

Appendix F: Washington's Freight Transportation System Needs, Issues, and Potential Improvements

(2022 Washington State Freight System Plan Update)

Appendix F: Washington's Freight Transportation System Needs, Issues, and Potential Improvements describes the identified freight needs and issues associated with each of the statewide policy goals over the short, medium, and long-term. The document also contains potential improvement strategies to address the identified needs and issues and suggested owners and partners.

Table of Contents

Table of Figures	ii
Acronyms & Abbreviations	iv
1. Introduction	1
2. Preservation	9
Highway system preservation	9
State safety rest area preservation	12
Freight rail preservation	13
Maritime preservation	16
Aviation preservation	18
3. Safety	21
Highway safety	21
Truck parking areas	23
Rail safety and security	25
Maritime safety and security	28
Hazardous Materials	30
4. Mobility	32
Congestion and capacity constraints	32
Connectivity	38
5. Environment	43
Climate change	43
Greenhouse gas emissions	49
Alternative fuels	51
The impacts of freight movement on flooding and stormwater runoff	56
The impacts of freight movement on wildlife habitat loss	57
Environmental justice	60
6. Stewardship	66
Funding and financing	66
Tribal relations	69
Pacific Northwest partnership and collaboration	70
State and local agency cooperation and support	73
7. Economic vitality	75
Population and economic growth	75
Growth of Freight Volume	76
Supply chain trends	83
E-commerce	89
Freight workforce shortages	96
Reference Chapter A: Potential strategy and tactics summary	98

Table of Figures

Figure 1: WSDOT maintenance responsibilities	9
Figure 2: Washington state pavement conditions, June 2021	10
Figure 3: Washington state bridge conditions, 2017-2021	10
Figure 4: Washington state bridge conditions, June 2021	11
Figure 5: Picture of trucks parked at the scatter creek rest area	13
Figure 6: Picture of Grain Train on Rail Bridge	14
Figure 7: Washington short line rail track miles	14
Figure 8: Washington lock gates.....	17
Figure 9: WSDOT airport classification system	18
Figure 10: Pictures of pavement distresses at Washington airports – alligator cracking, depression, and longitudinal and transverse (L&T) cracking from left to right.....	19
Figure 11: Airport pavement system condition (excluding SEA, GEG, PSC).....	19
Figure 12: Truck-involved crashes in Washington	21
Figure 13: Trespassing incident trends, 2012–2021	25
Figure 14: Top 50 priority crossings in Washington.....	26
Figure 15: Highway-rail grade crossing incident trends in Washington, 2012-2021	27
Figure 16: City of Vancouver balanced mobility concept	40
Figure 17: Wind turbine blade unloading	41
Figure 18: Washington state sea level rise projections.....	44
Figure 19: Forms of freight resilience	47
Figure 20: Washington GHG limits	49
Figure 21: State and federal programs available for reducing diesel exhaust emissions	61
Figure 22: Proximity of overburdened populations to heavy vehicle traffic.....	63
Figure 23: 2022 Washington state pavement 10-year investment gap (millions of dollars).....	67
Figure 24: Planned pavement preservation spending	67
Figure 25: 2022 Washington state bridge 10-year investment gap (millions of dollars).....	67
Figure 26: Planned bridge preservation spending	68
Figure 27: Traditional cultural landscape (TCL).....	69
Figure 28: Pacific Northwest shared transportation facilities	71
Figure 29: Historical and forecasted Washington state population, 1970-2050.....	75
Figure 30: Historical and forecasted Washington state GDP, 2000-2050	76
Figure 31: Tonnage and share by mode (2022-2050)	77
Figure 32: Value and share by mode (2022-2050)	77
Figure 33: Modal growth rate by tonnage and value (2022-2050)	78
Figure 34: Commodity group tonnage growth (2022-2050)	78
Figure 35: Truck tons and truck traffic (2050).....	79
Figure 36: Growth in truck tons and truck traffic (2022-2050).....	80
Figure 37: Commodity group value growth	81
Figure 38: Directional commodity flow tonnage by commodity group (2050)	82
Figure 39: Directional tonnage growth (2022-2050)	82
Figure 40: Directional tonnage growth by commodity group (2022-2050)	83
Figure 41: Directional value growth (2022-2050).....	83

Figure 42: Supply chain steps..... 84
Figure 43: Picture of ship loading grain at the Port of Seattle..... 85
Figure 44: Shift from Just-in-Time to Just-in-Case inventory strategies 88
Figure 45: U.S. grocery e-commerce projected sales, 2019-2024 89

Acronyms & Abbreviations

Abbreviation	Description
ADA	American Disabilities Act
AFDC	Alternative Fuels Data Center
AIS	Automatic Identification System
AMVER	Automated Mutual Assistance Vessel Rescue System
ARC	Airport Reference Code
ATRI	American Transportation Research Institute
AV	Autonomous Vehicles
BFI	Boeing Field
BIPOC	Black, Indigenous, and People of Color
BNSF	Burlington Northern Santa Fe Railway
BRIC	Building Resilient Infrastructure and Communities
CBP	Customs and Border Protection
CCA	Climate Commitment Act
CDL	Commercial Driver License
CHC	Commercial Harbor Craft
CHE	Cargo-Handling Equipment
CI	Carbon Intensity
CO	Carbon Monoxide
COPD	Chronic Obstructive Pulmonary Disease
COTS/GOTS	Commercial-off-the-Shelf / Government-off-the-shelf
CSI	Container Security Initiative
DAHP	Department of Archaeology and Historic Preservation
DHS S&T	Department of Homeland Security Science & Technology
DPM	Diesel Particulate Matter
DVD	Dark Vessel Detection
ECHO	Enhancing Cetacean Habitat and Observation
EJ	Environmental Justice
EJTF	Environmental Justice Task Force
EPA	Environmental Protection Agency
ESA	Endangered Species Act
EV	Electric Vehicles
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FRA	Federal Railroad Administration
FRAP	Freight Rail Assistance Program
FREAT	Freight Routing and Emissions Analysis Tools
FRIB	Freight Rail Investment Bank
FTZ	Foreign Trade Zone
GDP	Gross Domestic Product
GEG	Spokane Airport

Abbreviation	Description
GHG	Greenhouse Gas
GPS	Geospatial Positioning System
HEAL	Healthy Environment for All Act
HMF	Harbor Maintenance Fund
HMTA	Hazardous Materials Transportation Law
HOS	Hours of Service
IT	Information Technology
IWTF	Inland Waterways Trust Fund
JIC	Just-in-Case
JIT	Just-in-Time
KCIA	King County International Airport
LNG	Liquefied Natural Gas
LTL	Less-than-Truckload
MARAD	U.S. Maritime Administration
MDE/CSS	Maritime Domain Enterprise/Coastal Surveillance System
MRO	Manufacturing/Maintenance, Repair, and Overhaul
NAFTA	North America Free Trade Agreement
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NHS	National Highway System
NOAA	National Oceanic and Atmospheric Administration
NOx	Nitrogen Oxides
NWSA	Northwest Seaport Alliance
OSHA	Occupational Safety and Health Administration
PAE	Paine Field
PATRIOT	Uniting and Strengthening America (USA) by Providing Appropriate Tools required to Intercept and Obstruct Terrorism Act
PCC	Palouse River and Coulee City Rail System
PCHB	Pollution Control Hearings Board
PDD	Personal Delivery Devices
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIDP	Port Infrastructure Development Program
PIERS	Port Import Export Report System
PM	Particulate Matter
PNW	Pacific Northwest
PPE	Personal Protective Equipment
PROTECT	Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation
PSC	Tri-Cities Airport
PSR	Precision Scheduled Railroading
RTC	Regional Transportation Commission
SAFE	Security and Accountability for Every Port Act
SAF	Sustainable Aviation Fuel
SEA	Seattle-Tacoma International Airport

Abbreviation	Description
SEPA	State Environmental Policy Act
SLR	Sea Level Rise
SO2	Sulfur Dioxide
TACT	Ticket Aggressive Cars and Trucks
TCL	Traditional Cultural Landscapes
TPAS	Truck Parking Availability System
TSMO	Transportation Systems Management and Operations
UP	Union Pacific
UPS	United Parcel Service
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDOT	U.S. Department of Transportation
USMCA	U.S.-Mexico-Canada Agreement
UTC	Utilities and Transportation Commission
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
WASP	Washington Aviation System Plan
WSDOT	Washington State Department of Transportation
WSTC	Washington State Transportation Commission
ZEV	Zero-Emission Vehicle
ZNZE	Zero and Near-Zero Emission

1. Introduction

This Appendix describes future disruptive issues and needs that are expected to impact Washington's multimodal freight system and various strategies that WSDOT may consider preparing for the future. The memo is structured around the following statewide transportation policy goals from the *Washington Transportation Plan 2040 & Beyond*:



Preservation: to maintain, preserve, and extend the life and utility of prior investments in transportation systems and services, including the State Ferry System



Safety: to provide for and improve the safety and security of transportation customers and the transportation system



Mobility: to improve the predictable movement of goods and people throughout Washington state, including congestion relief and improved freight mobility



Environment: to enhance Washington's quality of life through transportation investments that promote energy conservation, enhance healthy communities, and protect the environment



Stewardship: to continuously improve the quality, effectiveness, resilience, and efficiency of the transportation system



Economic Vitality: to promote and develop transportation systems that stimulate, support, and enhance the movement of people and goods to ensure a prosperous economy

The following section summarizes major trends, issues, and needs pertaining to each of the Washington statewide transportation policy goals.

Preservation

- **Roads:** Maintenance of pavement in good condition saves 7 to 16 times the cost of rehabilitation or reconstruction when pavements are in worse condition. Aging concrete pavements make up approximately half of Washington's interstate highway system lane-miles.
- **Freight rail:** Freight rail infrastructure requires periodic maintenance to ensure the system is in good condition. Many short line railroads suffer from decades of deferred maintenance needs, such as lagging adoption to the higher railcar weight capacities. Intermodal connectors are also needed to connect rail-served facilities.
- **Maritime:** Washington's navigation channels have gone through major renovations on the Lake Washington Ship Canal locks in 2018 and 2020, including replacing a 100-year-old large lock gate and filling culvert valves. These renovations improve the overall mobility and reliability of the maritime system. Continued dredging is also needed to ensure channel depths are maintained to allow boats to operate. Port infrastructure is also needed to ensure commerce continues to move through Washington's ports. The U.S. Army Corps of Engineers is responsible for maintenance of federal navigation channels and their structures and coordinates with Washington maritime stakeholders on preservation needs.
- **Aviation:** Many airports are challenged to maintain the condition of their infrastructure, especially due to the increase in international widebody aircraft air service. Similarly, airport pavements in good condition are critical to safe and efficient air cargo operations across the state. WSDOT is currently updating the Washington Aviation System Plan (WASP), which depicts the performance and interaction of the aviation system as well as the contributions and needs of individual airports to the system as a whole.

Safety

- **Safety incidents:** Truck-related fatalities and serious injuries declined in 2020 during the COVID-19 pandemic and increased across the state and nation in 2021 as more people resumed travel. Trespassing, at-grade rail crossing collisions, rail cargo theft, and criminal sabotage of rail lines are all increasing in the state. WSDOT's Target Zero plan envisions zero deaths and serious injuries on Washington roadways by 2030, and the state is implementing key countermeasures for freight-related issues such as heavy truck inspections, high crash corridor enforcement, the Ticket Aggressive Cars and Trucks (TACT) Program, and education and outreach.
- **Oil spills:** More than 20 billion gallons of oil and other hazardous substances are transported as both cargo and fuel by vessels, pipeline, and rail across the state. This creates both safety and environmental risks when a spillage occurs. Washington's comprehensive program for spill prevention, preparedness, and response has contributed to having one of the lowest oil spill rates in the country. WSDOT partners with the Department of Ecology, Emergency Management Division, Washington State Patrol, and local response organizations to ensure forward planning of hazardous material freight movements.
- **Truck parking:** A lack of truck parking areas endangers both truck drivers and other roadway users, causes premature roadway deteriorating, especially in areas that are not designed for truck weights and volumes, and can also create environmental and noise disturbances on sensitive receivers in local areas. Washington state published a Truck Parking Action Plan in 2021, and HB 1655 was passed in 2022 to ensure state-owned and operated safety rest areas are open for use, except for closures or cleaning, maintenance, and repairs.

Mobility

- **Congestion and capacity:** Between 2022 and 2050, freight movements in the state are forecast to increase. As congestion increases and capacity is more constrained, freight is adapting to those conditions. Some of those adaptations are leading to more efficient use of the freight system's capacity, while others have negative impacts. Investments across the freight system to leverage existing, and develop new, multimodal capacity will be needed in order to address not just the growth in volume, but also changes in how freight will move in the future.
- **Connectivity:** Supply chain operations and goods movement require facilities that are linked together by an interconnected network of modes, routes, and infrastructure. Addressing current and future needs, gaps, blockages, and conflicts within this network will allow for affordable, reliable, and safe access to suppliers and markets. Connectivity challenges the state faces today include first/last mile access to freight facilities, inadequate and aging infrastructure, incompatible uses near or along with freight facilities and routes, and the need for low-cost, reliable freight transportation in specialized corridors.

Environment

- **Climate change:** Climate change is expected to increase the frequency and severity of system disruptions such as flooding, snowfall, landslides, wildfires, and extreme heat. To address climate change, the state has enacted greenhouse gas emission reduction goals. Achieving these goals will not be possible without a significant reduction in freight emissions, which includes transitioning away from fossil fuels and optimizing freight modes and technology. Washington is a leader in zero and near-zero emission technologies, providing many options to reduce transportation emissions.
- **Wildlife:** The freight system can impact the habitat of wildlife species, including protected species under the Endangered Species Act (ESA). To address impacts to wildfire, WSDOT continues to support the development of policies such as salmon recovery, wildlife corridors, preventing vessel strikes, minimizing underwater noise, reducing motor and rail emissions, and preventing oil spills.

- **Local air quality and environmental justice:** Overburdened communities tend to be disproportionately located to freight facilities and industrial areas and are more severely impacted by freight-related air emissions, congestion, noise, vibration, and other issues. The HEAL Act passed in 2021 requires WSDOT to embed environmental justice (EJ) in its decision-making, and WSDOT has published EJ guidance in Chapter 460 of the WSDOT Environmental Manual for projects subject to National Environmental Protection Act (NEPA).

Stewardship

- **Freight funding:** A continued shortfall of funding for freight system investments places pressure on the system and especially the preservation of existing assets. There is also often no clear path for major project funding, and time and resources are necessary to assemble and coordinate unique and non-repeating funding schedules and requirements.
- **Tribal relations:** Freight activity and infrastructure growth in the state continues to bring more landscapes and resources important to Tribes under increased risk of impact. Executive Order 21-02 requires WSDOT to integrate DAHP, Governor's Office of Indian Affairs, and concerned Tribes into its capital project planning processes. Additionally, using a Traditional Cultural Landscapes approach to protected shared resources and landscapes helps to improve long-term relationships between agencies and Tribal Nations.
- **Pacific Northwest Partnership and collaboration:** Freight does not necessarily follow or organize itself along political boundaries. Positioned at the center of the bi-national region of the Pacific Northwest, Washington must collaborate across the region to address shared issues and needs. WSDOT continues to work with neighboring states and provinces on issues such as economic competitiveness, truck parking, technology and information, electric vehicle infrastructure, and more.
- **State-local agency cooperation:** Capacity building and partnerships can lead to better understanding, decision-making, and alignment about freight priorities. WSDOT will continue to work with local agencies and provide technical freight expertise, actionable freight data, freight project delivery assistance and planning, and knowledge/best practice sharing.

Economic vitality

- **Supply chain trends:** Between 2021 and 2022, the COVID-19 pandemic unveiled constraints in global, national, and regional supply chains. Supply chain issues can threaten economic vitality through the stages of sourcing, production, and manufacturing; assembly, inventory, and warehousing; and final delivery to businesses and consumers.
- **Sourcing, production, and manufacturing:** Early on in the pandemic, many factories closed due to the virus or due to an inability to source parts and products from traditional suppliers. Residents also began purchasing online for home deliveries, adding pressure to supply chains designed to serve brick-and-mortar shops. Importers also struggled to find enough labor and equipment, leading to a backlog of container ships and a lack of empty shipping containers for Washington exporters. Reshoring also gained momentum, placing production activities closer to consumption centers.
- **Assembly, inventory, and warehousing:** Companies also began to stockpile inventory due to difficulty with predicting consumer demand and the timing of demand. This led to a need for more warehousing space, including micro-fulfillment centers that are smaller in footprint and located closer to consumers. Because industrial land use is not permitted in many areas, it is in limited supply, especially in urban areas. This leads to longer routes and larger vehicles navigating in urban regions.
- **E-commerce and last-mile delivery to consumers and businesses:** As consumers increasingly turn to e-commerce in lieu of in-person shopping, increasing e-commerce activity has created new volumes of truck traffic in areas that were not originally designed to support

substantial truck movements, such as dense residential neighborhoods or semi-rural roads serving large warehouses on the fringe of urban areas. In turn, this increasing truck traffic can have negative impacts on traffic congestion, noise, and local air quality. At the same time, companies are exploring new opportunities to improve delivery services, and Washington is a national leader in pioneering new urban freight delivery methods such as e-cargo bikes, delivery lockers, curbside parking management for deliveries, drone delivery, and autonomous trucks.

- **Truck driver workforce shortages:** A shortage of truck drivers has been a challenge in Washington since 2006 and is the number one issue facing the trucking industry. Without enough drivers, companies may have to pay a premium to move goods or may be unable to move them on schedule. Driver retention is impacted by salary, job satisfaction, frequency of being at home, availability of amenities, transportation issues, and public respect.

Ongoing WSDOT goals, strategies, policies, and programs

WSDOT already has numerous goals and strategies that seek to address some of the trends listed above, and which help WSDOT meet the federal freight planning requirements. The links between federal requirements and WSDOT’s ongoing efforts are summarized below. WSDOT will continue to advance these goals, strategies, policies, and program over the next 4 years in support of the freight planning requirements of the FAST Act and BIL.

Strategies and goals guiding freight-related transportation investment decisions in the state

The **Washington Transportation Plan 2040 & Beyond** is Washington’s overarching transportation policy and includes freight-specific policy goal elements described in the first chapter of this plan. The Washington State Legislature has also provided direction on how Washington’s NHFP funds should be utilized.

Improving the safety and efficiency of freight with innovative technologies and strategies

WSDOT has established a **Cooperative Automated Transportation (CAT)** program that focuses on how methods of transportation work together and share information. This program’s freight-specific work includes exploring truck parking and interstate truck platooning pilot projects. WSDOT also conducted an electric airplane feasibility study, which highlighted the potential for more efficient air cargo movement.

Reducing roadway deterioration from travel by heavy vehicles

One of Washington’s top transportation system policy goals is preservation. It is WSDOT’s policy that all its pavements handle expected freight traffic levels, as noted throughout the WSDOT Pavement Policy. Additionally, when facing constrained funding for pavement preservation, **WSDOT has continually prioritized heavy freight routes because they are the most likely to deteriorate faster and require more substantial rehabilitation.** To the maximum extent feasible, this approach avoids costly freight delay and costly rehabilitation of thicker pavement structures.

Deterioration of condition by heavy trucks was also accounted for in Washington’s selected National Highway Freight Program projects: **roughly one half of the 2021-2025 NHFP investments are allocated solely to roadway and bridge preservation projects** on the I-5 and I-90 corridors.

These investment and design efforts are complemented by commercial vehicle weight enforcement work. WSDOT administers the vehicle size and weight through a special motor vehicle permit program, and its partner, Washington State Patrol, **enforces vehicle size and weight laws including truck weight limits,** which further reduces the potential for roadway deterioration from overloaded trucks. Enforcement is accomplished through deployment and utilization of weigh-in-motion technology at weigh station sites across the state.

WSDOT also has several rail initiatives that help mitigate the pavement impacts of heavy truck movement by supporting movement of heavy cargo by other modes, including the ownership of the **Washington Grain Train** and **Palouse River and Coulee City Rail System.** Both systems move heavy bulk agriculture products and mitigate the wear and tear on roadways that would occur if goods were moved by truck.

In addition to support for these systems, WSDOT supports the movement of goods on alternate modes through the **Freight Rail Assistance Program** and **Freight Rail Investment Bank**, which are designed to support freight rail capital needs and make rail shipping available to more communities and businesses.

Addressing freight mobility issues, including congestion or delay caused by freight

Another one of the Washington Transportation Policy goals is mobility: to improve the predictable movement of goods and people throughout Washington, including congestion relief and improved freight mobility.

In recognition of this goal, **NHFP solicitations** for local projects included scoring criteria based on a project’s potential benefits for improving freight mobility and reliability.

Additionally, WSDOT is currently undertaking multiple projects intended to address traffic congestion, including delay caused by freight. For instance, the Puget Sound Gateway Program is a combination of major roadway and bridge projects that will complete critical missing links in the state’s freight network and build new connections to the Ports of Seattle and Tacoma and the Sea-Tac Airport. The project is expected to be completed by 2028 and includes a new SR 99 bridge over existing SR 509 highway, a new SR 509 expressway providing new access to SeaTac Airport, a new SR 167 bridge over I-5, and a new connection between I-5 and Port of Tacoma. This program will improve regional freight mobility and reduce port-related truck traffic on nearby local streets, further reducing traffic congestion caused by trucks.

WSDOT and its partners have also made information-sharing improvements to address traffic congestion caused by freight. For example, **WSDOT’s border crossing wait time information system** provides freight brokers and dispatchers with commercial vehicle wait times, helping them to structure their operations to avoid expected times of congestion, and reduce congestion overall.

Decreasing the severity of freight mobility impacts of extreme weather and natural disasters

WSDOT’s ongoing efforts to address weather and disasters’ impacts on freight include: a **Freight System Delay Notification** system for real-time messaging users of the freight system, participating in a Multi-Agency Hazard Mitigation Work Group, and FEMA-led **Cascadia Rising Exercises**.

Decreasing the impacts of freight movement on local air pollution

Ongoing WSDOT efforts related to air pollution include WSDOT’s adherence to **Washington’s Climate Commitment Act** to reduce greenhouse gas emissions and membership in the **Multi-State Zero Emission Vehicle Task Force**. WSDOT also administers zero-emission vehicle grants, including **Zero-Emission Vehicle Partnerships** grants for electric charging and fueling infrastructure. Air pollution and impacts on overburdened communities were also used as scoring criteria for WSDOT’s NHFP project solicitations.

In addition to WSDOT’s work, agencies such as the Department of Ecology and Puget Sound Clean Air Agency administer **programs intended to reduce harmful diesel emissions** by supporting the purchase of new, more-efficient trucks or trucks powered by alternative fuels and electricity.

Decreasing the impacts of freight movement on flooding and stormwater runoff

WSDOT recognizes the significant impact that transportation infrastructure can have on the quality and volume of stormwater runoff and flooding. Many of the actions WSDOT takes to comply with its National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge Municipal Stormwater General Permit help to avoid, minimize, and mitigate for these impacts. WSDOT’s design strategy defined in its Highway Runoff Manual as well as the Secretary’s Executive Order to **protect and preserve Washington’s wetlands** also direct employees to avoid, minimize, and mitigate for impacts. Further, WSDOT has developed a **Stormwater Management Program Plan, Stormwater Retrofit Management Plan**, and **included stormwater management as a criterion for NHFP project selection**.

Decreasing the impacts of freight movement on wildlife habitat loss.

WSDOT’s **Wildlife Connectivity Program** has two primary goals: 1) reduce wildlife-vehicle collisions and 2) increase the permeability of the state highway system in regard to wildlife movement. WSDOT has developed a ranking system that rates all segments of the state highway system for the potential benefit to ecological conservation as well as animal vehicle collision severity. This information is used in corridor planning and project analysis to assess potential benefits for designs that promote wildlife connectivity. WSDOT is partnering with other agencies, academics, and conservation NGOs to promote wildlife habitat

connectivity through research into animal activity, wildlife corridor management, and effective measures to improve safe crossings for wildlife. More details can be found in WSDOT’s Highway System Plan.

WSDOT has taken additional steps to reduce transportation’s impact on wildlife and habitat, including issuing Executive Order 1031.02, **Protections and Connections for High Quality Natural Habitats**, to ensure road and highway programs protect ecosystem health, the viability of aquatic and terrestrial wildlife species, and the preservation of biodiversity, along with other needs. Specific actions include a **fish passage** program, focus on removing fish barriers and reconnecting streams, and inclusion of **wildlife habitat considerations in NHFP solicitations and scoring**. Finally, the **Murray/Inslee Initiative** aims to develop a comprehensive solution for salmon recovery in the Columbia River Basin, assessing whether means exist to replace benefits, including freight transportation, provided by the existing Snake River dams.

Enhancing the reliability or redundancy of freight transportation

As noted in this plan, Washington’s freight system faces a number of disruptive threats such as severe weather, natural disasters, climate change, and accidents that can interrupt the flow of freight. WSDOT’s Strategic Plan guides all of the Department’s work, and one of its three key areas is resilience. This resilience goal includes guidance to improve the resilience of the transportation system as well as lead the development of transportation that combats climate change and enhances healthy communities for all.


WSDOT and other Washington agencies have been examining and addressing these resiliency concerns through a variety of measures. For example, WSDOT’s roles in supporting Washington’s overall resiliency are detailed in the State Emergency Management Division’s **Enhanced Hazard Mitigation Plan**, and WSDOT participates in a **Multi-Agency Hazard Mitigation Work Group** that is responsible for monitoring and implementation for the Mitigation Plan. WSDOT is also participating in operational exercises to improve resilience, such as FEMA-led **Cascadia Rising Exercises**, which identify preparedness needs for major disruptive natural disasters.




WSDOT also collaborates with other stakeholders on resiliency topics, an example of this work is WSDOT’s participation and data-sharing through Washington Sea Grant’s **Coastal Hazards Resilience Network**, a community of practice intended to help strengthen the resilience of coastal communities.



Finally, WSDOT’s investment choices reflect the need to continue improving the reliability and redundancy of freight transportation, and **the NHFP project selection criteria** included a scoring category that evaluated projects on their potential improvements to freight transportation network resiliency, or the ability to rapidly restore service after a closure.

Potential strategies

Potential strategies for WSDOT and its partners to consider in the future are noted below. Successful implementation of these potential strategies requires the partnership and support of multiple partners, including local, regional, state, and federal agencies and Tribal Nations, ports, railroads, airports, and freight stakeholders. Further suggestions and tactics to implement each of these strategies are contained within the corresponding chapters.

Issue	Potential Strategy
	Preservation
Roads	Continue to invest in road preservation and encourage partners to invest in road preservation. Continue to include freight traffic volumes and FGTS designations in prioritization of preservation projects.
State Rest Areas	Continue to raise awareness of the need for increased state investment in maintenance and preservation.
Freight Rail	Preserve the condition of state- and publicly owned and operated rail lines and continue to provide funding for preserving other rail lines through FRIB and FRAP.

Issue	Potential Strategy
Maritime	Continue to maintain navigable waterways and sufficiently maintained public ports as well as preserve, maintain, and enhance state and interstate route access to seaports.
Aviation	Maintain airport facilities at established airport classification level and preserve, maintain, and enhance state and interstate route access to airports.
	Safety
Highway	Implement the Target Zero plan with a focus on truck-involved fatalities and serious injuries.
Truck Parking	Expand truck parking capacity by keeping existing state rest areas open and facilitating the development of new truck parking sites statewide.
Freight Rail	Work with relevant authorities to address rising cases of trespassing, at-grade rail crossing collisions, rail cargo theft, and sabotage.
Maritime	Work with ports and relevant federal agencies to facilitate continuous improvement in maritime safety and security.
Hazardous Materials	Work with regulated communities and others to minimize the environmental threat of oil spills.
Complete Streets	Coordinate between WSDOT Rail, Freight, and Ports Division and Active Transportation Division to support incorporation of freight consideration in Complete Streets project implementation, when relevant.
	Mobility
Capacity	Assess methods to increase capacity on the multimodal state freight system and relieve freight bottlenecks.
Connectivity	Continue to support infrastructure projects that maintain and enhance Washington shippers’ access to domestic and global markets.
	Environment
Weather, Natural Disasters, and Resiliency Impacts	<p>Develop a plan to address transportation assets and system vulnerabilities to current and future disruptions.</p> <p>Improve freight resiliency planning and develop freight resiliency approaches, techniques, and effective practices for implementation.</p> <p>Continue to participate in inter- and intra-agency planning coordination to amplify freight resiliency planning effectiveness.</p>
Greenhouse Gas Emissions	Facilitate the replacement and upgrading of vehicles and technologies to reduce GHG emissions.
Flooding and Stormwater	Continue to manage stormwater impacts in accordance with regulatory requirements and invest in mitigation measures including stormwater retrofits to control the flow of and treat stormwater.
Wildlife Habitat	Coordinate with relevant authorities on strategies to minimize freight impacts on wildlife.
Local Air Quality and Environmental Justice	<p>Prioritize investments to mitigate negative freight impacts in areas where residents have been disproportionately impacted.</p> <p>Collaborate with community groups to identify opportunities for improved air quality through transportation system investments.</p>

Issue	Potential Strategy
 Stewardship	
Funding	Raise awareness of freight funding and financing needs statewide.
Tribal Relations	Consult and coordinate with Tribal Nations on all relevant freight policies, programs, and projects early in the planning process.
Pacific Northwest Collaboration	Collaborate with neighboring states and provinces on all freight decision-making impacting multiple states.
State and Local Agency Cooperation	Provide state freight expertise, guidance, data, and support to regional and local agencies.
 Economic Vitality	
Sourcing	Facilitate engagement with the private sector and public partners to better support multimodal transportation options for shippers.
Warehousing	Increase system efficiency in order to optimize freight system capacity.
E-Commerce	Support local jurisdictions with last-mile freight planning support and best practices.
Workforce	Facilitate growth in the freight system workforce through increasing diversity, removing barriers to training, and providing more training options.

2. Preservation

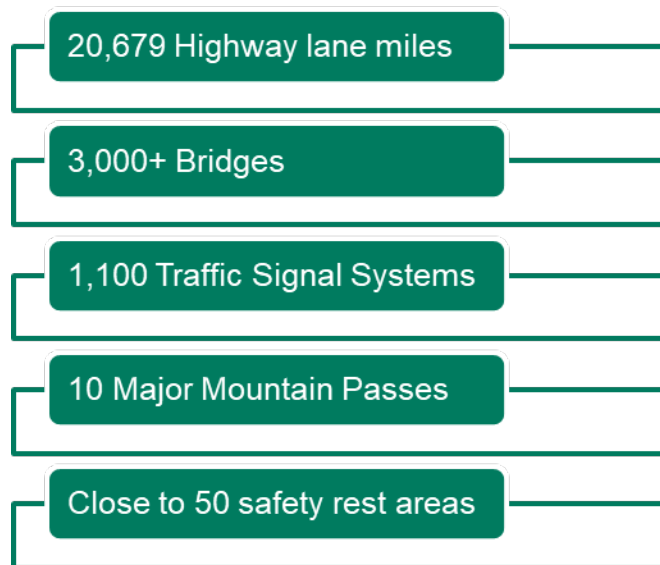
Washington’s statewide transportation policy goal of Preservation is “to maintain, preserve, and extend the life and utility of prior investments in transportation systems and services, including the State Ferry System” (Washington state Legislature Section 47.04.280). Washington’s state law, legislative direction, and the WSDOT Strategic Plan recognize the importance of preserving transportation infrastructure – including freight system infrastructure such as highway, bridges, safety rest areas, rail, maritime, and aviation.

Highway system preservation

Maintenance of pavement in good condition saves 7 to 16 times the cost of rehabilitation or reconstruction when pavements are in worse condition.¹

Washington state is currently meeting its targets for pavement conditions on both interstates and non-interstates. However, there is room for improvement, particularly on non-interstate pavements on the National Highway System (NHS). Stakeholders note that there is not enough money to adequately fund the current system, especially because preservation often competes with other capital system improvements.

Figure 1: WSDOT maintenance responsibilities



Aging concrete pavements make up approximately half of Washington’s interstate highway system lane miles. Most of this pavement was constructed in the 1960s and 1970s with an approximate lifespan of 20 years. WSDOT continues to extend the life of concrete pavement through rehabilitation treatments, but these pavements are now approaching 50-60 years of age – well beyond their useful life.

WSDOT prioritizes pavements based on 1) avoiding future liability; 2) asset use; and 3) life cycle cost. WSDOT prioritizes pavement needs based on annual condition surveys, followed by using

¹ “Washington Airport Pavement Management System Study” WSDOT, 2018. https://idea.appliedpavement.com/hosting/washington/reports/2018_WA_APMS_Statewide_Report.pdf

pavement deterioration models to determine needs assessment. Recommended investment funding target levels are then issued for each pavement type for each region. WSDOT regions are then able to use this information to scope projects and group projects into different investment areas (asphalt, chip seal, and concrete). Priority project lists are then developed and reviewed to ensure the project is the “lowest life cycle cost alternative.”

The current strategies may not sufficiently preserve pavement at fair or better conditions. Over time, pavements deteriorate due to traffic and environmental conditions, such as water and freezing temperatures. Poor pavement conditions are especially an issue for natural resource industries, such as agriculture and forestry, that rely on trucking to transport heavy loads.

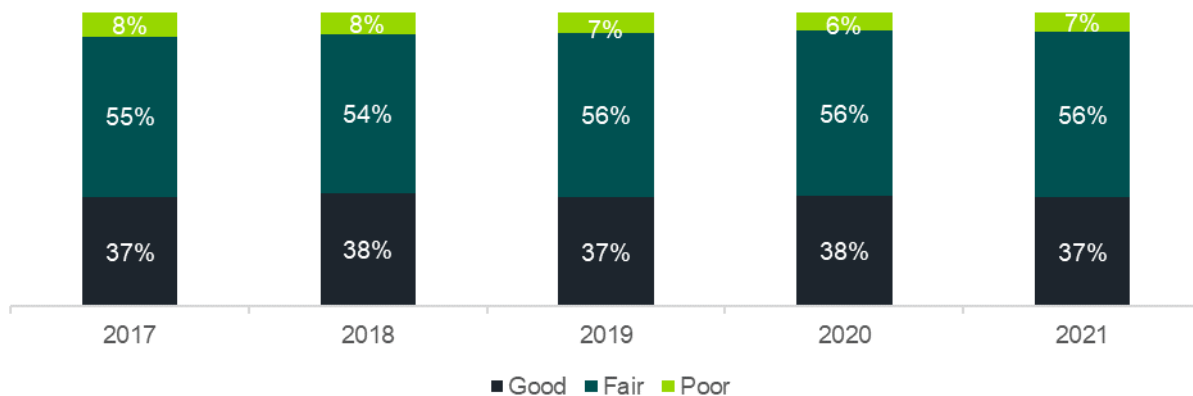
Figure 2: Washington state pavement conditions, June 2021

Performance Measure	2-Year Actuals	2-Year Targets	4-year Targets
Percent of interstate pavement on the NHS in good condition	39.8%	N/A	30%
Percent of interstate pavement on the NHS in poor condition	1.7%	N/A	4%
Percent of non-interstate pavement on the NHS in good condition	45.2%	45%	18%
Percent of non-interstate pavement on the NHS in poor condition	17.4%	21%	5%

Source: WSDOT Gray Notebook, September 2021.

The state is also meeting its bridge condition targets. However, bridge conditions worsened in 2021 – the number of bridges on WSDOT-owned bridges in poor condition increased from 164 bridges in June 2020 to 179 in June 2021, 3.5 million square feet to 3.8 million square feet respectively. This is partially due to two I-90 bridges at Mercer Slough in King County being newly designated as in poor condition.

Figure 3: Washington state bridge conditions, 2017-2021



Source: WSDOT Gray Notebook, September 2021.

As of June 2021, WSDOT needs to replace 18 bridges and rehabilitate 22 bridges. Further, 111 concrete bridge decks are due or past due for rehabilitation, and 131 bridges are currently load-restricted, or load posted. Rehabilitating or replacing these bridges in a timely matter is important, as the longer it takes, the more likely traffic disruption is to occur through bridge closure or load restrictions/postings. Notably, many off-system (non-WSDOT assets) roads and bridges are also in poor condition and will require maintenance by their owners to keep the overall transportation system in a state of good repair.

