOT and ODOT's initial model used the current equipment configuration. A second model using alternate vehicle seating capacities, and the two models were combined to create a plan for all equipment types that might be in service at a given time.

The modeling does not account for some practical considerations. For instance, the model does not assume limitations on funding and availability of manufacturing sources to be restrictions when introducing new equipment. The model also does not include any costs to transition between equipment types.

## 3.4 Current Fleet Configuration

This section provides an assessement of the current configuration of the Amtrak Cascades fleet and addresses the strengths and unique challenges in overseeing it. Appendix C provides a more detailed overview of the trainsets and locomotives in terms of history and operation.

### Passenger Vehicles/Cars

Seven trainsets serve the Amtrak Cascades corridor, each of which typically consists of a baggage car, two business-class coaches, one lounge/dining car, one cafe car (also known as a Bistro car), six standard coaches and one substitute power/service car. Six of the trainsets are named after mountains in the Cascade Range and one, the Mount Olympus, gets its name from the highest mountain in the Olympic Range. Table 3-1 lists ownership, size and capacity for each trainset, each of which was built and is currently maintained by Talgo.

**Table 3-1: Existing Trainset Ownership, Size and Capacity**

| Name (Talgo Series #) | Owner | Year Built | # of Cars | Seating Capacity |
|---|---|---|---|---|
| Mt. Adams (Series 6) | WSDOT | 1999 | 12 | 244 |
| Mt. Baker (Series 6) | WSDOT | 1999 | 13 | 269 |
| Mt. Rainier (Series 6) | WSDOT | 1999 | 13 | 269 |
| Mt. Hood (Series 6) | Amtrak | 1999 | 13 | 280 |
| Mt. Olympus (Series 6) | Amtrak | 1999 | 13 | 269 |
| Mt. Bachelor (Series 8) | ODOT | 2013 | 13 | 272 |
| Mt. Jefferson (Series 8) | ODOT | 2013 | 13 | 272 |

Source: Appendix C.
Notes: WSDOT owns three spare cars: one power car, one bistro car, and one baggage car.

### *Strengths and Challenges*

One of the unique performance characteristic of the Talgo trainsets is that each wheel is independently mounted on single axles connected by a frame located between the cars, with suspension columns sitting on top of the single axles. The carriage attaches to the top of the suspension columns and swings outward when the trainset is taking a curve in the track. This design feature increases stability and improves smoothness of the ride, providing passenger comfort and allowing for a more consistent speed through curves, which thereby reduces overall travel time along the Amtrak Cascades corridor. Despite a maximum design speed of 125 miles per hour, current infrastructure requirements along the corridor limit Talgo trainsets to 79 miles per hour.

The Talgo-manufactured trainsets are painted in the Amtrak Cascades colors of forest green, brown and cream. The Series 6 has a number of amenities, including individual reading lights, electrical outlets for laptops, wheelchair lifts on Americans with Disability Act (ADA) cars, onboard Wi-Fi service, a separate baggage vehicle and bicycle storage spaces. The Series 8 has similar amenities with some modern upgrades such as 4G enabled Wi-Fi. Trainsets rotate through various service patterns to ensure uniform delivery and maintenance scheduling. Trainset availability has been generally high, which has minimized the need for spare passenger equipment on the corridor.

Equipment challenges range from typical issues for a midlife fleet to unique maintenance challenges. Based on both the age of the Series 6 trainsets and their specialized technical and component design, any maintenance regime requires an increasing level of effort to source spare parts and other components to achieve the performance outcomes identified in maintenance contracts with WSDOT and Amtrak.

Not having spare trainsets places a greater demand on the maintenance approach, as the current configuration does not allow individual cars to be rotated out for service. Any defect or maintenance issue would require the entire trainset to be out of service, which would affect daily operations along the corridor.

If a Talgo-manufactured trainset is unavailable for service, Amtrak provides its Superliner bi-level equipment when needed and subject to availability from Amtrak's national fleet. This equipment forms a substitute "trainset" to serve primarily the Seattle to Vancouver, British Columbia rotation. Because the Superliner fleet does not have the same cant deficiency capability as the Talgo equipment and, therefore, cannot sustain the same speed through the track's curves as the Talgo equipment, there is some increase in journey times. As such, WSDOT and Amtrak prefer using any substitute equipment on the Seattle to Vancouver, British Columbia portion of the route, where time differences associated with cant deficiency are not as great.

One of the challenges associated with the uniqueness of fixed consist trainsets is the inability to easily add or remove seating capacity to meet short-term (or surge) demand or overall ridership growth. Because individual cars are semi-permanently coupled together, modifying trainset lengths is difficult to meet the requirements of current and projected service levels. Although reconfiguring existing trainsets is possible, it requires having a sufficient number of trainsets to operate the service, and therefore, requires the acquisition of additional equipment with technical, commercial and regulatory implications.

### Locomotives

Six Amtrak-owned F59PHI locomotives and six additional Amtrak-owned P42 locomotives make up the current locomotive fleet. The six F59PHI locomotives are permanently assigned to the Amtrak Cascades services and are maintained at the Seattle Maintenance Facility. Amtrak integrates six P42 locomotives within their fleet to support the Amtrak Cascades corridor and its long-distance services in the region[4]. Major maintenance of the P42 fleet is conducted in Chicago, with local running maintenance and operations being done at the Seattle Maintenance Facility. Table 3-2 presents ownership and general performance details for the locomotives.

**Table 3-2: Existing Locomotive Performance and Ownership**

| Equipment | Owner | Year Delivered | Performance |
|---|---|---|---|
| F59PHIs<br>(6 locomotives) | Amtrak | 1998 | 3,200 horsepower,<br>110 miles per hour top speed |
| P42s<br>(6 locomotives) | Amtrak | N/A [a] | 4,200 horsepower,<br>110 miles per hour top speed |

[a] *The six P42 locomotives are rotated in from Amtrak's pool of 204 P42 locomotives. Locomotive condition age is dependent on the locomotives provided at a given time.*

Source: Appendix C.

#### *Strengths and Challenges*

The F59PHIs are painted in the Amtrak Cascades paint scheme which matches and blends uniformly with the passenger vehicle/cars. In addition, the locomotives have operational push/pull functions. Each locomotive has a fully enclosed car body with protected walkways for easy access to the engine room and trailing units. When debuted in California in 1994, the F59PHI was the first locomotive in the United States that met California's stringent emission standards. The six F59PHI locomotives have all been equipped with a PTC[5] system and outward cameras.

The six F59PHI locomotives are nearly 20 years old and are reaching the end of their equipment life as defined in Amtrak's Fleet Strategy Plan. Recently, the F59PHIs have experienced higher levels of unreliability and failure, which have led to lengthy service disruptions. The replacement of the F59PHIs by the new Charger locomotives will occur in 2017 to alleviate this issue and provide enhanced operational performance.

#### *Equipment Acquisition*

WSDOT is acquiring eight new Siemens Charger diesel-electric locomotives to be delivered in 2017. These locomotives incorporate modern propulsion and control technologies and weight

[4] Amtrak Coast Starlight and Amtrak Empire Builder
[5] Positive Train Control

reduction design features. This allows them to operate at high speeds with low track forces. These 4,400 horsepower locomotives will meet Next Generation Equipment Committee (NGEC) specifications which includes US Environmental Protection Agency Tier 4 emissions standards. These locomotives will be painted with the Amtrak Cascades color scheme, have a top speed of 125 miles per hour and will be used to replace the locomotives in daily use on the Amtrak Cascades corridor. They have been designed to provide high levels of safety performance and reliability and should significantly improve reliability compared to the current locomotives which have shown reducing reliability as they age. Meanwhile, the compliance with Tier 4 emission requirements will deliver signficant environmental benefits.

### Non-powered Control Units (NPCUs)

NPCUs (generically called a control car) are non-powered railroad vehicles that controls train operations for the locomotive. A control car can be used with diesel or electric motive power, allowing push-pull operations without having to use an additional locomotive. One function of a control car is to eliminate the need for a locomotive to be re-positioned at the opposite end of a trainset when reversing direction at a terminus. Amtrak originally bought a series of locomotives (F40PHs) in the 1970s, some of which were converted to NPCUs in the 1990s. Six NPCUs are available to support the Amtrak Cascades corridor service. ODOT owns three of the NPCUs, and Amtrak owns the other three units. Table 3-3 provides general information on the six NPCUs.

**Table 3-3: Existing NPCU Ownership**

| Equipment | Owner | Year Delivered |
|---|---|---|
| NPCU (3 cars) | ODOT | 1970s |
| NPCU (3 cars) | Amtrak | 1970s |

Source: Appendix C.
Notes: ODOT leases its three NPCUs to Amtrak for use with the Talgo Series 6 trainsets.

#### *Strengths and Challenges*

The NPCUs match the Amtrak Cascades color scheme and provide an aesthetic match to the equipment, in addition to providing operational benefits. Currently, only the Talgo Series 6 trainsets use the NPCUs. Investigations are currently underway to incorporate an NPCU with the Series 8 trainset to provide redundancy and protection.

Although some NPCUs are in better condition, the six NPCUs are not in a state of good repair.[6] The body shells have had various levels of corrosion and spot repair, but no changes/updates have been made to the overall configuration since the original conversion.

## 3.5 Supporting Bus Services

This section describes the role of bus services, but does not address equipment issues since thruway connecting bus services are contracted, turnkey operations. Thruway connecting bus services extend the reach of Amtrak Cascades to more destinations with guaranteed connections

[6] Capital Investment Program for Amtrak Equipment Deployed in State Supported Services FY2014-FY2018.

to intercity and long-distance trains. Private bus operators provide ADA accessible operations. Bus operators are responsible for the acquisition, maintenance and operations of bus equipment. Bus service is also used when substituting train service due to disruptions such as landslides or equipment failure.

## 3.6 Planning Goals for Equipment Life

As the primary stakeholders in the Amtrak Cascades service, WSDOT and ODOT established planning goals for the equipment used to operate the service in order to inform future actions regarding the fleet. This section presents:

- The basis for why the planning goals are necessary.
- The purpose and methodology behind the life-cycle cost model used to establish each planning goal.
- The analysis results for each of the primary equipment types in service on the Amtrak Cascades corridor.

### Basis for Planning Goals

WSDOT and ODOT will use their planning goals to determine future actions regarding the fleet. These goals are subject to ongoing review and updating as circumstances dictate and in the larger interests of the corridor as a whole.

The planning goal's primary requirement is that all equipment be designed and operated in accordance with all associated laws and regulations as well as latest approach to safety. These include, but are not limited to, Federal Railroad Administration regulations for design and operation, Americans with Disabilities Act (ADA) regulations for vehicle accessibility and U.S. Food and Drug Administration regulations for food service areas in vehicles. In addition, all maintenance facilities are to comply with Occupational Safety and Health Administration requirements, as well as local railroad and union rules.

In order to plan for long-term equipment demand, WSDOT and ODOT established a planning goal for the age at which current equipment would be replaced. This commercial life goal establishes the age to replace equipment when the cost of replacing it is lower than that of sustaining the equipment. This principle recognizes that equipment can be sustained for a longer period provided that sufficient funding is available to cover the increased cost of maintenance and modifications.

A WSDOT team designed a life-cycle cost element model to set the goal for the commercial life of the equipment. However, the model does not require that the equipment be replaced exactly at that age. The actual date for replacement would be determined closer to the projected retirement date. A detailed review of the requirements for new acquisitions will determine 1) whether the equipment continues to operate as projected, 2) whether earlier retirement is warranted by poor performance or 3) whether additional life can be economically achieved. The life-cycle benefit/cost analysis also evaluates other equipment demand over a similar timeframe to determine whether WSDOT and ODOT can benefit from grouping equipment acquisitions together for a more economical procurement program. Finally, the replacement analysis further details the exact technical requirements and capacity projections at that time. This includes whether the type of equipment is still relevant and suitable, as well as whether or not the quantities of equipment required are more or less than projected in the FMP (see Appendix C).

WSDOT and ODOT will return to this analysis for future updates of the FMP. With the condition of the existing vehicles established and the requirements for equipment capacity and capability defined, WSDOT and ODOT can begin the procurement process. The model projects when equipment requirements exist. The decision-making to commence an acquisition/replacement program will be based on a business case analysis being completed for the given program.

### Purpose and Methodology

The purpose for modeling life-cycle costs is to:

- Determine an appropriate service life for equipment.
- Establish how sensitive the cost effectiveness of the equipment is to the out of service date.
- Create a framework for future planning.

A fully detailed life-cycle cost model would be ideal. Such a model would include all elements of cost (from acquisition to retirement), including program maintenance, spare parts usage, repair costs, modifications, overhauls and retirement costs. However, actual costs are currently unknown since they are protected by commercial confidentiality. Pricing is the only available data, and no accurate data is available for future maintenance costs. Therefore, a simplified model was created that incorporated certain assumptions. [7]

The model identifies an optimum equipment life for minimized cost. However, the model also demonstrates that this optimum includes:

- An approximate number for out-of-service dates that can be used for overall planning purposes, but is not a definitive statement of the actual dates.
- Identified overhaul events that are driven by an optimum point occurring just prior to an overhaul. (Since overhauls at the end of life will be reduced in scope, the optimum point would vary depending on such a reduction. However, this would be evaluated as part of the overall business case at that time.)
- A region around the optimum life that has a relatively flat variation in annualized average cost. (If equipment is used for a shorter or longer time than the calculated optimum, there is little penalty from a cost effectiveness perspective. Therefore, the out-of-service date can be tailored to meet other programmatic issues without incurring significant penalty in average cost.)

In conclusion, the simplified model presents an understanding of the approximate cost of the full life of the equipment; an approximate life that should be contemplated when making long-term plans; and the flexibility when dealing with equipment planning to accommodate other programmatic issues. The model does not make definitive statements about when individual

[7] Since some variables are established on the basis of assumptions, a sensitivity analysis was performed on those varibles. The results of this analysis show that the calculated year may change only slightly, and that the conclusions demonstrated by the model are stable. In other words, the sensitivity analysis served to increase confidence in the model and its outputs.

equipment should be replaced. Any equipment replacement decisions will need to be done in accordance with an individual and complete business case that evaluates the issues affecting service and the performance of the fleet at that time.

### Analysis Approach

While the analysis of life-cycle costs projects an optimum equipment life, any projection of the cost of future equipment and the cost of operating future equipment is an estimate. It is not possible to define with any certainty the future costs for either existing or new equipment. In addition, new equipment often comes with additional systems and capabilities, which while beneficial to operations, safety or the customer environment, can be more expensive to maintain. It is assumed that WSDOT and ODOT will choose a "like for like"[8] replacement. However, given the difference in technology and the changes in operational requirements, it is expected that the replacement equipment will have evolved from the equipment it replaces. Appendix D of the FMP includes the dates and quantities for new equipment only based on current projections. As individual procurements become more of a reality, WSDOT and ODOT would refine the requirements for those projected dates and quantities.

The graph below (Figure 3-1) illustrates the average annual cost for ownership of trainset equipment based on equipment life. The graph depicts a reduction in averaged acquisition costs as equipment life increases and the incremental costs introduced as overhauls are done, which the graph overlays with the annual maintenance costs. The lowest point in the graph represents the minimal point for the cost of ownership and where replacement of that equipment should be evaluated. The graph also shows that there is a range in equipment life where the average annual cost is relatively constant. Therefore, choosing a life point within that range can be achieved with minimal impact to the cost of ownership. This allows for the alignment of out-of-service dates with other acquisition requirements without significant penalty.

The graph bases its curve on estimated costs and current data for maintenance and overhaul activities. WSDOT/ODOT evaluated the sensitivity of the outcome to variations in the input variables when creating the model. The optimum life point is actually quite insensitive to changes in the parameters. The occurrence of overhaul events is a large factor in determining the minimum point on the curve. If an overhaul is scheduled at a point when a type of equipment's end of life is being contemplated, it would be practical to scale back the overhaul activities in relationship to the intended remaining life. While this would slightly modify the shape of the curve, it would not lead to a significant change in the life assumptions.

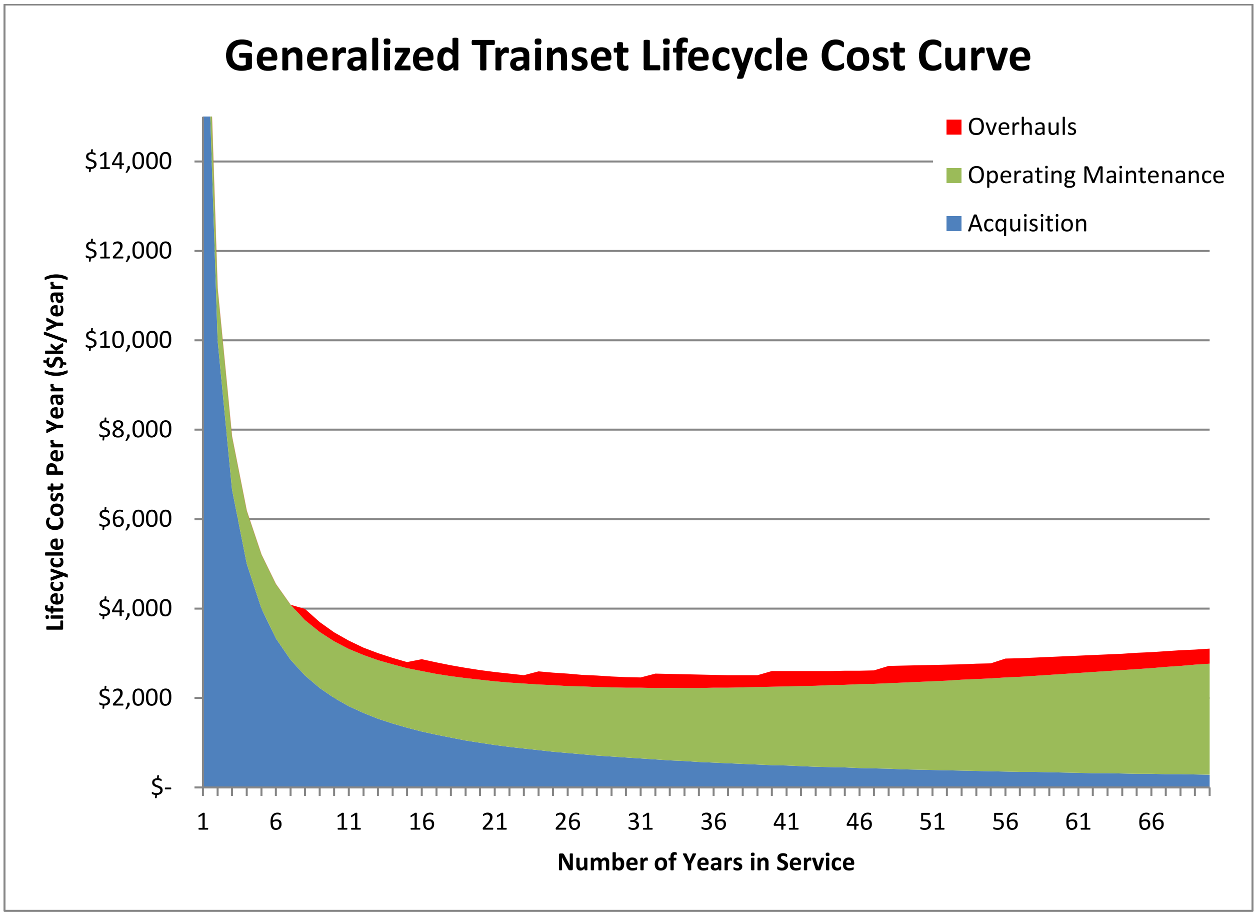
Reductions in the cost assumptions do not generally mean a longer equipment life. The increases as the equipment ages tend to override any benefit from individual variables.

However, increases in cost, can push the optimum point to an earlier point in the equipment's life, even though it still may be within the flat area of the nominal curve. Therefore, WSDOT/ODOT considered the assumed life to be robust for planning purposes. Of course, if

8 Choice of replacement equipment type will be based on current and future requirements. When contemplating the life cycle costs, an assumption of similar equipment is necessary for comparing costs at various ages. Different equipment types will impact costs but the systems that are changed will have other benefits. Therefore, a purely cost driven analysis would not cover the full range of issues.

there are significant changes in cost, WSDOT/ODOT would have to revise the planning assumptions.

**Figure 3-1: Generalized Trainset Equipment Lifecycle Cost**




While WSDOT and ODOT focused on an analysis of commercial life related to the cost of ownership and acquisition, there is an additional factor that should be considered in the financial equation:revenue generation. The addition of new equipment can boost service revenue. Industry experience for new equipment shows an increase in ridership and an increase in revenue per passenger from the perceived increase in value that customers place on new equipment. When considering that the revenue received is a substantial portion of the overall operating costs of the entire system, a small increase in revenue will have a proportionately larger effect on the cost of the equipment and their maintenance. While this is only a subset of the overall cost of the operation, with all other elements unchanged, the increased revenue, has a proportionately higher impact on equipment costs than on the system as a whole.