Over the next 10 years, the state projects 79 bridges (616,181 square feet of deck area) will need to be replaced or rehabilitated. This projection is an increase of 51.9 percent in deck area from 2020’s estimates.

Figure 4: Washington state bridge conditions, June 2021

Performance Measure	2-Year Actuals	2-Year Targets	4-year Targets
Percent of NHS bridges classified in good condition (weighted by deck area)	32.8%	30%	30%
Percent of NHS bridges classified in poor condition (weighted by deck area)	7.8%	10%	10%

Source: WSDOT Gray Notebook, September 2021.

Pavement condition is a particularly important topic in the context of freight for multiple reasons. First, freight operations can affect infrastructure condition. In particular, heavy vehicles can substantially deteriorate the condition of roadways, as the impact of vehicle weights on pavement increases drastically as weight increases. For example, the American Association of State Highway and Transportation Officials’ estimates that a 20,000-pound load on a truck axle creates 10,000 times more impact on pavement, compared to 2,000-pound load for a vehicle such as a passenger car. Additionally, poor road condition can affect freight movement, as rough roads can damage cargo.

WSDOT has recognized that roadway improvements may be required to reduce or impede the deterioration effects of truck traffic, and WSDOT has undertaken multiple efforts to reduce or impede roadway deterioration, including factoring freight into its overarching investment and design strategies, proactively enforcing weight limits, and supporting alternative modes of transportation such as rail. Each of these broad efforts is described below.

In regard to freight considerations in preservation funding, WSDOT is pursuing a full funding approach to address all needs, but if this approach (described below) is not approved, WSDOT will need to continue making trade-off decisions, such as prioritizing preservation activities using the Freight and Goods Transportation System (FGTS) designations (T1, T2, T3, T4, and T5) and speed limits. This prioritization methodology will continue to provide benefit to heavier freight corridors as investment priorities would be made on routes with higher freight volume.

In 2022, the Washington state Legislature approved the Move Ahead Washington revenue package, which provides \$17 billion to the state over 16 years. Of the \$17 billion, the Legislature provided approximately \$3 billion as a down payment toward fully funding highway preservation and maintenance. WSDOT is beginning to implement a full funding approach to preserving its highway assets, which means managing these assets at their lowest lifecycle costs by performing the necessary preservation activities as they become due. This approach is aligned with the expectations outlined in RCW 47.05 (The priority programming system must ensure the preservation of the existing state highway system) and the recently amended RCW 47.04, which puts preservation as a priority for the transportation policy goals. The Move Ahead Washington revenue package provided enough funding to continue this approach for approximately 5 years, but future funding will need to be provided beyond this time period to sustain this approach.

In terms of roadway design strategies, WSDOT designs all of its pavements to handle expected freight levels as noted throughout the WSDOT Pavement Policy. This is done by calculating Equivalent Single Axle Loads (ESALs) over the expected life of the pavement and designing structures to handle that freight. Additionally, when facing constrained pavement preservation, WSDOT has continually prioritized heavy freight routes because they are the most likely to deteriorate faster and require more

substantial rehabilitation. To the maximum extent feasible, this approach avoids costly freight delay and costly rehabilitation of thicker pavement structures.

Deterioration of condition by heavy trucks was also accounted for in Washington’s selected National Highway Freight Program (NHFP) projects: roughly one-half of the 2021 through 2025 NHFP investments are allocated solely to roadway and bridge preservation projects on the I-5 and I-90 corridors.

In addition to investments to reduce or impede deterioration from truck traffic, WSDOT’s Commercial Vehicle Services Office (CVSO) administers a permitting program for issuing special permits to operate vehicles of a size or weight greater than the legal maximum on state highways. CVSO also supports the Washington State Patrol (WSP) on efforts to enforce Washington’s truck weight limit requirements. These partnered efforts include the operation of 11 Commercial Vehicle Information Systems and Networks sites equipped with weigh-in-motion and automated vehicle identifier equipment. At these sites, WSP enforces vehicle size and weight laws by screening vehicles and allowing them to bypass scales if no violations are found. In addition, Washington operates four virtual weigh-in-motion sites on secondary state highways, and these sites are used to monitor commercial vehicle traffic. Together, enforcement effort such as these further reduce or impede roadway deterioration caused by truck traffic by reducing the number of illegally overloaded trucks operating in Washington.

To address pavement and bridge preservation, WSDOT continues to raise awareness of the need for increased state investment in maintenance and preservation. Potential tactics and suggestions are included below.

Potential Strategies and Tactics
<p>Potential Strategies:</p> <ul style="list-style-type: none"> • Continue to invest in road preservation and encourage partners to invest in road preservation. • Continue to include freight traffic volumes and FGTS designations in prioritization of preservation projects.
<p>➔ If full preservation funding is not available, WSDOT will need to continue making trade-off decisions such as prioritizing preservation activities using the FGTS designations (T1, T2, T3, T4, and T5) and speed limits.</p>
<p>➔ Proactively rehabilitate and maintain pavements and bridges on the National Highway Freight Network and critical urban/rural freight corridors, with priority given to assets with higher daily truck traffic.</p>
<p>➔ Focus on enforcement of truck weights through weigh-in-motion e-screening technology.</p>
<p>➔ Develop and share forecasts of freight volumes to better understand maintenance/operation needs.</p>

State safety rest area preservation

WSDOT safety rest areas are critical to the mobility of trucked goods but continue to deteriorate faster than WSDOT projections.

Adequate maintenance and rehabilitation are needed at WSDOT’s safety rest areas to ensure the efficient and safe movement of goods by trucking across the state. During winter 2021, misuse of some facilities and staff and budget shortages led to the closure of safety rest areas on the key freight corridor of I-5 north of Seattle. Across WSDOT’s safety rest area assets:

- 57 percent of restroom buildings are over 26 years old. Older buildings require additional maintenance and repairs, which can result in more building closures.
- 27 percent of buildings are in poor condition as of June 2021 and are deteriorating faster than projected.
- 64 percent of site infrastructure is in poor condition. Site infrastructure like pavement, fresh water, and wastewater systems continues to age and deteriorate.

Figure 5: Picture of trucks parked at the scatter creek rest area



Source: WSDOT.

To preserve safety rest areas, WSDOT may seek to raise awareness of the need for increased state investment in maintenance and preservation of safety rest areas. Some of the potential tactics are noted below.

Potential Strategy and Tactics

Potential Strategy: Continue to raise awareness of the need for increased state investment in maintenance and preservation at safety rest areas.

- ➔ Reduce maintenance backlog at safety rest areas, with priorities given to facilities on National Highway Freight Network and critical urban/rural freight corridors to ensure the efficient movement of goods.
- ➔ Consider public-private partnerships to supplement public funding for safety rest areas to ensure trucks have safe and secure locations for truck parking.

Freight rail preservation

Freight rail infrastructure requires periodic maintenance to ensure the system is in good condition. This maintenance may include rehabilitating or restoring tracks; preserving rail corridors; installing ties, rails, ballast, or other track material; repairing and upgrading railroad signal, communication, or operating systems; upgrading tracks to handle heavier railcars; installing siding track; improving connections to rail facilities; repairing bridges, trestles, culverts, or other elevated/submerged structures; rehabilitating rail equipment; and improving terminals, yards, roadway buildings, or fuel stations.

Figure 6: Picture of Grain Train on Rail Bridge

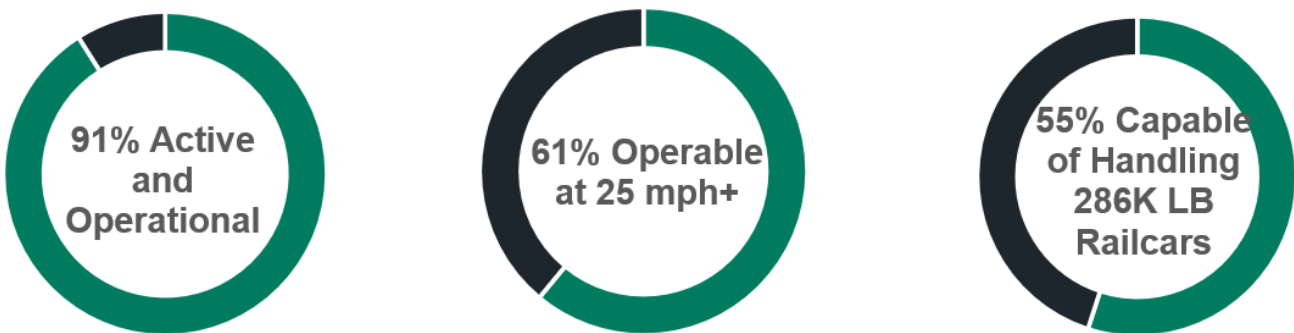


Source: WSDOT.

Class I railroads: BNSF Railway (BNSF) and Union Pacific Railroad (UP) own 60 percent of the rail mileage in Washington and move the majority of freight. Both BNSF and UP can handle 286,000-pound railcars over all of their main routes in the state, and all of their mainlines can be operated at 25 mph or above. The BNSF corridors accommodating Amtrak services (Cascades and long-distance services) can also support higher operating speeds for freight trains up to 60 mph.

Short line railroads: Short lines are rail lines that cover a short distance to switch, terminate, and connect Class I railroads to local regions across the state. Washington has 26 short line railroads, and in a 2019 survey of 19 short lines (representing 1,110 track miles), WSDOT found that of the short line rail miles, 91 percent are active and operational, 61 percent are operable at 25 mph or higher, and 55 percent are capable of handling 286,000-pound railcars.

Figure 7: Washington short line rail track miles



Source: 2019 Washington State Rail Plan, WSDOT, 2019. <https://wsdot.wa.gov/construction-planning/statewide-plans/freight-rail-plans/2019-washington-state-rail-plan>

While asset preservation needs vary among short line railroads, many of them suffer from deferred maintenance needs. The successful short line railroads align their business strategies with Class I railroads through technology investments, operational improvements, and successful business development. Regular maintenance is foundational to being able to attract business and prevent higher costs of deferred repairs.

Railcar weight standards: In 1991, Class I railroads began increasing railcar loads from 263,000-pound railcars to 286,000-pound railcars to increase the efficiency of freight rail movements. This was possible due to research advancements in steel rail technology, heat-hardened rail, rail grinding, and other technologies. However, as of 2019, only 55 percent of short line rail track miles in

Washington are currently capable of handling 286,000-pound railcars. Adopting this standard across the full short line network requires upgrades to bridges and tracks to handle increased weight, while failure to adapt has meant that portions of the system are obsolete to shippers that require heavier cars.

Freight rail intermodal connectors: While freight rail serves the “middle mile” of a commodity’s trip from origin to destination, trucks are often best-suited for the first or last mile of the trip. Intermodal connectors are roads where trucks can transport goods between rail facilities and farms, warehousing and distribution centers, ports, freight corridors, and other infrastructure assets. As rail-served facilities continue to consolidate across the state, such as mills and grain elevators, freight rail volumes are increasing in these regions and may overwhelm intermodal connectors. Heavy truck activity on these intermodal connectors causes a higher rate of pavement deterioration.

WSDOT administers two funding programs for freight rail capital projects:

Freight Rail Assistance Program (FRAP): FRAP provides grants for both the public and private sectors, including cities, county rail districts, counties, economic development councils, port districts, and privately or publicly-owned railroads. FRAP grants are directed towards larger projects where it is difficult to gain a contribution and where the rail location or the project concerned is of strategic importance to the state as well as the local community. For the 2021-2023 biennium, the Washington Legislature identified \$7.04 million for FRAP grants.

Freight Rail Investment Bank (FRIB): FRIB is a loan program available to public sector entities, including publicly-owned railroads, port districts, rail districts, and local governments. The bank is intended to fund smaller projects or provide a small final part of a larger project, where state funds would enable the project to be completed. Loans generally are limited to \$250,000, although requests for larger amounts will be considered if funds are available. All applicants must provide at least a 20 percent match. Loans come with a repayment period of no more than ten years. For the 2021-2023 biennium, the Legislature identified \$5.89 million for FRIB loans.

Washington Grain Train: WSDOT also jointly manages the Washington Grain Train with the ports of Walla Walla, Moses Lake, and Whitman County. The program includes 100 railcars that carry wheat and barley from loading facilities in eastern Washington (Warden, Schrag, La Crosse, Prescott, Endicott, Willada, St. John, and Thornton) to export facilities in western Washington and Oregon (Kalama, Tacoma, Seattle, Vancouver, Washington, and Portland, Oregon). The port districts collect monthly payments and can use up to 1 percent of the payments from railroads for fleet management.

Palouse River and Coulee City Rail System: Washington state also owns the Palouse River and Coulee City (PCC) rail system in eastern Washington. This system makes up 297 track miles and is the longest short line system in the state, with three branches: CW, P&L, and PV Hooper. The PCC Rail Authority is an intergovernmental entity with responsibilities for the business and economic development roles of the rail system, while WSDOT oversees the facilities for the operating leases. Some of the asset preservation issues on the system are as follows:

- Twenty-four percent of the system’s crossties (220,000) are in poor or defective condition.
- Thirty percent of the PCC rail lines are only operational up to 10 mph – some of the rail lines are light weight and/or aging with defects that may cause rail breakage and train derailments.
- Of the 157 bridges on the system, many were constructed between the 1930s and 1960s and are in poor condition, resulting in a need for more inspections and decreased operating speeds.

The 2015 PCC Rail System Strategic Plan prioritized \$58 million in infrastructure projects over the next 10 years to address infrastructure issues. This includes increasing 286,000-pound railcar

capability, rehabilitating track on the curves, identifying and replacing defective rail through rail integrity testing, inventorying, loading rates, and prioritizing bridges, initiating an annual tie replacement program, improving at-grade crossings, repurposing rail materials, and replacing substandard rail.

WSDOT continues to preserve the condition of state-owned and operated rail lines when funding becomes available and raise awareness of freight rail conditions statewide. Other tactics are noted below:

Potential Strategy and Tactics	
Potential Strategy: Preserve the condition of state- and publicly-owned and operated rail lines and continue to provide funding for preserving other rail lines through FRIB and FRAP	
➔	Seek to preserve abandoned rail lines such as through railbanking for “rails-with-trails” projects to allow the possibility of rebuilding a line for rail service in the future.
➔	Work with short lines to address deferred maintenance and compatibility with Class I railroad, especially to increase short line track capacity to 286,000 pounds.
➔	Improve the condition of the state-owned PCC rail system through rehabilitation and improvement projects.

Maritime preservation

U.S. Army Corps of Engineers: The U.S. Army Corps of Engineers (USACE) is responsible for the maintenance of federal navigation channels and their structures, such as for the Columbia-Snake River System, Grays Harbor, and Puget Sound. USACE also maintains the lock and dam system and the Inland Waterways Trust Fund (IWTF), a program to fund new construction and major rehabilitation of priority navigation projects. The IWTF helped fund the Bonneville Lock and Dam on the Columbia River and a plan of study concerning breaching the lower four Snake River dams. USACE also initiated the Port of Grays Harbor Long-Term Maintenance Strategy due to the risk that the shoreline erosion on the south jetty could again breach the adjacent landmass and adversely impact the federal navigation project.

Navigation infrastructure: Aging locks directly impact the efficiency and reliability of waterway freight movements. USACE indicates that service lives of navigation structures are between 60 and 75 years.² Of the nine locks on Washington’s river system, two locks exceed their estimated service life. These locks are 106-years-old on Lake Washington Ship Canal and have gone through major renovations in 2018 and 2020, including the replacement of 100-year-old large lock gates and the filling culvert valves.^{3,4} The ages of locks are shown in **Error! Reference source not found.**

² Capital Stock: Infrastructure Age, USACE, (n.d.). <https://www.iwr.usace.army.mil/Missions/Value-to-the-Nation/Fast-Facts/Capital-Stock/Infrastructure-Age/>

³ Ballard Locks awarded \$10.5m to replace 100-year-old large lock gates, My Ballard, Meghan Walker, September 2018. <https://www.myballard.com/2018/09/13/ballard-locks-awarded-10-5m-to-replace-100-year-old-large-lock-gates/>

⁴ Large chamber at Chittenden Locks in Ballard closes for upgrades, KING 5, February 2020. <https://www.king5.com/article/news/local/seattle/hiram-chittenden-ballard-locks-seattle-renovations/281-586095fc-0e22-4efa-90ef-37ebbe6a03b6>

Figure 8: Washington lock gates

River	Lock	Year Open	Age (as of 2022)	Note
Columbia River	Bonneville	1993	29	The Columbia – Snake River locks went through major repairs in 2017. Some of the upgrades include navigation lock controls, lock gate replacement, gate machinery upgrade, etc.
	The Dalles	1957	65	
	John Day	1968	54	
	McNary	1953	69	
Snake River	Ice Harbor	1962	60	
	Lower Monumental	1969	53	
	Little Goose	1970	52	
	Lower Granite	1975	47	
Lake Washington Ship Canal	Hiram M. Chittenden	1916	106	The large chamber went through renovations in 2018 and 2020.
	Hiram M. Chittenden Aux.	1916	106	

Source: USACE Lock Characteristics General Report

The Columbia River-Snake River system is currently among the U.S. waterways in the best state of repair due to heavy investments in lock and jetty improvements over the last decade, as well as a 20-year channel deepening project completed back in 2010. Continual investment in maintenance on Washington’s navigable channels is needed to ensure the system remains efficient and reliable, and to minimize larger expenses in the future.

Dredging: Few waterways are naturally deep enough to handle cargo vessels. Dredging is the process of removing sediment to ensure channel depths are maintained to allow boats to operate, and to develop new areas for boat access. Regularly scheduled maintenance is needed to ensure the maritime system is navigable for vessels. Dredged material is placed in both non-dispersive sites (on-site) and dispersive sites with strong tidal currents to disperse quickly. The Dredged Material Management Office is an interagency group made up of USACE, U.S. EPA, Washington Department of Ecology, and Washington State Department of Natural Resources to test and monitor dredged material for contaminants.⁵ Across the state, there are eight dredged material disposal sites around Puget Sound and two dispersive estuarine sites each in Grays Harbor and Willapa Bay.

Without dredging, many waterways, ports, and harbors would become impassable to commercial and recreational vessels.⁶

Port infrastructure maintenance: The upkeep of docks, piers, bulkheads, anchorages, dolphins, and other infrastructure is critical to minimize the risk of port disruptions to commerce. Land-side infrastructure also requires preservation. For example, in 2020, the Port of Bellingham secured a \$6.85 million federal grant through the USDOT Port Infrastructure Development Program (PIDP) to upgrade the shipping terminal, increase trade and commerce, and restore working waterfront jobs. This includes reinforcing a “heavy-load” receiving area at the shipping terminal to allow a wider range of cargo and to remove navigation high spots to allow deeper draft vessels to tie alongside the dock.

⁵ Dredged Material Management Office, US”, U.S. Army Corps of Engineers, (n.d.). <https://www.nws.usace.army.mil/Missions/Civil-Works/Dredging/>

⁶ Dredging, US”, U.S. Army Corps of Engineers, (n.d.). <https://navigation.usace.army.mil/CED>

Rehabilitation of a barge loading facility will also accommodate increasing customer demand for domestic coastwise and cross-sound transportation of cargo.⁷

The federal government continues to work to maintain navigable waterways and sufficiently maintained public ports. Other tactics are noted below:

Potential Strategy and Tactics	
Potential Strategy: Continue to maintain navigable waterways and sufficiently maintained public ports as well as preserve, maintain, and enhance state and interstate route access to seaports.	
➔	Support federal prioritization of maintenance dredging of the lower Columbia River, Grays Harbor, Swinomish Channel, and the Seattle and Tacoma harbors while monitoring environmental impacts.
➔	Work with public ports to ensure sufficient maintenance of docks, piers, bulkheads, anchorages, dolphins, and other infrastructure.

Aviation preservation

The physical condition of Washington’s aviation system is a foundational element to the performance of air cargo.

Airport maintenance: Many airports are challenged to maintain the condition of their infrastructure, especially due to the increase in international widebody aircraft air service. WSDOT updates its Washington Aviation System Plan (WASP) once every 5 years and is in the process of updating the 2022 plan. In 2017, WSDOT unveiled a new classification system for airports to better capture system performance (**Error! Reference source not found.**).

Figure 9: WSDOT airport classification system

Description	Primary Activities	Factors to Classify Airports
Major	Commercial service Aircraft or Aerospace manufacturing	Airport Reference Code (ARC) C-III or greater Primary Activity: Commercial Service and/or Aerospace Manufacturing/Maintenance, Repair, and Overhaul (MRO) Population over 40,000
Regional	Corporate GA and Business Travel Commuter Passenger Airline Service	ARC B-III or Greater Primary Activity: Corporate GA and Business Travel Population over 30,000
Community	GA-Personal Transportation/Business and Recreational Pilot Training	Not Metro or Regional Paved Primary Runway Surface 15 or more Based Aircraft
Local	GA-Personal Transportation/Recreational Pilot Training Agriculture	Not Metro or Regional Paved Primary Runway Surface Less than 15 Based Aircraft
General Use	GA-Personal Transportation/Recreational including backcountry	Unpaved Primary Runway Surface (including all seaplane bases)

Source: Washington Aviation System Plan Summary, WSDOT, 2017. <https://wsdot.wa.gov/sites/default/files/2021-10/aviation-washington-aviation-system-plan-summary.pdf>

⁷ Port Secures \$6.85 Million Federal Grant in Support of Working Waterfront, Port of Bellingham, October 2020. <https://www.portofbellingham.com/CivicAlerts.aspx?AID=322>

New investments in air cargo facilities: The UPS BFI Gateway Project is a \$100 million investment in UPS’s package sorting and transshipment facility at the King County International Airport (KCIA). The project includes upgraded building facilities as well as replacing deteriorated pavements, ground improvements, grading, paving, striping, and landscape/irrigation installation. The project allows UPS to accommodate growing e-commerce demand. Additionally, FedEx took over Boeing’s Dreamliner facility at Everett’s Paine Field (PAE) in August 2021 and provides daily flights between PAE and its Memphis hub. The agreement between the carrier and the airport allows for additional gates/parking positions to be developed.⁸ This provides shippers with earlier delivery in the morning and a later cut-off for delivering shipments in the northern part of the Seattle market area.

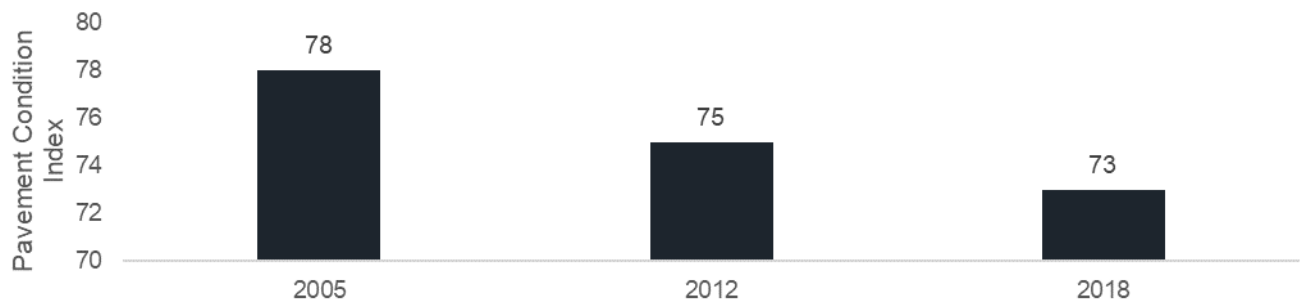
Airport pavements: Based on WSDOT’s Airport Pavement Management System Study in 2018, overall pavement conditions at airports have steadily deteriorated over the last decade, from a score of 78 in 2005 to 73 in 2018 (excluding Spokane Airport, Tri-Cities Airport, and Seattle-Tacoma International Airport).⁹ Good condition airport pavements – runways, taxiways, apron/helipad, and t-hangars – are critical to safe and efficient air cargo operations statewide. Airport pavement in distress can include cracking from temperature differences and repeated aircraft loadings or pavement depressions due to underlying settlement, insufficient drainage capacity, and weakened soils.

Figure 10: Pictures of pavement distresses at Washington airports – alligator cracking, depression, and longitudinal and transverse (L&T) cracking from left to right



Source: WSDOT Aviation Pavement Management Plan, 2019

Figure 11: Airport pavement system condition (excluding SEA, GEG, PSC)



Source: WSDOT Washington Airport Pavement Management System, WSDOT, 2018.

⁸ FedEx to begin weekday flights between Paine Field, Memphis, HeraldNet, Janice Podsada, J. Everett, August 2021. <https://www.heraldnet.com/business/fedex-to-begin-weekday-flights-between-paine-field-memphis/>

⁹ Washington Airport Pavement Management System Study, WSDOT, 2018. https://idea.appliedpavement.com/hosting/washington/reports/2018_WA_APMS_Statewide_Report.pdf

Runways at cargo airports: The majority of runways for Washington’s top ten cargo airports by volume are in good or excellent condition.¹⁰ King County International Airport and Tri-Cities Airport have two runways that are in fair condition. The only runway that is in poor condition is at Yakima Air Terminal/McAllister Field. Continued investment for airport runways is needed to ensure the system remains in good condition for air cargo movements.

Air cargo needs are evolving and growing. WSDOT and its partners need to ensure that the state’s air cargo system and facilities have the ability to meet the industry’s growing and changing needs. Other tactics are noted below:

Potential Strategy and Tactics
<p>Maintain airport facilities at established airport classification level and preserve, maintain, and enhance state and interstate route access to airports</p>
<p>➔ Legislatively direct aviation taxes and fees to fund investments in airport infrastructure.</p>
<p>➔ Plan for new capabilities to meet emerging requirements, including next-generation technologies and on-airport air cargo facilities.</p>
<p>➔ Support aviation capacity as a resource from the Legislature and WSDOT by preserving, protecting, and enhancing capacity through strategies focusing on airport operations, technology, safety, and land use.</p>
<p>➔ Emphasize as a priority and continue partnering with the FAA, Washington State Transportation Commission, and others to develop viable solutions to provide adequate future capacity to accommodate growth in air cargo demand.</p>
<p>➔ Continue to provide funding support for pavement, including preservation and maintenance, to continue stewardship of the most critical infrastructure element of the airport system.</p>

¹⁰ Airport Data and Information Portal,” FAA, 2020. <https://adip.faa.gov/agis/public/#/public>

3. Safety

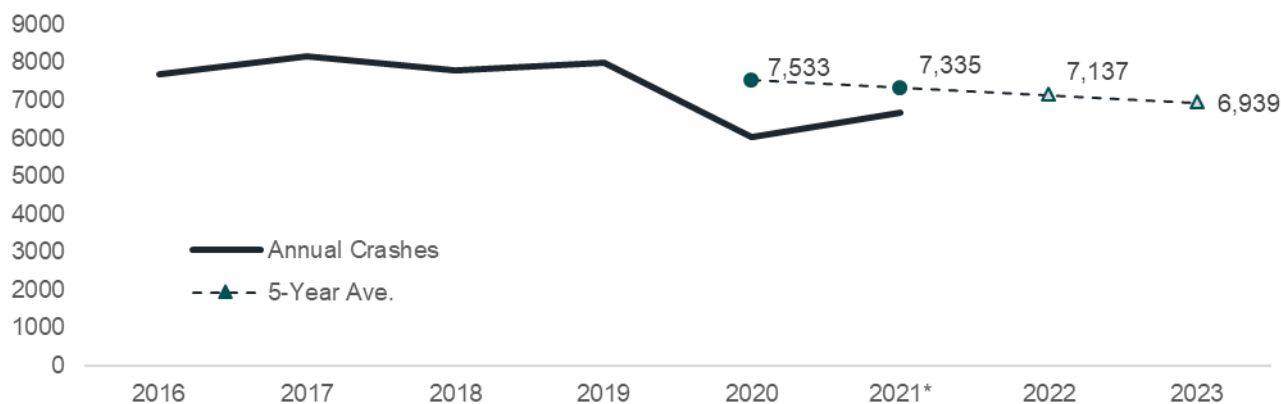
Washington’s statewide transportation policy goal of safety is “To provide for and improve the safety and security of transportation customers and the transportation system.” Some of the key issues include crash trends, rail safety and security, maritime safety and security, hazardous materials, and truck parking safety

Highway safety

Traffic fatalities and serious injuries declined in 2020 during the COVID-19 pandemic and increased across the state and nation in 2021 as more people resumed travel.

Crash trends: Heavy trucks have a higher risk of crashes that result in death and serious injuries due to the size and weight of the vehicle. Heavy truck drivers caused approximately 27 percent of crashes. Sixty percent of heavy-truck-involved crashes were caused by passenger car and motorcycle drivers, and the remaining were due to other causes.¹¹ Truck-involved crashes are more likely to result in casualties when vulnerable road users such as pedestrians and cyclists are involved. Pedestrians and cyclists died or suffered serious injuries in about 10 percent to 20 percent of the truck-involved crashes in Washington. Figure 12 illustrates truck-involved crash trends in the state between 2016 and 2021, as well as 5-year linear projected trendlines based on federal safety guidance.

Figure 12: Truck-involved crashes in Washington



Source: CPCS analysis of WSDOT’s crash data, 2022.

Note: 2021 data is preliminary and incomplete. WSDOT’s 2021 crash data will be verified and finalized in 2022.

Truck-involved crashes between 2016 and 2021 are primarily clustered along high-volume corridors such as I-5, I-405, and I-90. In particular, urban centers in King, Pierce, and Snohomish Counties have the highest concentration of truck-involved crashes, with 36 percent, 13 percent, and 9 percent of total statewide truck-involved crashes, respectively.

Fatigued drivers: Truck driver fatigue is a major factor in safety incidents and can result from inadequate sleep, lengthy hours of work, physical or mental exertion, or other strenuous activities. Federal hours of service requirements allow drivers to drive up to 11 hours a day with allocated rest periods. However, a lack of truck parking nearby to where trucks need to stop can contribute to fatigued driving and illegal parking. The Washington State Patrol’s Commercial Vehicle Enforcement

¹¹ Washington State Patrol internal review, from Washington State Strategic Highway Safety Plan: Target Zero, 2019.

Bureau focuses enforcement on fatigued heavy truck drivers through four statewide fatigue driving campaigns each year, and by using heavy truck crash location data to target enforcement efforts.

Target Zero: WSDOT’s 2019 Strategic Highway Safety Plan (Target Zero) aims to deliver zero deaths and serious injuries on Washington roadways by 2030. Key countermeasures for heavy-truck-involved crashes include enforcement with heavy truck inspections, high crash corridors, the Ticket Aggressive Cars and Trucks (TACT) Program, and education and outreach.¹²

Infrastructure improvements: Safety improvements must be addressed on a site-specific engineering basis based on individual risk factors. Safety treatment examples may include installing center and edge line rumble strips on the highest rated roadway segments, installing high friction surface treatment on horizontal curves, evaluating and upgrading signage, installing compact roundabouts at intersections, restricting access within 100 feet of intersections, adding pedestrian refuge islands on roadway segments, or adding leading pedestrian interval signal phasing at the highest-rated intersections.¹³

The interconnections between freight and other transportation users

Freight transportation needs and issues – and solutions to those needs and issues do not occur in a vacuum: freight impacts and is impacted by other transportation modes and users. At the same time, solutions to freight-specific needs and issues can provide broader benefits for other users, including bicyclists and pedestrians.

One example of this inter-connectedness is SR 20 in Skagit County. SR 20 has heavy traffic volumes and is a major thoroughfare to the San Juan Islands, a naval installation, and Whidbey Island. The route also passes through the Swinomish Reservation and is an important route for the movement of freight at the Swinomish Economic Development Zone and other local industrial areas. The route is also part of U.S. Bike Route 10.

Multiple intersections on SR 20, such as March Point Road and Padilla Heights Road are in need of improvement, as there are current problems with backup on travel lanes, access problems on and off the route, and pedestrians and bicycle users have unsafe crossings. Challenges like these illustrate how mobility and safety problems can often go hand-in-hand and affect multiple types of transportation users at a single location.

The proposed SR 20 Safe Access Improvements Project seeks to address challenges like these through safety and operational improvements such as improved interchanges and separate pathways for bicyclists and pedestrians. Investments like these will not only improve freight mobility and safety, but also safety and mobility for other transportation users.

WSDOT works with local agencies to develop *Local Road Safety Plans* to present data-driven crash data and prioritize roadways for traffic safety based on the top-rated crash types, locations, and factors. WSDOT will also continue to implement the Target Zero plan with a focus on truck-involved fatalities and serious injuries. Other tactics to improve freight safety on roads are as follows:

Complete Streets and modal conflicts: Recently, a complete streets requirement was added to the state highways section of the Revised Code of Washington (Chapter 47.24). The new requirement applies to all projects starting design after July 1, 2022, that are \$500,000 or more to ensure safety and mobility for all road users. The new requirement will provide renewed focus for locations of

¹² “Washington State Strategic Highway Safety Plan: Target Zero 2019,” WSDOT, 2019. www.targetzero.com/wp-content/uploads/2020/03/TargetZero2019_Lo-Res.pdf.

¹³ “Local Road Safety Plans,” WSDOT, May 2019. <https://wsdot.wa.gov/sites/default/files/2021-10/LP-Local-Road-Safety-Plan.pdf>

potential conflicts between freight and other modes and the need for careful consideration of truck loading areas, deliveries, location of facilities, and congestion.

Potential Strategy and Tactics
Potential Strategy: Coordinate between WSDOT Rail, Freight, and Ports Division and Active Transportation Division to support incorporation of freight consideration in Complete Streets project implementation, when relevant.
Potential Strategy: Implement the Target Zero plan with focus on truck-involved fatalities and serious injuries.
➔ Continue analysis of summary crash data to identify focus areas and priorities, assess individual fatalities and serious injuries to identify factors present, assess roadway networks for the presence of factors, and develop prioritized roadway locations where such factors are present.
➔ Identify countermeasures to address prioritized locations, such as lane departures, intersections, etc.
➔ Maintain traffic safety culture and carrier safety management with the freight industry through collaborations with Washington Trucking Association, Washington State Patrol's Commercial Vehicle Enforcement Bureau, and individual trucking companies.
➔ Increase enforcement of heavy truck inspections, high crash corridors, and the Ticket Aggressive Cars and Trucks (TACT) Program.
➔ Increase education and outreach to heavy truck drivers, passenger car drivers, and motorcycle drivers.
➔ Implement transportation systems management and operations (TSMO) strategies to maximize the efficiency, safety, and utility of freight transportation infrastructure.
➔ Address low-cost enhancement projects that improve safety, such as signage for low-height bridges.
➔ Continue to research causes of truck-related crashes, including through multistate corridor partnerships.

Truck parking areas

A lack of truck parking areas endangers both truck drivers and other roadway users, causes premature roadway deteriorating, especially in areas that are not designed for truck weights and volumes, and can also create environmental and noise disturbances on sensitive receivers in local areas.

Truck parking areas are critical for the safe movement of goods. Drivers need places to rest and recoup, use the restroom, check load securements, check equipment, make roadside repairs, stage their vehicle for scheduled deliveries or pick-ups, and sleep. The federal government requires that after 11 consecutive hours of driving within a 14-hour window, drivers must have 10 consecutive hours off-duty. This means that drivers may have a total of 14 hours of service (HOS) within a 24-hour period. WSDOT completed a truck parking survey in 2016 and found that 46 percent of survey respondents said they frequently drive fatigued as a result of insufficient parking. Fifty-nine percent of drivers also responded that they frequently do not feel safe while parked overnight in Washington. The top three corridors with unmet parking demand are I-5, I-405, and I-90. A 2021 Joint Transportation Committee (JTC) Truck Parking Action Plan resulted in 25 potential implementation actions to address truck parking issues, ranging from developing more facilities to better utilizing existing parking locations and developing truck parking information systems.

Shortage of designated truck parking facilities: Drivers try to park in proximity to route/destination, where there are restrooms or showers, and where parking availability is expected to be found, among other factors.¹⁴ However, there is a shortage of designated truck parking facilities due to both a lack of physical infrastructure as well as the closure of available facilities. Washington state owns or operates 47 rest areas across the state, but closures occur due to crowding, illegal activities, homelessness, shortages of rest area workers, and a lack of security. Additionally, WSDOT does not have the flexibility to contract for maintenance, operation, and safety of these rest areas. The Washington Legislature’s 2022 session includes a proposed HB1655, which would direct WSDOT to keep state rest areas open, other than for seasonal closures, cleaning, maintenance, and repairs. The bill would also give WSDOT the ability to contract out specialty services for both improved security and maintenance so that existing truck parking areas can remain open.