The result is a reduction of the life-cycle cost of new equipment, if including the revenue benefit. This suggests that WSDOT and ODOT may be able to replace equipment sooner from an overall economic perspective, although the certainty of revenue benefit is not clear. For the purposes of this analysis, the planning goals do not include a revenue benefit. This means that the analysis of commercial life is conservative and that the proposed retirement date could happen earlier without negative financial impacts.

Availability of financing is another consideration during replacement. WSDOT and ODOT based their understanding of commercial life on the full availability of funding when required. The reason that many rail operators have kept equipment in service beyond its commercial life is that they did not have available capital funding to invest in replacement equipment. Therefore, while the life-cycle cost of sustaining the older fleet was higher, it was the only available option. The FMP provides a long-term view of funding requirements, with a solid justification for that funding. In order to provide a basis for timely financial planning to allow for equipment use, maintenance and replacement needs to be done in a cost-effective manner.

WSDOT and ODOT completed modeling based on data from current vehicle operations and maintenance costs. They also included the sensitivity of the analysis to variations in the input assumptions. The current fleet of trainsets is relatively small. Therefore, any potential increase in fleet size could result in WSDOT and ODOT sharing the fixed costs across more vehicles, thereby reducing the cost per vehicle. Similarly, the current WSDOT/Talgo contract is due to expire in 2019 and could potentially be subject to an escalation in pricing above inflation. Both of these scenarios were considered in evaluating the sensitivity of the analysis. The impact on the economic life was minimal for the increased fleet size. The periodic costs of vehicle overhaul still had a significant effect on the calculation, and the out-of-service date did not change. However, if there was a significant increase in maintenance costs, it resulted in a shortening of the equipment's life. WSDOT and ODOT did not consider either of these scenarios to be the base case, and the assumed equipment life span is unaffected. However, the analysis allowed WSDOT and ODOT to contemplate the sensitivity of the vehicle life in relationship to the assumptions, should circumstances change.

## Planning Goals

The outcome of this analysis established a life span planning goal for each of the primary equipment types (i.e., the passenger trainsets and locomotives) in service on the Amtrak Cascades corridor. (The existing F59PHI life was not calculated and is based on previous Amtrak planning.) The goals are as follows:

**Table 3-4: Equipment Life Planning Goals**

| Equipment Type | Planning Goal | Source |
|---|---|---|
| F59PHIs | 20 years | Amtrak's Fleet Strategy Plan |
| NPCUs | N/A[a] | N/A |
| Series 6 | 25 years | WSDOT analysis |
| Series 8 | 25 years | WSDOT analysis |
| Charger | 20 years | WSDOT analysis |

[a] *Tied to Talgo-manufactured trainsets retirement plans.*

These length of service goals are subject to ongoing review, and should WSDOT and ODOT add other equipment types to their fleet, a similar review will be conducted in order to determine the expected equipment life spans and associated updates to the planning goals.

## 3.7 Equipment Key Performance Parameters and Potential Types for Current and Future Service

Several types of equipment and sub-types of equipment are in use each day as part of the Amtrak Cascades service. The configuration and design of each equipment type affect the way the equipment delivers service. This section expands upon each equipment type and presents both short-term and longer-term issues related to future equipment demand for the Amtrak Cascades corridor.

### Passenger Cars

Semi-permanently coupled trainsets manufactured by Talgo provide current service for the Amtrak Cascades corridor. The trainsets are of an articulated design that shares the load of two cars on a suspension system located between them. This design also includes an independent axle arrangement connected to a passive tilting system. These stub axles operate separately from each other, as opposed to the more commonly seen wheelsets containing one solid axle between the wheels.

This configuration has engineering and operational benefits and limitations. When considering WSDOT and ODOT future equipment acquisitions, the following review describes next generation equipment requirements and the relatability of each requirement for the current equipment.

Talgo built the Series 6 trainsets owned by WSDOT and Amtrak in the 1990s. More recently, ODOT acquired two Series 8 trainsets that were introduced into service in 2014. It is likely that WSDOT will replace the Series 6 equipment before ODOT needs to replace its Series 8 equipment. Therefore, any discussion of future equipment demand has to involve the issues associated with operating new equipment alongside the Series 8 trainsets.

In considering the next generation of equipment acquisitions, it is first necessary to evaluate the performance of the current equipment and determine lessons learned from its service. The current trainsets are all scheduled into service each day. There are no spare trainsets. All maintenance is done at night when equipment is rotated through the Seattle Maintenance Facility. This process has worked effectively both when the service required five trainsets and now when the service demands seven trainsets. However, with no ability to take any individual vehicles out of service, any defect in a single car causes the entire trainset to be out of service. Consequently, on-board Talgo maintenance technicians on all trains troubleshoot problems that occur in real time. Feedback from maintainers and operators suggest that this has enhanced some in-service technical issues. Additionally, if the trainsets require any upgrade or overhaul activity, an entire trainset must be removed from service.

As WSDOT and ODOT consider future equipment demand for the Amtrak Cascades corridor, both partners must address both short-term and longer-term issues.

**Short term:** Ridership is growing on the existing services, and there is pressure to add seating capacity aside from any additional service growth. WSDOT and ODOT will have to address how to provide this capacity using existing equipment.

**Longer term:** With various additional services identified in each state's respective SRP, WSDOT and ODOT will need additional equipment to deliver such services. WSDOT and

ODOT will have to integrate this additional equipment with the requirements for supplementing and eventually replacing the current equipment.

### *Short-term Options*

An option to address ridership growth would be to modify operations by acquiring additional passenger vehicles/cars to increase the existing trainset seating capacity. One approach would be to acquire additional passenger vehicles/cars for each of the current trainsets. Another approach would be to re-allocate cars from one of the existing Talgo Series 6 trainsets to lengthen the other Talgo Series 6 trainsets, and then acquire an additional trainset to replace the donor trainset.

The manufacturer has indicated that a number of spare Series 6 passenger vehicles/cars are currently stored in Europe. An evaluation can be done to determine the cost, technical issues, regulatory requirements, lead time and return on investment required to incorporate these cars into the existing trainsets. This evaluation could also establish whether all of the trainsets should be lengthened equally or whether a business case can be made to lengthen only some trainsets and schedule usage accordingly. The business case should also analyze the feasibility and necessity to lengthen the Talgo Series 8 trainsets in parallel.

The decision to lengthen a trainset would also be influenced by the service development strategy. Increased service levels beyond the 2017 schedule may affect both individual train seating capacity requirements and the out-of-service date for the Talgo Series 6 trainsets, which in turn would affect the return on investment calculation.

### *Long-term Options*

More long term, WSDOT and ODOT will likely require new equipment to supplement the current fleet and provide capacity for new service. The business decision to acquire new equipment will need to consider the following:

- Safety and operational features of the equipment that impact passenger safety, comfort and journey times.
- Flexibility to quickly add or remove capacity to meet operational needs.
- Time required to remove a trainset from service to work on individual passenger vehicles/cars.
- Ability to accommodate surge demands.
- Daily scheduling of all equipment, which limits maintenance opportunities.

The plan to introduce service distributed throughout the day and subject to different numbers of passengers would require an easily adjustable solution. This could involve trainsets of differing lengths to meet the requirements of the different services. However, this would also be restrictive since the ability to swap trainsets between services would be limited by the capacity differences. In addition, with increased seating capacity demand, the trainsets would not be able to accommodate growth in ridership unless:

- The passenger vehicles/cars types remained in production, and WSDOT and/or ODOT could acquire additional vehicles in a timely manner and at an affordable price.

- WSDOT and/or ODOT purchased additional vehicles at the time of the build program, holding the vehicles in storage to provide capacity at some future time. (This approach relies heavily on accurate projections of future demand.)

While both are a possibility with the manufacturer of the current equipment, another approach to flexible equipment is to acquire individual passenger vehicles/cars or flexible trainsets. The equipment would come in several configurations to provide a combination of:

- Cab car
- Baggage car
- Bistro car
- Business class car
- Coach car

Depending on the vehicle selected, WSDOT and ODOT could combine some of these functionalities into a single car.

Below are some of the features that illustrate the strengths and weaknesses for each of the options, including: trainsets, single-level vehicles and bi-level vehicles.

***Trainsets***

- Similar in appearance to the current trainsets for brand continuity.
- Flexible interior configurations provide the facilities required.
- Variable capacity based on the trainset manufacturer’s product.
- High or low-level loading depending on manufacturer.
- Capable of operating at high cant deficiencies and meeting the current journey times of the existing service.

***Single-level Vehicles***

- Similar in appearance to the current trainsets for brand continuity.
- Flexible interior configurations provide the facilities required.
- Capacity of approximately 60-70 passengers per vehicle in coach configuration.
- Optimized for high-level loading, but with the capability to load from low-level platforms using built in traps and steps. Since the Amtrak Cascades service operates exclusively from low-level platforms, WSDOT and ODOT will have to consider the acceptability of this method of loading if adopting this type of vehicle.
- Capable of operating at high cant deficiencies and meeting the current journey times of the existing service.
- Interoperable with existing Amtrak single level equipment.

***Bi-level Vehicles***

- Double-decker vehicles provide a very different vehicle shape compared to what Amtrak Cascades customers currently experience.
- Flexible interior configurations provide the facilities required.
- Capacity of approximately 80-90 passengers per vehicle in coach configuration.
- Only capable of loading at low-level platforms, which is currently compatible with the Amtrak Cascades corridor (ADA accommodation is provided only on the lower level of the vehicles).

- Capable of operating at high cant deficiencies and meeting the current journey times of the existing service.
- Interoperable with existing Amtrak Superliner, Surfliner, and California Car equipment.

The introduction of new equipment of a different type to the current trainsets would require a plan to allow the operation of both types of equipment in parallel. While new and existing equipment would not be directly compatible, both equipment types could continue to offer the service together on the same corridor. This would require a maintenance plan that deals with the different types cycling into the maintenance facility on different days. It would also require evaluation of whether the current overnight maintenance approach would remain the most appropriate methodology.

The overnight maintenance approach is currently required in order to ensure service delivery of all trainsets on a daily basis. Any new equipment, either single or bi-level, that is not semi-permanently coupled into a trainset, could have spare vehicles that allow cars to be cycled through the maintenance facility independent of the entire trainset. Therefore, with spare vehicles, it may be possible to maintain the vehicles during the day. However, while the Talgo equipment remains in service and no spare trainsets are part of the planning, current equipment will continue to require overnight maintenance. Since changing between approaches on a daily basis may be problematic from a planning perspective, it will probably remain appropriate that Talgo continues with its overnight maintenance of the Talgo-manufactured trainsets. This may reduce the number of spare vehicles WSDOT and ODOT would acquire to support the new trains.

In choosing the next generation of Amtrak Cascades equipment, WSDOT and ODOT should establish a process to define the core requirements for the vehicles. These requirements will not be vehicle specific, but will define the key performance parameters necessary for the next generation of equipment. The parameters will include such things as:

- Provisions of a safe operating and customer environment.
- Seating capacity.
- Mix of seating.
- ADA access levels.
- Speed, curving performance, and acceleration.
- Clearances for the route.
- Customer amenities, comfort, catering and on-board entertainment.
- Flexibility.
- Maintenance philosophy.

With these elements summarized in a requirements document, WSDOT and ODOT can evaluate the options for different equipment types against these requirements and develop a recommendation for the type of equipment to be acquired. As discussed previously, WSDOT and ODOT will compile a business case supporting the recommendation.

### Locomotives

An acquisition program is currently underway for new diesel electric locomotives. This multi-state procurement effort selected Siemens as the provider of their Charger locomotives, which are scheduled for delivery in 2017. The locomotives have a diesel engine driving an alternator that provides power to traction motors on the axles. The locomotives comply with the latest Tier 4 environmental requirements.

Alternative locomotive technologies are already available. Electric locomotives are in service in the United States, primarily in the Northeast Corridor. These locomotives provide a lighter locomotive, higher power and greater acceleration. However, they require the infrastructure to be electrified. There is currently little likelihood that the Amtrak Cascades corridor would be electrified. The host railroads have not shown any interest in electrification of the corridor, and there is no funding currently foreseen for it. Therefore, the potential to introduce electric locomotives is not on the current planning horizons.

The industry is investigating newer technological concepts for locomotives, including researching the use of batteries or fuel cells for power. However, this technology has not yet matured to the point where the design of a locomotive can match the performance of the existing technologies.

### Cab Cars versus Non-powered Control Units (NPCUs)

There is currently a mix of approaches on the Amtrak Cascades equipment concerning cab cars. The Series 6 trainsets use NPCUs, converted from old F40PH locomotives, that can be changed out as required. The NPCUs are an older fleet, having been built in the late 1970s, and are showing the signs of age with corrosion being a particular concern.

The Series 8 trainsets have a cab car as part of the train. Neither WSDOT nor ODOT have acquired any spare cab cars. Therefore, should one of the cab cars experience a grade crossing incident that takes it out of service, the entire trainset will be unavailable until either the cab car is repaired or a replacement is secured.

Alternative vehicle types under consideration, such as single-level vehicles, bi-level vehicles and flexible trainsets, can also incorporate cab cars. These vehicles, though, are individual cars that a service provider can remove and replace if damage occurs. Therefore, the train can continue to function with a replacement cab car in place.

In the meantime, WSDOT and ODOT must make a decision regarding the NPCU vehicles. With the Series 6 trainsets anticipated to be in service until 2025, there will remain a demand for the NPCUs or second locomotives. With the condition of the current NPCUs being poor, the NPCUs will either need an investment program to sustain them or WSDOT and/or ODOT will need to procure replacements. WSDOT and ODOT have considered both rehabilitation of the current NPCUs or introduction of new NPCUs. Conversion of the F59PHI locomotives currently operating in the corridor was considered as a possible approach. However, Amtrak has not yet determined what alternative uses it has for its locomotives once they are replaced by the Charger locomotives in 2017. Subsequently, conversion may not be possible. Also, the timing of such a conversion would be later than when a solution would be required. Therefore, WSDOT and ODOT are not pursuing F59PHI conversion.

Instead, Amtrak has commenced a rebuild program of its current NPCUs, which will be scheduled through a rebuild sequence as the cars become available to address any potential structural and systems issues. This will provide sufficient capability to last through the remaining life of the Series 6 trainsets, but it does not address the need for cab car protection for the Series 8 trainsets. Because there are no spare vehicles for these sets, any damage sustained by the cab car that cannot be quickly fixed will result in a trainset being out of service. ODOT is currently investigating its options for using an NPCU with a Series 8. WSDOT and ODOT may decide to revise the number of NPCUs in the pool.

## 3.8 Current Acquisition Programs

The multi-state program with Siemens to produce Charger locomotives is the one current program for vehicle acquisition within the Amtrak Cascades corridor. The total program is for 35 locomotives with additional options for state corridor and long-distance locomotives. WSDOT is a participant in the program and had a core requirement for five locomotives. Once the program commenced, WSDOT exercised the option to acquire three more locomotives for a total of eight based on demand for up to eleven locomotives (depending on the number of P42s retained) and the availability of funding due to the low price achieved for the base and option locomotives.

The eight locomotives will completely replace the current F59PHI locomotives. In addition, this program will reduce the number of locomotives on loan from Amtrak. Currently, WSDOT and ODOT use P42 locomotives from the Amtrak pool to supplement the F59PHIs. Since service requires seven trainsets each day and there are only six F59PHIs, the number of P42s in use depends on the program maintenance activities underway on the locomotives and any repair work resulting from service incidents.

Because the F59PHI locomotives are aging and suffering from reliability issues, the new Charger locomotives will provide an improved level of performance compared to the F59PHIs. The Chargers will also provide improved acceleration and increased hauling ability of longer trainsets without performance degradation. In addition, the new locomotives comply with Tier 4 emission regulations to emit a lower level of pollution than the current F59PHIs.

Consequently, the introduction of the Charger locomotives should result in more reliable service, improved performance for the current service, enhanced confidence from passengers, and the capacity to grow the length of trainsets without impacting the schedule. All while achieving reduced emissions compared to the current locomotives.

## 3.9 Future Acquisition Programs

WSDOT and ODOT do not have any proposed acquisition programs currently in progress beyond the eight Charger locomotives. Potential future acquisition programs could include additional Charger locomotives. Modeling of current service levels and potential service requirements for the next 10 years shows a base requirement of 11 locomotives through the mid-2020s. This would provide the required number of locomotives for service, in addition to sufficient cover for program maintenance, service spares and overhaul/repair activities.

The current state of the NPCUs requires a plan for sustaining this capability. As described in Section 3.7, Amtrak is currently managing a rebuild program for the NPCUs.

### Options for Increasing Seating Capacity

WSDOT and ODOT considered options to increase seating capacity on the current trainsets.

- Re-allocate the cars in one of the current Series 6 trainsets to create four longer trainsets and then acquire another trainset or set of cars to offset the changes.

- Acquire additional passenger vehicles/cars for the current trainsets.
- Reconfigure seating on the current trainsets.

It is recommended that a business case be pursued to acquire additional passenger vehicles/cars for the existing trainsets.

### Adding Equipment in Future Years

Under the four scenarios modeled, equipment requirements are consistent in the early years, but differ in the later years. The following is a break down of the number of trains required for each scenario modeled:

- **Scenario One:** The service currently requires seven trains, which would remain the demand through the end of the modeling period (2037).
- **Scenario Two:** The service currently requires seven trains to satisfy service demand until 2024. The service would then require an eighth train for 2 years and a ninth train in 2027.
- **Scenario Three:** The service currently requires seven trains to satisfy service demand until 2020. The service would then require an eighth train in 2021, a ninth in 2025 and a tenth in 2031.
- **Scenario Four:** The service currently requires seven trains to satisfy service until 2018. The service would then require an eighth train in 2019, a ninth in 2023, a tenth in 2027, and three more trains for a total 13 trains in 2030.

Adding trains would also increase the requirements for locomotives and the locomotive requirements have been modeled as well.

Based on the scenario analyses, WSDOT and ODOT would not need any additional trains for the currently funded service. Under Scenario 2, the first additional train would be required in 2025, which would be accelerated to 2021 for Scenario 3 and 2019 for Scenario 4.

## 3.10 Federal Grant Funding Requirements

The availability of federal grant funding to support capital projects is a benefit to the Amtrak Cascades service. However, requirements of the funding will influence WSDOT and ODOT decision-making in regards to both the supplier of the equipment and the equipment itself. These requirements may reduce options available to states like Washington and Oregon, as future grant requirements would likely include the need to use NGEC specifications and comply with Buy America requirements. This section details federal grant funding requirements and their effect on WSDOT and ODOT's future equipment acquisition programs.

The federal government has recently provided two main sources of funding via the FRA as the administrator of the grants: the High Speed Intercity Passenger Rail (HSIPR) Program and the stimulus funds from the American Recovery and Reinvestment Act (ARRA). Both funding sources have been made available separately or combined into single programs depending on the need of the applicant.

**NGEC Specification Development and Partnership**

Under PRIIA, the NGEC developed rail equipment specifications with the goal of reducing costs, decreasing procurement schedules and promoting a competitive and fairer market for U.S. manufacturers and suppliers. To date, a number of states are procuring equipment that complies with these specifications.

While HSIPR and ARRA grants have similar requirements regarding specifications and building of vehicles, ARRA funds are time sensitive. A state receiving ARRA funds must spend all money received by September 2017. Therefore, programs using ARRA funds must have the deliverables accepted and the billing complete in order to submit a claim to the FRAfor reimbursement. Currently, the FRA has noted that there will be no extension to the September 2017 deadline.

Fundamentally, these grants have very similar requirements that include two main technical areas of interest from an equipment planning perspective.

- **Use of NGEC specifications:** The FRA requires that all equipment bought with HSIPR or ARRA funds for intercity passenger rail service conform to NGEC specifications. Created under the requirements of PRIIA, the NGEC has created standard equipment specifications for intercity passenger rail service covering all types of vehicles currently or anticipated to be required.