Undesignated parking: Federal HOS requirements are enforced through electronic logging devices, meaning that drivers often must park in undesignated areas such as highway shoulders, on/off ramps, and local streets. Undesignated truck parking endangers both truck drivers and other roadway users, causes premature roadway deterioration, especially in areas that are not designed for truck weights and volumes, and can also create environmental and noise disturbances on sensitive receivers in local areas.

To address these issues, WSDOT may consider expanding truck parking capacity by keeping existing state rest areas open and by facilitating the development of new truck parking sites statewide as funding becomes available. WSDOT is proposing following truck parking strategies for further implementation:

Potential Strategy and Tactics	
Proposed Strategy: Expand truck parking capacity by keeping existing state rest areas open and facilitating the development of new truck parking sites statewide.	
➔	Establish and facilitate a Truck Parking Implementation Workgroup, comprised of legislative, agency, community, and industry leaders, to maintain focus on the JTC Action Plan and assure accountability for implementation.
➔	Identify most-feasible sites for truck parking facilities.
➔	Better utilize existing parking in urban areas, including identifying and evaluating opportunities to expand truck parking at safety rest areas.
➔	Coordinate with the city of North Bend and PSRC to evaluate truck parking feasibility on city land adjacent to I-90.
➔	Better utilize existing infrastructure along mountain passes, and convert vacant land owned by WSDOT near Snoqualmie ski areas to truck parking facilities.
➔	Develop a concept of operations to expand the pilot TPAS (truck parking availability system) program across the state and disseminate real-time truck parking information through various applications.
➔	Coordinate with other state, regional, and local planning partners to integrate truck parking into all planning efforts and decision-making processes.
➔	Collaborate with neighboring states and pursue opportunities for pooled fund study with California and Oregon to address truck parking issues.

¹⁴ Managing Critical Truck Parking Case Study – Real World Insights from Truck Parking Diaries, American Transportation Research Institute, C. Boris, and R.M. Brewster, December 2016. <https://truckingresearch.org/wp-content/uploads/2016/12/ATRI-Truck-Parking-Case-Study-Insights-12-2016.pdf>

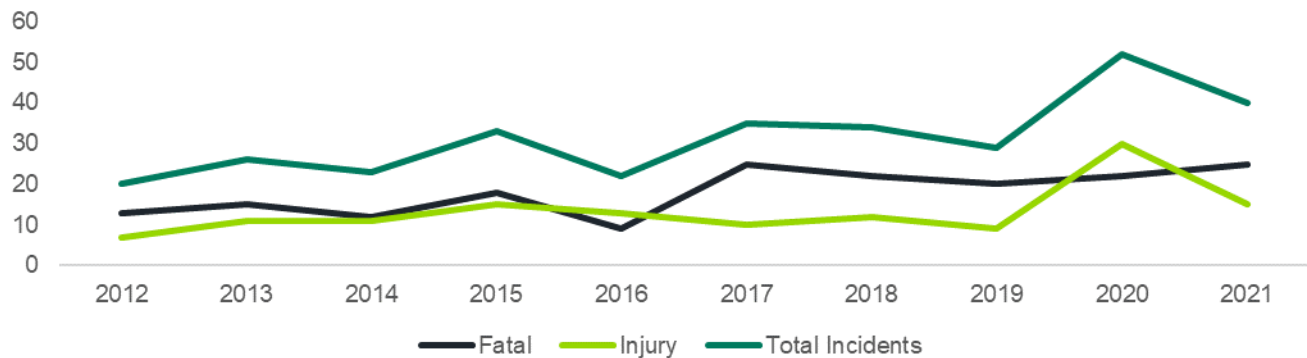
Rail safety and security

Trespassing, at-grade rail crossing collisions, rail cargo theft, and criminal sabotage of rail lines are all increasing in the state of Washington.

Trespassing on private railroad property is illegal and is the leading cause of rail-related fatalities in the country.¹⁵ Trespassers may be those who do not observe posted signage, those who do not understand the hazard of being around an active railroad, or those who intend to self-harm. The vast majority of trespass fatalities and injuries are preventable, and trespassers frequently sustain life-threatening injuries by failing to use designated locations such as at-grade rail crossings or dedicated pedestrian access paths.

Trespassing incidents steadily increased since 2012, with a slight decline in 2021 injuries but an increase in the number of fatalities (Figure 13). Between 2012 and 2019, about 50 percent of the trespassers in the state were between 20 and 40 years old. Fatalities and injuries are also relatively higher for this age group, with trespassing incidents primarily in King, Pierce, and Snohomish Counties. This may be due to population density, frequency of passenger and freight train activity, and other factors.

Figure 13: Trespassing incident trends, 2012–2021



Source: CPCS analysis of FRA Safety Data, 2012-2021 Washington state, 2022.

Blocked rail crossings are a concern across the state, especially as freight and passenger traffic increases on both roadways and rail lines. Blocked rail crossings can create safety risks to local communities by temporarily increasing emergency response times. In Washington, 79 percent of the most affected crossings have no nearby alternative route. Figure 14 illustrates the top 50 priority crossings in Washington.

¹⁵ Railroad Trespassing Fact Sheet, U.S. Department of Transportation, FRA, 2019.
<https://railroads.dot.gov/sites/fra.dot.gov/files/2019-11/FRA%20Rail%20Trespassing%20Fact%20Sheet.pdf>

Figure 14: Top 50 priority crossings in Washington



Source: Science, and Transportation Railroad Crossing Congestion and Its Impacts on Safety and Efficiency, U.S. Senate Committee on Commerce, March 2021

- Sixty-two percent of the top 50 crossings are on designated freight corridors.
- On average, the top 50 crossings are blocked on average for two hours each day.
- Two-thirds are near emergency service providers – making it more likely a blocked crossing will result in delayed response.

Precision Scheduled Railroading (PSR) operating model is almost adopted by all North American Class I railroads. PSR operations are built upon five principles: improve service, control costs, optimize asset utilization, operate safely, and develop employees.¹⁶ Trains operating on PSR have a fixed schedule, meaning that they depart at a certain time regardless of the number of loaded cars rather than using the number of cars to determine when a train should depart. Therefore, the train sizes following the implementation of PSR is a particular concern for transportation agencies due to the potential for longer trains to block at-grade rail crossings for a longer period.

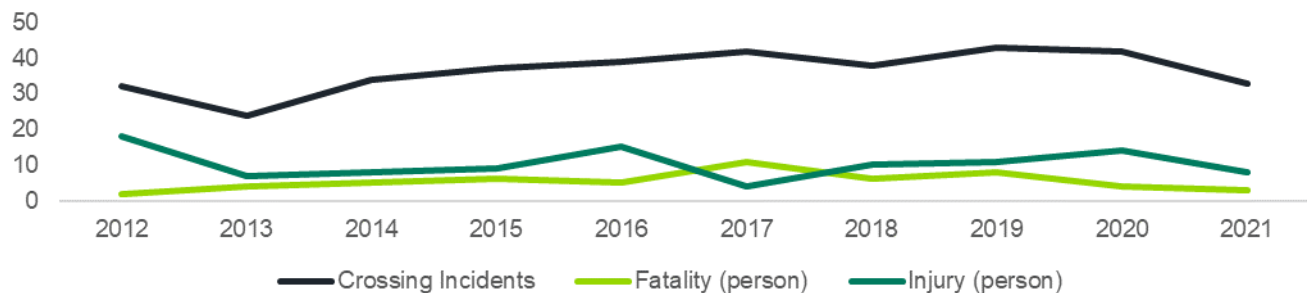
Additionally, PSR models also increase the number of trains that can slow down rail operations. As a result, trains may sit for long periods at or near busy yards and therefore block vehicle and pedestrian access at grade crossings.

¹⁶ Talking Freight: The Operational Nuts and Bolts of Precision Scheduled Railroading, FHWA, 2020. https://www.fhwa.dot.gov/Planning/freight_planning/talking_freight/march_2020/talkingfreight3_18_20cvd.pdf

Studies have shown that drivers will attempt to clear the crossings in front of arriving trains at locations where crossings are routinely blocked for extended periods. Pedestrians may also attempt to cross the blocked crossings by crawling between stopped railcars.¹⁷

Highway-rail grade crossings: Washington's highway-rail grade crossing incidents remain relatively consistent between 2012 and 2021, with a slight decline in 2021 (**Error! Reference source not found.**). During this time, 364 highway-rail grade crossing incidents occurred in the state, leading to 54 deaths and 104 injuries. Nearly 80 percent of incidents were at public highway-rail crossings, and the rest occurred at private crossings. Only 20 percent of public crossings in the state have gate arms to keep vehicles from crossing in front of trains, and individual crossings may require additional traffic control systems based on engineering needs. Rail safety strategies would be coordinated with the Washington Utilities and Transportation Commission (UTC), the state agency with regulatory authority over rail safety in Washington. UTC is responsible for highway-rail crossing safety inspections, inventorying, documentation, and reporting of incident data.

Figure 15: Highway-rail grade crossing incident trends in Washington, 2012-2021



Source: CPCS analysis of FRA Safety data, 2022.

Rail cargo theft: Theft costs approximately \$30 billion each year nationwide and has grown during the COVID-19 pandemic. Organized groups look for high-value merchandise in shipping containers and pitch them from slow-moving trains or offload them when trains stop. The FBI began adding cargo thefts to its Uniform Crime Reporting system as part of the USA PATRIOT Act revision in 2005, but very few local jurisdictions submit data to the system.¹⁸ BNSF uses a Risk Analysis Program to determine overall potential risk, reduce theft occurrences, and eliminate non-insured cargo claims. For example, shipments valued above \$100,000 may require additional cargo insurance, and less-than-truckload (LTL) shipments can sometimes offer less coverage than the actual cargo value.

Criminal sabotage: Sabotage of rail lines is a growing issue in Washington state where illegal actions are being taken against railways and rail lines as protests against oil/gas activity, especially where related to indigenous sovereignty. In December 2020, a train was derailed and caught on fire in Custer, Washington, resulting in 29,000 gallons of crude oil spilled and the evacuation of 120 people. Between January 2020 and July 2021, there have been at least 41 incidents in the state being investigated by the FBI – an unprecedented number of railway sabotage incidents in the state's history. Continued partnership with law enforcement and railroads is needed to ensure the safety and security of the freight rail system against these types of threats.

¹⁷ Federal Railroad Administration Launches Web Portal for Public to Report Blocked Railroad Crossings, FRA Newsroom, December 2019. <https://railroads.dot.gov/newsroom/press-releases/federal-railroad-administration-launches-web-portal-public-report-blocked-0>

¹⁸ Cargo Theft Looms as Railroad Problem, Trains.com, W. P. Diven, September 2015. <https://www.trains.com/trn/news-reviews/news-wire/11-cargo-theft/>

Potential strategies and tactics to address rising cases of trespassing, at-grade rail crossing collisions, rail cargo theft, and eco-sabotage are as follows:

Potential Strategy and Tactics
Potential Strategy: Work with relevant authorities to address rising cases of trespassing, at-grade rail crossing collisions, rail cargo theft, and sabotage.
➔ Study at-grade rail crossing traffic control system needs, with minimal treatments, including crossbucks, emergency notification system signs, and advance warning signs, along with stop/yield signs for crossings that do not have flashing lights and/or gates.
➔ Develop a federally required rail crossing safety action plan and use Section 103 funding to invest in crossing upgrades.
➔ Work with local jurisdictions to submit rail cargo theft data to the Uniform Crime Reporting system.
➔ Ensure the safety and security of the freight rail system against rail sabotage threats.

Maritime safety and security

Washington’s maritime safety and security responsibilities are distributed among the U.S. Coast Guard (USCG), U.S. Transportation Security Administration (TSA), U.S. Customs and Border Protection (CBP), U.S. Maritime Administration (MARAD), and ports and terminals.

- **U.S. Coast Guard (USCG):** The Coast Guard is a military force principally responsible for maritime safety and security for U.S. ports, inland waterways, along the coasts, and on international waters. USCG manages six major operational missions: maritime law enforcement, maritime response, maritime prevention, transportation system management, security operations, and defense operations. USCG also manages navigational aids through adequate signage, symbols, buoys, markers, lighthouses, and regulations.
- **U.S. Transportation Security Administration (TSA):** The TSA is responsible for developing policies to protect the security of the U.S. transportation system across all modes, including highways, railroads, buses, ports, pipelines, and intermodal freight facilities. TSA works collaboratively with surface transportation operators and local, state, and federal security partners to ensure appropriate security postures are employed.
- **U.S. Customs and Border Protection (CBP).** CBP is responsible for law enforcement at U.S. land, air, and sea ports of entry for both passengers and cargo. For freight, CBP helps facilitate legitimate trade and has deployed some technologies such as non-intrusive inspection to increase its ability to examine cargo efficiently. Among many responsibilities, CBP officers check manifests, screen incoming cargo, operate non-intrusive inspection equipment, and conduct other missions.
- **U.S. Maritime Administration (MARAD) Office of Maritime Security:** This office supports the development and implementation of maritime security policies, procedures, practices, statutes, and training against maritime security threats. The office also works with international and interagency partners to share maritime security information with industry stakeholders. MARAD runs the U.S. Maritime Alerts and Advisories program to provide basic information on threat events to the maritime industry.
- **Ports and terminals:** Washington’s ports and maritime terminals are responsible for working with federal authorities to ensure safety and security inside the port. Ports typically have security officers to monitor operations by patrolling by land or sea. These officers must possess a

Transportation Worker Identification Credential (TWIC) issued by the TSA allowing them unescorted access to regulated marine terminals.

Maritime safety

Some of the key maritime safety issues include navigational safety, fire protection, search and rescue, cargo securing and packing, and hazardous materials:

Navigational safety: Navigational safety includes steering and sailing practices, light and sound requirements, required equipment, and other practices to avoid collision and ensure safe navigation through international waters and inland waterways. Navigational safety equipment varies by vessel type but may include Automatic Identification Systems (AIS), radio communications, an echo depth-sounding device, an electronic position-fixing device, internal communications, an magnetic compass or swing meter, marine radar, navigation lights and shapes, a search light, and sound-producing devices. The U.S. Aids to Navigation System is also maintained by the U.S. Coast Guard and provides visual, audible, and electronic signals of marine features to aid in navigation.

Fire protection: Advancements in fire detection and fighting can prevent the endangerment of crew members, ports, harbors, and cargo. For example, making sure any carpets and wall coverings are controlled; rapidly detecting, containing, and extinguishing fires; designating easy evacuation routes; and keeping life-saving appliances (life-jackets, life rafts, and others) are key to preventing the risk of injury, property damage, and loss of life.

Search and rescue: Adequate communications are critical to search and rescue missions. All cargo ships above 300 gross tons conducting international voyages and cargo ships above 500 gross tons that are not engaged in international voyages are required to carry AIS – transponders that provide the position, identification, and other information to coastal authorities. The U.S. Coast Guard also sponsors the Automated Mutual Assistance Vessel Rescue System (AMVER), a global, voluntary vessel safety system to provide immediate assistance to vessels during emergencies.

Cargo securing and packing: Improper stowage and securing of cargo, overloading, and incorrect content declaration can cause serious ship casualties, injuries, or even loss of life both at sea and during loading/unloading. For bulk cargo, cargo should be distributed evenly to reduce the risk of instability during voyages and chemical reactions of commodities carried. Containers are the responsibility of the owner, and their condition must be periodically examined.

Hazardous materials: Hazardous materials can be explosive, flammable, combustible, corrosive, reactive, poisonous, toxic, biological agent, or radioactive. This is discussed further in the subsequent section.

Maritime security

- **The Security and Accountability for Every (SAFE) Port Act 2006** codified some maritime security programs and required that 100 percent of U.S.-bound ocean containers be scanned through non-intrusive inspection and radiation detection equipment in a foreign port before being loaded on a U.S.-bound ship. While this has yet to be fully implemented, a few programs were targeted to help address this:
- **The Container Security Initiative (CSI):** CSI helps increase security for containerized cargo by working with foreign government customs agencies to examine high-risk maritime containerized cargo at foreign seaports. Additionally, CBP deployed Radiation Portal Monitors and other radiation detection technologies to seaports around the world, and these systems now scan over 99 percent of arriving sea containers before arriving at U.S. seaports.
- **Port Security Grant Program:** This program is a discretionary grant funding program through FEMA to protect critical port infrastructure from terrorism, enhance maritime domain awareness,

improve port-wide maritime security risk management, and maintain or reestablish maritime security mitigation protocols to support port recovery and resiliency capabilities.

- **Customs-Trade Partnership against Terrorism:** The partnership is a voluntary supply chain security certification program that companies can go through to improve their supply chains against terrorism risks.
- **The Transportation Worker Identification Credential:** This item is an identification credential for maritime workers that need unescorted access to secure areas of port facilities and vessels.

The Department of Homeland Security is working on several innovations to increase maritime security. For example, the department’s Port and Coastal Surveillance project is making several investments to increase maritime situational awareness to improve detections, interdictions, and deterrence.

Port security measures may include regular security patrols, video surveillance of port roadways and terminals, restricted gate access, intrusive detection on port facilities, a robust incident reporting program, and close collaboration with emergency responders.

Potential strategies and tactics to address maritime safety and security are as follows:

Potential Strategy and Tactics	
Potential Strategy: Work with relevant federal agencies to facilitate continuous improvement in maritime safety and security.	
➔	Work with federal agencies to pilot maritime safety and security innovations in Washington and along its coastal and inland waters.
➔	Facilitate port security measures such as regular security patrols, video surveillance of port roadways and terminals, restricted gate access, intrusive detection on port facilities, development of a robust incident reporting program, and ensure close collaboration with emergency responders.

Hazardous Materials

More than 20 billion gallons of oil and other hazardous substances are transported as both cargo and fuel by vessels, pipeline, and rail across the state. This creates both safety and environmental risks when a spillage occurs.

Hazardous materials can be explosive, flammable, combustible, corrosive, reactive, poisonous, toxic, biological agents, or radioactive. Over 4,000 oil spills are reported every year in Washington,¹⁹ risking the health and safety of local communities along rail lines and along navigable waters – Columbia River, Grays Harbor, and Puget Sound waters. Spills can also reach the stormwater drainage system and result in contamination. Preventing oil spills is important, especially because the average removal rate once a spill occurs is only approximately 14 percent.²⁰

Washington has one of the lowest oil spill rates in the country due to its comprehensive program for spill prevention, preparedness, and response. The state manages hazardous material incidents through the Department of Ecology, Emergency Management Division, Washington State Patrol, and

¹⁹ Spill Incidents, Washington Department of Ecology, (n.d.). <https://ecology.wa.gov/Spills-Clean/Spills/Spill-preparedness-response/Responding-to-spill-incidents?msclkid=d7c249e0a54311ecbb4b4e2fad6f4c19>

²⁰ Washington RCW 90.56.005 (3)(b)

local response organizations. Washington state also has 43 local emergency planning committees to prevent, mitigate, and respond to these incidents.

Hazardous Materials Transportation Law (HMTA): The transportation of hazardous materials is governed by the federal HMTA (49 U.S.C. 5101) (HMTA). The HMTA designates certain materials as hazardous because transporting the material in a particular amount and form may pose an “unreasonable risk to health and safety or property” and issues specific regulations for the safe transportation and security of hazardous material from training, security, and packaging, to operational rules.

Volatile crude oil transportation: In 2019, Washington implemented a vapor pressure requirement for hazardous materials to reduce the risk of explosions and potentially fatal derailments through volatile crude oil and other flammable material being loaded and unloaded from rail tank cars. However, in May 2020, the Pipeline and Hazardous Materials Safety Administration (PHMSA) determined that the HMTA preempts the state’s requirement. While the state can no longer restrict volatile crude oil transportation, PHMSA kept in place the state’s advance notification requirements. This requirement enables Washington to track crude-by-rail movements throughout the state, disseminate information to local and tribal first responders, and ensure preparedness for oil spill-related emergencies.

Washington Department of Ecology works with the regulated community and others to minimize the environmental threat of oil spills. Other potential tactics are as follows:

Potential Strategy and Tactics	
Potential Strategy: Work with regulated community and others to minimize the environmental threat of oil spills.	
➔	Study human procedural and organizational factors to minimize the environmental threat of oil spills from vessels, railroads, pipelines, and oil-handling facilities.
➔	Track crude-by-rail movements throughout the state, disseminate information to local and tribal first responders and ensure preparedness for oil spill-related emergencies.

4. Mobility

Washington's statewide transportation policy goal of Mobility is "To improve the predictable movement of goods and people throughout Washington state, including congestion relief and improved freight mobility." Some of the trends that impact mobility of the freight system include capacity constraints and connectivity needs. This chapter explores key trends, issues/needs, and strategies for the freight system to support mobility throughout the state of Washington.

Congestion and capacity constraints

As congestion increases and capacity is more constrained, freight is adapting to those conditions. Some of those adaptations are leading to more efficient use of the freight system's capacity, while others have negative impacts.

Whether it is same or next-day e-commerce delivery to residential front doors, components arriving at factories across the state, or Washington agricultural products being delivered to markets locally or around the globe, supply chains count on a reliable transportation system. When the system is congested or capacity is constrained, the performance and reliability of the system become impaired.

Shippers take the freight system as a given and adapt their operations to the conditions on the system such that they continue to meet delivery needs, demands, and guarantees. Some of these changes are positive, such as looking to alternative modes and better use of underutilized capacity. Others can have negative consequences, such as added congestion and using routes that are not intended for goods movement.

System reliability: As system reliability decreases, shippers and carriers must alter their operations. As each trip takes longer, each truck can make fewer trips per day despite increasing freight volumes. As a result, it takes more trucks to move the same amount of cargo, further adding to congestion. More trucks require more drivers, contributing to existing driver shortages. Many companies will increase inventory to cope with delays, decreased reliability, and lack of service.²¹ As these storage stocks grow, there is less warehouse space dedicated to freight movement (processing, value-added, fulfillment, etc.), further increasing demand for warehouse space. This means freight activity moves further from key freight nodes and the freight system, adding to truck trip demand.

Local congestion and global supply chains: Local congestion and lack of reliability also impact companies' global supply chains. Congestion at or near major ports and airports as well as on urban road networks can cause shippers to miss delivery windows. The impact to a shipper that misses a vessel sailing, a flight, or a rail departure can be costly. Missing delivery windows can result in financial penalties to the shipper or lost business for the producer. Shippers of perishable products, such as Washington tree fruit, also face spoilage issues, meaning lost revenue from a shipment that could not be completed. Even for a long multi-day shipment, arriving at a port or airport even just a few minutes before or after cargo tendering cutoff times can make a difference between a successful shipment and a lost sale.

²¹ The Economic Impact of Increased Congestion for Freight-Dependent Businesses in Washington State – DRAFT, Washington State University, School of Economic Sciences, various authors, Taylor, J., et. al., March 2013. http://ses.wsu.edu/wp-content/uploads/2015/03/EI-_Congestion_-JTRF_Working.pdf

Significant delay and congestion caused by freight movements. In addition to being affected by congestion, freight movements themselves can cause significant congestion or delay. In Washington, some types of significant congestion or delay caused by freight movements include:

- Blocked railroad crossings. The 2019 State Rail Plan notes that increases in train lengths has created long and unpredictable travel delays for both the general public and freight users. This concern is particularly strong in areas where trains move at slow speeds. Additional information on crossing blockages is presented in Appendix E's discussion of crossing blockages.
- Congestion caused by major truck traffic generators such as ports and large distribution centers. The large volume of truck traffic created by these significant freight handling facilities can create general traffic congestion on nearby streets. An example is truck traffic around some port terminals in the Tacoma area, where large volumes of trucks must exit major highways and travel on surface streets to reach port facilities.
- Congestion at border crossings. Washington's border crossings with British Columbia are important corridors for freight movement and serve a high volume of truck traffic. The high volume of truck traffic at some crossings, particularly in Whatcom County, means that cross-border freight movements can generate localized congestion when freight volume exceeds border facilities' capacity to clear trucks.
- Congestion from e-commerce deliveries. The increasing use of e-commerce has resulted in a larger number of small truck trips into dense urban areas and neighborhoods. When delivery parking is unavailable, trucks may double-park or "circle" areas searching for parking, and both types of activity can contribute to local traffic congestion. Additional discussions of e-commerce trends and impacts can be found in Appendix F.
- Bridge lift operations for the passage of maritime shipping. Areas with low-clearance bridges over waterway shipping channels may experience traffic congestion when bridges are raised and lowered to let shipping traffic pass. A notable example of this issue is the I-5 Interstate Bridge between Vancouver, and Portland, Oregon, that has a drawbridge that must be raised to allow barges to pass.

WSDOT uses a variety of policies, programs, and projects to address and mitigate freight congestion and delay issues. For instance, the Puget Sound Gateway Program is a combination of major roadway and bridge projects that will complete critical missing links in state's freight network and build new connections to the Ports of Seattle and Tacoma and the Sea-Tac Airport. The project is expected to be completed by 2028 and includes a new SR 99 bridge over existing SR 509 highway, a new SR 509 expressway providing new access to SeaTac Airport, a new SR 167 bridge over I-5, and a new connection between I-5 and the Port of Tacoma. This program will improve regional freight mobility and reduce port-related truck traffic on nearby local streets, further reducing traffic congestion caused by trucks.

WSDOT and Oregon DOT are jointly planning for replacing the I-5 drawbridge over the Columbia River between Washington and Oregon. The current bridge structure is nearly 100 years old and no longer satisfies the resilience, safety, and mobility needs of the users. The Interstate Bridge Replacement Program seeks to improve mobility for all travelers crossing the Columbia River and will develop a regionally supported solution for addressing identified problems, including traffic interruptions and delays caused by bridge lifts.

Other operational improvements to reduce freight-caused congestion can include information sharing systems, such as WSDOT's border time wait system. WSDOT makes commercial vehicle wait times available to freight brokers and dispatchers, and these users can use current and historic crossing wait times to efficiently organize their companies' operations and reduce the likelihood of congestion.

Local congestion from smaller freight movements like deliveries can also be mitigated on a local level. For example, the city of Seattle has implemented a curbside management program that has designated specific zones for delivery vehicle parking.

Shipper monitoring of system performance and real-time decision making: Some companies are placing additional emphasis on managing their supply chain operations in real-time. These companies have identified system bottlenecks and monitored reliability, and they make both strategic and real-time operational decisions about when and where they route trucks to and from their facilities.²²

Improved utilization of existing terminal and facility capacity: Terminal and facility operators are seeking to improve the use of under- or unutilized facilities to move more cargo to improve options for shippers. Leveraging existing facility capacity can provide many benefits for goods movement. Additional mode choices can offer lower shipping costs, take freight off the road network, and provide more sustainable freight transportation. In terms of capital development, this approach can also be more cost-effective and faster to deliver than a new terminal. The Port of Bellingham received a \$6.85 million U.S. Department of Transportation Port Infrastructure Development Program (PIDP) grant in 2020 to update the Bellingham Shipping Terminal. As part of the work the grant is funding, the Port will rehabilitate an existing barge loading facility at the terminal. When completed, the new barge facility will enable the Port to meet increasing customer demand for both intra-Puget Sound and north-south coastwise barge shipping.²³ In central Washington, Grant County International Airport began working with local shippers in 2018 to bring in seasonal air freighter service to export Washington cherries to key markets in Asia. A former U.S. Air Force Base, the airport has runway capabilities and sufficient tarmac and apron space to handle freighter aircraft. This service provides an option to truck cherries to Seattle-Tacoma, Portland, and Vancouver International Airports, reducing cost, time, congestion, and air emissions. Having a dedicated freighter service in Moses Lake near the state's cherry-growing region also improves reliability as shippers avoid congestion and delay in Seattle, Portland, and Vancouver (BC).²⁴

Border crossings: Even during the pandemic, border crossings between British Columbia and Washington continued to be among the busiest anywhere along the U.S.-Canada border. While passenger vehicle volumes plummeted, as a result of border closures to non-essential travel, truck volumes largely only saw small decreases, demonstrating the importance of freight movement. In 2020, southbound truck volumes at three of Washington's border crossings ranked among the top 15 U.S.-Canada border crossings; Lynden was 4th, Sumas ranked 8th (and showed no change in truck volumes), and Lynden was 14th.²⁵ The value of trucked freight moving across the border has climbed steadily since the Great Recession, though it did see a drop in 2019 and again in 2020. This shows that efficient and secure border crossings for freight are an important element of the state's freight system.

In 2019, the U.S. and Canada reached an agreement to establish a preclearance program for land (and maritime) ports of entry. This agreement followed a series of pilot preclearance projects, one of which was located at the Pacific Highway crossing in Blaine.²⁶ While focused on land and maritime crossings, this also has the potential to offer pre-clearance for air cargo trucked across the border to

²² Top 100 Truck Bottlenecks – 2022, American Trucking Research, 2022. <https://truckingresearch.org/2022/02/08/top-100-truck-bottlenecks-2022/>

²³ Port Secures \$6.85 Million Federal Grant in Support of Working Waterfront, Port of Bellingham, October 2020. <https://www.portofbellingham.com/CivicAlerts.aspx?AID=322>

²⁴ Joint Transportation Committee Washington State Air Cargo Movement Study Final Report, Washington Legislature Joint Transportation Committee, December 2021. https://leg.wa.gov/JTC/Documents/Studies/AirCargo/JTCAirCargoMovementStudy_FinalReport.pdf

²⁵ International Mobility and Trade Corridor, 2021 Data Digest, August 2021. <https://theimtc.com/wp-content/uploads/2021-IMTC-DATA-DIGEST.pdf>

²⁶ US-Canada Truck Preclearance Moves Closer to Reality, On-line, JOC Staff, August 2019. https://www.joc.com/trucking-logistics/us-canada-truck-precleanance-moves-closer-reality_20190819.html

be flown out of Seattle-Tacoma or Vancouver International Airports. Additionally, Canada and Washington have differences in truck axle weight limits. Some industry stakeholders are proponents of regulatory alignment and believe it could facilitate mobility by consolidating the number of trucks on the road. However, roads, bridges, and overpasses may only be designed to handle certain weights and would need to be reviewed carefully across the state prior to implementation. Increased truck weights would also likely result in faster roadway deterioration and would require investment considerations and updates to pavement management models.

Development of alternative modes: For many years, Washington shippers have benefitted from a multimodal freight system. As population and freight volumes have grown, shippers, carriers, ports, and others using or operating the freight system have looked to leverage and expand that system to provide more alternatives for moving freight and take traffic off of congested roadways. For example, the previous state freight plan identified interest in exploring the possibility of establishing inland port locations in Washington to increase the use of rail for moving containerized ocean freight.²⁷ In the last 5 years, there have been many developments to provide additional options for the state's shippers.

Container-on-barge service: Early in 2019, the Port of Everett received federal designation as a Federal Maritime Administration Marine Highway Project, making the port eligible for future grants under the program. Those grants would fund infrastructure or equipment to enhance the capabilities of the port to ship containers by barge to the ports of Tacoma and Seattle on the M-5 marine highway. The port estimates this service could take 300 containers per day off the I-5 corridor in the Puget Sound region.²⁸ Before the temporary loss of container service at the Port of Portland, container-on-barge service provided an important alternative shipping option. The service was timed with sailing schedules of container carriers at the Port of Portland so that containers loaded on barges at upriver Lewiston (ID), Pasco, and Morrow (OR) would arrive in time to be transferred to an ocean vessel before its departure. A rail-barge connection was established between Lewiston, Morrow, and Portland following the loss of service.²⁹

Inland truck/rail intermodal facilities: In 2021, Savage opened an intermodal facility along the Union Pacific line near I-86 in Pocatello (ID). The primary market the facility serves is containerized agricultural exports moving between southeastern Idaho and the Ports of Tacoma and Seattle. By providing exporters with an intermodal option in southeastern Idaho, more of these exports now move by rail rather than truck. Driscoll Management Co., a Pocatello-based hay compressor and exporter, is now using this service instead of sending its 80 containers per week by truck to Salt Lake City only to have the Union Pacific rail them back west through Pocatello to the ports.³⁰ Other exporters can use this service instead of trucking their containers through western Idaho, eastern Oregon, Washington, and onto local freight networks to access port terminals. Two new inland intermodal facilities are under construction in Oregon as well. One, being developed in the mid-Willamette Valley in Millersburg, is designed to offer Oregon grass seed and hay exporters with an option to rail the exports to Tacoma and Seattle, taking trucks off the road in the congested I-5 corridor. The second is currently under construction in Nyssa, near the Idaho border. That intermodal facility will focus on domestic carload shipments of agricultural products, largely onions. This facility will offer an alternative for local growers to either long-distance trucking or trucking to the Cold Connect facility in Wallula.

²⁷ Washington State Freight System Plan Technical Update to the 2014 Freight Mobility Plan, Washington State Department of Transportation, 2019. <https://wsdot.wa.gov/publications/fulltext/freight/Freight-Plan-2017SystemPlan.pdf>

²⁸ Port of Everett Earns Short Sea Shipping Designation; Only Port on West Coast, Port of Everett press release, January 2019. https://www.portofeverett.com/news_detail_T31_R439.php

²⁹ Barge-Rail Shuttle Service Provides Shipping Relief, Port Dispatch, Port of Portland, November 2015. <https://portdispatch.portofportland.online/barge-rail-shuttle-service-provides-shipping-relief/>

³⁰ Intermodal facility already helping Idaho hay industry, Idaho Farm Bureau Federation, Sean Ellis, September 2021. <https://www.idahofb.org/news-room/posts/intermodal-facility-already-helping-idaho-hay-industry/>

Maritime: Whether it is the deployment of larger container vessels or improvements in dockside operations, maritime shipping continues to evolve. Keeping ahead of these changes is essential for managing terminal capacity. If terminal equipment (such as cranes), on-dock rail configuration (larger loop tracks), and terminal design and development/redevelopment do not keep pace, maritime capacity will become constrained. Washington's ports continue to invest to optimize and enhance capacity.

- **Northwest Seaport Alliance Terminal 5 Modernization Project:** NWSA's Terminal 5 improvement project includes \$500 million in improvements over 4 years to accommodate larger container vessels by strengthening the dock and upgrading utilities, as well as creating new environmental and technology improvements. Phase One is now complete and operational. When the final phase is complete in 2023, the facility will be able to handle some 500,000 containers per year. NWSA believes that carriers, which suspended service last year due to congestion, will return to the port given the additional capacity that is now available, reducing congestion for shippers.³¹
- **Port of Longview Berth 4 redevelopment, plans for Barlow Point, and rail improvements:** The Port of Longview has two capacity-enhancing projects underway. Redeveloping Berth 4 would involve removing an old grain elevator, which closed over 30 years ago, and returning that space to maritime productivity. An initial preparation phase has been completed and work is now ongoing to assess site hazards and estimates for demolition of the elevator's silos and related structures. The Port is also assessing the potential to develop 280 acres of port property at Barlow Point, 4 miles downstream from the Port's main terminal. In addition, the Port is adding nearly 5,000 feet of track to its internal rail system to improve efficiency and improve capacity. The Port is investing in this improvement because it has little room to handle new cargo. Today, the Port's rail system is at 70 percent to 80 percent of capacity.
- **Port of Grays Harbor East Terminal 4 redevelopment and expansion:** Looking to increase its terminal cargo space by 50 percent, the Port of Grays Harbor seeks to put a vacant 50-acre waterfront site that is served by rail back into productivity. The former WSDOT site of pontoon casting for the SR 520 Bridge has gone unused since 2015. The Port purchased the property in 2018 and has applied for just over \$4.1 million in Port Infrastructure Development Program grant funds for the project.³²
- **Amazon Charter shipments via Port of Everett:** It is not just ports that are figuring out how to develop congestion workarounds to enhance capacity. In November 2021, Amazon chartered a break-bulk ship to deliver containers to the Port of Everett. In its hold, the vessel carried rolled steel bound for Vancouver, BC. Atop the steel rolls were 181 Amazon containers. The Port of Everett's capacity and capabilities facilitated Amazon's ability to bypass congested ports to deliver both containers with Amazon products and empty containers to be used elsewhere in the company's supply chain.³³
- **Aviation:** The Joint Transportation Committee commissioned a statewide air cargo study, completed at the end of 2018, which assessed air cargo capacity in the state. The study considered air cargo capacity to be comprised of airside, landside, and access capacity. However, it only included Washington airports in the capacity assessment. Both Vancouver International (freighter service) and Portland International (freighter and express/integrator service) Airports serve Washington shippers. Seattle-Tacoma, Vancouver, and Portland all handle, for example, Washington cherry exports.