  There are many common elements to the specifications, which an applicant can customize for individual equipment types for single-level vehicles, bi-level vehicles, trainsets and diesel-electric locomotives. Designed in a way so that common equipment is procured across the country, the specifications set standardization goals to enhance supportability and improve both interoperability and flexibility to move equipment to respond to service development demands across the United States. Related to the Amtrak Cascades service, the multi-state procurement of the Charger locomotives applied the NGEC specification for diesel-electric locomotives

- **Buy America compliance:** FRA grant funding requires 100 percent compliance with Buy America requirements. The FRA's approach to Buy America is more stringent than the Federal Transit Administration's approach for transit programs. The method for demonstrating Buy America compliance looks at key subsystems and how these systems undergo substantial transformation at a United States location. There are certain components that are not produced in the United States and will not be in the foreseeable future, so this process is designed to allow them to be incorporated into larger subsystems by being substantially transformed. It also includes requirements for the sourcing of key materials, such as steel from domestic production. All assembly work must be done in the United States, and body shells cannot be manufactured overseas and fitted out in the United States, unlike FTA's approach. This limits the number of companies that are able to bid for work and deliver projects when FRA grant funds are used.

# Chapter 4. Sustainment of Equipment Fleet

This chapter:

- Summarizes the approach to equipment maintenance.
- Describes the condition of the current fleet that includes both Talgo Series 6 and Series 8 trainsets, along with F59PHI locomotives and non-powered control units (NPCUs).
- Looks at options for future maintenance.
- Discusses how modification programs will be developed.

## 4.1 Maintenance of Existing Fleet

Amtrak and Talgo work together to maintain equipment for the Amtrak Cascades service at the Seattle Maintenance Facility. While the Seattle Maintenance Facility is the primary location for maintenance, some minor work and daily inspections are completed at several layover facilities. The daily requirements are the same regardless of where the activities are performed.

Talgo maintains each of the trainsets as a single unit. With the need to have all trainsets in service each day, Talgo maintains a rotating mix of trainsets overnight at the Seattle Maintenance Facility within a time window between the end of service one day and the commencement of service the following morning. In addition, Talgo staff has limited access to the Seattle Maintenance Facility at other times because Amtrak requires access to the building for its own maintenance tasks.

Amtrak maintains the locomotive and NPCUs separately from the Talgo-manufactured trainsets in the Seattle Maintenance Facility. Because there are spare locomotives and NPCUs, Amtrak does not need to carry out maintenance in the same manner as Talgo does for the trainsets. This allows Amtrak to do maintenance work during the day shift alongside the other locomotive work for Sound Transit and core Amtrak operations.

Overhaul and upgrade programs are more substantial in scope. Amtrak moves the locomotives and NPCUs offsite to carry out any overhaul and upgrade requirements. These activities are planned and funded using the current PRIIA Section 209 funding methodology, which evaluates the capital costs across the fleet of a type of vehicle and apportions the costs to Washington and Oregon based on the use of that type.

Major overhaul work on the trainsets, not priced in Talgo's 20-year preventative maintenance scope of work, is negotiated between the parties on a case-by-case basis. The scope, schedule and pricing are determined ahead of commencement of the overhaul work. Depending on the scale and scope of the work, it could be completed on a spare track in Seattle or could be sent to an offsite location for completion. The upgrade of all the Series 6 Bistro cars in 2012-13 was completed on a track in King Street Station, as locations within the maintenance facility were limited for a full-length trainset. Additionally, upgrades to the seats and flooring of the Series 6 trainsets were done offsite in the Seattle area.

Since Washington State Department of Transportation (WSDOT) and Oregon Department of Transportation (ODOT) do not conduct any maintenance themselves, they instead administer the maintenance performed on the fleet. As the operator of the trains, Amtrak is in a position to oversee Talgo's performance on equipment maintenance to some extent. Its staff supports maintenance activities, and the staff checks equipment when being accepted into service each day. WSDOT and ODOT ensure that Amtrak and Talgo maintenance activities were done in accordance with the contract and regulatory requirements.

WSDOT staff undertake regular and frequent meetings with Amtrak and Talgo staff to review the current performance of the fleet and the achievement of service goals. These reviewes evaluate the ability of the equipment to continue to deliver service and the potential modifications, overhauls and upgrades as well as any changes to maintenance approaches that will be beneficial to the service. Asset management responsibility is allocated to a WSDOT staff member who leads this process with the maintenance providers and is responsible for planning for the fleets.

WSDOT is currently assessing ongoing maintenance needs, in light of the upcoming expiration of the current Talgo maintenance agreement in 2019. The maintenance agreement is performance based and places the obligation for delivering the vehicles into service on Talgo. WSDOT's interest is in ensuring that Talgo maintains the equipment in an appropriate condition and that the equipment does not have deferred maintenance issues. Therefore, WSDOT will plan for a condition assessment of the fleet in advance of any contract end dates. This assessment will support the return condition of the vehicles if the contract were to end such that the maintainer will have sufficient time to resolve any issues prior to the contract expiration. Additionally, it will provide a baseline for any negotiations on a renewed maintenance contract should that be the chosen approach.

The introduction of the Charger locomotives will require a modification to the maintenance contract with Amtrak. The approach will be for WSDOT to lease the locomotives to Amtrak for a nominal rental. Amtrak will then be responsible for providing the service using these locomotives and their own supplemental locomotives as required. The operations and maintenance contracts are being updated to reflect this relationship. This will also include supporting the warranty and reliability provisions of the acquisition contract with Siemens.

Once the locomtives are introduced to service, the WSDOT asset management staff will oversea the performance of Amtrak with regard to maintenance and operations as well as liaising with the partner states in ensuring that Siemens fulfills its responsibilities under the contract for reliability and performance.

## 4.2 Condition Assessment of Current Fleet

This Section describes the condition of the current fleet that includes both Talgo Series 6 and Series 8 trainsets, along with F59PHI locomotives and non-powered control units (NPCUs).

### Series 6 Trainsets

The Series 6 trainsets are now approaching 20 years of service. In 2013, WSDOT studied the Series 6 equipment to establish current condition and analyze what potential issues it may face in future years. This survey identified a number of issues with the fleet that were relatively minor. None of the identified issues threatened the viability of the fleet. Because of these findings, Talgo resolved some of the noted actions. Some issues were of greater significance, including concerns about the condition of wiring and the potential need for some areas to be rewired in due course. The value of the work will depend on the remaining service life of the trainsets.

In due time, WSDOT will have to do an overhaul to maintain the quality of the vehicles. This will include an exterior repainting program and interior upgrades to maintain the customer environment. Additional modifications are under evaluation as part of WSDOT's evaluation process, including systems replacement to provide commonality of maintenance and spares.

### Series 8 Trainsets

The Series 8 trainsets have only been in service for about three years. Therefore, the trainsets are in good condition. WSDOT and ODOT are currently evaluating the benefits and detriments between the Series 8 and Series 6 fleet as part of the modification process being developed.

### F59PHI Locomotives

The F59PHI locomotives are nearly 20 years old, and because of degrading performance, these locomotives are reaching the end of their effective life. High levels of unreliability and failure have been a problem for service in recent years and were at the heart of the decision to replace them with the Siemens Charger locomotives. The F59PHIs have received an ongoing program of maintenance and overhaul, and once WSDOT introduces the new Charger locomotives, Amtrak will determine the plan for disposing the F59PHIs. Whether this plan has any relevance to the Amtrak Cascades service remains to be determined. (Amtrak provides P42 locomotives to supplement the fleet, which come from Amtrak's pool of 204 P42s locomotives. As such, P42 locomotive condition depends on the locomotives provided at any given time.)

### Non-powered Control Units (NPCUs)

Talgo Series 6 trainsets use NPCUs that Amtrak converted from old F40PH locomotives built in the 1970s. Although some NPCUs are in better condition, the six NPCUs are not in a state of good repair.[9] The cab equipment is fundamentally the same as it was from the original conversion, and the body shells have various levels of corrosion. Amtrak completed some rebuild activities when required to keep the NPCUs in service. However, recently Amtrak initiated a structured rebuild program on the vehicles, which should allow the NPCUs to continue in service. Three of the six NPCUs have had some rebuild work done in Seattle and the work on all of them is scheduled to be completed in 2017.

## 4.3 Modification Programs

Aside from the overhaul and maintenance of the fleet, modification programs are also periodically developed. These are designed to improve performance, increase reliability, address obselesence of parts, provide new functionality and improve life cycle costs. These modifications require definition of scope and estimation in order to determine their value and priority.

WSDOT is presently developing an approach to determine and prioritize which modifications are done on the fleet. This will initially relate to the Talgo-manufactured trainsets, but WSDOT will expand the program to include the Charger locomotives (when delivered) and any new

[9] Capital Investment Program for Amtrak Equipment Deployed in State Supported Services FY2014-FY2018.

equipment acquisitions. In addition, WSDOT will coordinate with ODOT and Amtrak to ensure all three partners apply a corridor-based approach when modifying their equipment.

WSDOT and ODOT will establish a process based on a business case for each potential modification. The business case will consider:

- Mandatory/optional nature of the modification.
- Cost of the modification.
- Timescales for implementation.
- Remaining service life of the equipment.
- Impact to service of the modification process.
- Sources of funding for the modification.
- Cost of not doing the modification.
- Cost savings/revenue benefits of the modification.
- Return on investment.

For all non-mandatory modifications, WSDOT and ODOT will establish a priority to allocate available funding to the equipment in a manner that will provide the greatest benefit to the service as a whole. The states will be responsible for ensuring a common methodology to modification analysis.

Once WSDOT and ODOT have identified the modifications for implementation, they will determine the appropriate process to implement the modification under consideration consistent with their procurement rules. When proposals are received, WSDOT and ODOT will revise any previous analysis with the financial data from the proposals to ensure the modification continues to meet the business case assumptions originally used for the justification.

WSDOT and ODOT will similarly adjust implementation of the modifications and their performance in service to determine their effectiveness and provide updated information when evaluating future modifications.

## 4.4 Options for Review of Maintenance Practices

The current maintenance approach has supported the service at its current level. However, various alternatives may factor into future rolling stock decisions and contracting mechanisms related to WSDOT/ODOT maintenance methodology and its impact on operations. This Section looks at some options for future maintenance.

Currently, Talgo is under a 20-year contract for nightly maintenance of the trainsets through 2019. The agreement encompasses all elements of maintenance and technical support that ensures the daily availability and use of the trainsets outside of overhaul and upgrade work. (Overhauls and upgrades are separately priced.) Locomotive maintenance costs and services are currently included in the operating agreements the states have with Amtrak.

If WSDOT and/or ODOT make changes to the trainsets and/or acquire additional equipment, this will likely occur towards the end or beyond the end of the current Talgo contract. Therefore, the focus would be on how a new contract is established. WSDOT and ODOT could consider allowing the equipment maintenance task to be bid on the open market. Alternatively, the agencies could review whether they want to move to a maintenance regime that more efficiently uses the rolling stock in a manner that allows daytime maintenance. This would require Amtrak concurrence based on the other requirements at the Seattle Maintenance Facility.

If WSDOT and ODOT request bids for a maintenance contract, the proposals from the bidders will establish whether anyone is capable of competing with Talgo to support its equipment. It should be noted there are proprietary elements to these trainsets and supply issues that are currently controlled by Talgo that may make it difficult for an alternative supplier to compete against Talgo. This would also require a consistent approach to the contracts from WSDOT and ODOT since they are closely interlinked.

With regard to the locomotives and NPCUs, Amtrak is the incumbent maintenance supplier, and their maintenance is part of the operations agreements. WSDOT and ODOT could choose to split the operations and maintenance into two separate contractual elements, or continue to keep them together. The optimal approach to locomotive and NPCU maintenance is currently under review as WSDOT evaluates the various business models that could be used with the introduction of the new Charger locomotives to the Cascades fleet. If WSDOT or ODOT were to add equipment to the fleet that was not Talgo-related, the contract review would also have to evaluate whether Amtrak should maintain the additional equipment, whether the manufacturer should maintain the equipment or whether another maintainer might have a role. However, splitting the responsibilities amongst too many vendors may create management problems, particularly when trying to balance the competing maintenance requirements against the overall operational needs.

WSDOT will be taking a more active role in overhaul and upgrade activities in future years. In coordination with Amtrak, WSDOT has been influential in determining the scope of the upgrades for the Talgo equipment. Now WSDOT will share the task with ODOT in order to determine the scope across both Series 6 and Series 8 trainsets to provide a unified approach. For locomotives, Amtrak owns and maintains the current locomotives to its standards. With WSDOT and ODOT responsible for all capital costs under PRIIA Section 209 funding rules, the states should have a greater level of influence for the scope of work. However, within the short remaining life for the current P59PHI locomotives, there may be limited time or need to implement this approach. Because WSDOT will fully own the new Charger locomotives, WSDOT can dictate the scope and supplier for any overhaul work on these locomotives.

# Chapter 5. Maintenance, Layover and Overhaul Locations

This chapter:

- Provides an overview of the support facilities for the Amtrak Cascades service.
- Describes upgrade efforts at the primary maintenance facility.
- Briefly describes the plan and potential need for additional maintenance and layover facilities.
- Evaluates the capacity of facilities to accommodate future service growth.

Understanding both existing conditions and future challenges further inform an overall support facility strategy that will serve current and future demand for intercity passenger rail service along the Amtrak Cascades corridor.

Owned and operated by Amtrak and with additional services from Talgo, the Seattle Maintenance Facility is the primary maintenance facility supporting all seven Amtrak Cascades trainsets. Facility personnel provide daily upkeep, restock consumables, clean the interior and exterior of the trainsets, replenish fluids and conduct preventive maintenance and major/minor repairs as needed for each trainset.

In addition to the Seattle Maintenance Facility, equipment layovers occur at strategic locations on the corridor in Vancouver, British Columbia; Portland and Eugene, Oregon. Trainsets typically use these three locations to park at the end of daily service; as well as being used for evening refueling, cleaning, resupplying and inspecting each trainset in preparation for service the following day.

Equipment overhauls are done at various locations depending on equipment ownership. For instance, Amtrak does many of its overhauls in Beech Grove, Indiana, while Talgo equipment overhauls have occurred in Seattle and Tacoma. Overhauls typically extend the life of a trainset through periodic upgrades for safety and performance and upgrades to interior facilities and amenities. The following sections expand on each of these facility types.

## 5.1 Seattle Maintenance Facility

Amtrak obtained the Seattle Maintenance Facility via a perpetual lease with BNSF in 1998. Amtrak designed the facility, in part, with the length and needs of the current equipment in mind. Amtrak maintains the Amtrak Cascades locomotive fleet and the six NPCUs at this facility. Talgo is responsible for maintaining the trainsets under contracts with Washington State Department of Transportation (WSDOT) and Amtrak for the Series 6 equipment and Oregon Department of Transportation (ODOT) for the Series 8 equipment. Maintenance for the Talgo trainsets occurs in a nearby building constructed in 2011 as part of Amtrak's phased expansion for the facility. Talgo employs on-board technicians to troubleshoot issues that may occur when a train is in operation and to communicate the maintenance needs in advance of a trainset returning to the facility. Through agreement between Talgo and Amtrak, Talgo provides material and management for the trainset maintenance, using Amtrak staff to undertake the maintenance activities.

The Seattle Maintenance Facility presently maintains more than 20 trains split across Amtrak Cascades trains, Sound Transit's Sounder trains and Amtrak's Coast Starlight and Empire Builder long-distance service. The facility is also home to Amtrak's Pacific Northwest Operations, which includes mechanical, engineering and on-board services, as well as Amtrak's transportation division.

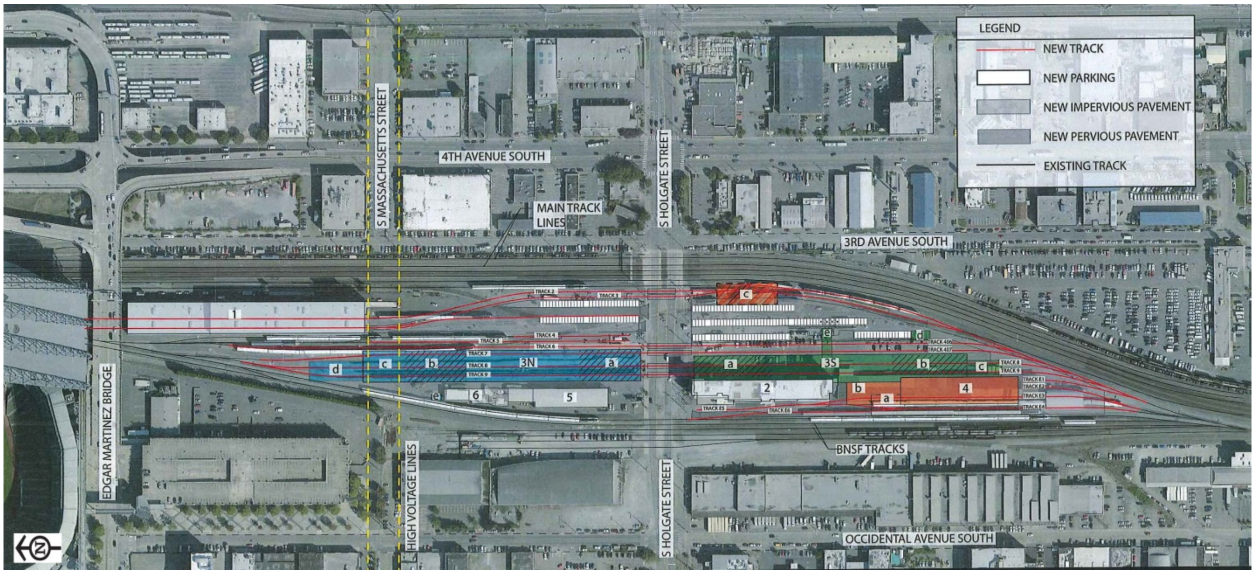
The facility is located south of Safeco Field and is bounded on the east by BNSF's main rail lines and on the west by private property. The Seattle Maintenance Facility has 11 active tracks, with several trains arriving and departing the facility 24 hours a day. The facility includes wash racks, catering and commissary facilities, environmental control systems and external vendor-provided fuel for the trains. Once the inspection and washing are completed, Amtrak conducts a variety of maintenance tasks on the trains.

Amtrak Cascades trains and Amtrak's long-distance Coast Starlight trains, arrive and are maintained at night. Amtrak's long-distance Empire Builder trains and Sound Transit's commuter rail trains arrive and are maintained during the day. Most of the trains are there for only short layover periods. This daytime and overnight maintenance schedule works well, since the Sound Transit service runs on morning and evening peaks, with its equipment out of service during the middle of the day and through the night, while the Amtrak Cascades service has a schedule spread across an entire day, with no overnight operations.

### Facility Improvements

Amtrak is presently in the process of upgrading the Seattle Maintenance Facility in four phases scheduled to be designed and constructed over a multi-year period. Construction for Phases 1 and 2, which began in 2009, was completed in 2012. Construction of Phase 4 is scheduled for 2017-2018. Phase 3 is currently in design. All of the work will allow for more efficient servicing of equipment at current and future levels of service. WSDOT contributed funds to the upgrade of this facility under Phase 1 and Phase 2 and has access rights as a result.

**Figure 5-1: Upgrades to the Seattle Maintenance Facility**




### *Phase 1*

Phase 1 involved construction of the Maintenance of Equipment (MOE) Building, preliminary track rehabilitation and modification, utility work on the north side of the facility to accommodate construction and the relocation of the Talgo Amtrak Cascades wheel-truing operations to the south side of the facility. Amtrak originally designed the MOE for Amtrak Cascades trainset maintenance, but Amtrak can maintain other equipment, (for example, Amtrak Cascades locomotives, Superliners and Sound Transit equipment) in the MOE as well.

The MOE is approximately 651 feet in length and 82 feet in width and contains approximately 5,000 square feet of offices and welfare facilities. The MOE has its own series of back shop areas and an internal material control area. A separate hazardous material storage area is inside a small outbuilding to the east of the MOE.

The MOE utilization plan required two tracks run the entire length of the building, supported on pillars over a pool. This design allows for a wide inspection area used for cars, trainsets and locomotives. Amtrak incorporated one existing milling machine and one new underfloor lathe into the new building in their current locations. Amtrak performed extensive site work to relocate the tracks, demolish the existing tracks and reroute existing utilities. The Phase 1 upgrade also included construction of storm drainage, sanitary sewer and new parking, roadways and at-grade rail crossings.

### *Phase 2*

Phase 2 included construction of the Warehouse and Administrative building and Health/Welfare building. The building, 378 feet in length and 53 feet in width, provides the necessary warehouse and storage space for Amtrak's material control needs and accommodates Amtrak's transportation, mechanical, onboard services, training, auxiliary support services and its Pacific Northwest administrative offices.

The ground floor level includes the material control offices and 16,000 square feet of warehouse space, with additional storage on the mezzanine above the offices on the first level. The second floor includes administrative and health/welfare spaces, and the third floor contains the executive administrative offices.

Phase 2 also consolidated multiple shop and storage facilities in the existing warehouse and demolished part of the warehouse. The design of Phase 2's Warehouse and Administrative and Health/Welfare building accommodates the future design and construction of Phase 3's overhead pedestrian bridge and both the long-distance and Sound Transit facilities, as well as allowing room for the new locomotive shop proposed under Phase 4.

### *Phase 3*

Phase 3 (construction currently unfunded) will construct the Service & Inspection (S&I) building, install additional storage tracks and reorganize the larger maintenance facility to more efficiently service locomotives and store cars. The upgrades will allow service and inspection of four or more trains inside the S&I building. This will free up space for train storage in the yard outside. Phase 3 will also construct a new pedestrian bridge that will connect the parking lot to the buildings constructed in Phase 2.

Phase 3 allows Amtrak to both service and inspect four or more non-Talgo trains out of the weather and to avoid having to service trains in the yard, which will be used for storing trains. Therefore, there will be additional storage tracks and the ability to service and store vehicles and locomotives more efficiently.

Two pre-engineered metal buildings will house the new S&I facilities separated by Holgate Street and connected by tracks 7, 8 and 9. Located north of Holgate Street, the North S&I facility will be approximately 650 feet in length and approximately 85 feet in width. The South S&I facility will be approximately 750 feet in length and approximately 65 feet in width and will be south of Holgate Street.

The new pedestrian bridge will span the South S&I facility, connecting a new stair/elevator tower located in the parking area east of south Phase 3's S&I Building to the second floor of Phase 2's Administration building. The pedestrian tower facade will match Phase 2's Administrative building towers.

Both the new S&I facilities and pedestrian tower and bridge construction will include, but not be limited to, the following elements;

***S&I – North***

- Service and inspection pits.
- Elevations
    - North: Partial height walls starting approximately 25 feet from the top of the finished floor.
    - East: 10-foot, chain-link fencing with un-insulated panels to roof.
    - South: Enclosed with rapid roll doors, 10-foot concrete block construction wainscot with un-insulated panels to the roof (facing Holgate Street).
    - West: 10-foot CMU wainscot with un-insulated panels to the roof.
- Shops located on the east side (in between tracks 7 and 8).

***S&I – South***

- Shared walls between Phase 2 and Phase 3 buildings and Phase 3 and Phase 4 buildings.
- Elevations
  - North/South: 10-foot CMU wainscot with un-insulated panels to the roof.
  - East: 10-foot , chain-link fencing with un-insulated panels to roof.
  - West: 10-foot CMU wainscot with un-insulated panels to the roof.

***Pedestrian Tower***

- Concrete masonry unit with glass and aluminum curtain wall.
- Eight-person geared traction elevator.
- Conditioned interior space.

***Pedestrian Bridge***

- Glass and aluminum curtain wall.

### *Phase 4*

As a result of its analysis of the future track and building capacities, Amtrak is prioritizing Phase 4 ahead of Phase 3. Phase 4 will construct a new locomotive service and repair facility roughly on the site of the old Material Control Warehouse, which will be demolished. A pre-engineered metal building approximately 325 feet in length and approximately 75 to 85 feet in width will house the shop. The new locomotive repair facility has been designed to accommodate the future Charger locomotives. Phase 4 is scheduled for completion in late 2018.

## 5.2 Overnight Train Locations Away from Seattle

In addition to the Seattle Maintenance Facility, there are overnight layover locations on the corridor. Currenly, one train lays over in Eugene, two trains lay over in Portland, and on train lays over in Vancouver B.C.. Personnel at the three layover locations perform similar tasks for each of the trainsets, including: fueling by a vendor, water filling, toilet dumping, stocking of supplies and daily inspections.

The train numbers and timeslots for layover are generally consistent for each of the layover locations:

**Portland -** accommodates layover for Train #509 and Train #513. Train #509 arrives in the late evening, while Train #513 arrives mid-afternoon.

**Eugene** - accommodates layover for Train #507 in the late evening.

**Vancouver, British Columbia -** accommodates layover for Train # 516 around midnight, in addition to a daytime layover of Train #510. VIA Rail Canada and Amtrak contractors provides security on the layover track.

Current planning does not involve a change in layover requirements beyond the 2017 service pattern. No change to the locations is currently required nor are any improvements to capabilities at the locations necessary.

## 5.3 Overhaul Locations

Since 2008, WSDOT, Amtrak and Talgo have renovated a number of cars to improve restrooms, upgrade seating and flooring, add safety features, reinforce suspension systems and on-board computers, and upgrade passenger amenities (adding Wi-Fi and new video monitors) on their five Series 6 trainsets. Figure 5.2 illustrates overhaul activities that have taken place recently. These capital projects were performed in the Seattle area.

Overhaul locations are more flexible than maintenance locations given the occasional nature of having to move equipment for overhaul work. As such, any future overhaul activity can be done at a location suitable for the work that needs to be done. This may include the current Seattle locations or those of a third-party provider.

**Figure 5-2: Equipment Overhauls**

**Stripped Lounge Car**

**Upgraded Bistro Car**

## 5.4 New Facilities for Maintenance and Layover

This Section briefly describes the plan and potential need for additional maintenance and layover facilities.

### Maintenance Facilities

WSDOT and ODOT currently have no plans to build a new maintenance facility to support the Amtrak Cascades service. Amtrak based the phased upgrade of the Seattle Maintenance Facility on projections for the future service needs of the Amtrak Cascades service and Amtrak's long-distance and commuter rail programs. WSDOT continues to discuss potential Amtrak Cascades service level changes for assessing the need for further facility upgrades. The lead-time for facility capacity growth is long and has to be completed in a timely manner to support any future service development.

### Layover Locations

WSDOT and ODOT also are aware that expansion of the service will alter the number of trains that layover at the defined locations along the corridor. As part of any service expansion or schedule change, WSDOT and ODOT will determine if there is sufficient space at the layover locations. With the assumed schedules under the four scenarios, the number of trains at each of the following layover locations each night would be as follows:

### Table 5-1: Layover Locations and Required Train Capacity

#### *Portland*

| Scenario | 2017 | 2023 | 2025 | 2027 | 2030 |
|---|---|---|---|---|---|
| 1 | 2 | 2 | 2 | 2 | 2 |
| 2 | 2 | 2 | 2 | 3 | 3 |
| 3 | 2 | 2 | 3 | 3 | 3 |
| 4 | 2 | 3 | 3 | 3 | 6 |

#### *Eugene*

| Scenario | 2017 | 2023 | 2025 | 2027 | 2031 |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 1 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 | 2 |
| 4 | 1 | 1 | 1 | 2 | 1 |

#### *Vancouver, British Columbia*

| Scenario | 2017 | 2023 | 2025 | 2027 | 2030 |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 1 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 | 1 |
| 4 | 1 | 1 | 1 | 1 | 1 |

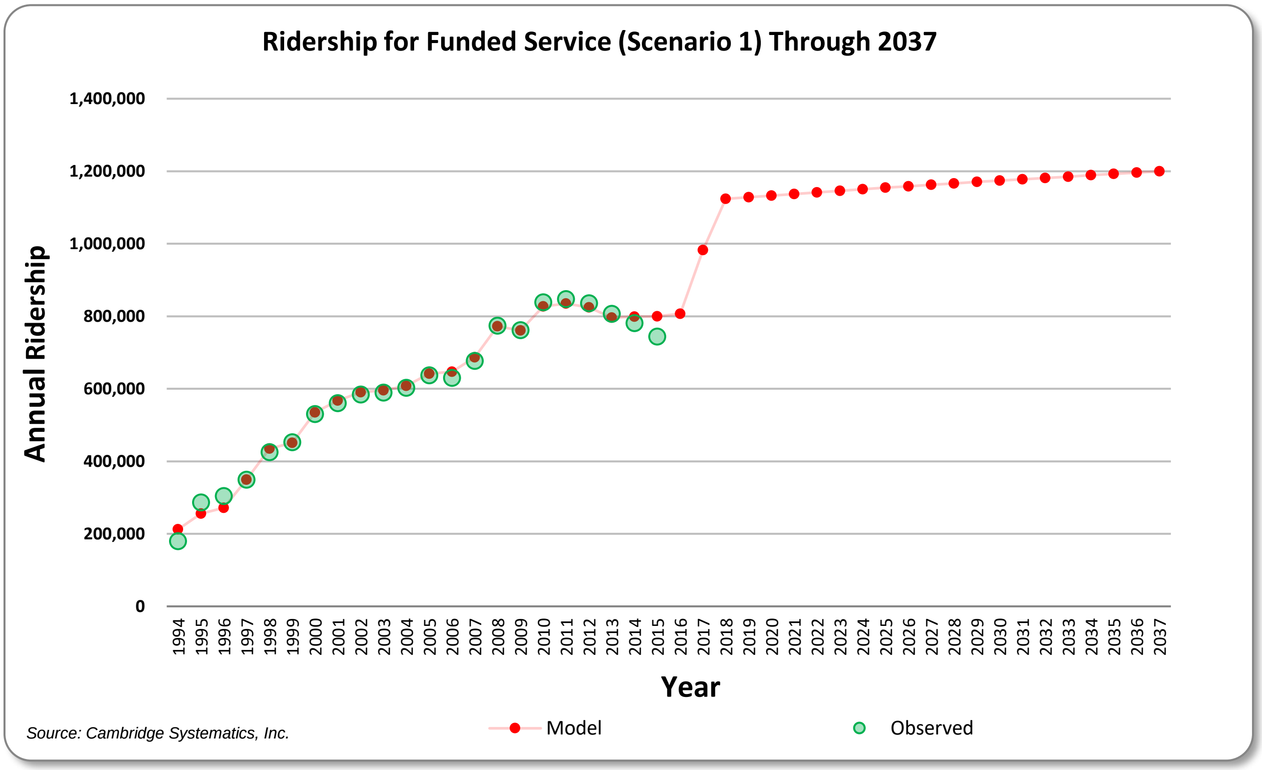
# Chapter 6. Current and Future Service Demand

This chapter:

- Looks at projected ridership growth.
- Analyzes the distribution of riders between services and between stations.
- Determines the usage of trains to meet all service patterns.

Approximately 807,000 passengers rode on Amtrak Cascades trains in 2013.[10] Figure 6-1 depicts the ridership growth and service expansion needs to accommodate the projected increase in ridership for the next 20 years.

**Figure 6-1: Current and Forecast Service Demand**




Over the next 20 years, annual ridership is forecast to grow to more than 1.2 million. Based on these projections, decision makers have the opportunity to strategically invest in an approach to reconcile the supply of equipment and maintenance that is sufficient to support current and projected ridership demand.

[10] WSDOT and ODOT are using 2013 data because it represents the last full year of undisrupted service and therefore serves as an appropriate initial benchmark for future projections. Since the provision of funding for the infrastructure upgrades to improve journey time and on time performance, the implementation of upgrades has caused significant disruption to services with a negative impact on ridership. This transition was anticipated as part of the upgrade but is not considered representative of the future ridership demand.

## 6.1 Analysis of Current Demand

The ridership data that is tracked by Amtrak and the states provides a comprehensive view of the usage of the service by passengers. This includes data on how many passengers are on the trains between each of the station stops. From this data, it is possible to see how the number of passengers varies along the length of the route and by the days and times of day of the individual services. This data can be compared with previous years to determine trends and can also be overlaid on the forecast from previous modeling exercises to allow the validity of the models to be tested and updated as appropriate.

The most heavily utilized part of the corridor is the segment from Seattle to Portland. As illustrated in Figure 6-2, there is a variation in passenger numbers throughout the year and, beyond the seasonal variation, there is quite a large level of variation on a daily basis. Median is a type of average. Looking at the yearly pattern of median occupancy (how many people are on the train) against median capacity (how many seats are available) reveals when and how often trains fill up. A key point to notice is the variation. This simple exercise highlights the importance of flexibility in sizing trains to meet demand. A sine curve shows the seasonal trends, smoothing out the highs and lows from holidays and weekly patterns.

**Figure 6-2: Occupancy Variation: Seattle to Portland throughout the Year**

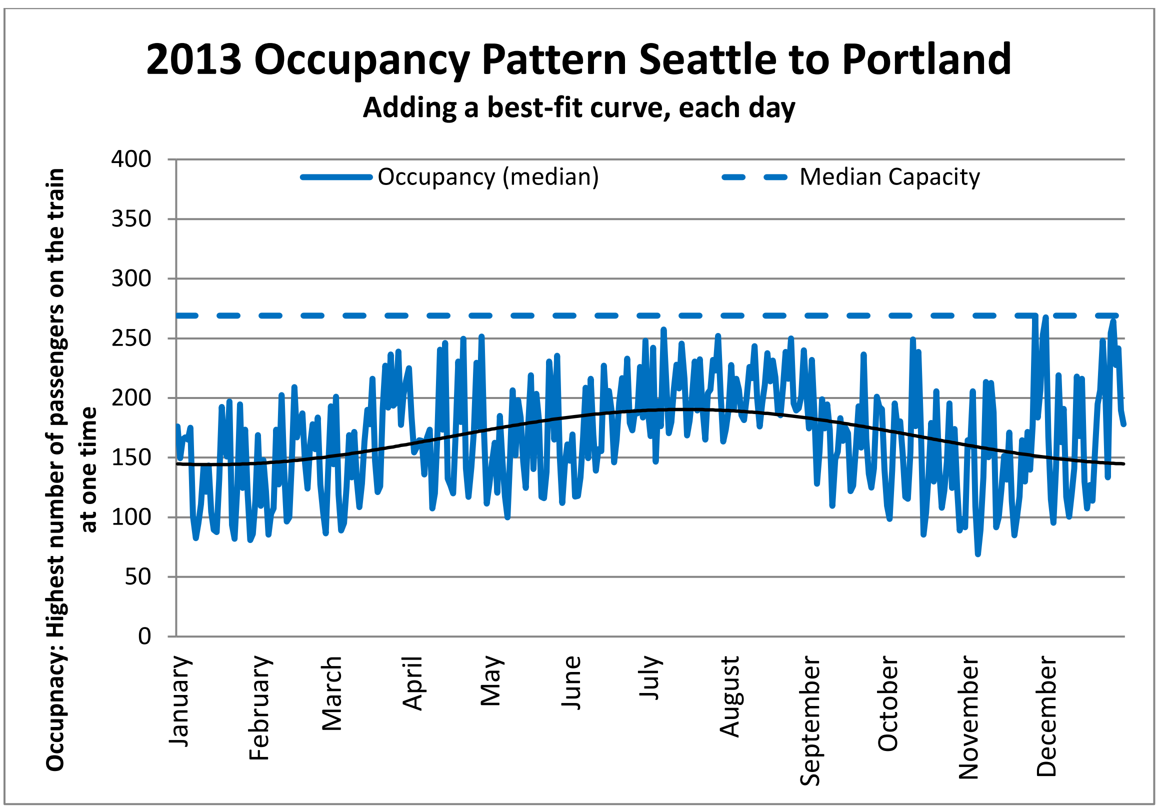
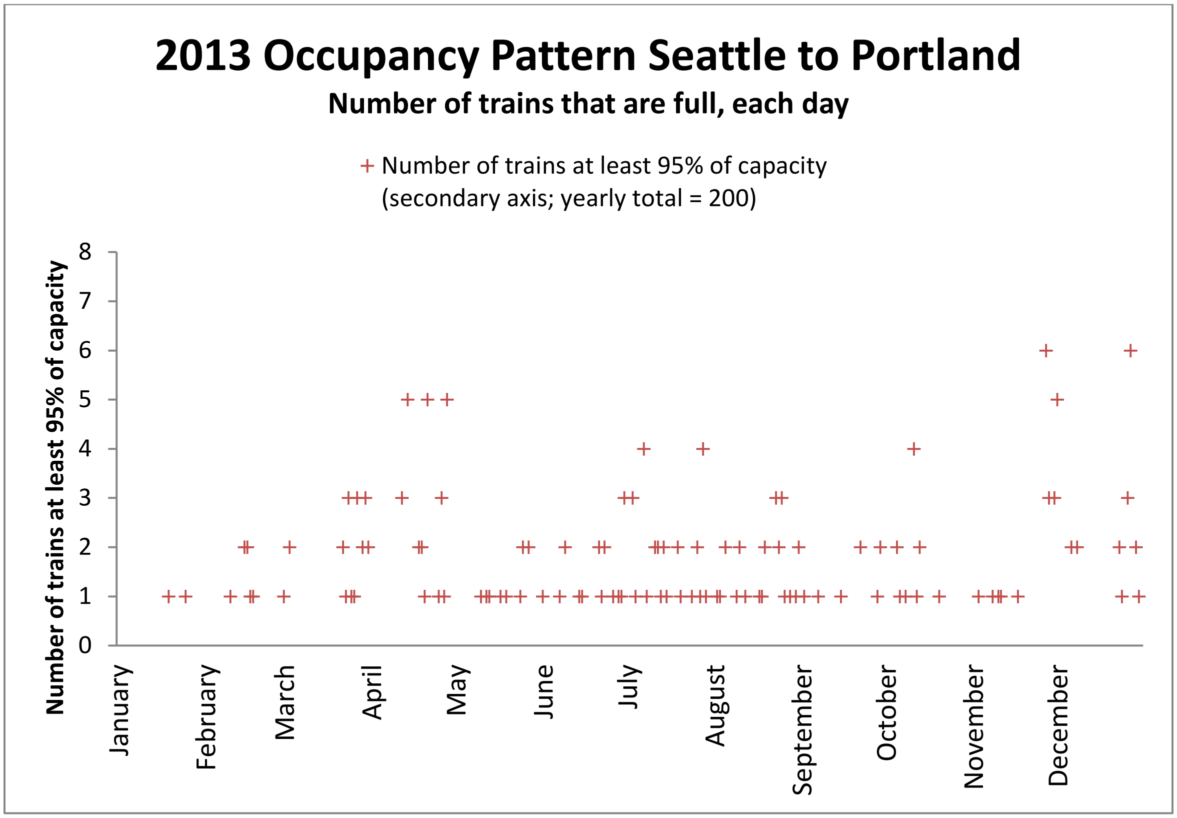


Figure 6-3 takes the more detailed analysis of the individual journeys and the levels of ridership between all of the station stops in the same segment of the corridor. Looking at the number of trains that are full each day shows some of the detail that is hidden by using averages. Of the 8 daily trains that operate between Seattle and Portland, this chart shows how many of them fill up on any given day (notice the general high season in summer months, punctuated by holidays throughout the year).

**Figure 6-3: Days Exceeding 95% Capacity between Seattle and Portland**




It can be concluded that there are already a significant number of occasions when the trains are effectively sold out and that, any growth in ridership is likely to increase these occurrences. The need for additional capacity to accommodate growth will be addressed later in this document.

The ridership and service levels between Seattle and Portland are large but similar analysis has been undertaken for the Seattle to Vancouver, British Columbia and the Portland to Eugene segments. As illustrated in Figures 6-4 and 6-5, combining all of the individual components into a single graph for each of these segments allows the ability to see the highs and lows for demand, as well as the times when trains are full (demand equal to or exceeding capacity). Note that for clarity, the secondary axis (right side axis) has been compressed to reside entirely below the first major gridline.