³¹T-5 Reopening Gives NWSA Much-Needed Capacity Boost, *Journal of Commerce Online*, Mongelluzzo, B, January 2022. https://www.joc.com/port-news/us-ports/t-5-reopening-gives-nwsa-much-needed-capacity-boost_20220106.html

³² Port of Grays Harbor Applies for Grant to Repurpose Former 520 Pontoon Casting Site, *The Daily World*, Hammock, D., October 2021. <https://www.thedailyworld.com/news/port-of-grays-harbor-applies-for-grant-to-repurpose-former-520-pontoon-casting-site/>

³³ Amazon doing shipping end-run, *Arkansas Democrat Gazette*, November 2021. <https://www.arkansasonline.com/news/2021/nov/28/amazon-doing-shipping-end-run/>

- **Airside capacity:** Overall, the state’s primary cargo airports have sufficient airside capacity. Planned airfield investments and improvements at these airports are deemed adequate to maintain and manage capacity.³⁴
- **Landside capacity:** Landside capacity constraints present themselves at Seattle-Tacoma (SEA), Spokane (GEG), and Boeing Field (BFI). The study determined that demand for cargo building space at SEA would exceed demand by 2021. This was prior to the pandemic and just at the beginning of the strong growth of e-commerce shipments. The strong growth in demand for passenger facilities means that cargo competes with passenger needs for limited space at the airport. Off-airport solutions are possible, but space availability near the airport is limited. Another possibility is to truck air cargo to facilities in Kent, but that also adds to congestion on the roadway connectors to and from SEA. Supply and demand issues exist at GEG as well; however, there is adequate vacant land at and near the airport to meet facility needs. The study noted that SEA, GEG, and BFI share a deficit of truck parking, with GEG as the only one of the three airports with sufficient land to address that issue. Additionally, the study assessed that Grant County International Airport had sufficient landside as well as access capacity.³⁵ With this capacity, as well as proximity, the airport has been successful in attracting seasonal freighter service to serve Washington’s cherry export market.
- **Access capacity:** Given their proximity to I-5, which continues to experience growing congestion, the study determined that both SEA and BFI have access capacity limitations.³⁶

To address freight capacity issues, WSDOT may consider assessing methods to increase capacity on the multimodal state freight system and relieve freight bottlenecks. Other potential tactics are as follows:

Potential Strategy and Tactics	
Potential Strategy: Assess methods to increase capacity on the multimodal state freight system, improve resiliency, and relieve freight bottlenecks.	
➔	Prioritize mitigation of freight bottlenecks with an emphasis on the system: focus on improving flows on key routes rather than on individual bottlenecks (in other words, mitigating two medium bottlenecks on a major freight corridor may be more impactful than removing a single, large bottleneck elsewhere).
➔	Deploy technology that can monitor and share real-time travel times along various high-volume segments of the freight system.
➔	Consider developing a system resiliency plan with a planning grant through the Bipartisan Infrastructure Bill § 176. Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) program.
➔	Maintain/improve incident response programs to minimize nonrecurring congestion and improve reliability, including snow and storm debris removal.
➔	Develop corridors for overweight and oversize freight. Coordinate with regional work to establish and maintain region-wide, multimodal high, wide, and heavy routes.
➔	Facilitate growth in rail demand and support infrastructure development to allow operation of longer trains, train speed adjustments, directional running, removal of pinch points to allow for double-stack service and oversize cargo, and expansion of industry, yard, and terminal facilities.

³⁴ Joint Transportation Committee Washington State Air Cargo Movement Study Final Report: Appendix B – Air Cargo Congestion, WSP and KSA, May 2018. https://leg.wa.gov/JTC/Documents/Studies/AirCargo/WashingtonStateAirCargoSystem_Appendix%20B.pdf

³⁵ Ibid.

³⁶ Ibid.

Potential Strategy and Tactics

- ➔ Lead, convene, and support work to identify needs and opportunities for alternative modes/shipping options; analyze value proposition; and secure funding (such as extending development of M-5).
- ➔ Continue and expand programs such as the Puget Sound Gateway that improve access and reliability for freight routes accessing maritime, air, and rail terminals, as well as logistics facility clusters.
- ➔ Partner with local jurisdictions, ports, airports, and others to deploy technology and maximize existing and new capacity to improve truck parking at and near these facilities.
- ➔ Explore the viability of an inland port east of the Cascades to reduce truck movements in/out of the Northwest Seaport Alliance.

Connectivity

Supply chain operations and goods movement require that facilities are linked together by an interconnected network of modes, routes, and facilities. Addressing current and future needs, gaps, blockages, and conflicts within this network will allow for affordable, reliable, and safe access to suppliers and markets.

Capacity addresses questions about the capability of the system to handle future volumes and how we can get the most out of our system. Connectivity looks at how that system is linked together and how freight can move from Point A to Point B. Connectivity answers questions about whether we have the right infrastructure in the right place to enable goods to move efficiently, safely, and cost-effectively. Some of the connectivity challenges facing the freight system today include first/last mile access to freight facilities, inadequate and aging infrastructure, incompatible uses near or along with freight facilities and routes, and the need for low-cost, reliable freight transportation in specialized corridors.

Infrastructure: WSDOT is currently engaged in several major connectivity projects. These projects provide critical connections to freight facilities and national and global markets.

Interstate Bridge Replacement Program: WSDOT is working jointly with the Oregon Department of Transportation on the Interstate Bridge Replacement Program. The two states are planning for a replacement of the existing Interstate Bridge on I-5 that not only connects Vancouver and Portland and Washington and Oregon but serves a critical West Coast freight corridor. The bridge is also a vital connection between Washington shippers and ocean container services at the Port of Portland. In addition to addressing delay and improving mobility, the replacement program is focusing on seismic resiliency. One of the two spans is now over 100 years old, and both spans are at risk during a major earthquake.

West Seattle Bridge: In July 2021, WSDOT selected the city of Seattle's West Seattle Bridge project to receive \$12 million in funding from a competitive, statewide bridge funding program.³⁷ This program for local bridges is funded by a federal grant. The bridge, which has been closed since March 2020 due to expanding cracks, is part of WSDOT's designated Freight and Goods

³⁷ The City of Seattle has received additional Federal resources for West Seattle Bridge repair!, SDOT Blog, Seattle Department of Transportation, Olsen, K., July 2021. <https://sdotblog.seattle.gov/2021/07/26/the-city-of-seattle-has-received-additional-federal-resources-for-west-seattle-bridge-repair/>

Transportation System. The bridge provides access to the rehabilitated Northwest Seaport Alliance/Port of Seattle's Terminal 5, linking the upgraded terminal to I-5 and I-90 and beyond.

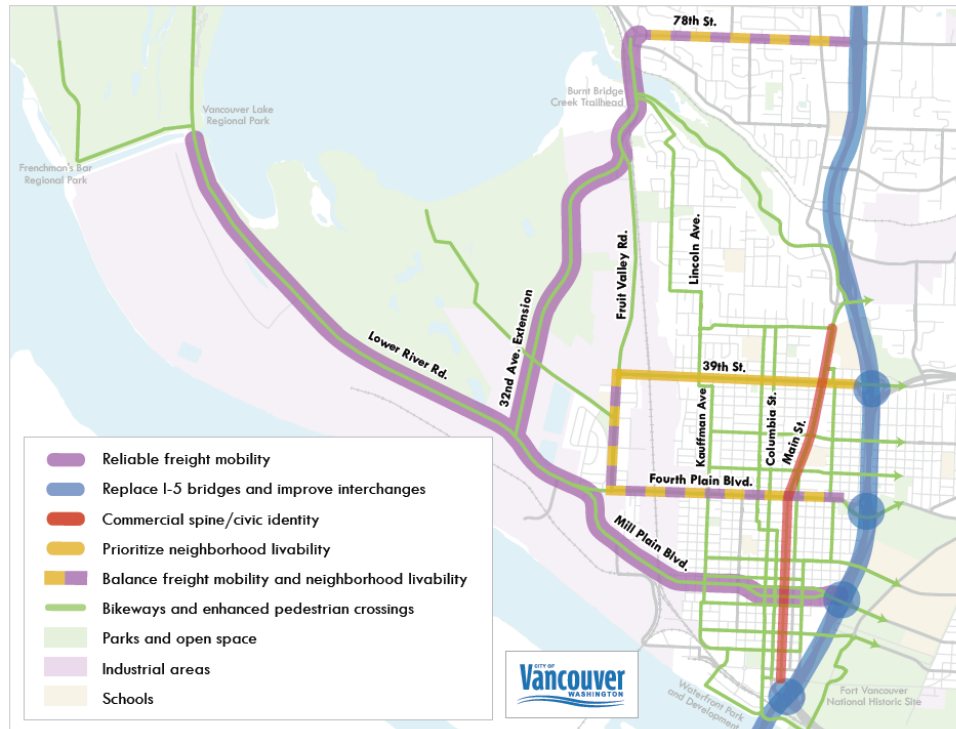
Puget Sound Gateway Program: WSDOT's Puget Sound Gateway Program is filling in critical gaps in the freight system connecting to the Port of Tacoma and air cargo facilities at Seattle-Tacoma International Airport. In Tacoma the project will create a highway connection on SR 167 from Puyallup to I-5 and through to the Port of Tacoma. The initial phase linking the Port and I-5 should be complete in 2022. Further north, work on SR 509 will connect that highway to I-5 and provide a southern access route to Seattle-Tacoma airport. Construction will be complete on both projects in 2028.³⁸

First/Last mile connections to state, national, and global freight systems: Much of the state's freight transportation activity occurs in urban areas near major freight facilities such as ports, airports, rail yards, and distribution facilities. However, freight and supply chains begin, end, and pass through suburban and rural communities as well. The state system connects to national and global systems as well as local freight systems. At the same time, local transportation systems need to provide for freight moving to, from, and through their communities. If the state system draws more through a community than its freight system can handle it can lead to congestion and add to first/final mile challenges. Similarly, if the local transportation network does not function efficiently, it can create delays for freight within the community and onto other parts of the state system.

Land use: The availability of developable industrial land near the freight system can support efficient freight movement and minimize impacts on the transportation system and nearby communities. Keeping freight-related development near the freight system offers several benefits: reduced VMT and emissions, improved safety and fewer conflicts with other system users, and keeping noise, lights, and traffic away from neighborhoods. If developable land is not available near the freight system, freight facilities, manufacturing uses, and other freight-related activity will move further from the system and freight terminals (ports, airports, railyards, truck terminals, etc.), adding to congestion, delay, emissions, conflict with other system users, and negative impacts on communities.

Existing land use and development patterns: In many Washington communities, the state freight system either passes through the community or connects to the local freight system. Rail yards, ports, airports, and other freight facilities, while located in industrially zoned areas, may be near residential and commercial areas. In some cases, accessing freight facilities, even if buffered from other uses, requires freight to pass through residential communities and commercial areas. Historical use and development patterns, which may not have created issues in the past, now have become sources of competing needs. The city of Vancouver's 2016 Westside Mobility Strategy is built around a principle of balanced mobility. Vancouver's west side is home to the Port of Vancouver's marine terminals and industrial parks. The first/last mile move for freight from I-5 involves passing through downtown Vancouver and nearby residential neighborhoods. As shown in Figure 16, the plan identifies routes that emphasize goods movement and which serve commercial district needs and neighborhood livability. The city of Vancouver, Port of Vancouver, WSDOT, Clark County, and Southwest Washington RTC collaborated in the strategy's development.

³⁸ Major Project: Puget Sound Gateway Program, WSDOT, (n.d.). <https://wsdot.wa.gov/construction-planning/major-projects/puget-sound-gateway-program>

Figure 16: City of Vancouver balanced mobility concept

Source: City of Vancouver/Port of Vancouver Westside Mobility Strategy Final Report, July 2016

Unserved/underserved industrial land on or near the freight system: One of the land use strategies used to support freight mobility is to designate land on or near the freight system for industrial/manufacturing, distribution, or other freight-related use. Making the most of that land can sometimes be challenging. In some cases, large blocks of land may not be served with all of the roads, rail, utilities, and other infrastructure necessary for their development. Providing this infrastructure can be costly, particularly for small land owners and public entities. Meanwhile, freight users continue to find workable locations, although these may be further away from the freight system and freight facilities. The Port of Pasco purchased 300 acres of ideally located vacant industrial land in 2019 just north of Pasco. Named Reimann Industrial Center, the industrial park is located between US 395 and the BNSF mainline, and the Port is targeting the land for food processing and other agriculture-related industries. The purchase price of \$6.5 million is just a fraction of the cost of building out roads, rail, utilities, and other services, which the Port estimates at between \$20 and \$30 million.³⁹ Darigold announced in mid-2021 that they purchased 150 acres of land for a processing facility at the park. With this development, infrastructure costs will likely be much less as the Port originally envisioned several 20- to 40-acre lots rather than a development this size. To support Darigold's investment, the state Legislature provided the Port with \$7.5 million in funding for infrastructure development. The remainder of the park, however, remains unserved.

Specialized corridors and networks:

There are a handful of specialized freight networks in Washington that leverage the multimodal freight system to provide low-cost, reliable freight transportation to provide access to markets. The Columbia-Snake River system enables farms in eastern Washington to connect with global markets. The system combines land-based modes (truck and rail) connecting to barge-served elevators on the river system for delivery to export terminals on the lower Columbia River. There, grain is loaded on ocean-going vessels for delivery around the world. The Port of Everett is also developing short-sea

³⁹ Port of Pasco: Industrial land in high demand, *Tri Cities Area Journal of Business*, Puig, E., October 2020. <https://www.tricitiesbusinessnews.com/2020/10/port-of-pasco-focus/>

shipping options in the Salish Sea along the designated M-5 route. Washington ports also play a critical role in getting goods between the contiguous U.S., Alaska, and Hawaii. The importance of protecting and enhancing these domestic shipping routes was affirmed with the recent U.S. Marine Highway Project Designation for Northwest Connect: Critical Lifeline between Alaska, Hawaii, and Washington.

Washington Grain Train: Since 1994, WSDOT has jointly managed the Washington Grain Train program with the Ports of Walla Walla, Moses Lake, and Whitman County. Providing 125 hopper cars for use by the region’s wheat farmers enables the Union Pacific, BNSF, and Washington short line railroads to operate train service connecting those farmers to export elevators on the lower Columbia River for final shipment abroad. The program provides reliable, low-cost transportation enabling farmers to move grain from their farms to global markets.

Figure 17: Wind turbine blade unloading



Source: Port of Vancouver.

High, wide, and heavy routes: There is growing demand to move high, wide, and/or heavy project cargo into inland regions of the Pacific Northwest as well as to the upper Midwest. Wind energy components (towers, rotors), solar panels and arrays, and industrial equipment used to maintain roads and support our energy grid are already moving to the region. Much of this moves through Gulf Coast ports, but more is moving on an emerging Pacific Northwest High, Wide, and Heavy corridor. A combined river and land route leveraging

the region’s river, rail, and truck routes, it offers shippers and cargo owners a substantially shorter, more efficient route. Cargo arrives at deep-water ports in Longview, Vancouver, and Portland (OR). Cargo that can viably move by barge often transfers to barge for delivery to the Port of Morrow (OR), where it begins its overland journey into the interior. Cargo too big for the river system moves by road or rail from the deep-water parts. As an example of the type of cargo the system handles, the Port of Vancouver, in summer 2020, handled the longest wind blades ever to traverse the North American transportation system. From Vancouver, blades and other equipment moved to a wind energy project in Saskatchewan.⁴⁰

To address freight connectivity, WSDOT may consider supporting infrastructure projects that maintain and enhance Washington shipper access to domestic and global markets. Potential tactics to accomplish this are as follows:

Potential Strategy and Tactics

Potential Strategy: Support infrastructure projects that maintain and enhance Washington shippers’ access to domestic and global markets.

- ➔ Partner with local and regional planning entities to identify places where existing freight routes now or soon could put freight in competition with other needs for limited capacity and develop solutions. Share lessons learned and develop case studies with regional and local entities across the state.
- ➔ Focus freight connectivity investments by using the Freight and Goods Transportation System’s designed first/last mile freight connectors.

⁴⁰ Port of Vancouver USA Receives Longest Wind Blades Ever to Enter the West Coast of U.S., Port of Vancouver, July 2020. <https://www.portvanusa.com/news-releases/port-of-vancouver-usa-receives-longest-wind-blades-ever-to-enter-the-west-coast-of-u-s/>

Potential Strategy and Tactics

- ➔ Develop funding programs or partnerships to help local ports, airports, economic development, and other agencies build transportation and other necessary infrastructure to unlock vacant, developable land on or near the freight system.
- ➔ Engage with regional and local planning and economic development agencies on freight needs. Support them in including intermodal freight connections in their planning activities and improve intermodal connector routes to ensure routes are designed for expected freight volumes.
- ➔ Support development of special connectivity corridors and services such as the Washington Grain Train and the High, Wide, and Heavy Corridor.
- ➔ Coordinate with British Columbia, Oregon, and federal partners to ensure Washington shippers have access to freight facilities in these locations.

5. Environment

Washington's state transportation policy goal of Environment is "To enhance Washington's quality of life through transportation investments that promote energy conservation, enhance healthy communities, and protect the environment." The key issues facing the state freight system include climate change, freight impacts to wildlife, environmental justice, and alternative fuels.

Climate change

Climate change will increase the risk of freight disruptions – especially for freight clusters that are most sensitive to disruption from climate-related hazards – in isolated areas, areas highly exposed to coastlines or floodplains, and systems that lack redundancy. State projections generally show increases in temperatures during all seasons and a modest increase in precipitation year-over-year.

In 2012, Washington state produced an integrated climate response strategy: "Preparing for a Changing Climate." The strategy documents risk by sector and forms the basis for climate change policies and plans. Further updated studies focus on specific sectors or climate hazards produced by the University of Washington's Climate Impacts Group. Climate change makes urgent the need to reduce greenhouse gas emissions, respond to weather and resiliency impacts that the system is already experiencing, and prepare for projected changes in climate conditions that may exacerbate impacts.

Weather, natural disasters, and resiliency impacts

Flooding, major snowfall, earthquakes, tsunamis, landslides, wildfires, pipeline hazards, and extreme heat have all historically impacted the freight system.

Weather events can lead to loss of life, environmental impacts, damage to infrastructure, economic losses, and other impacts. The severity of the impacts of extreme weather and natural disasters and weather can also affect the severity of economic impacts. The recent I-5/I-90 closures caused millions of dollars in infrastructure damage and economic losses.⁴¹ As the state continues to grow, WSDOT must plan for the system's longevity and ability to withstand future natural disasters and extreme weather events. Some of the weather impacts are noted below:

- **Flooding:** Washington's freight system is vulnerable to flooding events. I-5 is particularly prone to flooding events – it was closed overnight due to flooding and mudslides in November 2021 and January 2022.^{42,43} In 2007, I-5's flooding-related closures disrupted freight mobility across Washington and the broader region, lasting for 4 days and resulting in approximately \$47 million in economic losses and stranded truck drivers and commuters.⁴⁴

Projections show a slight increase in average annual precipitation, changing precipitation patterns, and an increase in seasonal flood frequencies. Under a moderate emissions scenario, a majority of climate models project decreases in precipitation in the summer months (14 percent

⁴¹ Storm-Related Closures of I-5 and I-90: Economic Impact assessment Winter 2007-2008, WSDOT, September 2008. https://leg.wa.gov/JTC/Meetings/Documents/WSDOT_I5_90ClosuresFinalReport._061808pdf.pdf

⁴² Hundreds displaced due to intense flooding in Washington state, *ABC News*, Emily Shapiro, Hope Osemwenkhae, and Melissa Griffin, November 2021. <https://abcnews.go.com/US/hundreds-displaced-due-intense-flooding-washington-state-latest/story?id=81200756>

⁴³ I-5 reopens after flooding closed 20-mile stretch in Chehalis for several hours, *The Seattle Times*, Christine Clarridge, and David Kroman, January 2022. <https://www.seattletimes.com/seattle-news/weather/20-mile-stretch-of-i-5-closed-in-chehalis-due-to-flooding/>

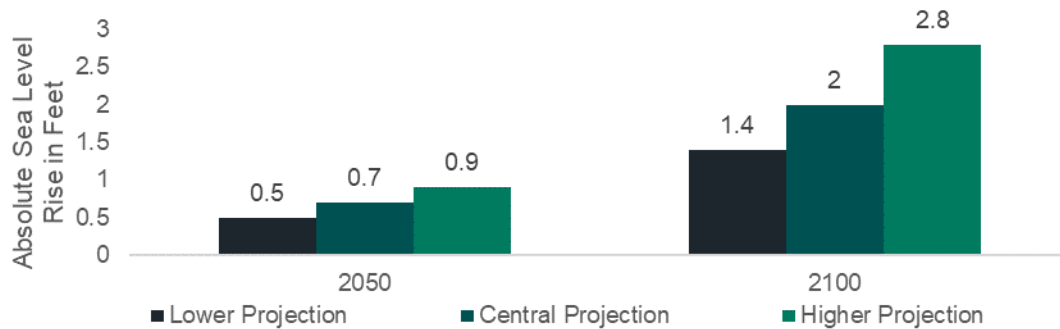
⁴⁴ Travel Costs Associated with Flood Closures of State Highways Near Centralia/Chehalis, Washington, WSDOT, Mark E. Hallenbeck, Anne; Goodchild, Jerome; Drescher, September 2014. <https://trid.trb.org/view/1331203>

average) and an increase in precipitation in winter (8 percent average) by the 2080s.⁴⁵ Seasonal flood frequency is also projected to increase with the shifts in the timing of peak spring flow to be earlier, increasing the incidence of winter-time flooding.⁴⁶ Overall flood frequency is projected to increase from the 2020s through the 2080s, with the largest increases predicted in basins in the Puget Sound, western slopes of the Cascades, and lower elevations on the east side of the Cascades – all with a high prevalence of mixed rain-snow runoff.⁴⁷

- **Storms:** Extreme weather events are also projected to increase in number and intensity in the state. Projections show storm intensity is slated to increase by 5 to 10 percent in the North Cascades and northeastern Washington regions and the Seattle-Tacoma area; the magnitude of the 24-hour storm is projected to increase by 14 to 28 percent over the next 50 years.⁴⁸ In addition, the instance of damaging, high-precipitation, high-wind events (referred to as “atmospheric rivers”) is anticipated to increase along the U.S. West Coast. In the future, these storms are estimated to be significantly longer, wider, and wetter, leading to more frequent occurrence across areas including Washington state. Increased flash flooding can result in road and rail closures, flooded airfields, and prolonged disruptions in service. Damage to fleet and cargo can also occur if water levels are high. Port facilities along waterways without adequate drainage or unprotected by levees can also be more sensitive to flooding and require more dredging after flash flooding.
- **Sea level rise:** Sea level rise is already impacting Washington’s freight system. Coastal inundation leads to corrosion and scouring of infrastructure, exacerbated flooding conditions, and impacts on navigation and accessibility. Maritime freight will be impacted due to lower clearance heights under fixed bridges and coastal flooding of port facilities. Aviation may be impacted due to flooding of airport facilities including buildings and runways. Railroads tracks within marsh areas may be inundated, and railroad tunnels may also be inundated with flooding in entrances and vents.⁴⁹

Though sea level rise is gradual, extreme tides and storm surges can lead to increased risk of damage to coastal infrastructure. Sea level rise can also lead to permanent inundation of areas or facilities, making them harder to reach for deliveries or forcing the closure of facilities. The projected range of sea level rise varies across the state’s coastline depending on geographic and geological settings. Figure 18 depicts the absolute sea level rise based on low, likely, and high projections.

Figure 18: Washington state sea level rise projections



⁴⁵ Preparing for a Changing Climate: Washington State’s Integrated Climate Response Strategy, Washington State Ecology Department, Adelman, H; Ekrem, J. April 2012. <https://apps.ecology.wa.gov/publications/documents/1201004m.pdf>

⁴⁶ Shifting Snowlines and Shorelines: The Intergovernmental Panel on Climate Change’s Special Report on the Ocean and Cryosphere and Implications for Washington State, Briefing paper prepared by the Climate Impacts Group, University of Washington, Heidi Roop, Seattle, Roop, H.A. et al., 2020. doi.org/10.6069/KTVN-WY66.

⁴⁷ Preparing for a Changing Climate: Washington State’s Integrated Climate Response Strategy, Washington State Ecology Department, Adelman, H; Ekrem, J. April 2012. <https://apps.ecology.wa.gov/publications/documents/1201004m.pdf>

⁴⁸ Ibid.

⁴⁹ Ibid.

Source: CPCS analysis of Projected Sea Level Rise for Washington State 2018 Assessment

Note: projections of sea level rise are under RCP 8.5 High GHG Emission Scenario and lower projection means 85 percent probability, central projection means 50 percent probability, and higher projection means 17 percent probability

As the sea level rises, the state's coastline is expected to experience regular flooding in the lowest-lying areas during high tide events. During major storm events, the sea level rise is expected to compound the effect of storm surges, contributing to more extensive coastal flooding and accelerating coastal erosion.⁵⁰ The vast majority (90 percent) of the sea level rise in the Seattle metro area by 2100 is predicted to be in the Duwamish Valley, in close proximity to the Port of Seattle and home to residents living in South Park and Georgetown who are already disproportionately impacted by air pollution.⁵¹

- **Snowfall:** Washington experienced significant closures of I-90 due to heavy snowfall and risk of avalanche as recently as February 2022. Weather events resulting in extreme snowfall can lead to road closures or roadway congestion. Moreover, snowfall coupled with rapid snowmelt in mountain passes can lead to avalanche danger and compromise freight infrastructure conditions. There was a 30 percent decline in snowpack in Washington state on average between 1955 and 2018, and it is projected to further decline by 38 percent to 46 percent above 2020 baseline by 2050 and 56 percent to 70 percent by the 2080s.⁵² This projected trend could potentially reduce snowstorm-related disruptions to freight corridors in winter months, though increased precipitation and increased incidence of flash flooding or avalanches may cause more disruptions.
- **Earthquakes and tsunamis:** Washington's entire shoreline sits on the Cascadia Subduction Zone, which is overdue for a major earthquake and has the potential to trigger tsunamis.⁵³ Inland and coastal earthquake and seismic activity can disrupt a spectrum of freight modes. Moreover, Washington's inland regions are susceptible to deep and shallow crustal fault earthquakes, which range in their magnitude and ability to impact freight infrastructure. For example, the 2001 Nisqually 6.8-magnitude earthquake damaged the Magnolia Bridge and Alaskan Way Viaduct, blocking freight access into and out of Seattle.⁵⁴
- **Landslides and erosion:** Washington is one of the most landslide-prone states in the country. Heavy rainfall (such as from an atmospheric river event) and sudden snowmelt can lead to slope instability that increases the risk of landslide or mudslide.⁵⁵ In addition, slopes that are destabilized after wildfires can be especially vulnerable. In coastal areas, shoreline erosion is expected to increase due to effects from sea-level rise, destabilizing bluffs and increasing the potential for a coastal landslide. Landslides and erosions can lead to congestion, detours, isolation, and risk of injury. For example, along the Amtrak Cascades Corridor, more than 900 coastal bluff landslides blocked the tracks and shut down rail service since 1914, with over 240 disruptions occurring between 2009 and 2013. WSDOT is implementing a Landslide Mitigation Action Plan to proactively address the climatic and other factors contributing to landslide-based rail closures.⁵⁶
- **Wildfires:** In 2021, wildfires burned about 670,000 acres of Washington land. Climate change

⁵⁰ The Washington Climate Change Impacts Assessment, Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Oceans, University of Washington. 2009., Seattle, Washington, McGuire Elsner, J. Littell, and L. Whitely Binder (eds), 2009. <https://doi.org/10.6069/GWSP-MB82>

⁵¹ Climate Justice, Duwamish River Community Coalition, (n.d.). <https://www.drcc.org/climate-justice>

⁵² Shifting Snowlines and Shorelines: The Intergovernmental Panel on Climate Change's Special Report on the Ocean and Cryosphere and Implications for Washington State, Briefing paper prepared by the Climate Impacts Group, University of Washington Seattle, Roop, H.A. et al., 2020. DOI: doi.org/10.6069/KTVN-WY66

⁵³ Washington State 2016 Cascadia Rising Exercise After-Action Report; Catastrophic Earthquake and Tsunami Scenario, State of Washington, 2018. <https://mil.wa.gov/asset/5ba41f5c7498c>

⁵⁴ After-Action Report for February 28, 2001, Nisqually Earthquake, Disaster Management Committee, July 2001. https://www.seattle.gov/documents/Departments/Emergency/AfterActionReports/Nisqually_Earthquake_AAR.pdf

⁵⁵ As landslides close roads, Washington's remote towns deal with isolation, Crosscut, Godwin, M., February 2020. <https://crosscut.com/2020/02/landslides-close-roads-washingtons-remote-towns-deal-isolation>

⁵⁶ Coastal landslide and bluff retreat monitoring for climate change adaptation and targeted risk assessment, ODOT, April 2016. <https://www.oregon.gov/ODOT/Programs/ResearchDocuments/SPR807WP.pdf>

leads to increased drought conditions that also increase the severity and frequency of wildfires.⁵⁷ Wildfires have the potential to damage highway and roadway infrastructure, which may inhibit freight access along corridors and may cause major disruptions to freight-dependent industries.⁵⁸ As an example, the Eagle Creek fire along the Washington–Oregon border in 2017 led to the closure of I-84 and an adjacent railway, increasing shipping costs and creating negative economic impacts on tourism and regional small businesses.⁵⁹

Earlier annual snowmelt, rising temperatures, increased high-heat days and decreased summer precipitation in combination contribute to an increased risk of wildfire. Lengthened fire and growing seasons along with decreased soil moisture increase the total area burned and the likelihood of large fires, especially fires in areas that may not have been previously burned (such as wet coastal forests).⁶⁰ In the face of these compounding climate change impacts, the Pacific Northwest projected wildfire burn area is expected to double by the 2040s and triple by the 2080s relative to a 1916-2006 baseline.⁶¹ Fire severity is also projected to increase, due to increased fuel loads (though this depends on forest composition).⁶¹ Wildfires can destroy hillside vegetation, leading to increased risk of erosion and roadway damage or even landslide. Smoke effects from wildfires can disrupt roads and railways, as well as reduce visibility at airports, grounding aircraft. Smoke furthermore poses a health risk for proximate workers.

- **Extreme heat:** Extreme temperatures ranging between 104°F and 108°F in June of 2021 set a new benchmark for heat waves and extreme heat characteristics for much of the Pacific Northwest.⁶² Overall temperatures and the number of extreme heat days in the Pacific Northwest are projected to increase steadily in the 21st century. Extreme heat can lead to an increased risk of heat-related illness and death as well as service interruptions if conditions are unsafe for outdoor work. Sustained high temperatures can also cause rail to buckle and asphalt to soften and shove, while concrete pavement can heave at the joints. This is exacerbated on roadways with high truck traffic. Bridges are also sensitive to thermal expansion, which can cause damage over time. Furthermore, electrical equipment necessary for rail, air, and sea freight carriers is susceptible to failure and/or deterioration if power systems overheat.
- **Changes to hydrological basins:** Hydrological basin changes mean there may be reduced agricultural production in the state if growing patterns shift, and potential challenges to inland freight along with the Columbia-Snake River System as water levels shift and/or water-saving regulations are enacted.

While the state is generally drier/arid in the east and wetter in the west, the regional climates are all projected to be affected by climate change. Changes to snowpack and annual runoff are changing the hydrologic basins in the state.

- **Puget Sound Basin:** Projections show that there will be less frequent snow and earlier snow melt in the basin in the future. All watersheds are expecting a reduction in snow water runoff, with some watersheds at lower elevations to see a 90 percent decrease in snow water equivalent

⁵⁷ Effects of Drought on Forests and Rangelands, U.S. Department of Agriculture, Forest Service, Climate Change Resource Center, Vose, J.; Clark, J.; Luce, C.; Patel-Weynand, T., (n.d.). <https://www.fs.usda.gov/ccrc/topics/effects-drought-forests-and-rangelands>

⁵⁸ Washington State Wildland Fire Protection 10-year Strategic Plan, Washington State Department of Natural Resources, 2019, https://www.dnr.wa.gov/publications/rp_wildfire_plan_summary.pdf

⁵⁹ Fire closes portion of I-84 through weekend, possibly longer, OPB, Cruz, Guevarra, June 2020. <https://www.opb.org/news/series/wildfires/interstate-84-closed-troutdale-hood-river-eagle-creek-fire/>

⁶⁰ Changing Wildfire, Changing Forests: The Effects of Climate Change on Fire Regimes and Vegetation in the Pacific Northwest, USA. *Fire Ecology*, vol. 16, no. 11, Halofsky, J.E. et al., Jan. 2020, 10.1186/s42408-019-0062-8, January 2020.

⁶¹ Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy, Washington State Department of Ecology, Adelman, H; Ekrem, J., April 2012. <https://apps.ecology.wa.gov/publications/documents/1201004m.pdf>

⁶² Astounding heat obliterates all-time records across the Pacific Northwest and Western Canada in June 2021, NOAA Climate.gov, Tom Di Liberto, June 2021. <https://www.climate.gov/news-features/event-tracker/astounding-heat-obliterates-all-time-records-across-pacific-northwest>

runoff starting from the 2020s.⁶³ Puget Sound basin is expected to see increased runoff in winter as winters warm and decreased runoff in summer as snowpack is reduced.

- **Yakima Basin:** East of the Cascades, snow water equivalent is projected to decline by over 30 percent in the 2020s and up to 80 percent by the 2080s. The peak flow for this basin is projected to shift to earlier in the year, thus affecting the production potential of this heavily agricultural region.⁶⁴

Freight system resilience can be achieved when an organization can reduce consequences related to freight disruptions. There are three forms of resilience: organizational, enterprise, and infrastructure resilience.

Figure 19: Forms of freight resilience

Organizational Resilience	Enterprise Resilience	Infrastructure Resilience
Organizational culture and mindset around continuous improvement, testing, and adaptation to freight disruptions.	Collaboration and information dissemination among all freight stakeholders to minimize the effects of freight disruptions.	Investments in physical freight infrastructure and operations to prevent and mitigate freight disruptions.

Source: CPCS and ICF.

Organizational resilience: Organizational resilience can be achieved through positive changes in the culture and mindset of WSDOT. This includes continuous improvement by reviewing past disruptions to the freight system and their causes, as well as the effectiveness of WSDOT’s responses. Closures of I-5 and I-90, for example, can be meaningful case studies. Cross-departmental training and scenario-based exercises can lead to greater preparedness, such as simulating total shutdowns of any portion of the freight system due to weather impacts. Finally, a commitment to resilience by all employees is necessary to embed a “resilience mindset” within culture and decision-making.

Enterprise resilience: Collaboration and information dissemination with freight stakeholders can improve communication pathways. WSDOT has an existing notification system for real-time responses to users of the freight system. However longer-term coordination may include communication redundancies, such as seasonal communication of potential weather disruptions, resilient power supplies, and telecommunication infrastructure. WSDOT has already begun to improve its resilience in this way through cross-functional working groups and training leaders and staff in resilience improvements systemwide and could expand participation to the broader freight community.

Infrastructure resilience: Ultimately, freight infrastructure must be resilient to potential disruptions. WSDOT’s roles in supporting Washington’s overall resiliency are detailed in the State Emergency Management Division’s Enhanced Hazard Mitigation Plan, and WSDOT participates in a Multi-Agency Hazard Mitigation Work Group, which is responsible for monitoring and implementation for the Mitigation Plan. WSDOT is also participating in operational exercises to improve resilience, such as FEMA-led Cascadia Rising Exercises, which identify preparedness needs for major disruptive natural disasters.

Climate adaptation strategies: In collaboration with the freight community, WSDOT may consider a freight-specific climate adaptation strategy that identifies ways to address and reduce the risk of each hazard along freight corridors. The strategy might identify alternate routes for high landslide or flood risk areas and needed equipment upgrades based on temperature increase thresholds. Or, in coastal

⁶³ Implications of 21st Century Climate Change for the Hydrology of Washington State, Climatic Change, vol. 102, no. 1-2, Elsner, Marketa M., et al., May 2010, pp. 225–260, 10.1007/s10584-010-9855-0, May 2020.