**Figure 6-4: Occupancy and Capacity Exceedances: Vancouver to Seattle Segment**

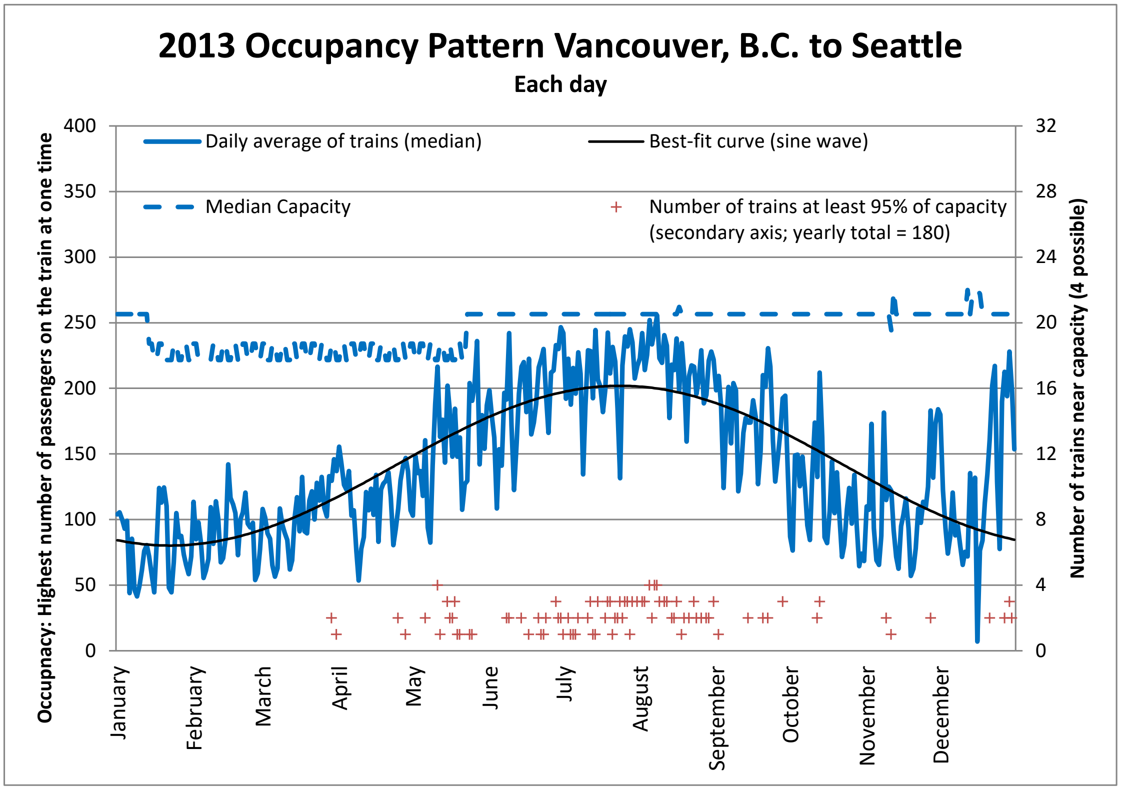
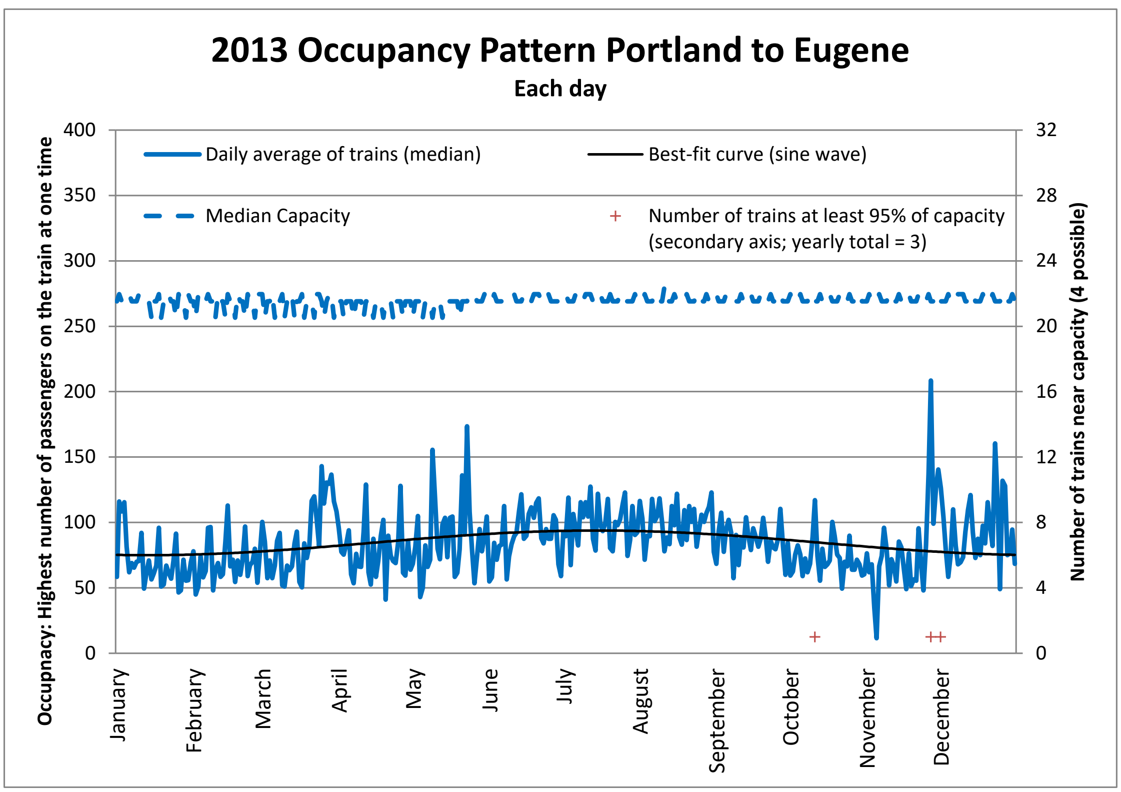



**Figure 6-5: Occupancy and Capacity Exceedances: Portland to Eugene Segment**



The segment from Seattle to Vancouver, British Columbia (Figure 6-4) is clearly more susceptible to seasonal variation. The Portland to Eugene segment (Figure 6-5) also shows variation, but it is at a lower overall level of ridership. Effectively, full trains occur frequently on the Vancouver, British Columbia services but infrequently on the service between Portland and Eugene. However, the nature of the service pattern that has trains running through multiple segments of the corridor means that it is not a simple proposition to reduce capacity in this area. The fixed size of the existing trainsets makes it necessary to carry additional capacity for some parts of the journey in order to accommodate the far higher ridership in other segments.

## 6.2 Forecasting Future Demand

Generating a forecast for future ridership requires an extensive analysis of a number of data sources. A macro model of ridership growth based on larger factors such as journey time reduction and increases in round trips has been created as part of the Federal Railroad Administration-approved (FRA) Washington State Rail Plan to identify the overall estimate of ridership levels. This is important from an overall demand perspective but it does not provide sufficient information to allow for fleet planning. When determining the requirements for rail vehicles, it is necessary to know how many passengers will be on any one train at any point in its journey.

A new model of ridership has been created that combines the overall ridership growth estimates from the macro model with the data on individual rider numbers for each train and segment of the journey. Under this model it is possible to make projections for riders on any point in the route for any future year. This model makes use of the time of day in which the journeys occur to allow redistribution of riders between trains in future scenarios when additional trips have been added.

The model then analyzes the number of times in which a train might be potentially sold out. Sizing the fleet for the highest demand day is not economically viable. Therefore, the model includes a function of acceptable days with full capacity of the trains to determine how large the trains need to be to meet the majority of demand situations. This will result in the trains being sized for the highest demand portion of the route.

Trains make multiple journeys each day and, currently, they cannot be reconfigured for size. Therefore, the model incorporates the rotation patterns for the trains to analyze which parts of the rotation have the highest ridership demand and size the trains accordingly. The model has many input parameters and can be adjusted to analyze different scenarios.

In the analysis of current ridership undertaken above, the number of trains exceeding 95% ridership at some point in the service is identified. Clearly, with a growth in ridership but no associated increase in capacity, the number of trains breaching this threshold will increase. This will either deter riders or result in movement to other services with greater remaining capacity.

## 6.3 Demand Trends

The modeling of ridership is based on the current demand patterns. The service has a high level of leisure travel and a smaller proportion of business usage. The model assumes that this split of demand is maintained. Increasing the number of round trips and reducing the journey time may combine with external factors, such as increased congestion, to cause a modal shift for business travelers. If this is to occur, the existing model will under-predict the ridership levels. Consequently, the overall ridership levels must be constantly analyzed to determine whether the modeling assumptions need to be revised.

# Chapter 7. Reconciling Supply and Demand

This chapter:

- Looks at the current fleet and the capacity it offers.
- Considers alternatives to enhance capacity for the current trainsets.
- Looks at how to manage demand with current equipment.
- Identifies how to align additional equipment purchase with existing vehicles.
- Lays out the business case approval required for new acquisition programs.

## Current Capacity

Modeling of ridership indicates that the current levels of demand already exceed the capacity of the current fleet. This indicates that the number of trains that are traveling at or close to full capacity exceeds a level that is desirable and some riders may be discouraged from using the service due to perceived availability concerns.

This does not impact all routes or all trains, but it is important at peak times. Passengers who experience full trains, may believe that there is not sufficient capacity on any of the Amtrak Cascades trains, even though this may not be true. This is acceptable up to a certain level but, if too frequent, has a negative impact on the service. With increases in ridership forecast, the situation will only become more pronounced.

The current fleet has been assessed for its potential for expansion. The semi-permanently coupled configuration of the Series 6 and Series 8 trainsets means that any capacity growth is a fairly complex proposition.

Reconfiguring the trainsets could be possible. Talgo has proposed ways to lengthen both types of trainsets by adding more cars. However, the older Series 6 trainsets currently operate under a waiver from the Federal Railroad Administration (FRA) that allows the European-style equipment to operate on U.S. tracks in their specific configuration and condition. Adding additional cars to these trainsets would involve a review of this waiver with the FRA.

Lengthening the trains also entails an analysis of all current stations and maintenance locations. The shortest station platforms are currently at Bellingham with this station able to accommodate up to a 14 car train. Introducing longer trains than this will initially require an assessment of this station. The next shortest stations have platforms 50’ longer than Bellingham and the assessment would become more extensive as longer trains are contemplated. Moreover, adding more cars would have an impact on journey time if more locomotive power is not also added. With the new Charger locomotives due to enter service in 2017, this should provide for additional horsepower, that would offset the loss of performance. However, until testing of the new locomotives is complete, the performance impact, if any, is not known.

There is not currently funding identified by Washington State Department of Transportation (WSDOT) and Oregon Department of Transportation (ODOT) to expand the fleet at this time. However, this option will remain under review based on ridership changes and the availablity of funding for fleet expansion.

### Future expansion

The four scenarios developed by WSDOT and ODOT and outlined in Chapter 1, provide a 20-year equipment outlook in response to probable growth, on-going maintenance requirements, and future fleet turnover . They also reflect the service goals set by each SRP by 2035.Taking into account these scenarios and the current financial constraints that limit WSDOT and ODOT's options, two alternate short-term strategies (Strategy 1 and Strategy 2) were evaluated. Additionally, three long-term strategies (Strategy 3, Strategy 4 and Strategy 5) were developed to respond to other challenges identified in meeting the 20-year demand projections under each of the scenarios.

> To analyze current and future equipment and maintenance demand, an equipment forecasting sketch model was developed specifically for this FMP.

## 7.1 Strategy 1: Managing demand (short-term)

Based on current ridership, some trains currently do not have enough seats to meet demand, leading to sold out conditions. Ridership projections indicate this situation will worsen in the future, as ridership increases. The modeled capacity demand is based on peak demand, where a proportion of riders have pre-existing time constraints (for example, business travelers). However, ridership also includes passengers (for example, tourists) that have more travel flexibility.

Currently Amtrak uses a demand-driven pricing structure to adjust ticket prices. By tailoring ticket prices for certain times and days, riders may be incentivized to use trains with lower ridership to help better distribute ridership across the entire service. This will help reduce the number of sold out trains, which otherwise would have a negative long-term impact if riders begin to perceive service to be unavailable on a regular basis. Therefore, by applying pricing and information management strategies to redistribute riders whenever possible, Amtrak Cascades may maintain an acceptable service level on the peak services until WSDOT and ODOT can acquire additional equipment and expand service.

## 7.2 Strategy 2: Modifying operations (short-term)

Another option to address short-term ridership growth would be to modify operations by acquiring additional passenger vehicles/cars to increase the existing trainset seating capacity during these times of greater demand. One of two potential approaches could be implemented to modify operations in the short term. One approach would be to acquire additional passenger vehicles/cars for each of the current trainsets.[11] The other approach would be to re-distribute cars from one of the existing Talgo Series 6 trainsets to lengthen other Talgo Series 6 trainsets, and then acquire an additional trainset to replace the donor trainset.

An evaluation is needed to determine the cost, technical issues, regulatory requirements and additional safety goals, lead time and return on investment required to incorporate these cars into the existing trainsets. This evaluation could also establish whether all of the trainsets should be lengthened equally or whether a business case can be made to lengthen only some trainsets and

[11] The manufacturer has indicated that a number of Series 6 passenger vehicles/cars are stored in Europe. These vehicles/cars are not currently in service.

schedule usage accordingly. The business case should also analyze the feasibility and necessity to lengthen the Talgo Series 8 trainsets (see Strategy 3 for business case criteria). Cars from the Series 6 and Series 8 trainsets are not compatible with each other and therefore are not interchangable.

The decision to lengthen a trainset also would be influenced by a service development strategy. Increased service levels beyond the 2017 schedule may affect both individual train seating capacity requirements and the out-of-service date for the Talgo Series 6 trainsets, which in turn would affect the return on investment calculation.

## 7.3 Strategy 3: Investing in equipment (long-term)

As forecast over the next 20 years, additional equipment will be necessary to respond to ridership growth and service expansion. The required number of passenger vehicles/cars and locomotives acquisitions will vary and depends on both the approved service pattern and the timing of the service pattern. When evaluating future equipment acquisitions related to the evaluated service scenarios (detailed in Appendix D), the following considerations must be addressed:

### Consideration 3a: Criteria for developing a compelling business case

Developing a compelling business case requires evaluating all parameters that affect service, beginning with acquisition, extending through support and operation, and concluding at the end of service life. Relevant and measureable performance parameters become critical to the process, the following criteria should be considered when developing a business case for every acquisition program:

- Long lead-time.
- Fuel efficiency and performance (including journey times).
- ADA accessibility.
- Fleet flexibility (reference Consideration 3c).
- Customer environment (for example, passenger amenities, safety and comfort).
- Cost of maintenance.
- Anticipated obsolescence risks and overhaul requirements.
- Availability of capital funding.
- Impact on the maintenance and layover facilities.

In addition, as discussed previously, the need for new equipment will be determined based on:

- How the existing equipment has performed as anticipated within the FMP.
- Whether the existing equipment has had higher costs of operation and/or lower trends of reliability than anticipated/projected.
- Whether the equipment has exceeded expectations and can continue in service longer than expected.

While some of the criteria could be considered discretionary and involve a tradeoff between cost and amenities, some criteria are necessary to deliver service. This includes achieving journey time requirements, providing sufficient passenger capacity and ensuring performance through the corridor's grades, curves and track conditions.

The ability of a train to meet these performance parameters is one aspect for the overall business case, with the cost effectiveness of maintenance support being equally critical. An acceptable level of maintenance costs will be driven by the type and variety of equipment in the fleet. Optimizing costs may require decisions concerning what equipment types to use or whether the out-of-service date of existing equipment should be modified to minimize ongoing costs.

### Consideration 3b: Tying replacement equipment to service-level increases whenever possible

Existing equipment will have to be replaced as it ages. A typical timeframe for the replacement of the Talgo Series 6 trainsets (WSDOT and Amtrak's current trainsets) is approximately 25 to 30 years. While this is not a rigid limit (as described further under Consideration 3e), the timeframe does provide an estimate for replacement. As such, when it is decided that equipment should be replaced, maximizing the quantity of the order will be the most efficient approach and provide the most competitive unit cost. Therefore, WSDOT and ODOT should consider tying Series 6 trainset retirements directly to the introduction of new equipment when adding service.

### Consideration 3c: Balancing fleet flexibility with operational flexibility

WSDOT and ODOT might consider acquiring new equipment that consists of individual passenger vehicles/cars or flexible trainsets to simplify the operations and maintenance processes. Presently, an entire trainset must be taken out of service for overhaul/repair. However, acquiring individual passenger vehicles or flexible trainsets would accommodate more efficient maintenance rotations and more flexibility to add seating capacity based on ridership demand. The incremental capital and operational costs of additional equipment will have to be included in the business case evaluation.

Because spare capacity requirements are a function of the overall size of the fleet, a smaller fleet of individual vehicles would lead to a disproportionate number of spares. For example, a small fleet would likely require over 50 percent of spare vehicles, as opposed to 10 to 20 percent for a larger fleet. This would be another reason to tie Series 6 trainset replacement directly to the acquisition of additional equipment in order to eliminate the potential for an unbalanced vehicle to spare ratio. Although spares will be necessary for all passenger vehicles/cars, the introduction of cab cars that also can be used as coach cars affords an opportunity to reduce the number of spare vehicles and to more effectively size the fleet.

### Consideration 3d: Tying acquisition to service-level increases whenever possible

The number of scheduled daily trains has a direct effect on the number of trainsets required to deliver service daily. While capacity growth is an issue throughout the corridor, an increase in the number of daily trains offered between cities would have the largest impact on equipment demand. Therefore, WSDOT and ODOT should consider tying any acquisition program directly to changes in service frequencies. In addition, they should consider consolidating small order quantities with any large acquisitions in order to maximize the efficiency of the equipment order.

### Consideration 3e: Retirement date flexibility

Related to Consideration 3b, analyzing the commercial life of the Series 6 trainset indicates that replacement dates are sufficiently flexible enough to meet the timeframe for additional acquisition and to maximize order quantities. While the hypothetical out-of-service date is based on the economics of operating the Series 6 trainsets, the date can vary without a significant impact to cost. Adjusting the date by a few years one way or the other is manageable because the vehicles can be supported over that length of time. Therefore, although the 20-year equipment outlook was oriented around currently funded 2017 service, modifications to the date by which changes are implemented are possible without incurring a significant cost or service impact. This ensures that any short-term decision on service or equipment acquisition would not inhibit the development of future service under the current service scenario or any of the other three scenarios described in Appendix D. This consideration is valid irrespective of equipment type.

The flexibility noted above is based on theoretical modeling through life-cycle costs. It includes some provision for obsolescence in aging vehicles. However, it does not account for any circumstances in which the commercial terms associated with dealing with obsolescence issues are significantly above the norm. If the pricing of modification and component replacement is excessive, the optimal out-of-service date will be earlier than what is noted above.

## 7.4 Strategy 4: Maintenance facility investment (long-term)

Decisions makers should not move forward with replacing or adding equipment without also considering maintenance facility, track, storage and work area capacity and capabilities. Sufficient capacity is critical to support operations and to sustain new and existing equipment. Chapter 5 identifies past and proposed modifications to the Seattle Maintenance Facility. Similar evaluations for any future equipment acquisition program should be considered.

The lead-time to construct or expand a maintenance facility is as long, if not longer, than the lead-time associated with equipment acquisition. Notwithstanding the lead-time to secure funding before construction and expansion could begin. Therefore, evaluating and implementing either a new facility or an existing facility expansion must be timed to provide capacity in parallel with new equipment delivery.

Impacts of future equipment acquisitions on the various layover locations along the corridor also should be considered. Increased service and/or changes to a service schedule may result in either trains having to layover at different locations or more trains having to layover at one specific location. Both ensuring that there is sufficient space to store trainsets overnight in Eugene, Portland and Vancouver (British Columbia), as well as to perform trainset layover servicing, are as important as having sufficient capacity in the primary maintenance facility.

## 7.5 Strategy 5: Ensuring the FMP is a living document

The development of intercity passenger rail service is a constantly evolving process. Subsequently, the planning and management of fleet issues have to be a “living” process in order to ensure fleet-strategy decision making relates to current and planned service. As such, the FMP should be revised, at a minimum, on a biennial basis to reflect the latest development in planned services, the status of the existing fleet, the status of equipment acquisitions and any changes to stakeholder relationships.

Currently, the FMP provides a forward-looking view of service demand based on current data and service development goals. The FMP does not provide definitive decisions regarding acquisitions and infrastructure requirements, but instead identifies what decisions will need to be made and when. The FMP presents the guidelines for those decisions to be evaluated at the appropriate time.

Procedures should be in place to ensure all equipment plans for every equipment type is up-to-date on an ongoing basis to provide the base document for all issues associated with the equipment overhaul, modification and investment. Updates will occur on an ongoing basis, and the latest versions of each equipment plan will be incorporated into the next revision of the FMP.

# Chapter 8. Financial Requirements

Ensuring a reliable fleet with sufficient capacity to accommodate ridership growth, and to provide an appealing customer environment and service level, requires significant financial investment. Given the current funded service levels for Amtrak Cascades (as described under Scenario 1), this chapter outlines an order of magnitude projection for financial needs of the service's equipment over the next 20 years. These financial needs include costs to operate and sustain the existing equipment as well as projected costs for replacement based on the life span planning goal. The equipment replacement costs and timing of the expenditure are for planning purposes to help inform decision makers regarding future-year expenditure requirements. As the dates come closer, the detail of the expenditure profiles will become more accurately forecast.

### Budget Assumption and Considerations

The operating budget expenditure is based on current levels of spending and future projections of cost change. The capital budget expenditure is based on the scenario planning included within this report. The proposed expenditure timing is based on replacement of the equipment in line with the overall goals of the fleet strategy. As previously discussed in Chapter 3 (Section 3.6), there is not a significant penalty in life cycle cost associated with moving the replacement date a short distance forward or back. Therefore, flexibility is possible. However, it should be noted that deferring investment in recapitalizing the fleet does increase the need for additional overhaul activities with their own capital expenditure. There will also be a progressive increase in operating budget as the equipment ages. Therefore, the proposed replacement date is based on minimizing overall program cost.

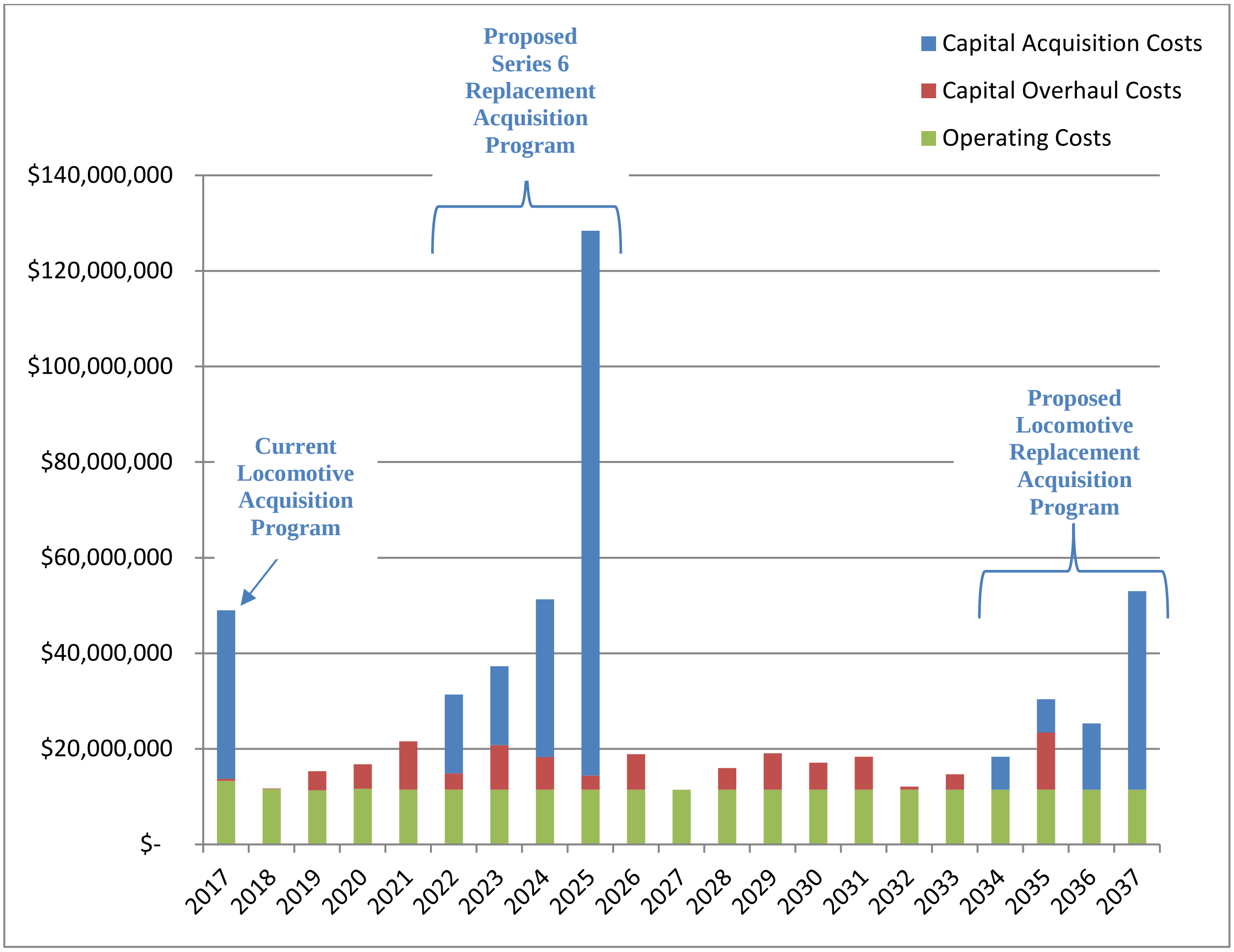
As a separate but related issue, there is also a revenue element associated with recapitalizing the equipment fleet. The ridership model indicates that the current levels of demand already exceed the capacity of the current fleet.With the projected growth in ridership as a result of the investments currently being made on the PNWRC, revenue is anticipated to improve. Delaying any recapitalization will have implications for ridership development and will have a revenue impact accordingly. If revenue management is used to accommodate capacity issues, this is also at the expense of overall program revenue. An increased fleet size and the customer perception benefits associated with new equipment will have a positive revenue impact.

### Budget Estimation

Figure 8.1 illustrates the projected financial requirements for equipment investment for the Cascades service over the next 20 years. This level of investment is predicated on the currently funded service levels with the increase in service in 2017 (two additional roundtrips between Seattle and Portland) followed by equipment needs to sustain that level of service and accommodate ridership growth at that service level. Costs are identified in state FY16 values and are subject to inflation.

The chart is a combination of costs for WSDOT, ODOT and Amtrak owned equipment. It includes already identified programs and those that are projected to be required to support the service as envisioned in Scenario 1 using the consolidated approach to equipment acquisition (described in Chapter 1, Section 1.4). It is important to note these costs are conceptual and that all capital and operating budgets will be subject to appropriation and successful grant applications as appropriate.

**Figure 8-1: Conceptual Capital and Operating Costs**




Note on graph: The gradual increase in capital acquisition costs represents the spending profile for a typical acquisition program, in that the majority (60%) of the cost is realized upon delivery of the equipment.

The 20-year time horizon is used because of the long timescales involved in projects like rail equipment acquisition and ownership. The upfront costs and sustaining costs for rail equipment are substantial and a long-term view of costs is necessary to ensure sufficient funding is in place to sustain and develop the service.

Projections of future service and the associated equipment requirements allow the modeling of the funding requirements for the coming years. These estimates combine the capital costs for acquisition of new equipment; capital costs for modifying, overhauling and enhancing the existing (and future) equipment and upgrading facilities with the operating costs for running the current and planned equipment.

## Capital Acquisition Costs

The proposed passenger vehicles/cars acquisition program shown in the chart illustrates the costs associated with replacing the Talgo Series 6 trainsets based on the life-span planning goal of 25 years. With an estimated acquisition timetable between five to six years, to meet a 2025 in-service date, an equipment acquisition program should be initiated by 2019. The acquisition program would not require significant capital expenditure until 2022 based on the assumed payment plan for new vehicle acquisitions; however as funding would need to be programmed in order to allow the commencement of acquisition activities, a 2019 date is proposed.

Any change to the in-service date of the new equipment would come with an associated change in the start date for acquisition activities. As previously discussed, the Series 6 trainsets could continue in service beyond the proposed replacement date. The fleet is sustainable if a change to the out of service date is required. However, a delayed retirement would require further investment in the aging fleet for overhauls and modifications.

Equipment capital costs are estimated based on the current market conditions, but are subject to variation based on a number of factors:

- Specification of equipment acquired.
- Size of potential orders.
- Capacity of the marketplace.
- Raw material and sub-contractor pricing.

## Capital Overhaul Costs

The chart illustrates the capital costs for modifying, overhauling and enhancing the existing (and future) equipment and upgrading facilities. The overhaul costs are based on lifecycle preventative maintenance. Similarly, costs for modifications and overhauls are based on estimates of the potential scope of such work. As discussed throughout this FMP, the scope is subject to a business case being generated at the outset of the project.

## Operating Costs

Operating budget numbers are a combination of the costs of operation and maintenance of the existing and proposed equipment and involve a number of core suppliers. The budgetary projections are indicative of the anticipated service levels but are also subject to revision.

# Chapter 9. Equipment 20-year Outlook

As outlined under Strategy 3 in chapter 7, equipment demand over the next 20 years has been estimated for both passenger vehicle/car and locomotive demand under the currently funded 2017 service (Scenario 1 and Scenario 1A). This chapter summarizes equipment needs based on the funded service scenario. Appendix D details equipment demand for the three alternative scenarios, and Non Powered Control Unit (NPCU) equipment is discussed briefly at the end of this chapter.

The Washington State Department of Transportation (WSDOT) and Oregon Department of Transportation (ODOT) conducted the analysis based on ridership demand and capacity to meet that demand. Ultimately, the number of passenger vehicles/cars to meet capacity demand will depend on the type of vehicle(s) selected. The model included both bi-level and single-level/trainset equipment. While this FMP identifies potential issues that need to be addressed when choosing future equipment, the plan does not determine what the equipment will be. For illustrative purposes, the seating capacity of a single-level/trainset type vehicle was used to quantify future equipment needs.. However, it is recommended that the actual number of passenger vehicles/cars to acquire should be based on ridership projections at the time of acquisition and the seating capacity of the selected vehicle type, whether the selected type is individual passenger vehicles/cars or flexible trainsets.

## 9.1 Passenger Vehicle/Car Needs

Under the current modeled growth for Scenario 1, seating capacity would need to increase from about 1,800 seats currently to about 2,300 seats by 2037. Based on FMP modeling results, 55 single-level/trainset passenger vehicles/cars[12] would be needed to meet ridership demand under the currently funded 2017-service level.

## 9.2 Locomotive Needs

The current locomotive acquisition program detailed in Section 3.8 will provide locomotives for the currently funded 2017 service. However, since the current requirement for locomotives is 11 units and eight are being acquired using the ARRA grant funds, Amtrak will have to continue to provide additional locomotive capacity to supplement WSDOT and ODOT's locomotive fleet. Under Scenario 1A, WSDOT and ODOT could eliminate the need for Amtrak locomotives by acquiring at some point in the future three additional locomotives, beyond the eight already being purchased by WSDOT.

## 9.3 The Future of NPCUs

The Series 6 trainsets are projected to remain in service until 2025, which would require using NPCUs or secondary locomotives for each trainset. Although Amtrak has sufficiently maintained the units to continue safe operations, until recently, no structured or formal rebuild program had been initiated for the NPCUs. Amtrak has begun a refurbishing program for the NPCUs, which

[12] Includes passenger and non-passenger carrying vehicles.

should allow the NPCUs to remain in service alongside the Series 6 trainsets for the entire length of their time in service.

The possibility of reconfiguring other vehicles to act as NPCUs, including the use of the F59PHIs as NPCUs when the Chargers locomotives are delivered, has been discussed and could be considered as an option. However, Amtrak may have alternative plans for the locomotives when they are replaced, so no current planning is underway to convert the F59PHIs to NPCUs.

Currently, the Series 8 trainsets use integrated cab cars. With no spare cab cars for that sub fleet, there is a risk that a trainset could be rendered out of service if a cab car is damaged. Therefore, ODOT is investigating how to use NPCUs for its Series 8 trainsets as well. This may require reviewing the number of NPCUs for the fleet and the long-term supportability of the NPCUs to meet the full-service life of the Series 8 trainsets. New equipment would likely include cab car variants that could be readily swapped out if needed. In the future, a higher proportion of cab cars should be acquired since the cars can operate as standard coaches or cab cars, which will provide greater fleet flexibility.

# Chapter 10. Conclusions

Washington State Department of Transportation (WSDOT) and Oregon Department of Transportation (ODOT) are committed to the continued development of the Amtrak Cascades corridor by providing safe, comfortable and reliable service to their customers. This FMP is a critical element for each state's long-term strategy to ensure a sufficient level of equipment is available to meet current and future service and ridership demand. The FMP also reconciles current and future supply and demand constraints to support reliable, safe and cost-effective service.

Although this FMP does not outline decisions concerning service development, the plan provides a level of understanding about equipment demand based on each state's SRP, taking into account current funding from each state's legislature. The FMP was developed by WSDOT and ODOT based upon the three unifying pillars of fleet management:

(1) support and enhancement of the current fleet,

(2) acquisition of new equipment, and

(3) additional service expansion and maintenance facilities to support the fleet.

Using this framework, WSDOT and ODOT have developed a series of strategies and a 20-year equipment outlook for both currently funded 2017 service scenarios and three other potential future service scenarios. While the FMP analyzes four different service scenarios, this version of the plan primarily focuses on currently funded 2017 service, current forecasts of ridership growth and the projected out-of-service date for the current equipment.

Before initiating any equipment acquisition program, a program-specific sound business case based on the most current data and projections should be developed. Procuring equipment flexible enough to serve the demands inherent to the Amtrak Cascades corridor should be considered. The value of equipment built from individual cars or flexible trainsets that can be easily rotated and quickly reconfigured on a daily basis should be evaluated. This will provide additional flexibility for maintenance and accommodate trainset adjustments in order to meet short-term ridership demand and overall ridership growth over time.

Through evaluation and modeling results, to meet projected demand, the FMP proposes procuring passenger vehicles/cars by 2025. Under the current modeled growth for Scenario 1, seating capacity would need to increase from about 1,800 seats currently to approximately 2,300 seats by 2037. An important aspect worth noting is the length of time required for implementing any equipment acquisition program. This time is estimated between five and six years and includes the following activities: funding to be in place, specifications to be developed, procurement processes to be initiated, and equipment production to be completed before equipment is delivered for service. Therefore, to meet a 2025 in-service date, an equipment acquisition program should be initiated by the 2019-2021 biennium.

# Appendices

# Appendix A: List of Reference Reports

## A.1 Reference Reports

- Available at www.wsdot.wa.gov/Rail/Plans.
- Washington State Rail Plan – March 2014
- Washington and Oregon Cascades Rail Corridor Management Workplan – January 2013
- Amtrak Cascades New Stop Evaluation – Auburn – September 2013
- Cascades Corridor Station Design Criteria – November 2012
- Previous Plans:
    - Amtrak Cascades Mid-Range Plan – December 2008
    - Amtrak Cascades Mid-Range Plan Appendices – December 2008
    - Washington State Long-Range Plan for Amtrak Cascades – February 2006
    - Washington 2010-2030 Freight Rail Plan

Available at www.oregon.gov/odot/td/tp/pages/railplan.aspx.

- Oregon State Rail Plan – September 2014

Other reports:

- Capital Investment Program for Amtrak Equipment Deployed in State Supported Services FY2014-FY2018 – October 2014
- Amtrak Fleet Strategy Version 3.1 – March 2012
- Grandfathering of Certain Passenger Equipment for Use on Specified Rail Lines, FRA Docket No. 1999-6404 – March 2009

# Appendix B: Acronyms

| Acronym | Term |
|---|---|
| ADA | Americans with Disabilities Act |
| Amtrak | National Railroad Passenger Corporation (American Travel by Track) |
| BCMoTI | British Columbia Ministry of Transportation and Infrastructure |
| BNSF | Burlington Northern Santa Fe Railway |
| DOT | Department of Transportation |
| FMP | Fleet Management Plan |
| FRA | Federal Railroad Administration |
| MAP-21 | Moving Ahead for Progress in the 21st Century Act |
| MOE | Maintenance of Equipment Building |
| NGEC | Next Generation Equipment Committee |
| NPCU | Non-powered control units |
| ODOT | Oregon Department of Transportation |
| OEO | Office of Equal Opportunity |
| Ore. | State of Oregon |
| OTC | Oregon Transportation Commission |
| PRIIA | Passenger Rail Investment and Improvement Act of 2008 |
| S&I | Service & Inspection |
| ST | Sound Transit: Central Puget Sound Regional Transit Authority |
| SRP | State Rail Plan |
| Talgo | Patentes Talgo, S.A. of Madrid, Spain |
| Wash. | State of Washington |
| WSDOT | Washington State Department of Transportation |

# Appendix C: Equipment plans

This Appendix details the equipment plan for the Amtrak Cascades service. The following provides an overview of the Talgo Series 6 and Series 8 trainsets and the current and future locomotives owned by Washington State Department of Transportation (WSDOT), Oregon Department of Transportation (ODOT) and Amtrak. The plan for each type of equipment provides the primary planning document to sustain the current equipment on the Amtrak Cascades corridor. The plan summarizes everything related to the vehicle from production to out-of-service date. The plan is a living document through which WSDOT and ODOT will manage all aspects of investment, modification and overhaul up to and including equipment retirement.

## C.1 Car Type: Talgo Series 6

### Built By

Talgo built the Series 6 trainsets for WSDOT and Amtrak. Talgo, Inc. is an American company fully owned by the Spanish Patentes Talgo SLU, that has over 70 years of experience designing and manufacturing intercity, standard and high-speed passenger trains in Spain, Portugal, France, Switzerland, Italy, the United States, Russian Federation, Kazakhstan and Uzbekistan. In addition to manufacturing passenger trains, Talgo also provides complete maintenance cycle services for railway operators across the globe, such as Renfe, Amtrak, Temir Zholly (Kazakhstan Railways), Temir Yo'llari (Uzbekistan Railways), Elipsos (JV of SNCF and Renfe) and RZD (Russian Federation Railways).

### Performance Characteristics

One of the unique performance characteristics of the Series 6 is that each wheel is independently mounted on single axles connected by a frame located between the cars, with suspension columns sitting on top of the single axles. The carriage attaches to the top of the suspension columns and swings outward when the trainset is taking a curve in the track. This design feature increases stability and improves smoothness of the ride, providing passenger comfort and allowing for a more consistent speed through curves, which thereby reduces overall travel time along the Amtrak Cascades corridor.

Despite a maximum design speed of 125 miles per hour, current infrastructure requirements along the corridor limit Talgo trainsets to 79 miles per hour. In addition to an improved rider experience, the Series 6 has a number of amenities, such as individual electric outlets for laptops, wheelchair lifts on Americans with Disability Act (ADA) cars, onboard Wi-Fi service, a separate baggage vehicle and bicycle storage spaces.

### Trainset History and Operation

Commercial service of a single Talgo-manufactured trainset for demonstration purposes commenced in 1993 between Seattle, Washington, and Portland, Oregon. In late 1994, the same demonstration trainset was returned to service between Seattle and Portland until May of 1995, when the service expanded to Vancouver, British Columbia. In 1997, a second Talgo demonstration trainset was leased to serve the corridor. Currently, the service covers over 467 miles of track that generally parallels Interstate 5 and has 18 stops, 12 of which are in Washington (See Figure C-1).

**Figure C-1: Amtrak Cascades Corridor**


In 1996, WSDOT and Amtrak ordered four Series 6 trainsets (two of which are owned by WSDOT and two of which are owned by Amtrak). During production, WSDOT leased two Series 200 trainsets from Talgo and two Amtrak trains to meet service needs in the corridor. Operated by Amtrak, the four trainsets replaced the two demonstration trainsets and the two Amtrak trains. Talgo manufactured a fifth trainset at the same time as the other four, which was scheduled to enter service between Los Angeles, California, and Las Vegas, Nevada, in early 2001. Service never began, and the trainset was eventually sold to WSDOT in 2003 and is currently in use on the Amtrak Cascades corridor.

Trainsets rotate through various service patterns to ensure uniform delivery and maintenance scheduling, with the exception of the Mt. Adams (the shorter trainset) that usually runs daily between Seattle and Vancouver, British Columbia. Amtrak typically operates the five Series 6 trainsets in a push-pull configuration, with an EMD F59PHI or GE P42DC locomotive at one end and an unpowered EMD F40PH locomotive (i.e., a Non-Powered Control Unit) on the other end of the 12 to 13-car trainset. Four of the five trainsets are named after mountains in the Cascade Range: Mount Rainier, Mount Baker, Mount Adams and Mount Hood. The last trainset gets its name from Mount Olympus in the Olympic Range.

A typical trainset consists of a baggage car, two business-class coaches, one lounge/dining car, one cafe car (i.e., a bistro car), six standard coaches and one substitute power/service car. Amtrak owns Mt. Hood and Mt. Olympus, and WSDOT owns Mt. Adams, Mt. Baker and Mt. Rainier, with some cars intermixed. There are 67 total units, with car numbers ranging from 7100 to 7905. Table C-1 provides more detail on the Series 6 trainset configurations.