⁶⁴ Ibid.

zones where sea level rise is an anticipated concern, climate adaptation strategies might help ports prioritize improvements to equipment based on sea-level rise projections. This kind of approach can also help freight system operators include climate risk information into routine maintenance and expenditure processes and make incremental changes to build resilience.

Resilient infrastructure: Project design and engineering occur on a site-by-site basis. Flooding and sea level rise impacts may be addressed through constructed marshes to protect coastal highways from erosion and by upsizing and repairing stormwater and drainage assets to increase capacity. Moreover, seasonal adjustments to freight mobility may help to avoid impacts of extreme snowfall and snowmelt as well as wildfire and extreme heat impacts to freight. Freight stakeholders may consider supply chain changes during these periods of impact. Additionally, consideration of existing structural integrity across all freight infrastructure and improvements to structural elements may aid in mitigating the impacts of earthquakes, tsunamis, landslides, and erosion. Lastly, increased redundancy and improved communication can bring about meaningful resilience improvements.

Given pressing concerns about climate change and the need to reduce GHG emissions, WSDOT could develop a System Resiliency Plan to address transportation assets and system vulnerabilities to current and future disruptions. Other tactics are as follows:

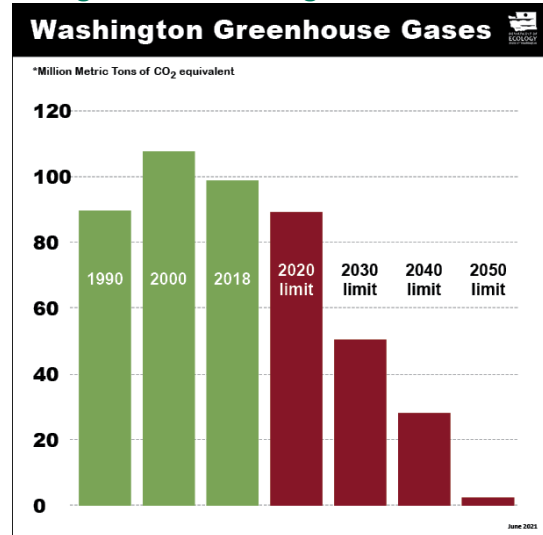
Potential Strategies and Tactics	
<p>Potential Strategy: Develop a plan to address transportation assets and system vulnerabilities to current and future disruptions.</p> <p>Potential Strategy: Improve freight resiliency planning and develop freight resiliency approaches, techniques, and effective practices for implementation.</p> <p>Potential Strategy: Continue to participate in inter- and intra-agency planning coordination to amplify freight resiliency planning effectiveness.</p>	
<p>➔ Improve enterprise-wide resilience through enhanced collaboration, training, and information dissemination to the broader freight community.</p>	
<p>➔ Develop freight-specific climate vulnerability assessments to understand how supply chains shift under a changing climate and how the state should adapt its strategies to address and reduce the risk of hazards along freight corridors.</p>	
<p>➔ Partner with local agencies to seek federal grant programs for freight resiliency and climate adaptation, such as the Building Resilient Infrastructure and Communities (BRIC) program or the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT).</p>	

Greenhouse gas emissions

Achieving state GHG emission reduction goals will not be possible without a significant reduction in freight emissions. This may include transitioning away from fossil fuels and optimizing freight modes and technology.

Climate Commitment Act 2021: The Climate Commitment Act (CCA) commits Washington to reducing greenhouse gas (GHG) emissions by 45 percent, 70 percent, and 95 percent below 1990 levels by 2030, 2040, and 2050, respectively.⁶⁵ Achieving these goals will not be possible without a significant reduction in freight emissions. WSDOT is required to continue its efforts to reduce GHGs while simultaneously promoting environmental justice and equity.⁶⁶

Figure 20: Washington GHG limits



Source: Reducing Greenhouse Gases, Washington Department of Ecology

Washington Energy Strategy and the Energy Efficiency of Freight Modes

In 2021, a new Energy Strategy was released for Washington. The energy strategy was created by the Washington Department of Commerce and recognizes that the transportation sector contributes the largest portion of carbon emissions and that land use and road design affect freight costs. The strategy calls for improving the efficiency of the freight system by reducing bottlenecks, improving first and last mile connections, and where feasible, reducing freight miles of travel. The strategy also calls for infrastructure to support freight decarbonization, including fueling and recharging for zero emission vehicles and air quality monitoring.

While the freight transportation system is a major emitter of greenhouse gas emissions, not all freight transportation modes have similar emission footprints. Maritime transportation is the most energy-efficient mode and can move large loads exceptionally long distances with relatively little fuel. By comparison, railroads are less efficient than shipping, but more efficient than trucking. Air transportation has the highest level of emissions relative to the other modes.

GHG emissions from the transportation sector consist of carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons. Washington's transportation sector accounted for 45 percent of all GHG emissions when looking at a 3-year average from 2016 to 2018, with the closest other sector being the Industrial sector at 19 percent.⁶⁷ Despite improvement in the energy efficiency of both passenger and freight transportation, transportation GHG emissions steadily grew from 27.9 MMTCO₂e in 2010 to almost 44.7 MMTCO₂e in 2018.⁶⁸ To address this, and GHG emissions across all sectors more broadly, the Washington Legislature set the following GHG emissions limits:⁶⁹

- **2020:** Reduce to 1990 levels (90.5 MMTCO₂e)

⁶⁵ Greenhouse gases, Tracking greenhouse gases - Washington State Department of Ecology, (n.d.). <https://ecology.wa.gov/Air-Climate/Climate-change/Tracking-greenhouse-gases>

⁶⁶ Greenhouse gas emissions cap and invest program, Washington State Legislature, July 2021. <https://lawfilesexternal.wa.gov/biennium/2021-22/Pdf/Bills/Session%20Laws/Senate/5126-S2.SL.pdf>

⁶⁷ Washington State Greenhouse Gas Emissions Inventory: 1990-2018, State of Washington Department of Ecology, January 2021. <https://apps.ecology.wa.gov/publications/documents/2002020.pdf>

⁶⁸ MMT CO₂e: Million Metric Tons of CO₂ equivalent

⁶⁹ Greenhouse Gases, Washington State Department of Ecology, (n.d.). <https://ecology.wa.gov/Air-Climate/Climate-change/Tracking-greenhouse-gases>

- **2030:** 45 percent below 1990 levels
- **2040:** 70 percent below 1990 levels
- **2050:** 95 percent below 1990 levels and achieve net-zero emissions

In collaboration with statewide freight stakeholders and agencies, WSDOT seeks to achieve the CCA's GHG reduction and climate change mitigation objectives through a transition of the freight system away from fossil fuel; investment and utilization of alternative fuel sources; optimization of highly efficient freight technologies, modes, and routes; as well as general best practices described below.

Diesel emissions: Diesel emissions can be reduced by shifting truck traffic to other modes, such as train or ship, to mitigate congestion along roadways throughout the state and to reduce truck queueing or idling, which contribute to emissions. Washington State Ferries has also begun exploring methods to improve fuel efficiency and reduce diesel engine emissions across its entire fleet through hybrid-electric ferries.

Fleet vehicles and technology: Replacing and upgrading of freight vehicles and technology will assist in reducing GHG emissions and achieve climate goals and objectives. For example, in accordance with the Washington State Ferries 2040 Long Range Plan⁷⁰, the State Ferries is planning to convert three of its largest diesel-fueled ferries to hybrid-electric propulsion.⁷¹

Funding for GHG reduction strategies: Washington Department of Ecology's Clean Diesel Program and the Puget Sound Clean Air Agency's Diesel Solutions Program, among other state, local, and private financing programs, continue to provide funding to private and public sectors for use in employing strategies to reduce diesel emissions.⁷²

Mitigating the climate impacts of freight transportation can be achieved by increasing the energy efficiency of the freight system (i.e., use energy more efficiently) while at the same time reducing the carbon intensity of the energy that powers the freight system (i.e., decarbonize transportation energy).⁷³ This approach is also in alignment with the Washington Department of Commerce's 2021 State Energy Strategy.

A primary method to increase the efficiency of the freight system is to shift goods movement from energy-intensive modes such as trucks to more efficient modes of freight transportation such as rail and maritime.

Freight optimization: Shifting from on-road freight to maritime or train can reduce emissions through better optimization of routes and by mitigating idling and congestion along with on-road freight infrastructure. USDOT's Research and Special Programs Administration developed the Freight Routing and Emissions Analysis Tools (FREAT) to help agencies quantify emissions generated from

⁷⁰ Washington State Ferries Long Range Plan, WSDOT. <https://wsdot.wa.gov/travel/washington-state-ferries/about-us/washington-state-ferries-planning/washington-state-ferries-long-range-plan>

⁷¹ New funding secured for cleaner, Greener Ferries, WSDOT, October 2019. <https://wsdot.wa.gov/about/news/2019/new-funding-secured-cleaner-greener-ferries>

⁷² 2012 WA State Energy Strategy, Washington State Department of Commerce, (n.d.). <https://www.commerce.wa.gov/wp-content/uploads/2016/06/energy-state-strategy-2012.pdf>

⁷³ 2021 State Energy Strategy, Washington State Department of Commerce, January 2022. <https://www.commerce.wa.gov/growing-the-economy/energy/2021-state-energy-strategy/>

landside versus waterside freight alternatives.⁷⁴ WSDOT may benefit from analyzing the cost/benefits related to pollutant emissions, travel time, cost, and overall efficiency across all freight modes.

New technologies: Additionally, private companies may consider adopting new technologies that aid in increasing the efficiency of freight and reducing total VMT by eliminating the need for transport of truck drivers to and from origin and destinations of freight routes. WSDOT may also promote the U.S. Environmental Protection Agency's SmartWay program to freight stakeholders, businesses, and logistics centers to help improve supply chain sustainability.⁷⁵ Zero and near-zero emission technologies are detailed in the next section.

Alternative fuels

Washington is a leader in zero- and near-zero emission technologies across all freight modes, providing many options to reduce transportation emissions.

Washington has adopted alternative fuel policies, incentives, laws, regulations, and programs ranging from grant and tax incentives to the Clean Fuel Standard (currently in development). Since a significant share of the state's electricity generation is produced through carbon-free sources, the decarbonization of Washington's freight system is well-placed to reduce lifecycle emissions. Washington's only remaining coal-fired power plant, located in Centralia, has started the process of shutting down and must phase out by 2025 per Senate Bill 5769.⁷⁶

Some companies in Washington are converting their vehicle fleets to ZNZE powertrains, including Amazon, which has ordered 1,800 electric vans from Mercedes and 100,000 electric vehicles (EVs) from start-up Rivian Automotive.⁷⁷ Washington State Ferries, the largest operating public ferry system in the U.S., developed their Ferries System Electrification Plan and partnered with Vigor and ABB to launch its new hybrid-ferry program in 2019.⁷⁸ The Port of Tacoma is developing the Puget Sound Liquefied Natural Gas (LNG) Terminal to provide shoreside access to deliver fuel to ships calling at the Port, leading to reductions in SOx, PM, and NOx emissions, as well as fewer CO2 emissions compared to diesel or bunker fuel.⁷⁹

Washington State Clean Vehicles Program – Zero-Emission Vehicle (ZEV) Standards: The Washington Administrative Code Title 173, Chapter 423, Section 075 lays out the zero-emission vehicle standards that require manufacturers to meet ZEV production and sales requirements. Beginning with the model year 2025, manufacturers will be required to sell ZE Class 2b through Class 8 trucks as an increasing percentage of their annual sales, including all-electric and fuel cell vehicles.

Multi-State ZEV Task Force: In 2020, Washington signed a memorandum of understanding with 14 other states and the District of Columbia to support the deployment of ZEVs through a Multi-State ZEV Task Force. In 2021, Virginia and the Province of Quebec, Canada, became the latest

⁷⁴ Emissions analysis of freight transport comparing land and Water-Side Short-Sea Routes: Development and Demonstration of a Freight Routing and Emissions Analysis Tool, USDOT, (n.d.).

https://www.transportation.gov/sites/dot.gov/files/docs/emissions_analysis_of_freight.pdf

⁷⁵ Freight Matters to Supply Chain Sustainability, U.S. EPA, (n.d.). <https://www.epa.gov/smartway/learn-about-smartway>

⁷⁶ Engrossed Second Substitute Senate Bill 5769, Washington 62nd Legislature, 2011.

<https://apps.leg.wa.gov/billsummary/?BillNumber=5769&Year=2011&Initiative=false>

⁷⁷ Amazon Expands Zero-Emission Fleet with Mercedes-Benz Electric Van Order, *Forbes*, Greg Gardner, August 2020.

<https://www.forbes.com/sites/greggardner/2020/08/28/amazon-orders-1800-mercedes-benz-electric-vans/>

⁷⁸ ABB and vigor are helping Washington state electrify its iconic ferries, *Forbes*, Jim Vinoski, August 2020.

<https://www.forbes.com/sites/jimvinoski/2020/08/05/abb-and-vigor-are-helping-washington-state-electrify-its-iconic-ferries/>

⁷⁹ Puget Sound Energy LNG Facility, Port of Tacoma, (n.d.) <https://www.portoftacoma.com/puget-sound-energy-lng-facility>

signatories to the Task Force. The Task Force released an initial Multi-State ZEV Action Plan in 2014 with an update in 2018, and it is currently working to develop another action plan to support the electrification of medium- and heavy-duty vehicles more specifically.

Washington Clean Fuel Standard: In 2021, Washington announced the start of a rulemaking process for the Clean Fuel Standard as part of House Bill 1091. Washington's Clean Fuel Standard will require fuel suppliers to gradually reduce the carbon intensity (CI) of transportation fuels to 20 percent below 2017 levels by 2038. Washington's program will require fuel producers to reduce the CI of their fuels or purchase credits in place of CI reductions. While the rule is still in development by the Department of Ecology, credits may be generated by low-carbon fuel providers through the provision and consumption of approved low-carbon fuels, such as through EV charging. The program must go into effect no later than January 1, 2023, and the Washington Department of Ecology is currently planning to adopt the rule by November 2022.⁸⁰ A complete list of alternative fuel laws and incentives in Washington can be found on the AFDC.⁸¹

ZNZE technology is being developed and applied in nearly all freight modes, including on-road transportation, non-road equipment, rail, maritime vessels, and aircraft.

Cargo handling equipment: Cargo handling equipment (CHE) is non-road equipment used for moving cargo around terminals and to/from marine vessels, railcars, and on-road trucks. The main types of CHE are terminal tractors, top handlers, side handlers, reach stackers, rubber-tired gantry cranes (RTGs), straddle carriers, and forklifts.

- **Electric terminal tractors** are commercially available from a few manufacturers, but the technology is in the early stages of commercialization and continues to develop. Examples of electric terminal tractor makes and models include the BYD 8Y, the Kalmar Ottawa T2E, and the Orange EV T-Series. Other manufacturers with currently available and/or announced electric terminal tractor models include EasyMile, Lonestar Specialty Vehicles, and Meritor. A comprehensive database of ZE terminal tractors is documented by the Global Commercial Vehicle Drive to Zero Program.⁸²
- **Electric forklifts** are also commercially available today for up to 40,000-lb lift capacities. For lift capacities above 40,000 lbs, Tier 4 diesel engine forklifts may be considered and could result in NOx and diesel particulate matter (DPM) emission reductions when compared to lower-tier diesel engines.
- **Electric top handlers and reach stackers** are not yet commercially available, but several crane manufacturers are developing such models, such as Taylor Machine Works and Konecranes. Taylor Machine Works deployed the first ZE-loaded container handler at the Port of Los Angeles in 2019 as part of a demonstration program,⁸³ and Konecranes has developed the first hybrid reach stacker.⁸⁴ Rubber-tired gantry cranes are commercially available, and multiple ports have

⁸⁰ Clean Fuels Program Rule Chapter 173-424 WAC Stakeholder Meeting, State of Washington Department of Ecology, January 2022. <https://ecology.wa.gov/DOE/files/b3/b39b1c75-3247-4101-9300-8f831cb6a5b1.pdf>

⁸¹ Washington Laws and Incentives, Alternative Fuels Data Center of U.S. Department of Energy, (n.d.). https://afdc.energy.gov/laws/state_summary?state=WA

⁸² Zero-Emission Technology Inventory, Global Commercial Vehicle Drive to Zero, (n.d.). <https://globaldrivetozero.org/tools/zero-emission-technology-inventory/>

⁸³ Port of Los Angeles Unveils World's First Zero-Emissions Top Handlers, Port of Los Angeles, October 2019. https://www.portoflosangeles.org/references/news_100219_top_handler

⁸⁴ Konecranes Hybrid Reach Stacker, Konecranes, (n.d.). <https://www.konecranes.com/discover/konecranes-hybrid-reach-stacker>

deployed them, including The Port of Savannah⁸⁵ and The Port of Long Beach.⁸⁶

Harbor craft: Commercial Harbor Craft (CHC) includes a wide range of commercial marine vessels, such as, but not limited to, ferries, excursion vessels, tugboats, pilot vessels, crew and supply vessels, barges, dredges, and workboats. These vessels are a significant contributor to NOx and diesel PM emissions, especially at ports and marine terminals.

- **Tugboats** have been developed with hybrid electric and all-electric technologies. Fully electric tugboat technology is being developed but is not yet widely commercially available. The world's first all-electric tug, the ZEETUG, designed and built by Navtek Naval Technologies for GISAS Shipbuilding, went into service at the Port of Tuzla in Istanbul in 2020.⁸⁷ In the U.S., the first all-electric powered harbor tugboat is eWolf, built and operated by Crowley Maritime Corporation, and designed by Jensen Maritime based in Washington.⁸⁸ Other all-electric tugs have also been in development, such as one ordered from Damen Shipyards by the Port of Auckland and one powered by both battery-electric and hydrogen fuel cells in development by Tokyo-based company e5 Lab.^{89,90} Hybrid-electric tugs are also available, and several companies have introduced hybrid tugs into their fleets, including Foss Maritime Shipyard in Rainier, Oregon, Baydelta Maritime in San Francisco, Great Lakes Towing Company of Cleveland, Ohio, and Harbor Docking and Towing of Lake Charles, Louisiana.
- **Ferries** have also been developed with all-electric and hybrid-electric ferries, as they have predictable routes, which enable ease in range planning and charging schedules. The Washington State Ferries is embarking on several projects to meet the goals of EO 20-01 directly to move towards a zero-emissions fleet. The three main capital components of ferry electrification include building new Olympic class of hybrid-electric vessels, converting the existing three Jumbo Mark II vessels to hybrid-electric vessels, and developing terminal charging infrastructure.
- **Electric pilot boats** are also in development, including the all-electric pilot boat developed by Robert Allan, the Rally 1600-E.⁹¹ Other examples include the Canaveral Pilots Association's project with Glosten and Ray Hunt Design to build an electric pilot boat and a hybrid electric pilot boat launched by the Port Authority of London.^{92,93}

ZE technologies generally have a higher upfront cost than conventional technologies and the potential for significantly lower operating costs. While the emissions reduction benefits of ZE technology are clear, the business case can be variable. In addition to electric and hybrid powertrains, CHC may also use engines designed to reduce emissions. The U.S. Environmental Protection Agency (EPA) has adopted emissions standards for marine diesel engines that are installed within various U.S. vessels. The EPA rules separate marine vessel engines into categories of which varying tiers of emissions standards apply, the strictest currently being Tier 4. While the applicable tier of emissions standards varies based on vessel type, engine type, and age of the vessel, tier 4 engine technology reduces emissions the most and it is commercially available. An up-

⁸⁵ Port of Savannah Receives Five New Electric Rubber-Tired Gantry Cranes, Georgia Ports Authority, July 2016. <https://gaports.com/blog/port-of-savannah-receives-five-new-electric-rubber-tired-gantry-cranes/>

⁸⁶ Long Beach Port Gets Clean Energy Upgrade, Southern California Edison, Mary Ann Milbourn, April 2018. <https://energized.edison.com/stories/long-beach-port-gets-clean-energy-upgrade>

⁸⁷ First All-Electric Tug Delivered and Three More Under Construction, Zero Emission Electric Tug Boat, August 2020. <https://www.zeetug.com/post/world-s-first-all-electric-tug-delivered-and-three-more-under-construction>

⁸⁸ Crowley's eWolf – First Fully Electric US Tugboat, The Old Salt Blog, Spillman, R, 2020. <https://www.oldsaltblog.com/2021/07/crowleys-ewolf-first-fully-electric-us-tugboat/>

⁸⁹ Ports of Auckland's Fully Electric Damen RSD-E Tug 2513 Launched at Song Cam Shipyard, Damen Shipyards Group, December 2020. https://archive.damen.com/en/news/2020/12/ports_of_aucklands_fully_electric_damen_rsd_e_tug_2513_launched_at_dscs

⁹⁰ "e5 Tug" - Electric Tub Powered by Battery and Hydrogen Fuel Cell, e5 Lab, October 2019. <https://e5ship.com/pdf/2019-10-29.pdf>

⁹¹ Pilot Boats go electric, Charged Electric Vehicles Magazine, Charles Morris, May 2018. <https://chargedevs.com/newswire/pilot-boats-go-electric/>

⁹² Canaveral Pilots planning to build electric pilot boat, WorkBoat, February 2020. <https://www.workboat.com/shipbuilding/canaveral-pilots-planning-to-build-electric-pilot-boat>

⁹³ Pilot Cutters, Port of London Authority, (n.d.). <http://www.pla.co.uk/About-Us/Pilot-Cutters>

to-date list of engines certified by tier can be found on the U.S. EPA's Annual Certification Data website.⁹⁴

Shore power: Also known as cold ironing, shore connection, or alternative maritime power (AMP), shore power provides shoreside electrical power to a ship at berth while its main and auxiliary engines are turned off. Through continuous supply of electric power, shore power satisfies a ship's energy needs while it loads or unloads cargo. Shore power mitigates harmful emissions from auxiliary diesel engines that otherwise would need to be running to power cargo handling equipment and other ship's services while in port.

The Northwest Ports Clean Air Strategy sets a bold, new vision to phase out emissions from seaport-related activities by 2050 and an objective to install shore power at all major cruise and container berths by 2030.⁹⁵ Major shore power infrastructure investments in the state include:

- The TOTE Terminal in Tacoma (Operated by TOTE Maritime) has been equipped with shore power since 2010. The two TOTE vessels on regular service between Tacoma and Alaska call weekly and plug in to the grid while they are at dock in Tacoma.⁹⁶
- The Northwest Seaport Alliance (NWSA) modernization of the Terminal 5 facility in Seattle includes the installation of shore power at both berths. This initiative is partially funded by a special appropriation from the state of Washington.⁹⁷
- The NWSA plans to expand shore power capabilities to other large international container terminals in Tacoma and Seattle, including Terminal 18 in Seattle and Washington United Terminal and Pierce County Terminal in Tacoma.⁹⁸

On-road transportation: There are a handful of zero-emission heavy-duty truck models currently available, and several more are expected to become available in the short- and mid-terms. In general, zero-emission technology applications for on-road goods movement are developing in markets with shorter and more predictable routes first, while the development of technologies for heavier-duty, more complex, and longer-range routes are anticipated to deploy over a longer timeframe. Multiple auto manufacturers are currently developing medium-duty electric cargo vans and trucks, including both longstanding manufacturers like Ford, General Motors, and PACCAR, as well as new startups such as Arrival, Chanje, Lion Electric, and Motiv. Engines designed to meet U.S. EPA emissions tier standards are also available for heavy-duty diesel vehicles.

A database of zero-emission vehicle makes and models currently available or announced for release in the near future can be found in the Zero-Emission Technology Inventory on the Global Commercial Vehicle Drive to Zero website.⁹⁹

Freight rail: Both electric and hydrogen freight rail are in research and development phases in the U.S., with the world's first battery-electric freight train unveiled in Pittsburgh in 2021 and companies

⁹⁴ Annual Certification Data for Vehicles, Engines, and Equipment, U.S. EPA, (n.d.). <https://www.epa.gov/compliance-and-fuel-economy-data/annual-certification-data-vehicles-engines-and-equipment>

⁹⁵ Northwest Ports Clean Air Strategy, The Northwest Seaport Alliance, August 22. <https://www.nwseaportalliance.com/environment/clean-air/northwest-ports-clean-air-strategy>

⁹⁶ Investing in cleaner air. The Northwest Seaport Alliance, August 2022. <https://www.nwseaportalliance.com/environment/clean-air/investing-cleaner-air>

⁹⁷ Terminal 5 Improvements. The Northwest Seaport Alliance, August 2022. <https://www.nwseaportalliance.com/about-us/planning/terminal-5-improvements>

⁹⁸ The Past, Present, and Future of Shore Power, Port of Seattle, August 2022. <https://www.portseattle.org/blog/past-present-and-future-shore-power>

⁹⁹ Zero-Emission Technology Inventory, Global Commercial Vehicle Drive to Zero, 2020. <https://globaldrivetozero.org/tools/zero-emission-technology-inventory/>

recently announcing demonstration work on hydrogen fuel cell locomotives.^{100,101} In addition to battery-electric and hydrogen fuel cell systems, options for reducing emissions also include wayside electrification – the electrification of rail lines by overhead contacts – Tier 4 engines, and generator sets (Genset).

High emissions locomotives could also be replaced with Tier 4 switcher locomotives that meet the most stringent EPA standards. Where feasible, Genset switchers could be used as a way to increase efficiencies and reduce emissions. A Genset switcher is powered by one or more engines with relatively low horsepower rather than a single large diesel-powered engine. This allows the locomotive to use as few or as many of the engines as needed, as opposed to a conventional switcher that must power up its large engine to full power for all uses. Additionally, both battery-electric and hydrogen fuel switchers have been tested. As an example, Progress Rail has developed an all-electric switcher. Sierra Northern Railway announced that it will build a hydrogen fuel cell switcher using state funding from the California Energy Commission.¹⁰² Natural gas locomotives have also been developed, such as the Napa Valley Wine Train, which has been running on 100 percent natural gas since 2003.¹⁰³

Aviation: Three primary pathways currently exist to reduce emissions from aviation: sustainable aviation fuel (SAF), electric, and hydrogen.

- **SAF** is a biofuel that has similar properties to conventional jet fuel but with a smaller carbon footprint, and it can be produced from a variety of feedstocks (e.g., corn grain, algae, oilseeds, etc.). An increasing number of airlines are using sustainable aviation fuel to power travel, including major airlines such as JetBlue, Delta, and United Airlines. United Airlines launched its first commercial flight from Chicago to Washington, D.C., using 100 percent SAF. Washington State University (WSU) is studying aviation biofuels through a four-state (WA, OR, ID, and MT) effort: Sustainable Aviation Fuels Northwest. This project is to conduct a regional assessment of challenges and opportunities associated with the production of sustainable aviation biofuel in the Northwest. WSU is also involved with the Northwest Advanced Renewables Alliance (NARA), focused on the viability of wood-based jet fuel.
- **Electric:** While still in research and development phases, electric aircraft have already been developed, and they are primed for use in short-haul applications (i.e., 200 – 500 nautical miles). Several companies are developing electric aircraft, such as Eviation's Alice, which DHL purchased and plans to use as cargo planes.¹⁰⁴
- **Hydrogen** is also being explored as a zero-emission fuel option for commercial aircraft, with companies like Airbus and Universal Hydrogen working to develop the technology.¹⁰⁵ Hydrogen aircraft are still in research and development stages, and similar to expectations for on-road transportation, hydrogen is expected to be more suitable for use in longer-range applications.

¹⁰⁰ 'Dramatically more powerful': world's first battery-electric freight train unveiled, *The Guardian*, Oliver Milman, September 2021. <https://www.theguardian.com/us-news/2021/sep/16/battery-electric-freight-train-wabtec-rail-transport-emissions>

¹⁰¹ North American railway companies work on hydrogen-powered locomotive, *Reuters*, December 2019.

<https://www.reuters.com/events/downstream/engineering-and-construction/north-american-railway-companies-work-hydrogen-powered-locomotive>

¹⁰² California Energy Commission awards Sierra Northern Railway Team nearly \$4,000,000 to build and test Hydrogen Switcher Locomotive, Sierra Northern, March 2021. <http://sierranorthern.com/news/articles/california-energy-commission-awards-sierra-northern-railway-team-nearly-4-000-000-to-build-and-test-hydrogen-switcher-locomotive/>

¹⁰³ Napa Valley Wine Train, Napa Valley Wine Train, (n.d.).

https://www.winetrain.com/content/uploads/2018/04/nvwt_sales_book_2017.pdf

¹⁰⁴ Electricity is in the Air: The Alice E-Cargo Electric Aircraft Preps for Takeoff. DHL, (n.d.). <https://www.dhl.com/global-en/spotlight/sustainability/electric-aircraft-sustainable-logistics.html>

¹⁰⁵ ZEROe, Airbus, (n.d.). <https://www.airbus.com/en/innovation/zero-emission/hydrogen/zeroe>

Potential tactics may include the following:

Potential Strategy and Tactics	
Potential Strategy: Facilitate the replacement and upgrading of vehicles and technologies to reduce GHG emissions.	
➔	Conduct statewide analysis to evaluate modal costs/benefits related to pollutant emissions, travel time, cost, and overall efficiency across all freight modes.
➔	Promote U.S. EPA SmartWay and other emission reduction programs to freight stakeholders, businesses, and logistics centers to improve supply chain sustainability.

The impacts of freight movement on flooding and stormwater runoff

Stormwater runoff: Freight corridors in the state are both impacted by and contribute to flooding issues. The development of new roads, parking lots, and other impervious surfaces typically increase runoff, which can increase flooding risks. If left untreated, stormwater runoff can also flush toxic chemicals from streets directly into streams.¹⁰⁶ These pollutants, such as heavy metals, petroleum products, excess nutrients, and pathogens, accumulate on highways, streets, and other impervious surfaces. They are carried by stormwater runoff, which can enter nearby bodies of water – creeks, lakes, rivers, and bays – and eventually the ocean. Killer whales, salmon, steelhead, and bull trout are among the species that can be affected by stormwater pollution.¹⁰⁷

Motor vehicles: While motor vehicles release chemicals into the environment due to tire and brake pad wear, oil and transmission fluid leakage, and tailpipe exhaust, many of these chemical contaminants have not been studied for their toxicity to aquatic organisms. However, recent studies suggest toxic runoff,¹⁰⁸ including a mix of chemicals that leach from vehicle tire wear, can cause recurring and premature death of adult coho salmon when they return each autumn to spawn in urban watersheds.¹⁰⁹

Many of the actions WSDOT takes to comply with its National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge Municipal Stormwater General Permit help to avoid, minimize, and mitigate the impact of freight movement on flooding and stormwater runoff.

WSDOT’s design strategy defined in its Highway Runoff Manual as well as the Secretary’s Executive Order to protect and preserve Washington’s wetlands also directs employees to avoid, minimize, and mitigate for impacts. Further, WSDOT has developed a Stormwater Management Program Plan, Stormwater Retrofit Management Plan, and included stormwater management as a criterion for NHFP project selection. WSDOT is also making the following investments for mitigating stormwater runoff:

¹⁰⁶ Coho Salmon: A Species at a Crossroads, The Nature Conservancy in Washington, February 2016. <https://fws.maps.arcgis.com/apps/MapSeries/index.html?appid=5dd4a36a2a5148a28376a0b81726a9a4>

¹⁰⁷ Roads to ruin: Conservation threats to a Sentinel species across an urban gradient 27(8), 2382–2396, Ecological Society of America, various authors, 2017. <https://doi.org/10.1002/eap.1615>

¹⁰⁸ An urban stormwater runoff mortality syndrome in juvenile coho salmon, *Aquatic Toxicology*, various authors, September 2019. <https://www.sciencedirect.com/science/article/pii/S0166445X19301936?via%3Dihub>

¹⁰⁹ Tire-related chemical is largely responsible for adult coho salmon deaths in urban streams, University of Washington News, Sarah McQuate, December 2020. <https://www.washington.edu/news/2020/12/03/tire-related-chemical-largely-responsible-for-adult-coho-salmon-deaths-in-urban-streams/>

- **State investments in clean water infrastructure:** This includes \$24 million in new funding as part of the Governor’s 2022 proposed budget to support the acceleration of toxic cleanup in stormwater runoff from industrial and contaminated sites, improve water quality through grants, study the ability of stormwater systems to filter out toxic tire dust, evaluate alternatives to current toxic chemicals in tires, and other actions to support stormwater quality and salmon needs.¹¹⁰
- **State investments in stormwater treatment and green infrastructure:** This includes \$500 million in new funding as part of the Move Ahead Washington funding package to enhance stormwater treatment from existing roads and infrastructure over the next 16 years, with an emphasis on green infrastructure retrofits, benefits to salmon recovery and ecosystem health, reducing toxic pollution, addressing health disparities, and cost effectiveness.

Potential Strategy and Tactics

Potential Strategy: Continue to manage stormwater impacts in accordance with regulatory requirements and invest in mitigation measures, including stormwater retrofits to control the flow and treat stormwater.

➔ Explore opportunities to include value-added stormwater management projects as part of freight investments.

➔ Continue to consider stormwater criteria as part of future National Highway Freight Program solicitations.

The impacts of freight movement on wildlife habitat loss

Freight transportation can impact wildlife species that include terrestrial and marine mammals, fish, birds, reptiles, amphibians, invertebrates, as well as species currently protected or proposed for protection under the federal Endangered Species Act (ESA) or other federal/state regulations. Primary species of concern include the endangered southern resident killer whale and salmon, with 17 subgroups of Chinook, coho, chum, and sockeye salmon listed as either threatened or endangered.¹¹¹

Truck freight: In addition to the stormwater and flooding impacts on wildlife mentioned above, the road network impacts wildlife by dividing habitat areas, altering habitat areas, and introducing potential for collision between vehicles and wildlife. To reduce the impact on wildlife, WSDOT has created a Wildlife Connectivity Program. This program has two primary goals: 1) reduce wildlife-vehicle collisions and 2) increase the permeability of the state highway system in regard to wildlife movement. WSDOT has developed a ranking system that rates all segments of the state highway system for the potential benefit to ecological conservation as well as animal vehicle collision severity. This information is used in corridor planning and project analysis to assess potential benefits for designs that promote wildlife connectivity. WSDOT is partnering with other agencies, academics, and conservation NGOs to promote wildlife habitat connectivity through research into animal activity, wildlife corridor management, and effective measures to improve safe crossings for wildlife. More details can be found in WSDOT’s Highway System Plan.

Freight rail: Rail routes located in river floodplains and marine shorelines may impact river and shoreline habitats. Routes include the BNSF railway along the Columbia River and the BNSF railway running the eastern Puget Sound. Rail operations could contribute to the accumulation and

¹¹⁰ 2022 Legislative Priorities, Washington State Department of Ecology, 2022. <https://ecology.wa.gov/About-us/Budget-legislative-priorities/2022-Legislative-priorities>

¹¹¹ How are Washington’s Salmon and Steelhead doing?, Washington Department of Fish and Wildlife, (n.d.). <https://fortress.wa.gov/dfw/score/score/species/species.jsp#doing>.

transportation of caked-on grease on tracks, creosote discharge from old railroad ties, and fugitive coal dust that can contaminate soil and water and affect aquatic species and their habitats.

Maritime: Shipping operations can contribute to vessel strikes, underwater noise, and habitat alteration, which can affect marine mammals, sea turtles, fish, wildlife species, and their habitat.

- **Vessel strikes** can occur anywhere where ships and marine animals co-occur – in both open ocean as well as marinas, inlets, and well-used channels.¹¹² Most reports of collisions involve large whales, although collisions with smaller species also occur. Certain vessel speeds, types, and sizes also make vessel strikes, fatalities, or serious injuries more likely.¹¹³
- **Underwater noise** impacts a wide range of aquatic species, including marine mammals, sea turtles, and fish. For many species, the sound is the primary means by which they navigate, find food and mates, communicate with one another, and avoid danger. Underwater noise from shipping can interfere with many species’ ability to carry out these activities.¹¹⁴ In 2014, Vancouver Fraser Port Authority founded the Enhancing Cetacean Habitat and Observation (ECHO) Program to address underwater noise by concentrating on vessel slowdowns, lateral displacements, financial incentives for quiet vessels, educational tools for mariners, and support for research and monitoring.¹¹⁵
- **Aquatic habitat alteration** from shipping vessels can result from maintenance dredging, vessel wake, or from fuel or lubricant leaks from transiting vessels. Dredging can increase suspended sediments and alter the seabed. Waves created by a vessel can also strand juvenile salmonoids and impact vegetation located near water bodies, affecting species dependent on those habitats. Inadvertent releases of fuels and lubricants into the waterway can also degrade wildlife habitat.
- **Oil spills** from oil-transferring vessels and vehicles or oil-handling facilities are harmful to marine birds, mammals, fish, and shellfish. By destroying the insulating ability of fur-bearing mammals and the water repellency of a bird’s feathers, oil exposes these creatures to harsh elements and can cause them to die from hypothermia.¹¹⁶ Fish, shellfish, and corals may not be exposed to oil spills immediately but can come into contact with oil if it is mixed into the water column and may experience reduced growth, enlarged livers, changes in heart and respiration rates, fin erosion, and impaired reproduction.¹¹⁷

To address impacts to wildlife from freight, WSDOT may continue to monitor and support the development of legislative and regulatory actions such as salmon recovery, wildlife corridors, preventing vessel strikes, minimizing underwater noise, reducing motor and rail emissions, and preventing oil spills.

WSDOT has taken additional steps to reduce transportation’s impact on wildlife and habitat, including issuing Executive Order 1031.02, **Protections and Connections for High Quality Natural Habitats**, to ensure road and highway programs protect ecosystem health, the viability of aquatic and terrestrial wildlife species, and the preservation of biodiversity, along with other needs. Specific

¹¹² Understanding Vessel Strikes, NOAA Fisheries, (n.d.).

<https://www.fisheries.noaa.gov/insight/understanding-vessel-strikes#where-do-vessel-strikes-occur?>

¹¹³ Large Whale Ship Strike Database, National Marine Fisheries Service, Aleria S. Jensen and Gregory K. Silber, January 2004.

https://tethys.pnnl.gov/sites/default/files/publications/Jensen_Silber_2003.pdf

¹¹⁴ Shipping and Underwater Noise: A Growing Risk to Marine Life Worldwide, WWF, Melanie Lancaster, 2021.

<https://wwfwhales.org/resources/2021-wwf-report-shipping-uw-noise>

¹¹⁵ Ibid.

¹¹⁶ How Oil Harms Animals and Plants in Marine Environments. National Oceanic and Atmospheric Administration, Aug 2022.

<https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/how-oil-harms-animals-and-plants-marine-environments.html>

¹¹⁷ How does oil impact marine life? National Ocean Service, Aug 2022.

<https://oceanservice.noaa.gov/facts/oilimpacts.html#:~:text=Oil%20destroys%20the%20insulating%20ability,mammals%20will%20die%20from%20hypothermia>

programs and efforts include WSDOT wildlife connectivity program, fish passage program, and the state's salmon recovery efforts.

Wildlife connectivity program: This program has two primary goals: 1) Reduce wildlife-vehicle collisions and 2) Increase the permeability of the state highway system in regard to wildlife movement. WSDOT has developed a ranking system that rates all segments of the state highway system for the potential benefit to ecological conservation as well as animal vehicle collision severity. This information is used in corridor planning and project analysis to assess potential benefits for designs that promote wildlife connectivity. WSDOT is partnering with other agencies, academics and conservation NGOs to promote wildlife habitat connectivity through research into animal activity, wildlife corridor management and effective measures to improve safe crossings for wildlife. More details can be found in WSDOT's Highway System Plan.

Fish Passage Program: Freight transportation highway routes can also have a significant impact on aquatic habitat, as state highways cross streams and rivers in thousands of places in Washington. Some of these crossings can impede fish migration. Culverts may allow water to flow under a highway but not provide conditions that fish can swim through. A culvert may block fish migration when the flow is too swift, too shallow, or has an excessive drop into or out of the culvert. Most of the culverts were installed decades before scientists fully understood the needs of fish.

A federal court injunction (culvert injunction), issued in March 2013, requires WSDOT to significantly increase efforts to remove state-owned culverts that block habitat for salmon and steelhead trout by 2030. As of June 1, 2021, WSDOT has completed 365 fish passage barrier corrections statewide, allowing access to approximately 1,215 miles of potential upstream habitat for fish. There are other valuable co-benefits. Depending on site conditions, some projects can be designed to provide safe under crossings for large animals like deer, which reduces animal/vehicle collisions and connects habitats. The communities served by these new water crossings also benefit from reduced risk of road failures from washouts or debris slides. A culvert that was fish passable at the time of installation might have become a barrier over time due to changes in the landscape resulting from development, logging and fire. The new fish-passable structures WSDOT constructs now are much larger and more resilient to changes in the landscape or streamflow patterns, which will provide fish passage long into the future.

WSDOT reports on fish passage work annually and is continuing investments to correct barriers to fish movement created by highway culverts.

Salmon recovery: The four lower Snake River dams were originally built to create a seaport in Lewiston, Idaho. Today, wheat, barley, and other goods are shipped through Lewiston-Clarkston, Washington, and other ports along the river downstream to the Port of Portland for export overseas. If efforts to remove or modify the dams move forward, land transportation alternatives by road and rail may need to be developed. Ongoing salmon recovery efforts in the state include:

- **The Murray/Inslee Initiative:** The joint federal-state process was announced in 2021 to establish a comprehensive solution for salmon recovery in the Columbia River Basin. This effort will determine whether sufficient means exist to replace benefits provided by the Lower Snake River Dam to support breach as part of a salmon recovery strategy for the Snake River and Pacific Northwest.¹¹⁸ As part of this process, the Governor's Office is exploring reasonable means for replacing Lower Snake River Dam benefits as part of a comprehensive salmon recovery strategy.

¹¹⁸ Inslee and Murray statement on establishing solutions for salmon recovery in the Columbia River Basin, Washington Governor's Office, October 2021. <https://www.governor.wa.gov/news-media/inslee-and-murray-statement-establishing-solutions-salmon-recovery-columbia-river-basin>

WSDOT provided input to the study regarding transportation impact analysis needs and cost estimates.

- **June 2021 action of the Washington Pollution Control Hearings Board (PCHB)** gave the state authority to regulate water temperature at the dams on the lower Snake and Columbia Rivers.
- **State Investments in Clean Water Infrastructure:** This includes \$24 million in new funding as part of the Governor’s 2022 proposed budget to support the acceleration of toxic cleanup in stormwater runoff from industrial and contaminated sites, improve water quality through grants, study the ability of stormwater systems to filter out toxic tire dust, evaluate alternatives to current toxic chemicals in tires, and other actions to support stormwater quality and salmon needs.¹¹⁹

WSDOT will continue to be a partner to the Department of Ecology and other relevant authorities on strategies to minimize freight impacts on wildlife. Some of the potential tactics are noted below:

Potential Strategy and Tactics	
Potential Strategy: Coordinate with relevant authorities on strategies to minimize freight impacts on wildlife.	
➔	Improve fish passage given existing and projected future stress to fish populations through highway improvements or route changes, per WSDOT’s Fish Barrier Correction Program.
➔	Construct wildlife corridors or passages to increase habitat connectivity and improve wildlife resilience to climate change while reducing road disruptions and incidence of wildlife mortality.
➔	Coordinate with the National Oceanic and Atmospheric Administration (NOAA) Fisheries and the U.S. Coast Guard on strategies to address vessel strikes.

Environmental justice

HEAL Act 2021: WSDOT is one of seven state agencies governed by the Healthy Environment for All (HEAL) Act of 2021. The HEAL Act aims to embed environmental justice (EJ) in the missions of the Washington state government. Built upon recommendations from the 2020 Environmental Justice Task Force (EJTF) report to the Governor’s Interagency Council on Health Disparities, the HEAL Act is the first statewide law in Washington to coordinate an approach for addressing EJ across state agencies.

HEAL Act 2021 defines Environmental Justice as:

“The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, rules, and policies. Environmental justice includes addressing disproportionate environmental health impacts in all laws, rules, and policies with environmental impacts by prioritizing vulnerable populations and overburdened communities, the equitable distribution of resources and benefits, and eliminating harm.”

Source: Environmental Justice, Washington State Department of Health, (n.d.). <https://doh.wa.gov/community-and-environment/health-equity/environmental-justice>

¹¹⁹ 2022 Legislative Priorities, Washington State Department of Ecology, 2022. <https://ecology.wa.gov/About-us/Budget-legislative-priorities/2022-Legislative-priorities>

WSDOT has long been committed to inclusive community engagement in the transportation decision-making process. The agency provides specific guidance for addressing EJ in transportation planning and environmental review. Chapter 460 (Environmental Justice) of the WSDOT Environmental Manual details EJ analysis for projects that require an Environmental Impact Statement or Environmental Assessment under the National Environmental Policy Act (NEPA). Projects exempt from NEPA must also consider impacts to communities. Additionally, the State Environmental Policy Act (SEPA) stipulates requirements for analyzing environmental impacts of government decisions, including permits for private projects, constructing public facilities, and adopting regulations, policies, and plans. With the new HEAL Act legislation, WSDOT anticipates the evaluation of environmental justice, particularly in underserved and vulnerable populations, which will be expanded beyond current NEPA requirements.

Overburdened communities tend to be disproportionately located close to industrial areas and freight facilities such as ports, rail yards, highways, and truck stops.

The impacts of freight movement on local air pollution and public health: The Washington State Department of Ecology has identified diesel exhaust emissions, especially diesel particulate matters, as a toxic air pollutant that contributes to adverse public health impacts such as asthma, heart and lung diseases, and cancer. In Washington, nearly five million people, especially those within low income and disadvantaged communities, live or work close to transportation corridors where they are exposed to high levels of diesel exhaust emissions, putting them at higher risk for adverse health impacts.¹²⁰ This issue of local air pollution is particularly relevant because Washington’s largest sources of diesel exhaust are heavy duty trucks, commercial marine vessels, construction equipment, locomotives, farm equipment, and buses. For example, Washington’s 2017 Air Emissions Inventory estimated that on-road diesel vehicles along with commercial marine vessels and locomotives contribute to more than 2,500 tons of diesel particulate matter (DPM) each year. More of than 70 percent of these emissions are associated with on-road diesel vehicles. Aside from DPM, diesel vehicles are also a significant source of nitrogen oxide (NOx) emissions, which contribute to both ground level ozone as well as secondary ambient particulate matter.

Given the health impacts of diesel vehicle operations, upgrading old vehicles with more-efficient vehicle models and replacing fuel sources entirely can provide significant public health benefits. However, administration of most of these programs is handled by departments other than WSDOT: various state agencies and associations in Washington state have implemented many programs to reduce diesel emissions from freight vehicles and equipment, especially on-road medium and heavy duty (MHD) vehicles. In addition to these programs, there are several funding programs offered through the federal government, especially the EPA, with the goal of reducing emissions from mobile sources and transitioning them to zero emission vehicles and equipment. Programs range from code exemptions to traditional grants, emission standards, and tax rebates, to scrap and replace programs. These programs are administered by different local, state, and federal agencies including the Washington Department of Ecology, Washington Department of Transportation, Puget Sound Clean Air Agency, Northwest Seaport Alliance, EPA, DOE, DOT, and IRS. Figure 21 summarizes notable programs that are intended to reduce diesel exhaust emissions.

Figure 21: State and federal programs available for reducing diesel exhaust emissions

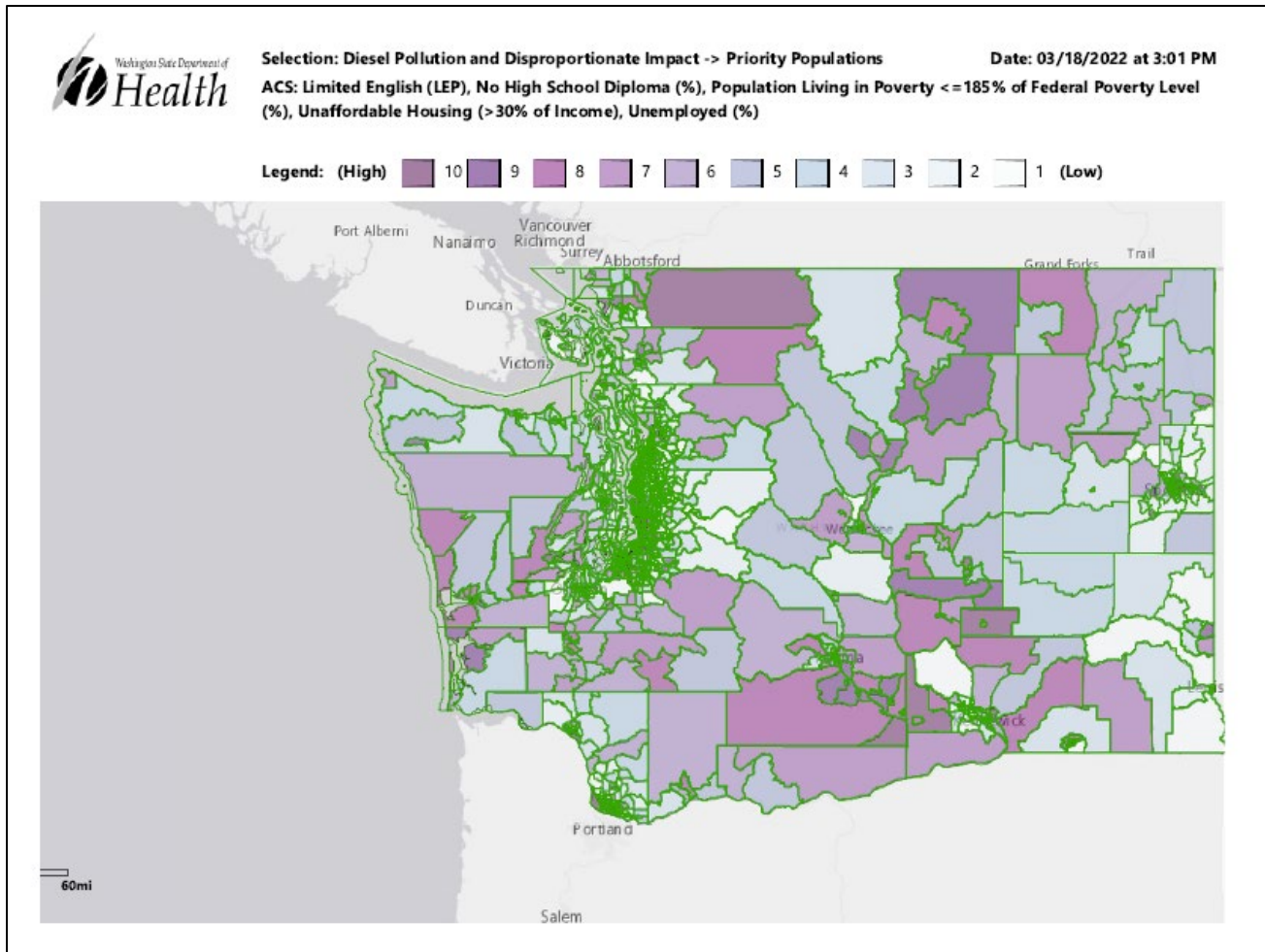
Program	Administrator	Status	Description
Washington State Programs			

¹²⁰ [Environmental Health Disparities GIS Mapping Information], Washington Environmental Health Disparities Map, WSDOH, December 2018. <https://fortress.wa.gov/doh/wtnibl/WTNIBL/>

Program	Administrator	Status	Description
Air Quality Clean Diesel Grant Program	WA State Department of Ecology	Opened July 13, 2022	Heavy-duty diesel reduction grants
Washington Advanced Clean Trucks Requirement	WA State Department of Ecology	Opened November 29, 2021	Zero-emission truck sales requirement
Truck Scrapping Program	Northwest Seaport Alliance	Active	Scrapping incentives
Idle Reduction Weight Exemption	WA State Department of Transportation	November 13, 2020	Vehicle weight code exemption
Grant Opportunities	Puget Sound Clean Air Agency	Active	Grant matching for diesel emission reduction projects
Air Quality Clean School Bus Grant Program	WA State Department of Ecology	Opened June 28, 2022	Bus scrap-and-replace program
Federal Programs			
Inflation Reduction Act	U.S. EPA / U.S. DOE / U.S. DOT	Legislation passed in August 2022	MHD zero emission truck purchase tax credits, equivalent to 30 percent of the vehicle purchase price (up to a \$40,000).
Heavy-Duty 2027 and Beyond: Clean Trucks	U.S. EPA	Proposed Rulemaking published in March 2022	Heavy-duty NOx emissions regulations
Clean School Bus Program: DERA	U.S. EPA	First funding opportunity closed August 19, 2022	Rebates to replace existing school buses with ZE models.
Tribal and Insular Area Grants: DERA	U.S. EPA	Opened August, 2022	\$8M in grant funding for tribal and insular area governments

Prolonged exposure to noise generated by trucks, trains, ports, and distribution centers—from horns and brakes to cranes, forklifts, and backup alarms—also imposes health risks to residents. In addition to the potential for hearing loss, chronic noise makes it difficult for people to concentrate at school or work and can cause sleep disturbances, which in turn affect weight, mood, and productivity.

Figure 22: Proximity of overburdened populations to heavy vehicle traffic



Source: Washington Environmental Health Disparities Map, Washington State Department of Health, 2022. <https://fortress.wa.gov/doh/wtnibl/WTNIBL/>

Traffic congestion: Although freight represents only one component of traffic along major highways, trucks contribute to congestion. In urban areas, parked trucks compete for curbside space with residential and business parking, bicycle routes, public transit, and shared-ride service pickup and drop-off. Local traffic backups around at-grade rail crossings also increase with growth in freight rail traffic, which can reduce accessibility for drivers, transit riders, pedestrians, and cyclists. Ports and distribution centers also generate traffic on local roads that lead to interstate highways. Throughout Washington state, overburdened communities are more likely to reside near areas of heavy traffic.¹²¹

Stakeholders also voiced that the recent growth of e-commerce can be disruptive to local neighborhoods. Last-mile delivery centers tend to operate 24 hours a day, 7 days a week, with a typical day beginning in the middle of the night as tractor-trailers deliver bulk packages from larger fulfillment centers. Many of these last-mile delivery centers are located in urban residential areas or abandoned shopping malls near where overburdened communities reside.

Safety: Heavy-duty truck traffic exacerbates roadway degradation, development of potholes, and other highway safety and road quality issues. Non-local truck drivers often fail to understand local community travel patterns and may speed through communities or drive routes that are not suitable

¹²¹ Environmental Health Disparities GIS Mapping Information, Washington Environmental Health Disparities Map, Washington State Department of Health, December 2018. <https://fortress.wa.gov/doh/wtnibl/WTNIBL/>

for freight vehicles. In addition to damaging local streets, curbs, sidewalks, and other facilities, neighborhood truck traffic can discourage walking and biking and increase residents’ anxiety about safety in the public realm. Commercial loading zones often do not provide space for drivers to park, unload, and deliver goods without intruding upon sidewalks and roadway lanes. These actions put themselves and other road users in direct conflict and potentially in harm’s way.¹²²

Aesthetics: The design and operation of ports, warehouse districts, railyards, truck parking, and major freight corridors focus on functionality/efficiency but not always aesthetic consistency with surrounding neighborhoods. When located around residential areas, facilities can be eyesores that diminish community character or impose physical barriers that disrupt the social and economic fabric. Intrusive freight-related developments may decrease property values and create an undesirable reputation that makes economic revitalization difficult. Additionally, around-the-clock operations often require high-power, industrial lighting to ensure nighttime safety. This puts overburdened communities at higher risk for exposure to light pollution, which, like noise pollution, can disrupt sleep patterns.

Economic impacts: Attracting a global big-box retail distribution center, e-commerce warehouse, or inland port is often perceived as an economic boon, especially in a rural community where jobs are scarce and incomes are disproportionately low. Although proximity to the freight system can have a positive impact on the number of local jobs available, some of the companies can even have a negative impact, such as discount retailers that undercut small, locally owned businesses. Some stakeholders expressed concern that promised warehouse jobs would be automated.

WSDOT may consider multiple approaches to implement the HEAL Act, including by prioritizing investments to mitigate negative freight impacts in areas where residents have been disproportionately impacted. Some of the potential tactics raised by community groups are noted below:

Potential Strategies and Tactics	
Potential Strategy: Prioritize investments to mitigate negative freight impacts in areas where residents have been disproportionately impacted.	
Potential Strategy: Collaborate with community groups to identify opportunities for improved air quality through transportation system investments.	
➔	Collaborate with community groups to identify opportunities for improved air quality through transportation system investments.
➔	Coordinate with local jurisdictions on industrial land-use decisions and community impacts, with specific evaluation of proposed decisions and their relationship to historically overburdened communities as identified in the Washington State Health Disparities tool.
➔	Coordinate with local jurisdictions to define, identify, and map preferred truck routes and focus resources on improving the efficiency, capacity, and condition of these routes to support freight movements towards minimizing or reducing further impacts in environmental justice communities.
➔	Consolidate loads and logistics, especially in congested urban areas.
➔	Mandate off-hour delivery and/or schedule during non-peak hours.

¹²² Final 50 Feet Research Program, University of Washington Supply Chain Transportation & Logistics Center, (n.d.). <http://depts.washington.edu/sctlctr/research-project-highlights/final-50-feet-program>

Potential Strategies and Tactics
→ Prioritize potential below or above-grade rail line crossing improvements at major intersections with main arterial roads.
→ Create a screening tool to prioritize funding for natural gas or electric fleet programs along major freight corridors that traverse communities where residents have been disproportionately impacted by air quality.
→ Coordinate with local jurisdictions to establish zero-emission delivery zones in overburdened communities.
→ Coordinate with ports to incentivize and negotiate with port operators to use and require low or no-emission equipment within their operations and of their operators.
→ Retrofit highways and roads with upgraded infrastructure to capture stormwater runoff.
→ Coordinate with local jurisdictions to prioritize FRA “Quiet Zone” approvals at major railroad crossings among overburdened communities.
→ Design facility flow and loading areas to minimize the use of OSHA-required backup signals and idling.
→ Coordinate with local jurisdictions to identify freight routes with safety countermeasures that supports a safe system approach by protecting all roadway users, particularly pedestrians, bicyclists, and persons with disabilities, and to implement strategies such as traffic calming measures to deter trucks from using residential streets.
→ Create a multilingual truck driver education campaign to increase driving safety awareness, particularly when sharing road right-of-way with pedestrians, bicyclists, and persons with disabilities.
→ Prioritize opportunities to improve multimodal connectivity when investing in freight routes, such as improving sidewalks, bicycle facilities, and lighting on or adjacent to underpasses and bridges.
→ Improve at-grade rail crossing safety technology, signage, and design to protect drivers, pedestrians, persons with disabilities, and bicyclists.
→ Coordinate with local jurisdictions to improve/define overnight truck parking ordinances and layover areas.
→ Prioritize grant opportunities to improve visual aesthetics of public facilities (e.g., screening, foliage blocking views of truck parking, landscaping along truck routes).
→ Partner with local jurisdictions and residents to develop infrastructure design guidelines reflective of their communities’ geographic and cultural identities.
→ Partner with local jurisdictions and residents to find opportunities to incorporate community art into new or updated facilities (e.g., community-designed murals or mosaic art).
→ Retrofit lighting to reduce the impact of light and glare on proximate residential areas.
→ Incorporate other infrastructure improvements (e.g., drainage, electrical, broadband) when making improvements to the freight system.
→ Evaluate opportunities to relocate existing facilities away for overburdened communities.

6. Stewardship

Washington's state policy goal of Stewardship is "To continuously improve the quality, effectiveness, resilience, and efficiency of the transportation system." The key stewardship issues facing Washington state include obtaining funding and financing for freight system investments, managing tribal relations, continuing Pacific Northwest partnership and collaboration, and providing state-local agency cooperation and support on freight-related planning and coordination needs.

Funding and financing

Financial investments are needed to maintain the freight system in a state of good repair. Deferred maintenance increases costs and can require the full replacement of facilities that could have been rehabilitated at much lower costs.

In 2020, a study for the Joint Transportation Commission found that current funding levels for all jurisdiction types statewide are less than half of what is needed. An underfunded freight system leads to reliability, safety, and public health issues for freight system users and local communities. Increased levels of funding for freight system improvements are needed to ensure that the freight system remains competitive and can support the needs of freight users in the future, and the recently passed \$17B transportation package is a good start.

Between 2022 and 2050, freight movements in Washington are forecast to increase 44 percent from 600 to 866 million tons of cargo weight.¹²³

This projected growth in freight continues to outpace funding availability. There is also often no clear path for major project funding, and time and resources are necessary to assemble and coordinate unique and non-repeating funding schedules and requirements. This means that some projects may fail to reach the construction phase. Dedicated funding programs are also sometimes repurposed and not allocated to intended uses. The Harbor Maintenance Trust Fund and Airport Improvement Program are examples of programs where funding has been diverted to support other federal uses. There is also industry uncertainty in whether certain federal programs will be reauthorized, and effective planning requires a multi-year horizon.

There is a need for both dedicated funding to solve critical infrastructure and safety problems as well as flexible funding to reflect changing needs of a multimodal transportation system to move people and goods effectively and efficiently. The state should increase investment in areas that have been underfunded or disproportionately harmed by past investments.

WSDOT takes an active approach to work with local agencies and freight stakeholders on providing guidance for discretionary grant applications, identifying freight priorities and distributing limited freight dollars, and implementing the removal of fish passage barriers on state-owned highways.

Figure 23 illustrates the state's expected growing investment gap for pavements based on the state's Transportation Asset Management Plan 2022. Note: this figure focuses on pavement condition and does not include investments in system improvements or new capital projects.

¹²³ CPCS Analysis of FHWA Freight Analysis Framework Version 5, measuring Washington total freight movements in 2022 and 2050 including Washington cargo origins, destinations, and within movements across all modes.

Figure 23: 2022 Washington state pavement 10-year investment gap (millions of dollars)¹²⁴

Pavement Ten Year Average Need (\$ in Millions)	2022	2023	2024	2025	2026	2027-2031	Total
Capital Preservation	\$318	\$318	\$318	\$318	\$318	\$1,590	\$3,180
Operational Maintenance ¹²⁵	38	38	39	39	39	204	397
Total Need	\$356	\$356	\$357	\$357	\$357	\$1,794	\$3,577

Figure 24: Planned pavement preservation spending

Pavement Ten Year: Planned Spending (\$ in Millions)	2022	2023	2024	2025	2026	2027-2031	Total
Total Capital Preservation Spending	\$186	\$177	\$177	\$168	\$168	\$863	\$1,739
<i>Preservation</i> ¹²⁶	30	28	28	27	27	138	278
<i>Rehabilitation</i>	104	99	99	94	94	483	973
<i>Replacement</i>	52	50	50	47	47	242	488
Operational Maintenance Spending	38	38	39	39	39	204	397
Total Spending	\$224	\$215	\$216	\$207	\$207	\$1,067	\$2,136
Investment Gap	\$(132)	\$(141)	\$(141)	\$(150)	\$(150)	\$(727)	\$(1,441)

Source: WSDOT Statewide Transportation Asset Management Plan. 2022.

Note: The document is subject to changes by FHWA through August 2022. TAMP does not fully incorporate the Move Ahead Washington package and funding provided by IJA/BIL, which is not expected to be finalized until after the Washington legislative session in 2023.

Figure 25: 2022 Washington state bridge 10-year investment gap (millions of dollars)¹²⁷

Ten Year Average Need (\$ in Millions)	2022	2023	2024	2025	2026	2027-2031	Total
Capital Preservation	\$332	\$332	\$332	\$332	\$332	\$1,661	\$3,321
Operational Maintenance ¹²⁸	27	27	27	28	28	144	281
Total Need	\$359	\$359	\$359	\$360	\$360	\$1,805	\$3,602

¹²⁴ Operational Maintenance reflects only activities that act upon the short-term condition of the pavement.

¹²⁵ Preservation, Rehabilitation, and Replacement activities were aligned to FHWA activity types using WSDOT’s improvement type codes.

¹²⁶ Funding is in 2021 dollars.

¹²⁷ Operational Maintenance reflects only activities that act upon the short-term condition of the pavement.

¹²⁸ Preservation, Rehabilitation, and Replacement activities were aligned to FHWA activity types using WSDOT’s improvement type codes.

Figure 26: Planned bridge preservation spending

Ten Year: Planned Spending (\$ in Millions)	2022	2023	2024	2025	2026	2027-2031	Total
Total Capital Preservation Spending	\$266	\$253	\$253	\$240	\$240	\$1,233	\$2,485
<i>Preservation</i> ¹²⁹	152	144	144	137	137	703	1,417
<i>Rehabilitation</i>	85	81	81	77	77	394	795
<i>Replacement</i>	29	28	28	26	26	136	273
Operational Maintenance Spending	27	27	27	28	28	144	281
Total Spending	\$293	\$280	\$280	\$268	\$268	\$1,377	\$2,766
Investment Gap	\$(66)	\$(79)	\$(79)	\$(92)	\$(92)	\$(428)	\$(836)

Source: WSDOT Statewide Transportation Asset Management Plan, 2022.

Note: The document is subject to changes by FHWA through August 2022. TAMP does not fully incorporate the Move Ahead Washington package and funding provided by IJJA/BIL, which is not expected to be finalized until after the Washington legislative session in 2023.

Between 2022 and 2027, Washington state is projected to receive substantial funding through the Bipartisan Infrastructure Law passed in November 2021. Additionally, the Bipartisan Infrastructure Law also makes funding available through competitive, discretionary funding and financing programs. Key USDOT competitive federal grant programs could be sought for infrastructure improvements, such as the Railroad Crossing Elimination Grant Program, projects of National Significance, INFRA Grants, RAISE Grants, PROECT Grants, Bridge Discretionary Grants, Culvert removal, replacement, and restoration grants, and Safe Streets Grants.

WSDOT uses the “Practical Solutions” approach to identify and solve problems as quickly and inexpensively as possible. This approach involves using the lowest lifecycle cost to preserve the system in a state of good repair, implementing Target Zero strategies for safety, transportation system management, demand management, and capital project investments. WSDOT will continue to use available funds to implement solutions to freight needs and issues. Additionally, WSDOT will continue to raise awareness of freight funding and financing needs statewide. Some of the potential tactics include:

Potential Strategy and Tactics
Potential Strategy: Raise awareness of freight funding and financing needs statewide.
➔ Identify alternative project delivery methods and proactively implement methods to raise capital for critical freight projects, such as engaging the private sector on public-private partnership opportunities.
➔ Assist local agencies with funding and financing guidance and support for freight system investments, such as federal discretionary grant funding.
➔ Provide local agencies with freight-related funding to address freight system needs through a data-driven prioritization process.

¹²⁹ Funding is in 2021 dollars.

Tribal relations

Freight activity and infrastructure growth in Washington continue to bring more landscapes and resources important to Tribes under increased risk of impact.

Coordination with tribes: In Washington, there has been a progressive trend over the past two decades for more coordination between agencies, Tribes, and the Washington State Department of Archaeology and Historic Preservation (DAHP) to identify, address, and resolve concerns as projects move forward. In particular, EO 21-02 (EO 21-02), which went into effect in March 2021, requires state agencies with capital improvement projects to integrate the DAHP, the Governor's Office of Indian Affairs, and concerned Tribes into their capital project planning processes. This order applies to state agency capital construction projects or land acquisitions not otherwise reviewed under federal law if the projects or acquisitions have the potential to affect cultural resources. Agencies with projects or acquisitions subject to review under the executive order must consult with DAHP and concerned Tribes and invite their participation in project planning. If cultural resources are present, then reasonable steps to avoid, minimize, or mitigate potential effects must be taken.

Traditional Cultural Landscapes (TCL): Tribes may not see clear divisions between natural and cultural resources. To more adequately address their concerns, projects increasingly take a more holistic approach towards resources as traditional cultural landscapes (TCL).

The purpose of a TCL approach is to document places and resources of past and present significant to tribal communities, using an interdisciplinary approach integrating environmental science with historical, archeological, and traditional knowledge.¹³⁰ Although challenging to examine resources with this approach, it helps to strengthen tribal capacity and improves long-term relationships between agencies and Tribal Nations by protecting shared resources and landscapes.¹³¹ This may increase the complexity around consultations with Tribes related to treaty rights, which could result in increased schedule requirements to perform consultations and potential delays related to maintaining, improving, or building new infrastructure.¹³²

Tribal perspectives on truck driving, congestion, and environment: Tribes noted during consultations that truck driver shortages are a concern and there is a need for adequate workforce training. Barriers to employment include background checks, physicals, and insurance eligibility. The Lummi Tribal Employment Rights Ordinance (TERO) program, for example, is working to train and

Figure 27: Traditional cultural landscape (TCL)

Traditional Cultural Landscape (TCL)

A geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person exhibiting other cultural or aesthetic values. The four categories include:

- Historic Sites associated with an important event or person
- Designated Landscapes that display artistic creations or patterns of expression
- Ethnographic Landscapes where land is used or valued in a traditional way by an established ethnic group
- Historic Vernacular Landscapes showing how people used the land over time and reflect patterns of settlement, use, and development.

Source: Preservation Briefs: Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes, U.S. Department of the Interior and National Park Service, Charles A. Birnbaum, September 1994.

¹³⁰ Characterizing Tribal Cultural Landscapes Volume I: Project Framework, U.S. Department of the Interior and the Bureau of Ocean Energy Management, various authors, December 2017. <https://www.nrc.gov/docs/ML1905/ML19058A361.pdf>

¹³¹ A Guidance Document for Characterizing Tribal Cultural Landscapes, U.S. Department of the Interior and the Bureau of Ocean Energy Management, various authors, November 2015. <https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/BOEM-2015-047.pdf>

¹³² ESA Section 7, and Section 106 of the NHPA

recruit tribal truck drivers. Tribes, especially those situated near I-5, also suffer from truck-involved incidents near reservations and endemic congestion issues.

Tribes are also especially concerned about the environmental risk of trains carrying hazardous material as well as polluting refineries. For many Washington Tribes, fishing is a way of life. While water temperature, water quality, and Canadian regulations have changed fishing practices, many people still choose to fish even when fish supply is not secure. One Tribe noted that more training programs related to water-based employment would provide the connection many people want to the natural environment.

Asotin County’s Snake River Road Improvement Project, Mileposts 19.00 to 21.97: This project was located within an area with a high degree of traditional significance to the Nez Perce Tribe. In recognition of this, Asotin County included Nez Perce Tribe representatives early in the preliminary planning process and performed environmental studies earlier in the process than is typical so that resource avoidance could be built into the early project design in collaboration with the Tribe. Ultimately, this approach helped to avoid or significantly minimize impacts to traditionally important resources well before the final project design was established.

State Route (SR) 520 West Approach Bridge Project: To establish trust with consulting parties who were concerned with the possibility that human remains would be discovered during construction, WSDOT completed the Section 106 compliance process before signing the NEPA Record of Determination. A customized approach to cultural resources investigations for the project was then also designed and implemented, with archaeologists working side by side with Native American monitors for the duration of archaeological subsurface investigations specifically tailored to the footprint of the proposed bridge pilings and pier shaft locations for the new structure.

WSDOT should consult with Tribal Nations on all relevant freight policies, programs, and projects early in the planning process. Some of the potential tactics are as follows:

Potential Strategy and Tactics	
Potential Strategy: Consult and coordinate with Tribal Nations on all relevant freight policies, programs, and projects early in the planning process.	
➔	Facilitate earlier consultations within a project schedule to identify issues and allow for strategies to be built into the project, such as small design revisions to reduce impacts to an acceptable level. Early coordination can also develop a higher level of trust and understanding to facilitate good and productive collaboration to identify acceptable mitigation strategies.
➔	Utilize cultural landscape and ethnographic studies to better understand and plan for impacts to resources important to Tribes.

Pacific Northwest partnership and collaboration

Freight flows do not necessarily follow or organize themselves along political boundaries.

Washington is positioned at the center of a bi-national region. The Pacific Northwest, particularly the I-5 corridor between Vancouver (BC) and Portland (OR), has clusters of population centers in relative proximity that, aside from California, is not found west of the Rockies. Washington transportation facilities serve shippers in British Columbia, Idaho, and Oregon. Washington shippers use freight facilities across the region, including those in British Columbia and Oregon.

Beyond having these regional freight facilities, these are truly shared facilities. Washington and Oregon share the Columbia River (with the state boundary being the middle of the navigation channel) until it bends north just beyond I-82 and McNary Dam. Washington and British Columbia share an international border, and while operated by both countries’ federal border service agencies, the connectivity that the border brings, is shared.