**Table C-1: Series 6 Trainset Configurations**

| Trainset Name | Car Type | WSDOT Car # | Amtrak Car # |
|---|---|---|---|
| Mt. Baker | Power Car | 7902 | |
| | Business Class | 7451 | |
| | Business ADA | 7551 | |
| | Diner/Lounge | 7801 | |
| | Bistro | 7301 | |
| | Coach ADA | 7501 | |
| | Coach ADA | | 7521 |
| | Coach | 7409 | |
| | Coach | 7408 | |
| | Coach | 7407 | |
| | Coach | 7406 | |
| | Coach | 7405 | |
| | Baggage Car | 7104 | |

There are **12** WSDOT cars on the Mt. Baker trainset.

| Trainset Name | Car Type | WSDOT Car # | Amtrak Car # |
|---|---|---|---|
| Mt. Olympus | Power Car | 7901 | |
| | Business Class | | 7453 |
| | Business ADA | | 7553 |
| | Diner/Lounge | | 7803 |
| | Bistro | | 7304 |
| | Coach ADA | | 7503 |
| | Coach ADA | | 7522 |
| | Coach | | 7419 |
| | Coach | | 7418 |
| | Coach | | 7417 |
| | Coach | | 7416 |
| | Coach | | 7415 |
| | Baggage Car | | 7103 |

There is **one** WSDOT car on the Mt. Olympus trainset.

| Trainset Name | Car Type | WSDOT Car # | Amtrak Car # |
|---|---|---|---|
| Mt. Rainier | Power Car | | 7904 |
| | Business Class | 7452 | |
| | Business ADA | 7552 | |
| | Diner/Lounge | 7802 | |
| | Bistro | 7302 | |
| | Coach ADA | 7502 | |
| | Coach ADA | | 7520 |
| | Coach | 7414 | |
| | Coach | 7413 | |
| | Coach | 7412 | |
| | Coach | 7411 | |
| | Coach | 7410 | |
| | Baggage Car | | 7100 |

There are **10** WSDOT cars on the Mt. Rainier trainset.

| Trainset Name | Car Type | WSDOT Car # | Amtrak Car # |
|---|---|---|---|
| Mt. Hood | Power Car | | 7900 |
| | Business Class | | 7450 |
| | Business ADA | | 7550 |
| | Diner/Lounge | | 7800 |
| | Bistro | | 7300 |
| | Coach ADA | | 7500 |
| | Coach ADA | | 7400 |
| | Coach | | 7425 |
| | Coach | | 7402 |
| | Coach | | 7403 |
| | Coach | | 7404 |
| | Coach | | 7401 |
| | Baggage Car | 7101 | |

There is **one** WSDOT car on the Mt. Hood trainset.

| Trainset Name | Car Type | WSDOT Car # | Amtrak Car # |
|---|---|---|---|
| Mt. Adams | Power Car | 7903 | |
| | Business Class | 7454 | |
| | Business ADA | 7554 | |
| | Diner/Lounge | 7804 | |
| | Bistro | | 7303 |
| | Coach ADA | 7504 | |
| | Coach | 7424 | |
| | Coach | 7423 | |
| | Coach | 7422 | |
| | Coach | 7421 | |
| | Coach | 7420 | |
| | Baggage Car | 7102 | |

There are **11** WSDOT cars on the Mt. Adams trainset.

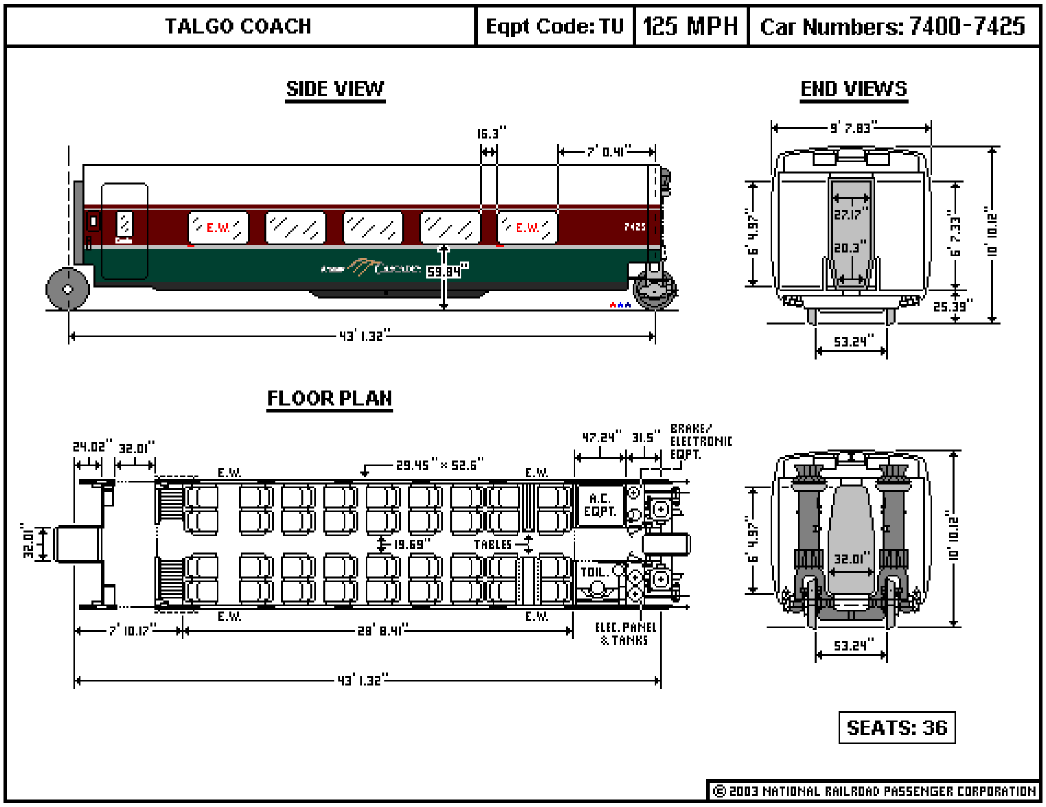
| Trainset Name | Car Type | WSDOT Car # | Amtrak Car # |
|---|---|---|---|
| Spares | Power Car | 7905 | |
| | Bistro | 7305 | |
| | Baggage Car | 7105 | |

There are **three** WSDOT cars on the spare consist.

## General Configuration

Figure C-2 depicts the general configuration (i.e., views and floor plan) for a typical Series 6 coach.

## Figure C-2: Diagram of Sample Talgo Series 6 Coach




### Maintenance

#### *Maintenance Facility*

Amtrak owns and operates its Seattle maintenance facility where maintenance and upkeep occurs for the Series 6 trainsets. Talgo is responsible for maintaining all of the Series 6 trainsets under a contract with WSDOT and Amtrak. Maintenance for the Series 6 occurs in a building recently constructed as part of a phased expansion of Amtrak's facility. Talgo provides material, engineering and management for the program, using Amtrak staff to undertake the maintenance activities. Talgo schedules maintenance activities via shifts that cover 24 hours a day, 7 days a week that involve daily upkeep, consumable restocking, cleaning, fluid replenishment, defects/scheduled preventive maintenance, and repairs.

Layover facilities providing satellite support are located in Vancouver, British Columbia, and Portland and Eugene, Oregon.

#### *Maintenance Regime*

The Talgo maintenance regime includes a preventive maintenance program that covers periodic inspection and servicing for each of the trainsets. Talgo designed the program's schedule to maintain reliability by detecting potential defects and correcting issues before a failure occurs. The objective of the program is to minimize in-service failures and maximize mean miles between failures.

Talgo runs every trainset through daily and periodic inspection as required by 49 Code of Federal Regulations Part 229 (Railroad Locomotive Safety Standards), Subpart B (Inspections and Tests) and Part 238 (Passenger Equipment Safety Standard), Subpart D (Inspection, Testing and Maintenance Requirements for Tier I Passenger Equipment). Inspections typically monitor the front and sides of a trainset for various damage and defects on the exterior body, wheels, running gear and brake shoes. The inspections also monitor the interiors of all vehicles.

The Federal Railroad Administration requires daily inspections, periodic inspections, various tests during the periodic inspections, annual tests and main reservoir tests. Additionally, the Federal Railroad Administration (FRA) requires operational (efficiency) tests and electronic recordkeeping. The current Amtrak inspection program and test plan complies with all FRA requirements outlined in 49 CFR Part 229, Subpart B and Part 238 (Passenger Equipment Safety Standard), Subpart D (Inspection, Testing and Maintenance Requirements for Tier I Passenger Equipment).

#### *Reliability-Centered Maintenance*

Reliability-centered maintenance (RCM) focuses on the maintenance process and evaluates all the contributing components to that process. As an approach to improve trainset reliability without affecting availability, RCM derives information from the Failure Modes Effects and Criticality Analysis, which identifies the expected failure rates of various components. Using this information, RCM requires the replacement or reconditioning of a component per the RCM definitions. RCM is somewhat similar to periodic maintenance, but RCM goes into much more detail based on the life expectancy of a particular component. Talgo is currently performing RCM on the Series 6 trainsets and ensures compliance with all FRA regulations.

### Mileage

Table C-2 lists the accumulated and average annual mileage for each of the Series 6 trainsets.

**Table C-2: Series 6 Trainset Mileages**

| Trainset | Annual Mileage | Current Mileage[a] |
|---|---|---|
| Mt. Baker | 140,000 | 2,656,886 |
| Mt. Olympus | 140,000 | 2,660,716 |
| Mt. Rainier | 140,000 | 2,659,000 |
| Mt. Hood | 140,000 | 2,663,940 |
| Mt. Adams | 140,000 | 1,871,595 |

[a] *As of July 31, 2016.*

### Overhauls, Upgrades and Modifications

#### *Completed and Ongoing*

WSDOT and Amtrak have invested nearly $6 million to overhaul, upgrade, and modify various components of the Series 6 trainsets. The project began in 2007 and work is ongoing. The following is a list of modifications that have been completed on the Series 6 without differentiation between funding source or contractual arrangement.

- New coffee makers installation (2007).
- Dining car outlet (2007).
- Door sensors (2007).
- Reinforcement of tower supports (2007).
- End car handholds (2007).

- Passenger area floor reinforcement and new seats (2007).
- Passenger area new wall panels (2008).
- New electrical and brake lines in rolling assemblies (2008).
- New bearing temperature sensors (2008).
- Axle housing inspections (2008).
- Emergency windows (2009).
- Suspension valve overhaul (2010).
- 110 VDC battery chargers (2010).
- On-board technician computer (2011).
- Wi-Fi and audio and video systems (2011).
- Clean, oil, test, and stencil (braking systems, 2011, 2015).
- Bistro and diner/lounge upgrades (2012).
- Restroom upgrades (2012).
- Vestibule upgrades (2012).
- ADA restroom doors, controllers and motors (2013).
- Screen content re-design (2013).
- Interior detailing (luggage racks and ticket holders) (2013).
- Segway restrains (2013).
- Additional bike racks on the baggage cars (2013).
- New appliances for the bistro cars (2013).
- Upgrades of Wi-Fi system (2013).
- Fissure Repair (2007, 2015) and Inspections (ongoing).

All passenger trains are required to have positive train control (PTC) systems installed by 2018. The five Series 6 trainsets are all operated with locomotives and NPCUs, which are equipped with a PTC system. ODOT plans to upgrade the Series 8 cab cars with PTC systems.

***System Replacement Considerations***

Under its 20-year maintenance contract with WSDOT and Amtrak, Talgo ensures that on-board systems required to keep the trains in revenue service are functional and are replaced under a schedule included in their preventive maintenance plan. Beyond the 20-year maintenance contract, WSDOT and Amtrak will evaluate the various equipment systems that will need to be upgraded or replaced to extend the life of the equipment beyond 2019. This evaluation will include assessment of the condition of the following systems:

- Brake systems.
- Rolling assemblies and guidance systems.
- Suspension systems.
- Power Car generators.
- Heating, cooling, and air ventilation systems.
- Interior and exterior doors.
- Toilets, sinks, and water systems.
- Electrical systems.
- Communications systems.
- Bistro car systems and appliances.
- Seats and car interiors.
- Flooring and carpets.
- Windows.
- Waste tanks.
- Exterior paint and decals.

Of the above noted systems, some elements of major work are anticipated based on known information. Timing and implementation of these changes will be reviewed with available funding and other service needs. This work is anticipated for the equipment, regardless of contractual relationships and funding.

**Table C-3: Projected Series 6 Modification/Overhaul Activities**

| Future Major Work | 1 to 7 Years | 8 to 15 Years |
|---|---|---|
| Body shell repaint | X | X |
| HVAC unit-system compressor, evaporator coils, controls-upgrade-analog to digital | X | |
| Leather seat cover replacement | X | X |
| Waste tank cover replacement | X | |
| Underfloor panel-seal and reapplication of sound deadener | X | |
| Replacement carpeting and flooring | X | |
| Bistro Car: Refrigeration equipment evaporator and compressor replacement | X | |
| MTU power unit rebuild/replace | X | |
| Exterior safety glass: Select replacement | | X |

### Reliability Issues

All Talgo Series 6 cars are considered to be in a state of good repair.

### Wreck Repairs

Over the life of the Series 6 trainsets, some vehicles have experienced collisions. The current agreements between Talgo, WSDOT and Amtrak include provisions that set the conditions under which Talgo will repair damaged vehicles.

### Legislative Requirements

The accessibility and crashworthiness standards for passenger railcars have not changed, and all five Series 6 trainsets are currently in compliance with the existing standards.

### Planned Out-of-Service/Disposal

Based on WSDOT analysis, a planning goal of 25 years has been projected for the Talgo-manufactured trainsets.

## C.2 Car Type: Talgo Series 8

### Built By

Talgo built two Series 8 trainsets for ODOT and they were delivered in 2013.

### Performance Characteristics

Similar to the Series 6, the Series 8 provides safety reliability, operational efficiency, and passenger comfort by using the trainset's gravity-based tilting system. The lightweight construction (with very low weight per seat and the zero energy consumption to tilt the car body through track curves) allows the trainset to take a curve without a considerable loss of speed and without compromising rider comfort and travel time.

Each trainset holds approximately 270 passengers and includes features such as catering facilities, a baggage car with space to store bicycles, business class accommodations, at-seat passenger electrical outlets, 4G Wi-Fi, reclining seats and a full-service bistro and lounge car. Additional amenities include ADA accessibility, air conditioned units, an audio/video system, media rack, restrooms, individual reading lights, spacious luggage rack compartments, waste and recycle containers and five large panoramic windows on either side of the passenger coaches.

## Trainset History and Operation

In 2009, ODOT purchased two, 13-car, Series 8 trainsets with federal stimulus funds. Delivered in spring 2013, the two Series 8 trainsets, named Mt. Jefferson and Mt. Bachelor after two peaks in Oregon, are operated by Amtrak alongside the five Series 6 trainsets described above.

ODOT's trainsets differ from the five Series 6 trainsets in that the Series 8 are structurally stronger, have some equipment underfloor and include a cab car with a crash energy management system integrated into the trainset, thus eliminating the need for an NPCU. The Series 8 trainsets also have other minor interior differences, such as the cafe car layout, additional ADA features and updated onboard diagnostic and electrical systems. Table C-4 provides more detail on the Series 8 trainset configurations.

**Table C-4: Series 8 Trainset Configurations**

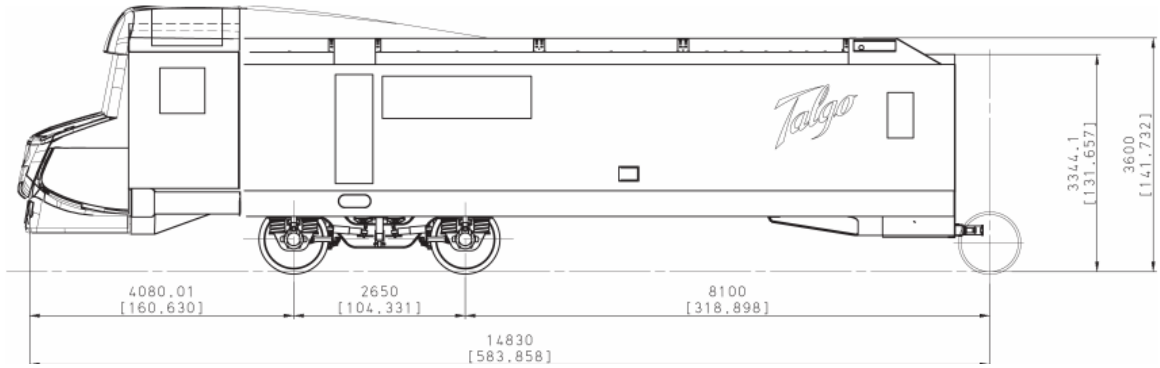
| Trainset Name | Car Type | ODOT Car # |
|---|---|---|
| Mt. Bachelor | Power/Cab Car | 7911 |
| | Business Class | 7563 |
| | Business Class | 7561 |
| | Diner/Lounge | 7811 |
| | Bistro | 7311 |
| | Coach | 7705 |
| | Coach | 7203 |
| | Coach | 7702 |
| | Coach | 7200 |
| | Coach | 7706 |
| | Coach | 7205 |
| | Coach | 7703 |
| | Baggage Car | 7111 |

| Trainset Name | Car Type | ODOT Car # |
|---|---|---|
| Mt. Jefferson | Power/Cab Car | 7910 |
| | Business Class | 7562 |
| | Business Class | 7560 |
| | Diner/Lounge | 7810 |
| | Bistro | 7310 |
| | Coach | 7700 |
| | Coach | 7204 |
| | Coach | 7701 |
| | Coach | 7201 |
| | Coach | 7704 |
| | Coach | 7202 |
| | Coach | 7707 |
| | Baggage Car | 7110 |

## General Configuration

Figure C-3 depicts a typical Series 8 cab car.

**Figure C-3: Diagram of Series 8 Cab Car**




## Maintenance

### *Maintenance Facility*

Talgo maintains the two Series 8 trainsets at the same maintenance facility it maintains the Series 6 trainsets.

### *Maintenance Regime*

Detailed above, both Series 8 trainsets follow the same maintenance regime as described for the Series 6 trainsets.

### *Reliability-centered Maintenance*

Talgo performs RCM on the Series 8 similar to what it does for the Series 6, except that the existence of a cab car requires an expanded scope of work.

## Mileage

Table C-5 lists the accumulated and average annual mileage for the Series 8 trainset.

**Table C-5: Series 8 Trainset Mileages**

| Trainset | Annual Mileage | Current Mileage[a] |
|---|---|---|
| Mt. Bachelor | 140,000 | 351,164 |
| Mt. Jefferson | 140,000 | 360,866 |

[a] *As of July 31, 2016.*

## Overhauls, Upgrades and Modifications

With their more recent introduction to the service, there have been relatively few modifications to the Series 8 trainsets. Both Series 8 trainsets will be equipped with a PTC system. Additionally, a Wi-Fi system and outward cameras (located on the cab) are already in place on both Series 8 trainsets.

## Reliability Issues

All Talgo Series 8 cars are considered to be in a state of good repair.

### Legislative Requirements

The accessibility and crashworthiness standards for passenger railcars have not changed, and both Series 8 trainsets are currently in compliance with the existing standards.

### Planned Out-of-Service/Disposal

Based on WSDOT analysis, a planning goal of 25 years has been projected for the Talgo-manufactured trainsets.

### Warranty

The Series 8 trainsets have been in revenue service since Winter 2013/14. Typically, most components have a 2-year warranty, as such they would be out of warranty in 2015. However, warranties for some structures and frames extend for 10 years.

## C.3 Car Type: F59 PHI Locomotive

### Built By

Presently owned and operated by Caterpillar, Inc., General Motors Electro-Motive Division built the F59PHI diesel-electric locomotives for Amtrak. EMD's headquarters, engineering facilities and parts manufacturing operations are in McCook, Illinois. EMD's final assembly site was in London, Ontario (Canada) until the plant was closed in February 2012. A new assembly site was opened in late 2011 in Muncie, Indiana. EMD also operates a traction motor maintenance, rebuild and overhaul facility in San Luis Potosí, Mexico.

### Performance Characteristics

The F59PHI locomotive is a 3,200-horsepower, B-B diesel-electric locomotive equipped with a turbocharged EMD 12-710G3C-EC, which is a 12-cylinder, 2-stroke diesel engine (prime mover). The main (traction) alternator converts mechanical energy from the prime mover into electrical energy distributed through a high-voltage cabinet to four direct current traction motors. Each of the four traction motors is directly geared to a pair of driving wheels. The gear ratio of the traction motors (model D87BTR) to wheel axle determines the maximum operating speed of a locomotive, with a standard F59PHI having a gear ratio of 56:21, which will allow for a top speed of 110 miles per hour (176 kilometers per hour). The locomotive has a fully enclosed car body with protected walkways for easy access to the engine room and trailing units. This configuration allows routine maintenance while the locomotive is in service. Of note, when the locomotive debuted for the California Department of Transportation in late 1994, the F59PHI was the first locomotive in the United States that met California's stringent emission standards. Another noteworthy aspect is the locomotive's exterior that uses composites to present a streamlined appearance.

To supply electrical power for passenger service, the F59PHI is equipped with a secondary electrical generator, referred to as the head-end power unit. The head-end generator generates AC power at 480 volts, 60 hertz AC, and can be rated between 500 and 750 kilowatts to provide power to the passenger cars for lighting, electric heating, and air conditioning. The head-end generator is powered by a second diesel engine dedicated to it. Through this configuration, the prime mover is not burdened by head-end power generation and, consequently, is used solely for supplying tractive power.