Figure 28 identifies the transportation facilities that serve the regional freight shed. Many of the facilities noted connect to other facilities listed.

Figure 28: Pacific Northwest shared transportation facilities

Facility	Facility Location	Facility Serves or Connects to Facilities in
Port of Seattle	Washington	Oregon, Idaho
Port of Tacoma	Washington	Oregon, Idaho
Port of Longview	Washington	Oregon, Idaho
Port of Kalama	Washington	Oregon, Idaho
Port of Vancouver	Washington	Oregon, Idaho
Seattle Intl Airport	Washington	Oregon, Idaho, British Columbia
Spokane Intl Airport	Washington	Idaho
BNSF	Washington	Oregon, Idaho
Union Pacific	Washington, Oregon	Idaho
I-5/BC 99	Washington, Oregon, British Columbia	-
I-90	Washington, Idaho	Oregon, British Columbia
I-82	Washington, Oregon	Idaho, British Columbia
US 97	Washington, Oregon	-
US 395	Washington	Oregon, Idaho
U.S.-Canada International Border	Washington, British Columbia	Oregon, Idaho
Columbia River Channel	Washington, Oregon	Idaho
Snake River Channel	Washington, Idaho	Oregon
Port of Lewiston	Idaho	Washington, Oregon
Port of Morrow	Oregon	Washington
Port of Portland	Oregon	Washington, Idaho
Vancouver Intl Airport	British Columbia	Washington, Oregon
Portland Intl Airport	Oregon	Washington
I-84	Oregon, Idaho	Washington, British Columbia
PNW High/Wide/Heavy Corridor	Washington, Oregon, Idaho	-
Savage Intermodal Facility	Idaho	Washington
Mid-Willamette Valley Reload Center	Oregon	Washington

Economic competitiveness: A well-functioning freight system benefits the entire region and is essential to remaining competitive. More coordination on regulatory alignment, federal advocacy, and case making could benefit all parties. With a highly connected regional economy, the transportation

system in the Pacific Northwest states and British Columbia as well serves some of the same industries and shippers. The operation and maintenance of the system involves similar entities across the states and British Columbia at regional, state, and federal levels. Taking a broader, systemic view of the greater PNW freight system can help create a more efficient and sustainable system to serve the region’s communities and freight-dependent sectors.

Truck parking: With an international border crossing and two large bi-state metro areas, Vancouver-Portland and Spokane-Couer d’Alene, one prominent shared issue is truck parking. Truck parking supply or demand in one state may help or hinder truck parking in an adjacent state. Navigating the Pacific Northwest requires truck drivers to have as much information about the system, including truck parking, regardless of in which state the parking lies, as they can to make well informed, real-time routing decisions.

Technology and information sharing: Congestion, delay, travel times, and other critical information for real-time supply chain management in these metro areas is a bi-state need. The impact of congestion and delay occurring in one state may be felt in another state. For example, as an alternate to I-5 for shippers in the western part of the Portland area, freight can divert from US 26 and I-5 to US 30. Trucks cross the Columbia River from Rainier to Longview and add to traffic volumes on local streets in Longview and Kelso before connecting back to I-5. Southbound, to avoid congestion on the Vancouver side of the river, the reverse alternative puts additional traffic on surface streets in communities in Oregon’s Columbia and Washington Counties.

Electric truck infrastructure: Both Washington and Oregon have strong interests in having trucking companies shift to a ZE/NZE fleet. One of the challenges is providing sufficient charging infrastructure (both quick charging kiosks and kiosk availability at regular intervals) along key long-haul, heavy-duty freight corridors. Plans and strategies may look different if developed in a bi- or multi-state program as opposed to each state focusing internally.

WSDOT will continue to strengthen collaboration with neighboring states and provinces on all freight decision-making impacting multiple states. Some of the potential tactics are as follows:

Potential Strategy and Tactics
Potential Strategy: Collaborate with neighboring states and provinces on all freight decision-making impacting multiple states.
➔ Share and collaborate on investment plans to optimize freight mobility and maximize the impact of funding for capital projects. Align project so that investments in one state/province support investments in a neighboring state/province, particularly when they provide access to key freight and intermodal facilities.
➔ Convene key agencies (state/province DOTs, ports, airports, key government agencies [such as CBP and Canada Border Services]) along with shippers in an organized, PNW regional venue to bring people to the table.
➔ Identify priority regional issues that can be addressed jointly, such as truck parking.
➔ Collaborate on technology and information development and deployment to drive greater innovation and maximize investments, drawing on university and industry expertise to deliver system or industry-specific solutions.
➔ Coordinate and convene planning teams to deliver high-priority strategies and plans, such as a PNW-wide approach to delivering heavy-duty electric charging for heavy-duty trucks (or other alternative fuel approaches).

Potential Strategy and Tactics	
➔	Provide greater uniformity (to the extent possible) in terms of truck regulations, such as processes and requirements for high, wide, and heavy loads such that shippers and carriers can seamlessly move cargo through the PNW region.
➔	Support maintenance and improvement of cross-border mobility solutions, such as the U.S.-Canada land and maritime border preclearance program.
➔	Regular meetings of agency leadership (annually) and of freight offices across the states and British Columbia (twice per year) to discuss, identify, and coordinate on common and multistate/province issues.
➔	Partner with Oregon, Idaho, other states, and the federal government to pursue development of a national freight strategy similar to Canada and create programs such as Canada’s National Trade Corridors Fund to help with infrastructure investments across freight modes.

State and local agency cooperation and support

Capacity building and partnerships can lead to better state and local understanding, decision-making, and alignment about freight movement priorities.

Mid- to small-sized MPOs, RTPOs, ports, and airports may not always have the capacity needed to assess freight movement, identify needs, and implement solutions, many of which require a successful funding application to start. Regional entities need to understand freight needs and trends and to develop and maintain an efficient freight system that also addresses environmental stewardship and community impacts. To be able to do this, they need greater technical and financial capacity, including data.

Technical freight expertise: While most small and mid-sized agencies have a staff position with assigned responsibility around freight mobility, it is likely just one part of a much larger portfolio of assignments. That staff person may or may not have specific expertise in freight movement. Other agency staff may have some level of expertise and familiarity with goods movement as they work with freight issues related to their assignments. However, there typically is not a staff position under which all of this technical expertise is centralized. There is a need for access to technical freight expertise to help these agencies support freight mobility by assessing needs, developing plans, identifying projects, and aligning with state and federal freight priorities.

Actionable freight data: There are numerous public and private freight databases. Some describe elements of the system as a whole across all modes, such as USDOT’s Freight Analysis Framework, which is free. Others, such as PIERS (Port Import Export Report System), is a private database available by subscription that provides detailed data on maritime import/export shipments. Knowing what data is relevant and how much detail is needed can be challenging. Often without the technical expertise on staff that they need (see above), acquiring, evaluating, and analyzing the most relevant freight data can present a gap in their work. As a result, the agencies struggle to adequately understand freight needs and develop and implement solutions. Ready-to-use data sets (and funding to purchase them) that have been assessed to be valid and reliable would assist local agencies with their freight planning work and facilitate deeper alignment with state and national goods movement objectives. Jurisdictions noted that if WSDOT could fund or send a staff member to conduct traffic counts, they would have better information on their own areas.

Freight project assistance: Developing projects to improve the efficiency of freight movement can be a great challenge to small and mid-sized local and regional entities. Sound project identification and prioritization require thorough study and analysis. These studies and analyses also facilitate

project adoption and inclusion in key state and regional modal and transportation improvement plans. While these entities may be able to identify what they need to study, they may not have the financial capacity to study the project. This can limit their ability to develop projects such that they could be considered for inclusion in state and regional modal plans and/or transportation improvement plans and create a hurdle to access state and federal funding.

Knowledge/best practice sharing and collaboration: At all levels, freight planners are working hard to understand and address issues related to the disruptions and challenges facing goods movement and increasingly the equity implications of this work. Most communities and regions in the state are having to plan for (to greater or lesser extents) similar freight issues: growth in e-commerce and curbside delivery, work-from-home, developing complete streets (including accommodating freight with active transportation), alternative fuels, automated freight vehicles, and others. With limited staff, expertise, and budget, many small and midsized agencies will find it difficult to address all of the issues sufficiently. There is a need for knowledge sharing and collaboration among state and local entities so that there can be robust regional and local planning around these topics and alignment and consistency across the state. Many of the larger ports or cities, for example, are years ahead in terms of community involvement and equity analysis. Sharing this information with smaller jurisdictions would be a good start.

WSDOT will continue to support regional and local agencies by providing state freight expertise, guidance, data, and other support. Some of the potential tactics are as follows:

Potential Strategy and Tactics
Potential Strategy: Provide state freight expertise, guidance, data, and support to regional and local agencies.
➔ Provide state freight expertise, guidance, data, and support to regional and local agencies to build capacity.
➔ Work with regional and local agencies to identify freight data needs and provide processed, validated, ready-to-use data sets for them to use in their freight work.
➔ Develop mechanisms to support small and mid-sized agencies to identify, study, and develop freight infrastructure, such as providing some level of funding for studies to get them ready for adoption into state and regional modal and transportation improvement plans (in order to make them eligible for state and federal funding).
➔ Coordinate knowledge and best practice sharing with local planning entities.
➔ Conduct studies to develop best practices (such as curbside delivery strategies) to be shared with local partners for them to incorporate into their freight planning work.
➔ Allow local partners to contribute money to help fund studies and research to address common issues.
➔ Convene a public-sector freight workgroup to share experiences, study and research results, and identify common issues for collaboration. Include leading in-state academic institutions as well as other related state and federal agencies.

7. Economic vitality

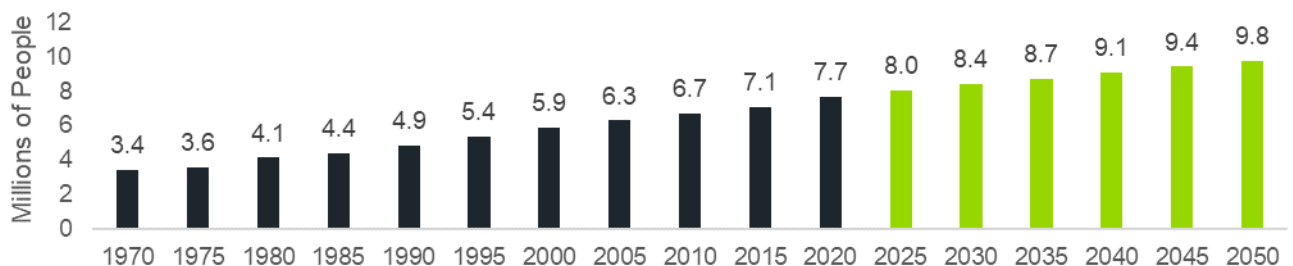
Washington’s statewide transportation policy goal of economic vitality is “To promote and develop transportation systems that stimulate, support, and enhance the movement of people and goods to ensure a prosperous economy.” Economic vitality of the state is underpinned by a safe, reliable, and efficient multimodal freight system. The supply chain issues facing the state can threaten economic vitality through the stages of sourcing, production, and manufacturing, assembly, inventory, and warehousing, and final delivery to businesses and consumers.

Population and economic growth

A growing population is likely to drive an increase in freight transportation volumes.

The state of Washington was home to 7.7 million people in 2019 and is forecasted to grow to 9.8 million by 2050, an annualized growth rate of 0.8 percent (Figure 29). Over the last decade, Washington’s population grew at double the pace of the U.S. and is expected to continue to surpass national growth rates over the next 30 years. This population growth will likely produce more demand on Washington’s multimodal freight system. Local regions will need to accommodate growth through planning to ensure the competitiveness of the freight system.

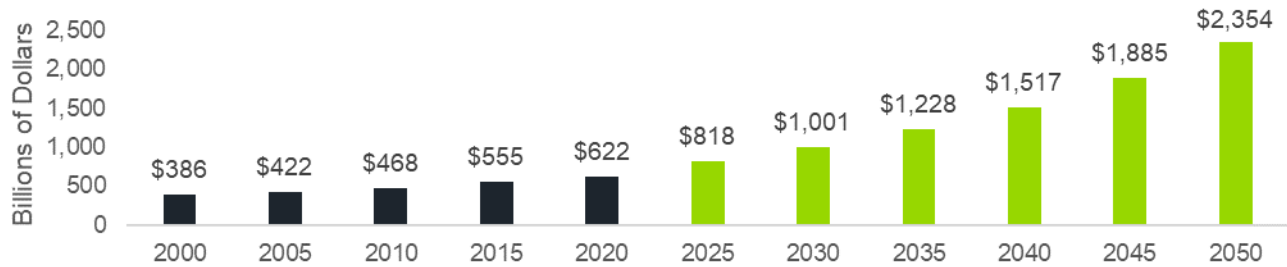
Figure 29: Historical and forecasted Washington state population, 1970-2050



Source: CPCS analysis of Washington Office of Financial Management Population Forecast, 2022.

Economic growth in freight-dependent industries will also drive demand on Washington’s multimodal freight system.

In 2019, Washington’s GDP was \$651.9 billion and forecasted to grow to \$2.4 trillion by 2050, an annualized growth rate of 4.4 percent (Figure 30). Over the last decade, the state’s GDP grew at twice the rate of the national average (+40 percent growth in Washington compared to +21 percent growth in the U.S.). Over the next 30 years, projected GDP growth will be driven by information technology (IT) and manufacturing sectors. While the IT sector does not produce significant amounts of freight goods by itself, new logistics and supply chain technologies are expected to change how and when freight moves on the multimodal freight system. Despite growing economic inequality in urban areas around the state, continued high volumes of goods consumption are expected from those with higher disposable incomes, leading to more freight activity on Washington’s freight system.

Figure 30: Historical and forecasted Washington state GDP, 2000-2050

Source: CPCS analysis of REMI TranSight Economic Summary for Washington, 2022. Values presented in 2021 dollars.

Growth of freight volume

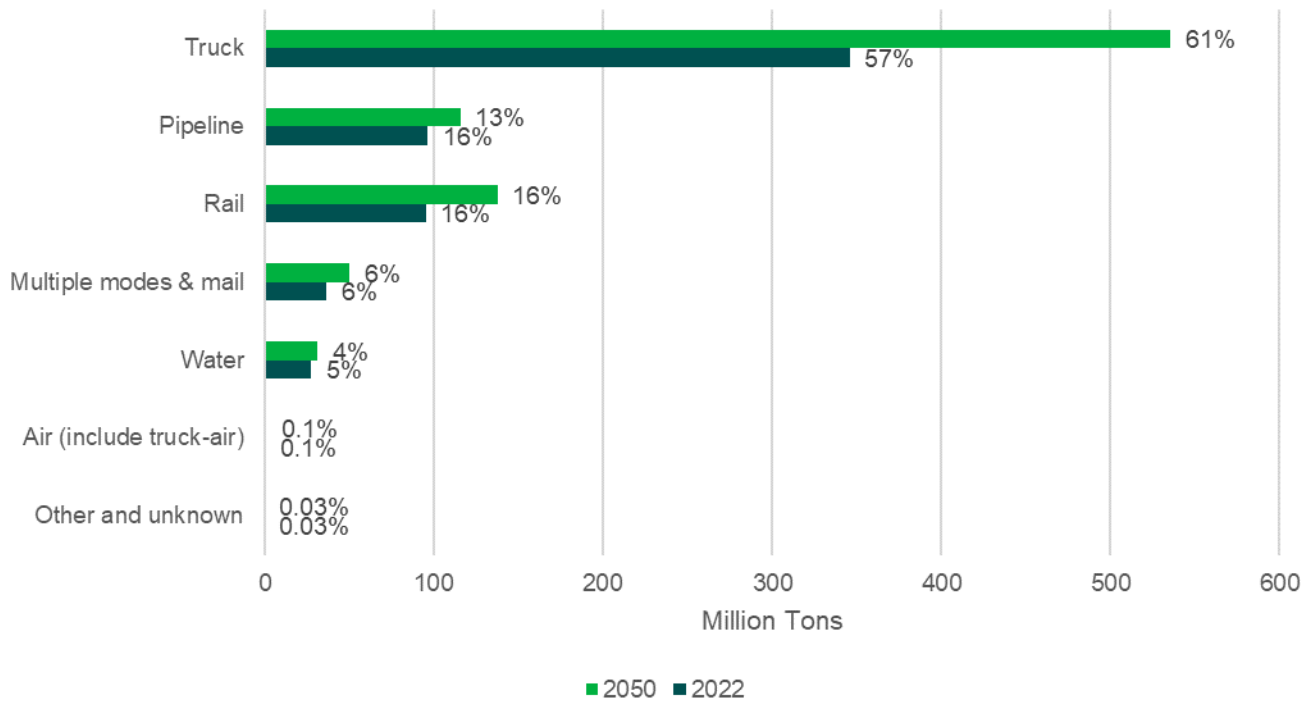
As Washington's population and economy grow in the future, the volume and value of freight moving in the state will increase as well. This section provides information about the projected growth of Washington's freight transportation activity up to 2050, and this growth information provides context for further discussion about other trends, needs, and issues. This freight growth analysis is based on forecasts provided by FHWA's Freight Analysis Framework (FAF) dataset. FAF offers a comprehensive picture of freight movements between states and major metropolitan areas by all modes of transportation. FAF constitutes the best publicly available multimodal commodity flow dataset in the U.S. The 2017 Commodity Flow Survey, which serves as one of the foundational data sets used to develop FAF, was last released in 2021, marking this the fifth iteration of FAF (hence, the term FAF5 noted in citations below). FAF5 provides future commodity flow forecasts up to 2050 for all commodity types and origin-destination pairs. Additional data were available for Washington state that permitted more precise commodity flow forecasts.

Washington's roadway system will continue to play a critical role in carrying freight: the share of commodity tonnage carried by trucks is projected to increase from 57 percent in 2022 to 62 percent in 2050, an equivalent of 190 million more tons of goods (Figure 31). Forestry products, industrial manufacturing materials, construction materials, and agriculture and seafood products are projected to be the top commodities carried by trucks. In 2050, rail is projected to carry approximately the same share of commodity tonnage as in 2022 (16 percent) but will carry 42 million tons more in weight. Agriculture products, energy products, construction materials, and manufacturing materials are projected to be the top commodities carried by the rail system. All modes considered, Washington's freight infrastructure system is projected to carry 872 million tons of goods in 2050, a 45 percent increase from the 2022 level.

This increase in the volume of commodity flows is accompanied by an even larger increase in the value of goods carried by the state's freight infrastructure network. Trucks are projected to continue to carry the highest share of goods value (54 percent) in 2050, followed by multiple modes (31 percent), air (8 percent), and rail (4 percent). Together, 1.3 trillion dollars of commodities are expected to be moved by Washington's freight network in 2050, an 87 percent increase from the 2022 level (Figure 32).

Figure 33 shows the growth rate for each mode. While truck-based freight movements are projected to experience the biggest growth by weight, air traffic shows the fastest growth in percentage terms, with air-dependent commodity tonnage and value both projected to double in 2050.

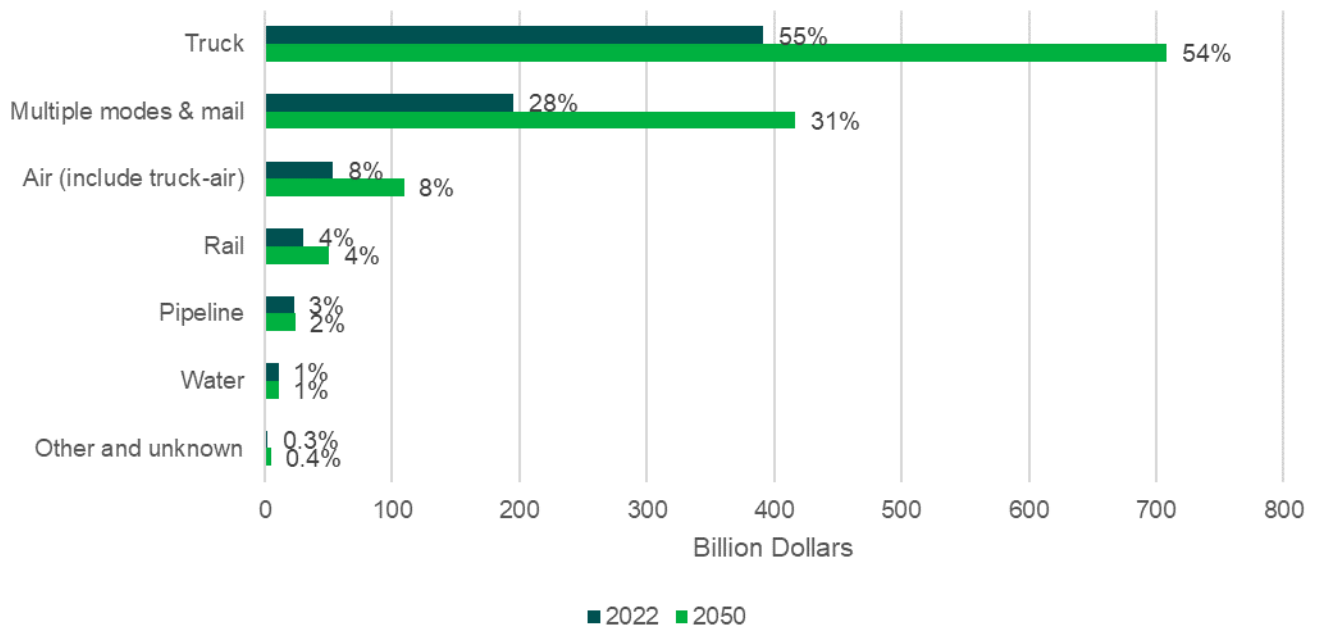
Figure 31: Tonnage and share by mode (2022-2050)



Source: CPCS Analysis of FAF5.3 data

*Note: Growth in freight by commodity and mode was derived from FAF, but the growth in future tonnage and value are assumed to be unconstrained by infrastructure capacity.

Figure 32: Value and share by mode (2022-2050)



Source: CPCS Analysis of FAF5.3 data

*Note: Growth in freight by commodity and mode was derived from FAF, but the growth in future tonnage and value are assumed to be unconstrained by infrastructure capacity.

Figure 33: Modal growth rate by tonnage and value (2022-2050)

Mode	Tonnage growth	Value growth
Truck	55%	81%
Rail	44%	64%
Water	13%	2%
Air (include truck-air)	104%	104%
Multiple modes & mail	39%	113%
Pipeline	20%	4%
Other and unknown	-14%	81%

Source: CPCS Analysis of FAF5.3 data

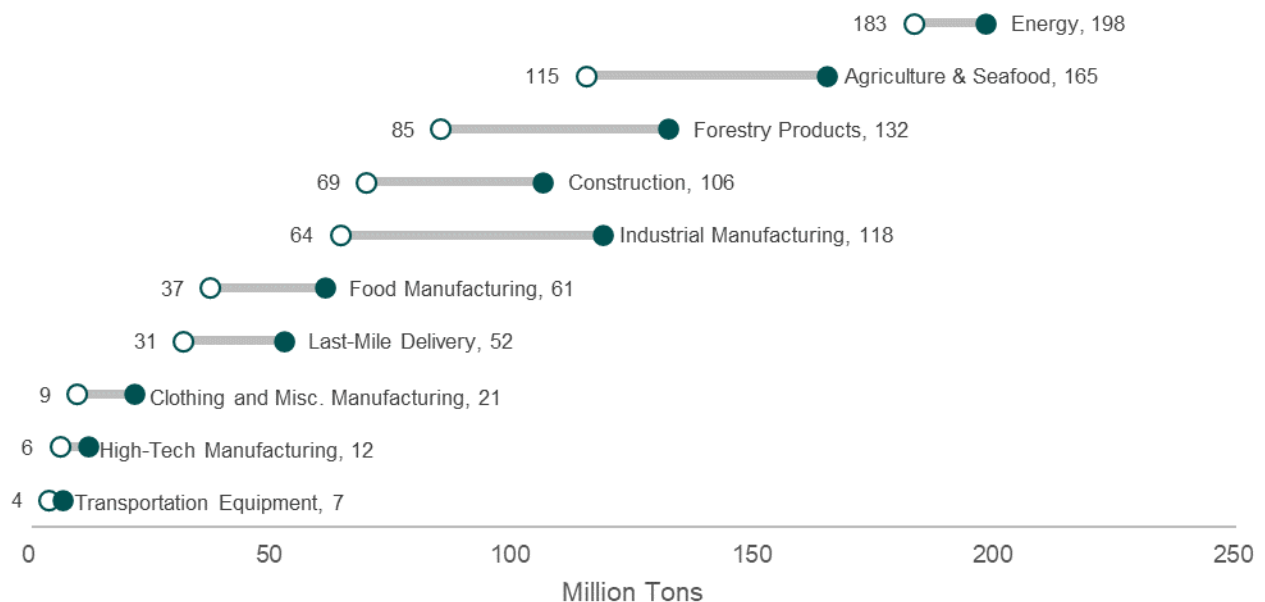
*Note: Growth in freight by commodity and mode was derived from FAF, but the growth in future tonnage and value are assumed to be unconstrained by infrastructure capacity.

Figure 35 shows projected truck traffic volume in 2050 and truck-dependent commodity tonnage by county. Forecasted truck vehicle miles traveled on the various interstates is expected to increase by 67 percent from 2022 to 2050. Figure 36 shows the growth in truck traffic and commodity tonnage by county from 2022 to 2050. The interstate system is expected to absorb most of the increase in truck traffic to accommodate the growth in commodity flow. In terms of non-interstate roadways, U.S. Route 2 (US 2) between US 97 and I-90 is projected to carry much of the east-west truck traffic growth. US 97 between US 2 and I-90 and US 395 south of I-90 are projected to see significant increase in north-south truck traffic volume.

Commodity category growth

Figure 34 shows the projected growth in tonnage from 2022 to 2050 by commodity group. Industrial manufacturing products, agriculture and seafood products, forestry products, and construction materials are expected to have both the highest total tonnage and fastest growth in 2050.

Figure 34: Commodity group tonnage growth (2022-2050)



Source: CPCS Analysis of FAF5.3 data

*Note: Growth in freight by commodity and mode was derived from FAF, but the growth in future tonnage and value are assumed to be unconstrained by infrastructure capacity.

Figure 35: Truck tons and truck traffic (2050)

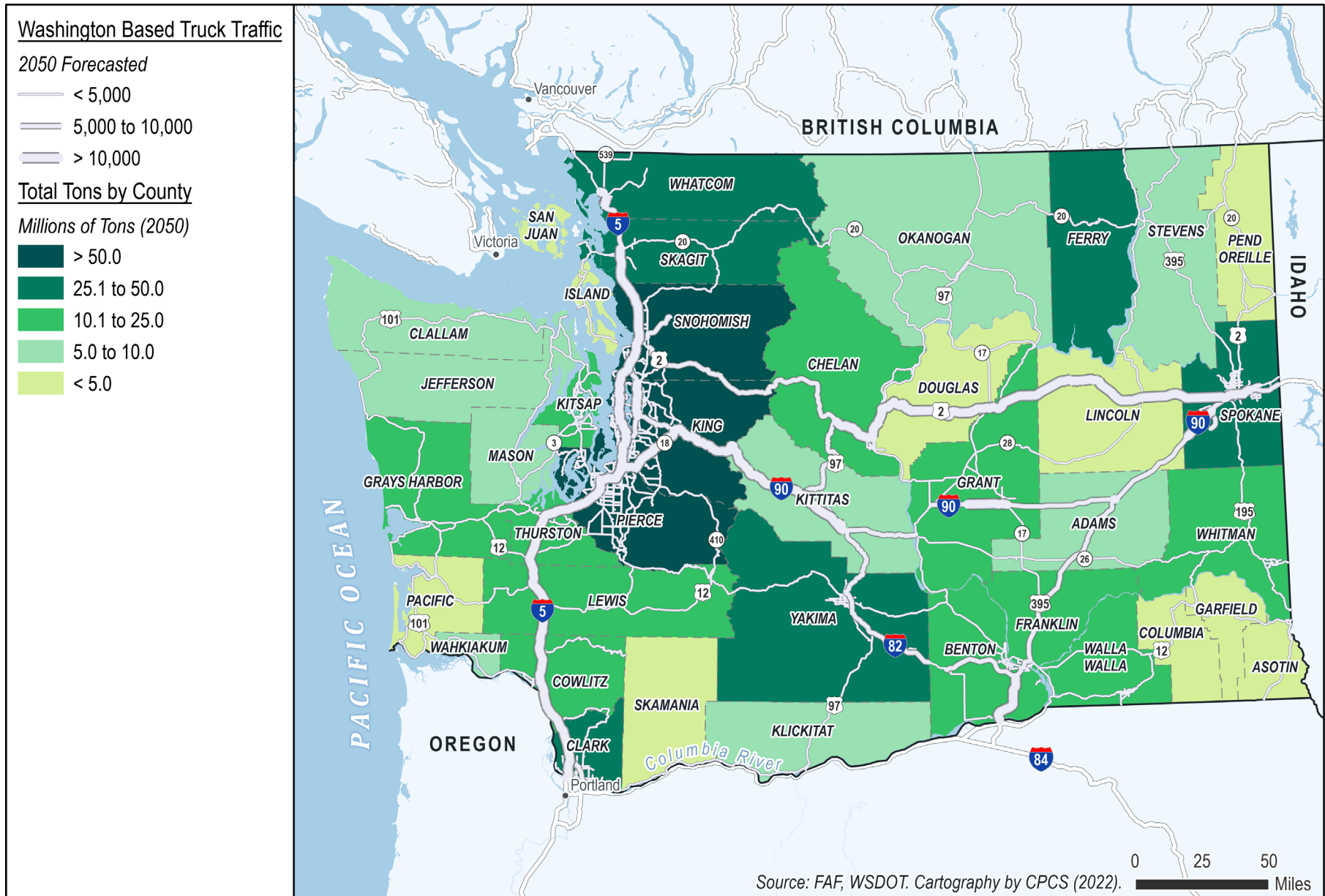
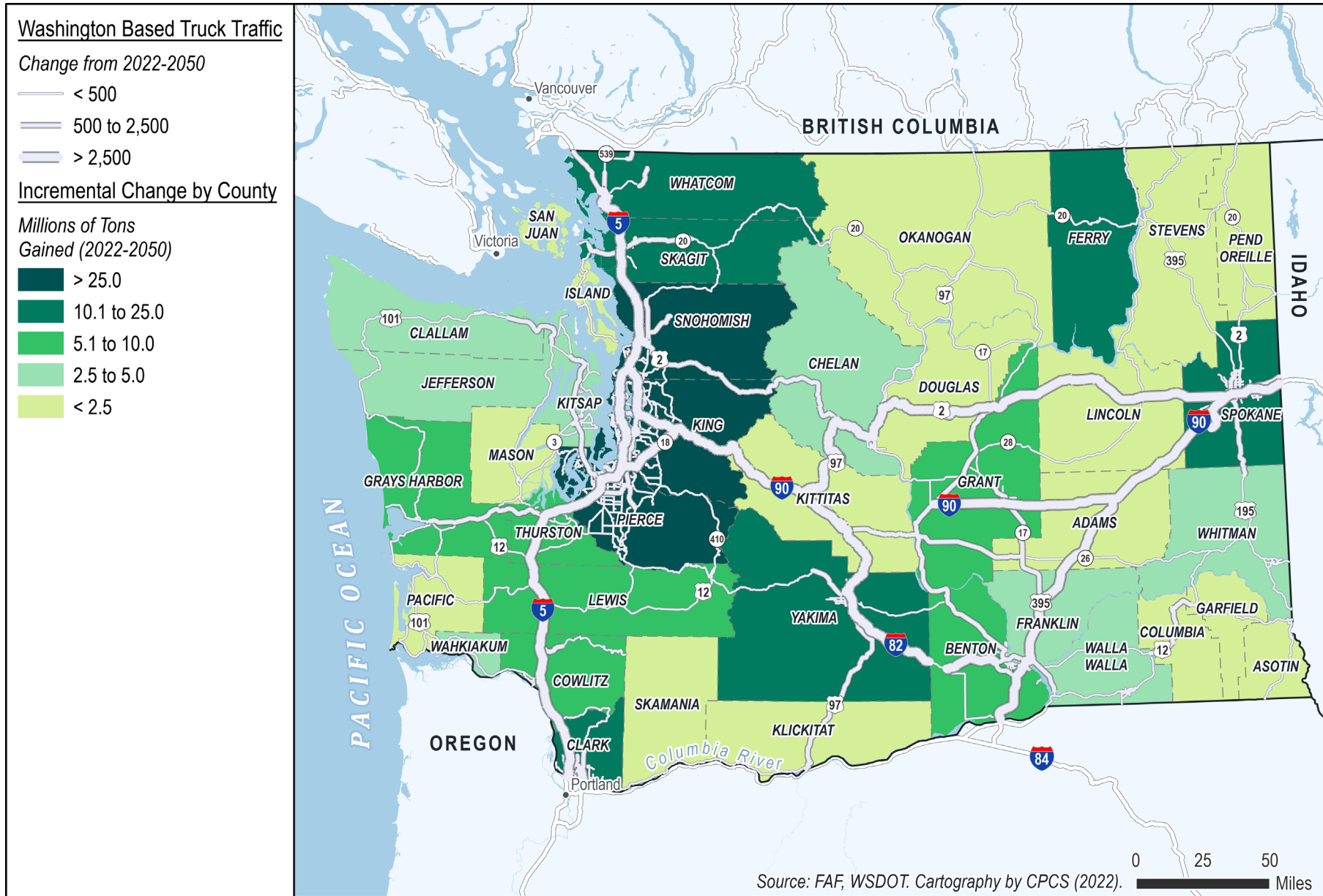
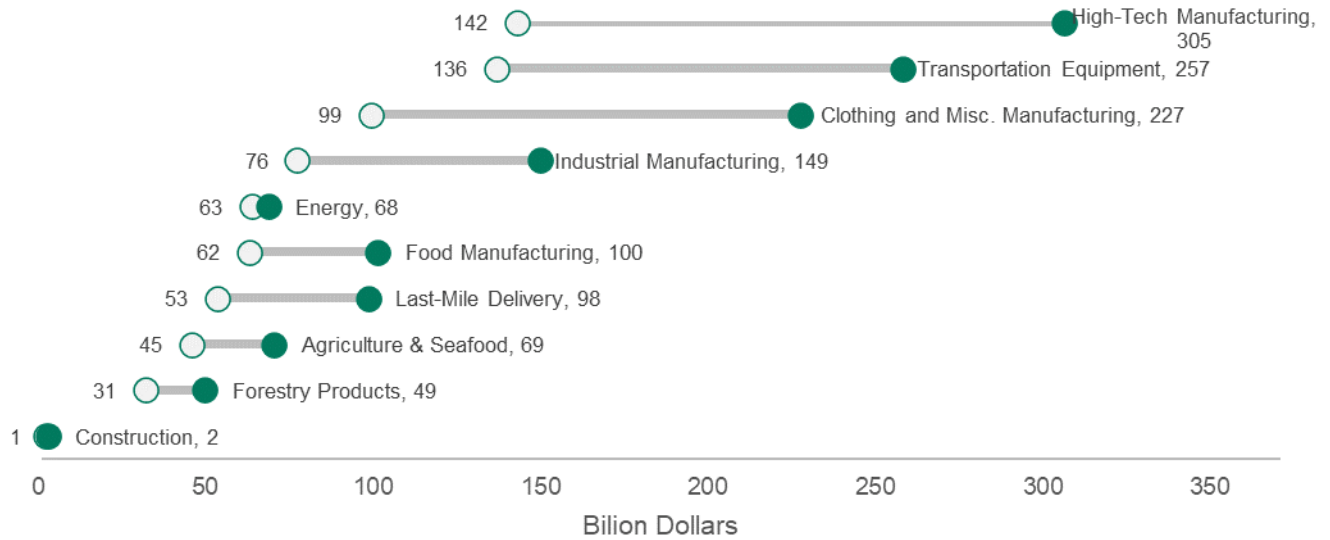


Figure 36: Growth in truck tons and truck traffic (2022-2050)



From a value perspective, high-tech manufacturing, transportation equipment, and clothing and other miscellaneous manufacturing materials are projected to both account for the highest value and experience the fastest growth (Figure 37).