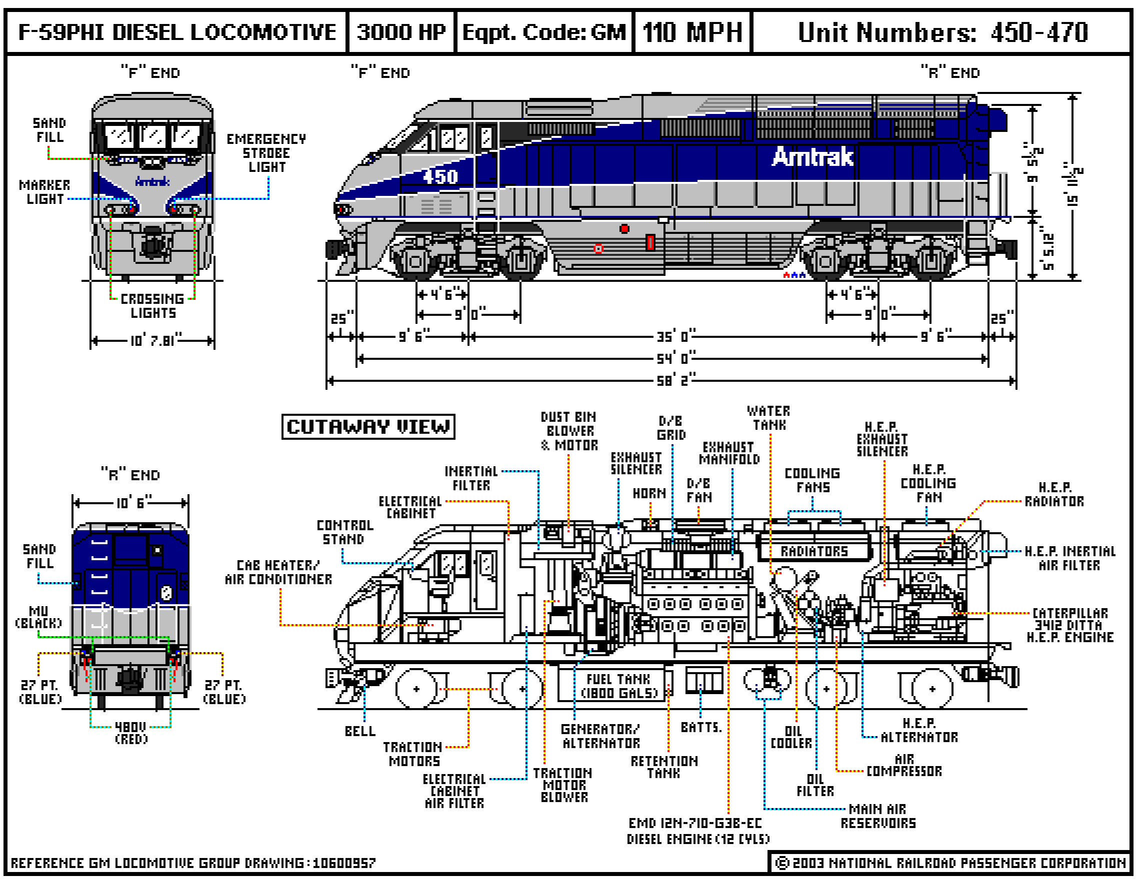
### History and Operation

In partnership with WSDOT and ODOT, Amtrak owns and operates six F59PHI that provide service along Amtrak Cascades corridor. Amtrak has had the six F59PHI locomotives in service for nearly 20 years.

### General Configuration

Figure C-4 depicts the general configuration (i.e., views and interworking) for a typical F59PHI locomotive.

**Figure C-4: Diagram of F59PHI Locomotive**




### Maintenance

#### *Maintenance Facilities*

Amtrak maintains the F59PHI locomotives at the same maintenance facility Talgo uses to maintain the Series 6 and Series 8 trainsets..

#### *Maintenance Regime*

The F59PHI locomotives are transitioning from an overhaul and operational maintenance regime to a life-cycle preventative maintenance regime.

#### *Reliability-centered Maintenance*

Amtrak is implementing RCM across its locomotive fleet. This change is focused on providing the maximum reliability within available funding and other constraints.

### Mileage

Table C-6 lists the accumulated and the average annual mileage for the F59PHI locomotives.

**Table C-6: F59PHI Locomotive Mileages**

| Unit | Annual Mileage | Current Mileage[a] |
|---|---|---|
| 465 | 144,000 to 156,000 | 1,861,954 |
| 466 | 144,000 to 156,000 | 1,827,952 |
| 467 | 144,000 to 156,000 | 1,896,205 |
| 468 | 144,000 to 156,000 | 1,831,818 |
| 469 | 144,000 to 156,000 | 1,760,757 |
| 470 | 144,000 to 156,000 | 1,822,932 |

[a] *As of 5/31/2015.*

### Overhauls, Upgrades and Modifications

The six F59PHI locomotives have all been equipped with a PTC system and outward cameras.

### Reliability Issues

As noted in Amtrak's Capital Investment Program for Amtrak Equipment Deployed in State Supported Services FY2014 – FY 2018, 11 of Amtrak's 21 F59 locomotives were in a State of Good Repair. Amtrak's plan identifies future investment to bring the fleet into a state of good repair. However, the replacement with Charger locomotives will deal with any issues relating to F59PHI reliability.

### Legislative Requirements

Amtrak maintains F59PHI locomotives in accordance with applicable laws and regulations. PTC has been installed.

### Planned Out-of-Service/Disposal

Amtrak will decide, in coordination with the states, on the retirement of equipment used in state service.[13] At this time, there is no specific plan to retire the F59PHI locomotives. A transition plan for the introduction of the Chargers will include the criteria for when any F59PHIs are released back into the Amtrak pool.

[13] Capital Investment Program for Amtrak Equipment Deployed in State Supported Services FY2014-FY2018.

## C.4 Car Type: NPCU (Non-Powered Control Unit)

### Build By

General Motors EMD built a number of F40PH locomotives in the 1970s for Amtrak, which Amtrak subsequently converted to NPCUs.

### Performance Characteristics

A control car is the generic name for a non-powered railroad vehicle that controls train operations and the locomotive. A control car can be used with diesel or electric locomotive power, allowing push-pull operations without having to use an additional locomotive. One function of a control car is to eliminate the need for a locomotive to be moved to the opposite end of a trainset when reversing direction at a terminus. While a control car can carry passengers, baggage, mail, small freight or a combination thereof, and may contain an engine-generator set to provide head-end power; the NPCUs on the Amtrak Cascades corridor are configured to only carry baggage and small freight. In addition to the driver's cab built into one end of the car (which includes all the controls and gauges necessary for remote operations of the locomotive), control cars have a horn, whistle, bell, plow (as appropriate) and the lights typical of a locomotive..

### History and Operation

Six NPCUs are available to support the Amtrak Cascades service. Amtrak originally bought a series of locomotives in the 1970s, some of which it converted to NPCUs in the 1990s. ODOT owns three of the NPCUs, and Amtrak owns the other three units. ODOT leases its three units to Amtrak, which was renewed in August 2014 for 10 additional years at a nominal cost.

Table C-7 lists all relevant details for the six NPCUs.

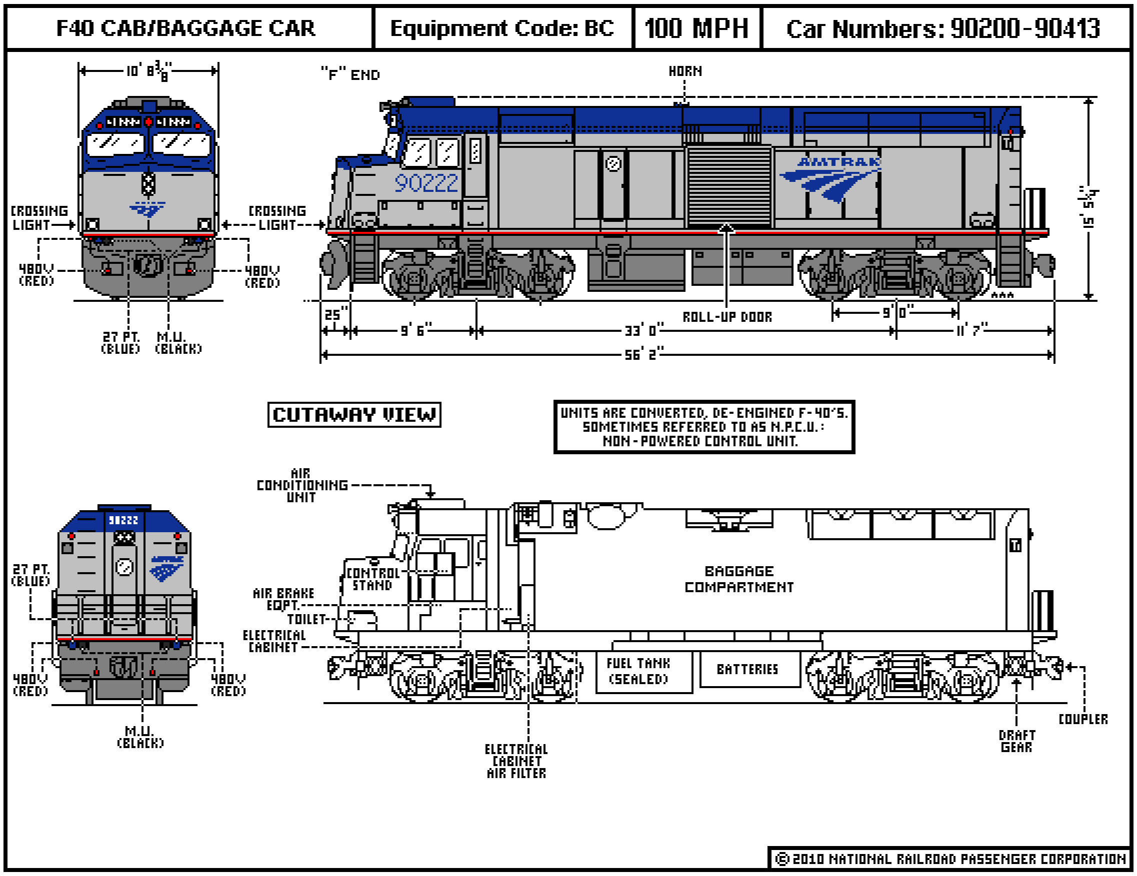
**Table C-7: NPCU Fleet**

| Model | Builder | Owner | Road # | Active |
|---|---|---|---|---|
| F40PH | EMD | Amtrak | 90278 | Yes |
| F40PH | EMD | Amtrak | 90250 | Yes |
| F40PH | EMD | Amtrak | 90251 | Yes |
| F40PH | EMD | ODOT | 90340 | Yes |
| F40PH | EMD | ODOT | 90252 | Yes |
| F40PH | EMD | ODOT | 90253 | Yes |

### General Configuration

Figure C-5 depicts the general configuration (i.e., views and interworking) for a typical F40PH locomotive, which is the NPCU used for the Amtrak Cascades service.

**Figure C-5: Diagram of NPCU**




## Maintenance

### *Maintenance Facility*

Amtrak maintains its NPCUs at the same maintenance facility it uses to maintain the F59PHI locomotives.

### *Maintenance Regime*

The NPCUs have a time/mileage-based maintenance regime.

### *Reliability-centered Maintenance*

Amtrak is currently not performing RCM on the NPCUs.

## Mileage

Table C-8 lists current NPCU mileage.

**Table C-8: NPCU Mileages**

| Road # | Annual Mileage | Current Mileage[a] |
|---|---|---|
| 90278 | 144,000 to 156,000 | 4,314,861 |
| 90250 | 144,000 to 156,000 | 5,199,552 |
| 90340 | 144,000 to 156,000 | 4,697,618 |
| 90251 | 144,000 to 156,000 | 5,246,553 |
| 90252 | 144,000 to 156,000 | 5,047,515 |
| 90253 | 144,000 to 156,000 | 4,921,130 |

[a] *As of 5/31/2015.*

### Overhauls, Upgrades and Modifications

The six NPCUs have been equipped with a Class 1 PTC system and outward cameras.

### Reliability Issues

As noted in Amtrak's Capital Investment Program for Amtrak Equipment Deployed in State Supported Services FY2014 – FY 2018, 2 of Amtrak's 22 NPCUs (P40 Cab/Baggage Cars) were in a State of Good Repair. Amtrak is developing a maintenance program that will bring the vehicles all into a State of Good Repair.

### Legislative Requirements

Amtrak maintains NPCUs in accordance with applicable laws and regulations. PTC has been installed.

### Planned Out-of-Service/Disposal

Use of NPCUs on the Amtrak Cascades corridor depends on the type of train used to provide passenger service. The Series 6 trainsets require either an NPCU or a second locomotive. The Series 8 trainsets have cab cars integrated within the trainset and do not necessarily require a separate NPCU. Investigations are currently underway to incorporate an NPCU with the Series 8 trainset to provide redundancy and protection. The out-of-service date for the NPCUs will then be determined based on the out-of-service date for the Series 6 trainsets and whether Series 8 integration is completed. The current condition of the NPCUs is not considered a driver for establishing an out-of-service date, provided that maintenance continues as needed.

## C.5 Car Type: New Charger Locomotive

### Being Built

The Departments of Transportation for Illinois, California, Michigan, Missouri and Washington have awarded Siemens a $225 million contract to deliver 35 diesel-electric passenger locomotives and spare part supply. The contract includes a purchase option for additional locomotives to be used for regional and long-distance. Presently being manufactured at the Siemens plant in Sacramento, California, the 35 Charger locomotives are scheduled for delivery between Fall 2016 and Summer 2017.

### Performance Characteristics

The Charger locomotives will be used exclusively for passenger service. The primary traction drive, a 4,400 horsepower-rated diesel engine with 16 cylinders and a cubic capacity of 95 liters, is being manufactured in the United States by Cummins Inc., which is headquartered in Columbus, Indiana. These modern locomotives are powerful and efficient enough to reach speeds of 125 miles per hour, but can also deliver a cleaner ride with better air quality and reduced emission rates, ensuring compliance with the FRA's EPA Tier IV regulations required to be in place in 2015.

### Procurement and Delivery/Testing Schedule

The projected procurement and delivery/testing activities and schedule dates are as follows:

- Request for Proposals (released August 8, 2013).
- Contract award (completed March 2014) .
- NEPA Categorical Exclusion approval (received March 2014).
- Preliminary design (completed July 2014).
- Intermediate design (completed Fall 2014).
- Final design (completed Spring 2015).
- Locomotives delivery to WSDOT (begins Spring 2017).
- Locomotives testing (to be completed Spring 2017).

### Maintenance Facilities

WSDOT will maintain the Charger locomotives at the same maintenance facility used to maintain the F59PHI locomotives.

### Legislative Requirements

The new Charger locomotives are being built to comply with the current legislative requirements, including PTC.

# Appendix D: Scenario planning

## D.1 What is scenario planning?

Scenario planning evaluates a number of potential service options and resulting impacts on the equipment demand and infrastructure requirements. Service planning helps in determining the flexibility of the current strategy to adapt to changes in service goals should these goals be adopted. It also provides an understanding of potential capital costs of different service options.

## D.2 Why was scenario planning chosen?

Planning exclusively for only funded service may not fully evaluate the impact of short-term decisions on fleet flexibility associated with ridership growth, infrastructure and maintenance improvements, and the service horizons identified in Washington State Department of Transportation (WSDOT) and Oregon Department of Transportation's (ODOT) unfunded, longer-range plans.

## D.3 Which scenarios were evaluated?

Scenario 1 is defined as currently funded service to expand to 2017 service levels: six round trips between Seattle and Portland, two round trips between Eugene and Portland, and two round trips between Seattle and Vancouver, British Columbia. Under Scenario 1, investment would only sustain the basic level of service and accommodate ridership growth.

Scenario 1A represents investment opportunities above the minimal fleet requirements. One consideration is for WSDOT and ODOT to acquire additional locomotives that would completely replace the Amtrak locomotives currently supporting the Amtrak Cascades service.

Scenario 2 proposes an increased level of service beginning in the 2025 with an additional daily roundtrip between Portland and Eugene, two additional trips between Seattle and Portland in 2026, an additional daily trip between Seattle and Vancouver, British Columbia starting in 2028 and another trip added between Portland and Eugene in 2035.

Scenario 3 builds upon Scenario 2 by adding the two additional trips between Seattle and Portland one year earlier in 2025 and then adding two more trips in this segment beginning in 2031 (for a total of 10 daily roundtrips between Seattle and Portland). It also adds the two additional Portland to Eugene trips in 2029, rather than 2035.

Scenario 4 proposes a progressive build out of daily service based on the full implementation of WSDOT and ODOT's SRPs. Under this scenario, there would be 13 round trips between Seattle and Portland beginning in 2030, six round trips between Eugene and Portland beginning in 2035, and four round trips between Seattle and Vancouver, British Columbia, beginning in 2030.

**How was the analysis performed?**

To analyze current and future equipment demand, an equipment forecasting sketch model specifically for this FMP was developed. This model evaluated the four scenarios to forecast the varying levels of equipment demand based on ridership forecasts.

## D.4 What are the Conclusions of this Effort?

Although the scenarios are only projections of future demand, each scenario could inform decision-making in reference to 1) when fleet turnover would be expected, 2) a current and anticipated equipment acquisition plan to parallel service expansion, and 3) different options for procuring equipment.

Table D-1 and Table D-2 list proposed passenger vehicle/car and locomotive equipment demand for each of the four service scenarios (based on the consolodated acquisition approach). It should be noted that while each scenario best represents a range of forecast conditions based on current data, these scenarios are subject to change, and subsequently, WSDOT and ODOT would have to adjust vehicle and locomotive usage accordingly.

## Table D-1: Passenger Vehicle/Car Demand by Scenario and Year [a]

| Scenario | 2017 | 2019 | 2021 | 2023 | 2025 | 2027 | 2030 | Equipment Type | Total |
|---|---|---|---|---|---|---|---|---|---|
| Scenario 1 | - | - | - | - | 48 cars | - | - | Bi-Level | **48 cars** |
| | - | - | - | - | 55 cars | - | - | Single Level | **55 cars** |
| | - | - | - | - | 55 cars | - | - | Trainset | **55 cars** |
| Scenario 1A | 20 cars | - | - | - | - | - | - | Existing | **20 cars** |
| | - | - | - | - | 48 cars | - | - | Bi-Level | **48 cars** |
| | | | | | 55 cars | | | Single Level | **55 cars** |
| | - | - | - | - | 55 cars | - | - | Trainset | **55 cars** |
| Scenario 2 | - | - | - | - | 63 cars | - | - | Bi-Level | **63 cars** |
| | - | - | - | - | 77 cars | - | - | Single Level | **77 cars** |
| | - | - | - | - | 77 cars | - | - | Trainset | **77 cars** |
| Scenario 3 | - | - | 19 cars | - | 50 cars | - | - | Bi-Level | **69 cars** |
| | - | - | 21 cars | - | 65 cars | - | - | Single Level | **86 cars** |
| | - | - | 21 cars | - | 65 cars | - | - | Trainset | **86 cars** |
| Scenario 4 | - | 26 cars | - | - | 75 cars | - | - | Bi-Level | **101 cars** |
| | - | 28 cars | - | - | 97 cars | - | - | Single Level | **125 cars** |
| | - | 28 cars | - | - | 97 cars | - | - | Trainset | **125 cars** |

[a] Vehicle quantities include both passenger and non-passenger carrying equipment and are based on assumed values of passengers per car. The assumed values for trainsets are based on a similar single level car. If the seating configuration of a proposed trainset were to vary, the number of cars would vary to compensate. These numbers are indicative.

Notes: While the above scenarios represent a range of forecast conditions based on current data, these scenarios are subject to change, and subsequently, WSDOT and ODOT would have to adjust vehicle usage accordingly.

**Table D-2: 20-Year Locomotive Demand by Scenario and Year** [a]

| Scenario | Baseline Demand 2017 | 2019 | 2021 | 2023 | 2025 | 2027 | 2030 | 2031 | Horizon Year Demand 2037 |
|---|---|---|---|---|---|---|---|---|---|
| Scenario 1 | 11 locos | - | - | - | - | - | - | - | **11 locos** |
| Scenario 2 | 11 locos | - | - | - | 12 locos | 13 locos | - | - | **13 locos** |
| Scenario 3 | 11 locos | - | 12 locos | - | 13 locos | - | - | 14 locos | **14 locos** |
| Scenario 4 | 11 locos | 12 loco | - | 13 locos | - | 14 locos | 18 locos | - | **18 locos** |

[a] *The years listed only represent the years in which an equipment acquisition is proposed to meet the demand. If the table does not list the year, no equipment acquisition is proposed. Scenario 1 assumes use of three Amtrak owned locomotives to supplement the fleet.*

Notes: This does not include the acquisition of the eight new Charger locomotives to be delivered in 2017. While the above scenarios represent a range of forecast conditions based on current data, these scenarios are subject to change, and subsequently, WSDOT and ODOT would have to adjust locomotive usage accordingly.