Figure 37: Commodity group value growth



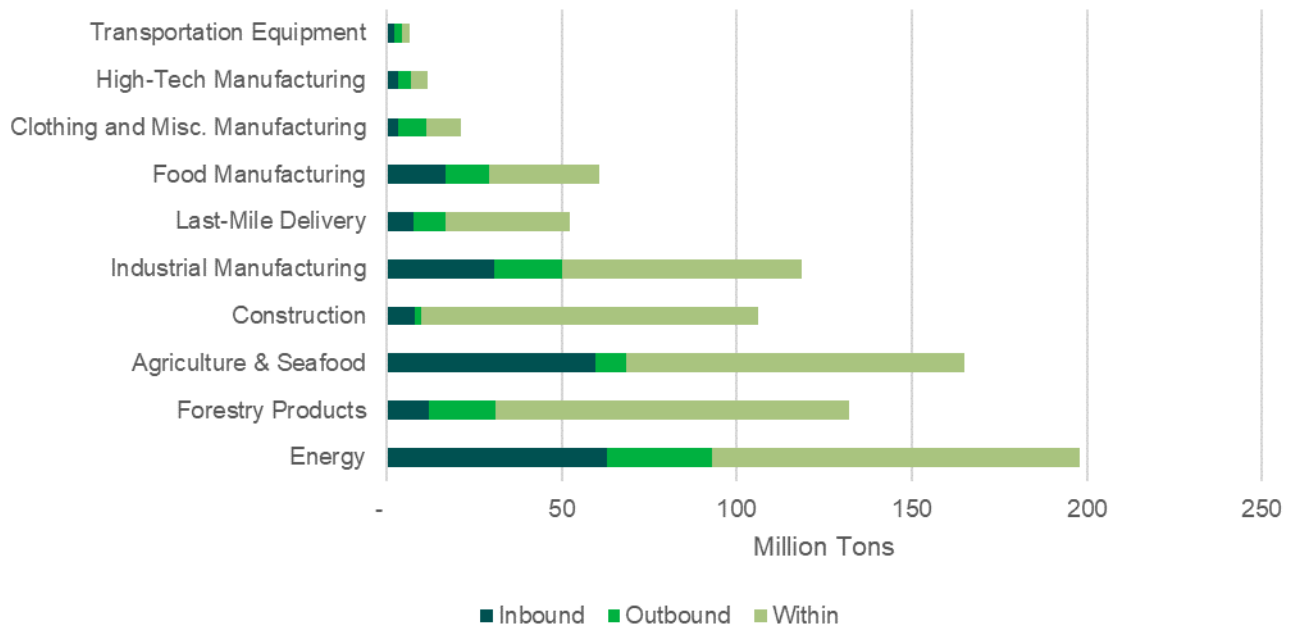
Source: CPCS Analysis of FAF5.3 data

*Note: Growth in freight by commodity and mode was derived from FAF, but the growth in future tonnage and value are assumed to be unconstrained by infrastructure capacity.

Directional shifts in freight movement

Commodity flows that are both originated from and destined to Washington (within flows) are projected to continue to be the dominant direction, accounting for more than 63 percent of total tonnage. Energy commodities, forestry products, agriculture and seafood products, and construction materials are projected to be the main commodity groups flowing within the state boundary (Figure 38).

Figure 38: Directional commodity flow tonnage by commodity group (2050)



Source: CPCS Analysis of FAF5.3 data

*Note: Growth in freight by commodity and mode was derived from FAF, but the growth in future tonnage and value are assumed to be unconstrained by infrastructure capacity.

Freight trips that start and end in Washington are also projected to contribute to the increase in overall goods tonnage the most (Figure 39). Construction materials, agriculture and seafood products, energy commodities, and clothing and miscellaneous manufacturing materials are projected to be the dominant commodity groups driving the growth of goods movement within the state (Figure 40).

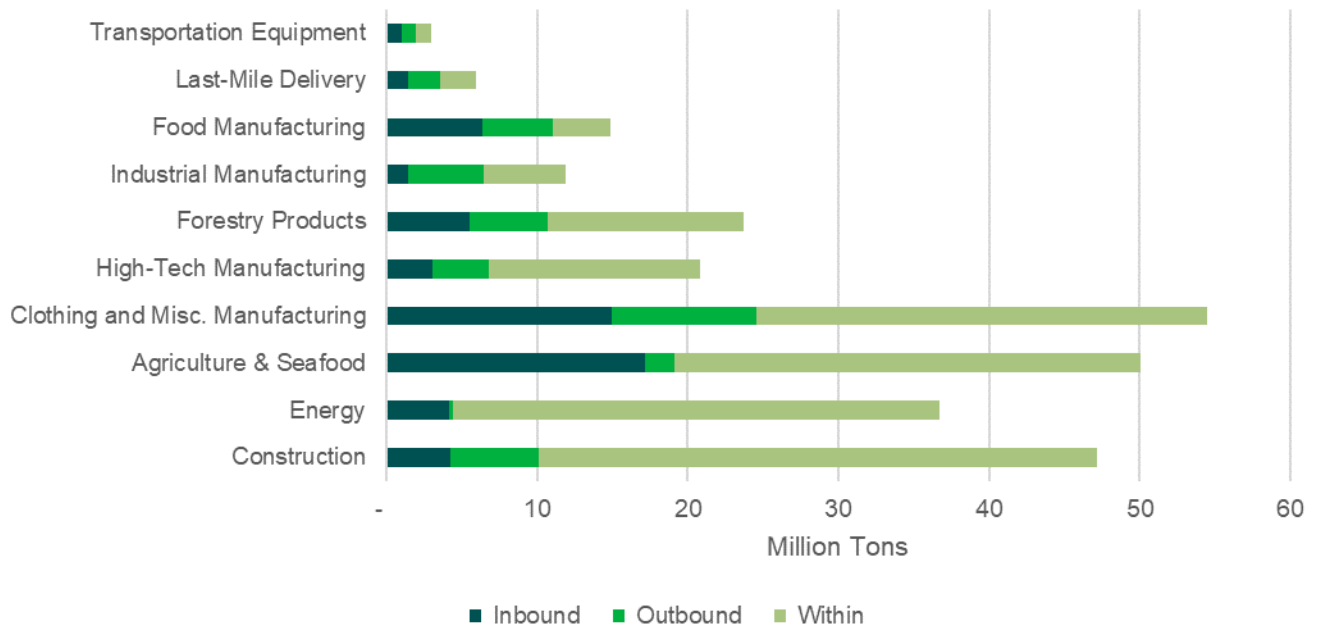
Figure 39: Directional tonnage growth (2022-2050)

Direction	2022 (Million Tons)	2050 (Million Tons)	% Growth	% Annual Rate of Growth	% Share of Tonnage Increment
Inbound	147	207	40%	1.2%	22%
Outbound	75	114	52%	1.5%	15%
Within	381	551	45%	1.3%	63%
Total	603	872	45%	1.3%	100%

Source: CPCS Analysis of FAF5.3 data

*Note: Growth in freight by commodity and mode was derived from FAF, but the growth in future tonnage and value are assumed to be unconstrained by infrastructure capacity.

Figure 40: Directional tonnage growth by commodity group (2022-2050)



Source: CPCS Analysis of FAF5.3 data

*Note: Growth in freight by commodity and mode was derived from FAF, but the growth in future tonnage and value are assumed to be unconstrained by infrastructure capacity.

Outbound commodity flows starting in Washington and ending elsewhere are expected to grow at the fastest pace, with an annual growth rate of 1.5 percent from 2022 to 2050 (Figure 39). High-tech manufacturing materials, clothing and miscellaneous manufacturing materials, construction materials, and forestry products are the main commodity groups projected to drive the growth of these outbound commodity flows (Figure 40). The growth in exporting these high-value commodities reflects how outbound shipments make up the biggest and fastest growth in the total commodity value (Figure 41). Outbound commodity flows are projected to account for 39 percent of value increment, an annual growth rate of 2.7 percent from 2022 to 2050.

Figure 41: Directional value growth (2022-2050)

Direction	2022 (Billion Dollars)	2050 (Billion Dollars)	% Growth	% Annual Rate of Growth
Inbound	195	342	75%	2.0%
Outbound	222	462	108%	2.7%
Within	290	520	79%	2.1%
Total	707	1,324	87%	2.3%

Agriculture and seafood products, food manufacturing materials, and clothing and other miscellaneous manufacturing materials are projected to account for most of the growth in inbound commodity flows (Figure 40).

Supply chain trends

Few states sit at the intersection of key north/south, east/west, domestic, and international trade lanes as Washington does.

Washington’s freight transportation system connects shippers to markets in Washington, the Pacific Northwest, the U.S, and the world, while also facilitating the delivery of goods to businesses and homes. The state’s freight system plays a critical role in linking Washington businesses and consumers to global and domestic markets. This section details supply chain issues related to sourcing production, and manufacturing; assembly, inventory, and warehousing; and final delivery to businesses and consumers as shown in Figure 42.

Figure 42: Supply chain steps



Source: CPCS.

Sourcing, production, and manufacturing

Pandemic impacts

Over the last two years, the COVID-19 pandemic has unveiled constraints in global, national, and regional supply chains. As one of the nation’s leading trade gateways, Washington and its residents have experienced these challenges.

Disruptions in 2020: Early in the pandemic, China began to close factories to control the spread of the virus. This led to supply shortages for many manufacturers. As the pandemic spread, factories closed around the globe either as a result of the virus or the inability to source parts and products from traditional suppliers. By the 2020 holiday season, manufacturers and retailers who had kept production and inventories lean found themselves attempting to respond to stronger-than-expected demand. At the same time, the growth in COVID cases had an impact on transportation labor supply as many truck drivers were idled due to illness or the need to quarantine. As companies were finding it harder to source and stock products, consumers ramped up their holiday spending but used a different channel. Largely in response to the virus, consumers switched from brick-and-mortar shopping to online purchasing. Retail supply chains, however, were still designed to serve a predominantly brick-and-mortar model, adding pressure to already distressed global supply chains.¹³³

Supply chains, in any industry, cannot change immediately. They are difficult to establish, and once set up, take time and effort to change.

Agricultural impacts: Agriculture felt the supply chain crunch early in the pandemic. In Washington, potato farmers faced a particular challenge in the spring and summer of 2020. The crop was in hand, but restaurants (roughly 90 percent of the market for some farmers) and french fry processors were shuttered leaving few buyers. Farmers suddenly were without a market. Unable to pivot to supply grocery stores or other outlets, some farmers in eastern Washington opted to give their potatoes away rather than dispose or destroy the crop.¹³⁴ Other farmers across the Pacific Northwest, such as onion producers, faced similar issues.

¹³³ Julianne Dunn, COVID-19 and Supply Chains: A Year of Evolving Disruption, Federal Reserve Bank of Cleveland, February 2021. <https://www.clevelandfed.org/en/newsroom-and-events/publications/cfed-district-data-briefs/cfddb-20210226-covid-19-and-supply-chains.aspx>

¹³⁴ Nina Culver, Folks flock to Ritzville to pick up potatoes farmers can’t sell, *The Spokesman-Review*, April 2020. <https://www.spokesman.com/stories/2020/apr/29/ritzville-sees-rare-traffic-jam-as-folks-flock-to/>

Figure 43: Picture of ship loading grain at the Port of Seattle



Source: BERK Consulting.

Disruptions in 2021 and 2022: In 2021 and into 2022, production and supply chain disruptions continued as both production and transportation lagged consumer-driven demand. Many Puget Sound residents saw some of the impacts firsthand. As demand for consumer import goods spiked, it outpaced the supply chain's ability to handle the cargo. This resulted in several container vessels sitting at anchor in the Puget Sound simply waiting for an empty berth at terminals in either Tacoma or Seattle. The primary factors of this congestion are the lack of space at port terminals and transportation workers and equipment to move goods in and out of the terminals. There does not appear to be a shortage of longshore workers at the docks. Port congestion, however, impacts their work by constraining their productivity.¹³⁵

Container shipping: While ocean carriers offload containers at terminals in Tacoma and Seattle, importers struggle to find enough labor and equipment to haul those containers to warehouses, distribution centers, and factories. As those containers dwell longer on the dock, it leaves less space for other vessels' containers, slowing the speed with which vessels can offload containers. Meanwhile, containers return to the terminals for shipment back to Asia (and elsewhere). These containers sit on the dock waiting for the vessel to be emptied so they can be loaded, further limiting space on the dock and the ability to unload and load vessels. This backlog can create challenges in situations where federal services such as customs or agricultural inspections are required. The number of containers needing inspection grows along with overall volumes. Shippers have indicated that they experience delays in getting required inspections, which compound other issues, such as demurrage charges and equipment availability to haul containers. Port leaders have called for CBP to be adequately staffed to handle the volume of import containers to prevent more delays at U.S. ports.¹³⁶ Further down the supply chain, warehouses struggle to find workers to empty the containers' contents, slowing down the flow of containers in the chain from the ship to dock to warehouse and back to dock and ship. The situation is improving, however. At one time in late 2021, there were 12 ships at anchor awaiting a berth; by mid-January 2022 there were only three.¹³⁷ The problem is not unique to Washington as major ports around the country face similar, and in some cases much larger, challenges. Although the

¹³⁵ Dick Marzano and Fred Felleman, Working through Supply-chain Congestion, Port of Seattle, July 2021.

<https://www.portseattle.org/commission-blog/1985/northwest-seaport-alliance-committed-working-through-pandemics-supply-chain>

¹³⁶ US port chiefs call for more funding for CBP inspections, *The Journal of Commerce Online*, July 2021. https://www.joc.com/port-news/us-ports/port-seattle/us-port-chiefs-call-more-funding-cbp-inspections_20210712.html

¹³⁷ How the Port of Seattle is whittling away at supply chain backlogs, KUOW, Joshua McNichols, January 2022.

<https://www.kuow.org/stories/how-the-port-of-seattle-is-whittling-away-at-supply-chain-backlogs>

backlog may now be lessening, likely due in part to now having moved beyond the peak holiday season, truck driving and warehousing employee shortages remain prevalent.

International trade trends: While Washington has experienced a drop in international trade volumes over the last few years, the state still ranks as one of the largest exporting states in the country. The state exports a variety of goods to global markets, ranging from manufactured goods to grain, tree fruit, and other agricultural products grown in Washington. International trade is not just limited to the state's biggest companies; small businesses, farms, and consumers rely on trade. However, a large percentage of the goods moving to, from, within, and through the state is domestic. Much of the freight transported in Washington is sold and bought within the U.S.

Import surge and export container availability: The pandemic-driven surge in imports has created a problem for exporters. Instead of having more empty containers for Washington exporters, the heavy demand for imports has led to many carriers opting to return their empty containers as fast as they can without taking the time for an export load. While international demand for Washington exports, such as hay and tree fruit, remain strong, the state's exporters are unable to ship their products. In some cases, vessel backlogs in other ports, such as southern California, are such that vessels unload all their cargo there and immediately return to Asia, skipping port calls in the Pacific Northwest that would have loaded Washington exports bound for Asia. If these trends continue long-term, overseas buyers may permanently switch to competing providers in other locations.¹³⁸

Reshoring:¹³⁹ While a nascent trend before the pandemic, reshoring (or nearshoring, where manufacturers bring parts of their operations and supply chains to North America), has gained momentum as a result of the pandemic-driven supply chain challenges companies are currently managing. Today, reshoring also is shaping how companies think about future investments. Although the primary goal is to bring the supply chain closer to customers where it is possible, another driver is the growing commitment to sustainability. Shortening supply chains can contribute to greater sustainability by bringing production and consumption hubs closer together. Reshoring is now manifesting itself through investments in the U.S. and northern Mexico by both domestic and foreign companies. Early adopters of reshoring are the auto and high-tech sectors. Not all companies or all industries can pursue reshoring, however, so while some are opting to operate more of their supply chain domestically, global supply chains will continue to exist.¹⁴⁰ Some Washington companies, such as Boeing, already deploy a combination of global and domestic supply chains.

USMCA: The United States-Mexico-Canada Agreement, ratified in March 2020, is expected to strengthen north-south trade ties for the state. The state experienced substantial trade growth with Canada and Mexico following the signing of NAFTA in 1994 and should benefit from this new agreement as well.¹⁴¹ The agreement maintained duty-free access for most agricultural products, such as tree fruit, and broadens the access to Canadian markets for the dairy industry.¹⁴² Given the proximity of northwest Washington's dairy industry to the border, this is likely a trade growth opportunity. In any case, the trade agreement could potentially increase truck volumes at the border crossings between Washington and British Columbia. In addition to trade between these two markets, trade will likely grow

¹³⁸ COVID-19 even affects apples: Washington farm exports crimped by cargo-container shortage, *The Seattle Times*, Paul Roberts, March 2021. <https://www.seattletimes.com/business/international-trade/in-pandemic-twist-washington-farm-exports-crimped-by-shortage-of-cargo-containers/>

¹³⁹ 'Reshoring' initiative seeks to boost Washington County's chip industry, *The Oregonian*, Mike Rogoway, January 2022. <https://www.oregonlive.com/silicon-forest/2022/01/reshoring-initiative-seeks-to-boost-washington-countys-chip-industry.html>

¹⁴⁰ Supply chain woes prompt a new push to revive U.S. factories, *The New York Times*, Nelson D. Schwartz, January 2022. <https://www.nytimes.com/2022/01/05/business/economy/supply-chain-reshoring-us-manufacturing.html>

¹⁴¹ Washington state has much at stake in trade deal with Canada, Mexico, *The Seattle Times*, Lori Otto Punke, March 2019. <https://www.seattletimes.com/opinion/washington-state-has-much-at-stake-in-trade-deal-with-canada-mexico/>

¹⁴² Agricultural Provisions of the U.S.-Mexico-Canada Agreement, Congressional Research Service, April 2019. <https://sgp.fas.org/crs/row/R45661.pdf>

in two other key lanes these border crossings serve: British Columbia – Mexico as well as British Columbia – Oregon and California.

The International Mobility and Trade Corridor Program (IMTC) is focused on improving mobility and security for the border crossings between Whatcom County, Washington, and the Lower Mainland of British Columbia.

Trade with China: It is not clear what the long-term impact of the recent U.S.-China tariffs and the Phase 1a agreement have had and will have on Washington trade, though in the short term, trade disputes with China are challenging for agricultural producers. While Washington saw a substantial drop in export value of \$17.5 billion (nearly a 25 percent decline) between 2018 and 2019 due to 737 Max difficulties, exports to China dropped only \$7 billion. On a commodity basis, aircraft, engines, and parts exports fell \$16.5 billion.¹⁴³ Further, Chinese tariffs did not cover some of the state’s largest exports, including the Boeing 737.¹⁴⁴ While some of the state’s larger exporters may be more resilient, small and medium-sized exporters may be more negatively impacted. These impacts may cut across industries and not be as noticeable in the trade data.

To address sourcing, production, and manufacturing challenges, WSDOT and its partners may consider facilitating engagement with the private sector to better support multimodal transportation options for shippers. Other potential tactics are also included below.

Potential Strategy and Tactics	
Potential Strategy: Facilitate engagement with the private sector and public partners to better support multimodal transportation options for shippers.	
➔	Invest in advanced supply chain tracking technologies to better track and optimize freight sourcing, production, manufacturing, and transportation.
➔	Support state, regional, and local economic development of reshoring strategies.

Assembly, inventory, and warehousing

While supply chains generally improved over the last decade at dealing with fluctuations in demand, the COVID-19 pandemic disrupted entire supply chains. Some commodities surged in demand and required rapid expansion of supply, such as personal protective equipment (PPE), household supplies, and residential food items. Other products suited for a work-from-home environment also surged over time, such as home office equipment and home fitness goods. Other markets declined with lockdown orders – the most significantly impacted industries include travel services, accommodation and restaurant food services, freight delivery to workplaces and retail stores, and more.

Just-in-Case inventory: Supply chains increasingly shifted inventory strategies from “just in time” (JIT) to “just in case” (JIC) due to the difficulty with predicting consumer demand or the timing of demand. Companies, therefore, take on more warehousing space and incur higher holding costs for their inventory to ensure inventories do not run out during high surges in demand. This has also led to greater competition for warehousing space, a land use that is not permitted in many areas and thus is in limited supply. As JIC activity increases, and more space is allocated to static storage, a smaller

¹⁴³ USA Trade Online, U.S. Census Bureau. <https://www.census.gov/foreign-trade/statistics/state/index.html>

¹⁴⁴ Washington businesses brace for impact of trade war with China, *Puget Sound Business Journal*, Emily Parkhurst, April 2018. <https://www.bizjournals.com/seattle/news/2018/04/13/washington-businesses-brace-for-impact-of-trade.html>

portion of warehouse space is available for active cargo handling such as fulfillment, sorting and packing, processing, and other activities that keep goods moving through the supply chain. Increased cooperation across the supply chain is also needed to ensure goods can be delivered on time. Figure 44 explains the differences between these inventory strategies.

Figure 44: Shift from Just-in-Time to Just-in-Case inventory strategies

Just-in-Time (JIT) Companies minimize inventory costs by waiting to produce goods until orders are made.	Just-in-Case (JIC) Companies minimize the probability that they will run out of stock by stockpiling inventory.
<p>Advantages: Lower inventory costs due to less stocked materials, lower storage costs, less waste from unsold inventory.</p> <p>Disadvantages: Risk of lost sales or production shut downs if unable to handle rush orders, slower delivery of goods, better forecasting required to be ready for influxes of orders.</p>	<p>Advantages: Minimize risk of lost sales when inventories run out when difficult to forecast consumer demand or timing of demand, quicker delivery of goods.</p> <p>Disadvantages: Higher inventory and storage costs, wasted inventory if all stock does not sell before expired or outdated.</p>

Warehousing and freight land use issues: As companies stockpile more inventory and guarantee quicker delivery, larger and more dispersed warehousing and distribution facilities are required. At the end of 2021, the national vacancy rate for warehouse space dropped to a record low of 3.4 percent.¹⁴⁵ Available warehousing space is not meeting the surging demand for more space. Moreover, trucks may have access issues due to long queues, inadequate on- and off-ramps, circuitous routes, or other difficulties with accessing warehousing facilities, particularly those further away from the state freight system. In addition, as some urban regions are experiencing residential redevelopment pressures on industrial lands, it is important for cities to balance a mix of freight and non-freight land uses to support a full range of employment opportunities. Local, regional, and state agencies can take action to accommodate the mobility needs of warehousing and other freight land uses, including integrating freight mobility as a criterion in project selection process, adequate capacity and reliable performance of the transportation system, sufficient geometric design and site access to accommodate trucks and rail equipment, and context-sensitive solutions such as form-based or performance-based zoning overlays.¹⁴⁶

New warehousing strategies: The Puget Sound Regional Council (PSRC) designates Manufacturing and Industrial Centers (MIC) to preserve industrial land uses such as manufacturing, transportation, warehousing, and freight terminals.¹⁴⁷ Through monitoring the vital signs of each of the MIC (such as employment, number of facilities, etc.), the PSRC evaluates the success of regional growth programs in preserving the viability of existing freight generating land uses. In addition to public sector land use strategies, companies are also innovating with new warehousing solutions. In 2018, Prologis built the nation’s first multi-level industrial warehouse in Seattle, and Amazon leased this warehouse in 2019. Multi-story warehouses with truck ramps and docks on multiple floors may proliferate as industrial land becomes both scarcer and more expensive, especially in urban areas.¹⁴⁸ Micro-fulfillment centers in urban areas are also being increasingly used, such as for urban e-grocery

¹⁴⁵ Record-Setting Year for Logistics Real Estate, Prologis, February 2022. <https://www.prologis.com/news-research/global-insights/record-setting-year-logistics-real-estate>

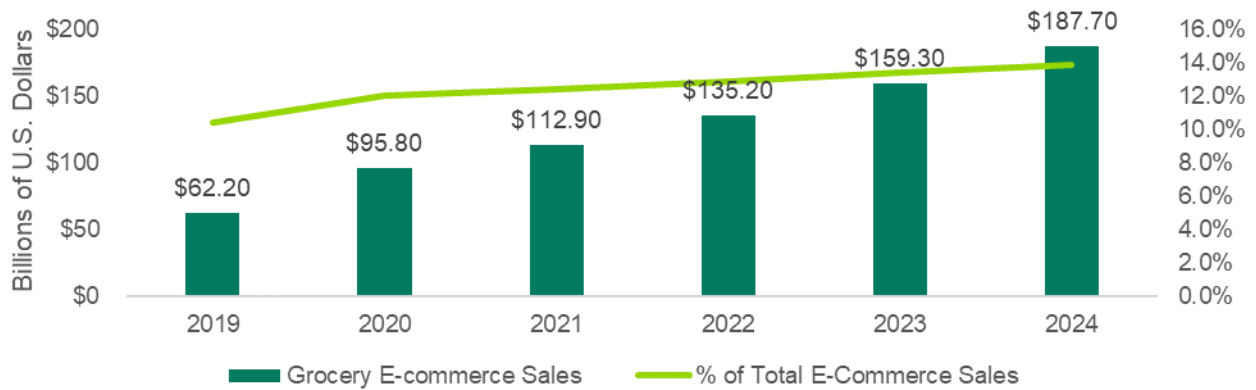
¹⁴⁶ FHWA Freight and Land Use Handbook, USDOT, April 2012. https://dev-nocoe.s3.amazonaws.com/uploaded_files/fhwahop12006-FHWA-Freight-and-Land-Use-Handbook.pdf

¹⁴⁷ Regional Centers Framework Update, Puget Sound Regional Council, March 2018. <https://www.psrc.org/media/3038>

¹⁴⁸ Amazon's new multistory warehouse aims to cut delivery times, *The Wall Street Journal*, Keiko Morris and Jennifer Smith, September 2019. <https://www.wsj.com/articles/amazons-new-multistory-warehouse-aims-to-cut-delivery-times-11568113201>

deliveries, to increase fulfillment efficiency and expedite delivery time to end consumers. Figure 45 indicates that national grocery e-commerce sales may triple between 2019 and 2024.

Figure 45: U.S. grocery e-commerce projected sales, 2019-2024 ¹⁴⁹



Source: In 2021, online grocery sales will surpass \$100 billion, *Insider Intelligence*, February 2021. <https://www.insiderintelligence.com/content/2021-online-grocery-sales-will-surpass-100-billion>

The logistics industry continues to wrestle with a short supply of warehouse workers, especially as demand for warehousing space continues to expand. To improve assembly, inventory, and warehousing, WSDOT and its partners may wish to assess how to improve system efficiency and optimize system use. Some of the potential tactics are also included below.

Potential Strategy and Tactics	
Potential Strategy: Increase system efficiency in order to optimize freight system capacity.	
➔	Improve supply chain forecasting with supply chain partners to minimize inventory waste.
➔	Facilitate supply chain cooperation through formal and informal information exchange channels.
➔	Share truck routing and operational times to enable efficient movements to warehouses and, where possible, rail-serviced facilities.
➔	Prioritize and preserve vacant industrial land located on or near the multimodal freight system for future industrial expansion needs.

E-commerce

E-commerce – The buying and selling of products or services through electronic means - is a \$960 billion industry in the United States.¹⁵⁰ As a replacement for in-person shopping and sales, E-commerce generally takes three major forms:

- **Business-to-consumer:** online shopping websites developed by both traditional brick-and-mortar shops and online-only companies.

¹⁴⁹ In 2021, online grocery sales will surpass \$100 billion, *Insider Intelligence*, February 2021. <https://www.insiderintelligence.com/content/2021-online-grocery-sales-will-surpass-100-billion>

¹⁵⁰ U.S. Census Bureau, “Monthly Retail Trade Report,” 2021, <https://www.census.gov/retail/index.html>

- **Business-to-business:** transactions done entirely online between companies, manufacturers, wholesalers, or retailers.
- **Consumer-to-consumer:** online exchanges between consumers such as Facebook Marketplace, eBay, and other websites.

E-commerce is growing rapidly – 55 percent of Washington residents surveyed responded that they were shopping more online, second only to California. ¹⁵¹

E-commerce has grown rapidly over the last decade thanks to advances in mobile technology, online financial transactions, and logistics services. U.S. retail e-commerce sales grew by 290 percent between 2011 and at the onset of the COVID-19 pandemic in 2020, when online shopping increased rapidly in response to quarantine and business shutdown measures.¹⁵² In 2020, Amazon Logistics delivered over four billion packages in the U.S., representing a 127 percent growth compared to 2019.¹⁵³ Although in-person shopping rebounded in late 2021, e-commerce’s shares of total retail sales held steady at around 13.0 percent at the end of 2021. Figure 46 illustrates these trends.

Figure 46: U.S. e-commerce sales as a portion of total retail sales, 2011-2021



Source: CPCS analysis of Federal Reserve Bank of St. Louis data, 2021. <https://fred.stlouisfed.org/series/ECOMPCTSA/>

One of the notable trends of e-commerce is that consumers are increasingly demanding shorter delivery times, such as one-day and same-day delivery from online retailers, as evidenced from the increasing number of ultrafast grocery platforms.¹⁵⁴ A large percentage of Amazon’s 112 million Prime subscribers use the service for its fast delivery benefits.¹⁵⁵ Retailers are also partnering with on-demand delivery providers such as DoorDash or Uber’s Postmates for fast delivery.

COVID-19’s impact on E-Commerce

E-commerce was growing fast before the COVID-19 pandemic began in 2020. The pandemic accelerated e-commerce growth, as it pushed more U.S. consumers to shop online more frequently. Three notable changes in e-commerce activity during the pandemic included:

¹⁵¹ Nearly Half of Americans are Making More Online Purchases Amid Pandemic, Lending Tree, Devon Delfino, October 2020. <https://www.lendingtree.com/personal/more-online-purchases-study/>

¹⁵² CPCS analysis of Federal Reserve Bank of St. Louis data, 2021. <https://fred.stlouisfed.org/series/ECOMPCTSA/>

¹⁵³ Number of packages delivered by Amazon Logistics in the United States from 2018 to 2020 (in billion packages) September 2022. <https://www.statista.com/statistics/1178979/amazon-logistics-package-volume-united-states/>

¹⁵⁴ Amazon launches same-day delivery from some brick-and-mortar retail brands, September 2022. <https://www.cnn.com/2022/08/01/amazon-launches-same-day-delivery-for-some-retail-brands.html>

¹⁵⁵ Why do eCommerce Marketplaces have Fast Delivery Programs? September 2022. <https://www.kaspien.com/blog/fast-shipping-for-ecommerce/>

E-Commerce reaching a wider range of consumers: Prior to 2019, e-commerce shopping had traditionally been used by individuals with more disposable income. During 2020 and 2021, consumers increasingly turned to e-commerce for essential goods from groceries, toilet paper, cleaning supplies, and other core consumer products. As a result, a wider social and economic range of consumers began using e-commerce to fulfil their purchasing needs. For example, online grocery sales increased 54 percent from 2019 to 2020, with online grocery spending expected to surpass 100 billion in 2021.*

Changes in consumer spending habits: During the pandemic, demand for consumer goods (e.g., hardware/home improvements, electronics, etc.), surged as consumers replaced their spending on services (such as dining out and travel) with spending on material purchases such as furniture. This substitution in spending was supported by e-commerce. Economic uncertainty during the pandemic also affected consumer spending behavior – many consumers avoided spending on big-ticket items during COVID-19, with auto sales falling to their lowest levels since the fuel crisis in the 1980s. Of those who did not lose their ability to work in 2020, 40 percent to 45 percent of 18- to 49-year-old consumers stated they saved more money during work-from-home. This was likely a combination of fewer discretionary purchases and federal stimulus checks. Over half of consumers under the age of 50 postponed a major purchase (\$500+) due to COVID-19 and the majority of them expected to make these purchases in 2022.**

Disrupted supply chain: The pandemic significantly disrupted retailers’ supply chain, causing inventory shortages and more out-of-stock messages since 2020. Consumers encountered 60 billion out-of-stock messages from online retailers between March 2020 and February 2022 and are now likely to see an out-of-stock message on one out of every 59 product pages, a 235 percent increase compared to before the pandemic.***

* Source: In 2021, online grocery sales will surpass \$100 billion, Insider Intelligence, February 2021.

<https://www.insiderintelligence.com/content/2021-online-grocery-sales-will-surpass-100-billion>

**Source: The Nielsen Total Audience Report: Advertising Across Today’s Media”, Nielsen, March 2021.

<https://www.nielsen.com/us/en/insights/article/2020/the-nielsen-total-audience-report-hub/>

*** Source: Coronavirus pandemic adds \$219 billion to U.S. ecommerce sales in 2020-2021.

While purchases increasingly occur online, e-commerce deliveries have real-world transportation and environmental impacts through increased traffic and emissions from delivery vehicles, changing last-mile delivery patterns, changing land use needs, new facility configurations, and vertical integration.

Impacts of e-commerce on freight infrastructure

E-commerce activity has produced significant impacts on freight infrastructure at both the statewide and local level. Statewide or regionally, increasing volume of e-commerce deliveries increase overall freight traffic. On a more local level, trucks completing the “last mile” of e-commerce delivery trips to consumers and businesses can add to congestion and compete for curb space on local streets.

Increased delivery activity and freight traffic: The average number of deliveries households receive per month has more than doubled from 2009 to 2017.¹⁵⁶ In addition to the general traffic created by final deliveries, e-commerce activity creates additional freight traffic through less-obvious factors like returns and failed deliveries. For example, 21 percent of online orders are returned and more than 10 percent of orders are not delivered on the first attempt and a single online order may result in multiple delivery trips.^{157,158} The widespread adoption of one-day or same-day delivery services has also contributed to increased delivery traffic as the time-sensitive nature of these

¹⁵⁶ National Household Travel Survey (2019). <https://nhts.ornl.gov/>

¹⁵⁷ A more than \$761 billion dilemma: Retailers’ returns jump as online sales grow, September 2022.

<https://www.cnn.com/2022/01/25/retailers-average-return-rate-jumps-to-16point6percent-as-online-sales-grow-1/index.html>

¹⁵⁸ Research reveals the cost of failed deliveries, September 2022. <https://www.enterprisetimes.co.uk/2021/03/09/research-reveals-the-cost-of-failed-deliveries/#:~:text=Failed%20deliveries%20a%20growing%20problem&text=99%25%20of%20eCommerce%20organisations%20own,delivered%20on%20the%20first%20attempt.>

deliveries means that rapidly-fulfilled orders are less likely to be consolidated into full truckloads with other packages for maximum delivery efficiency.

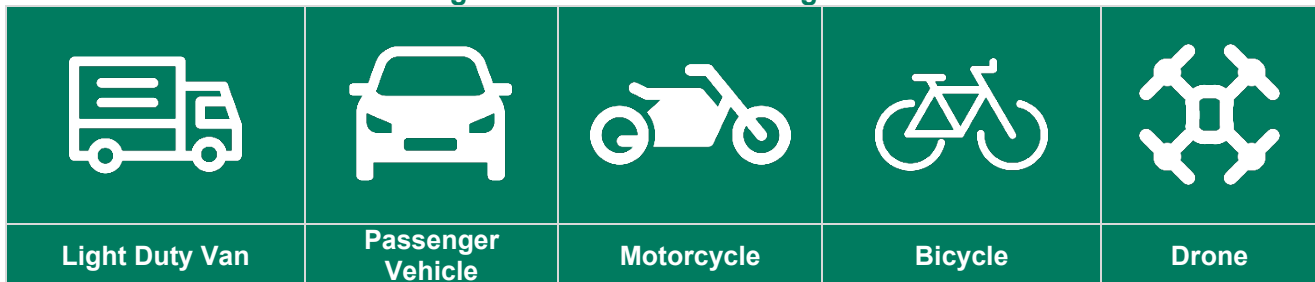
It is important to note that e-commerce deliveries also have the potential to replace personal vehicle trips for shopping. The convenience of e-commerce shopping may also make it easier for residents to live without cars. Nonetheless, an increased demand for e-commerce shipping services has resulted in an increase in freight delivery activity. In turn, this increased delivery activity has grown the volume of truck traffic traveling to and from warehouses and distribution centers and in many areas that traditionally did not have much truck traffic.

Increased neighborhood congestion: The “last-mile” of e-commerce deliveries to their final destination is one driver of congestion on local streets in many cities. These local deliveries include activities such as parcel pickups and drop-offs at homes and businesses and product deliveries to stores. This “last-mile” for freight delivery is frequently the least efficient portion of an entire trip due to inefficient access to delivery locations such as apartments and single-family homes. Local truck deliveries during daytime business hours both contribute to, and are affected by, congestion on neighborhood streets. This concern is particularly important in dense urban areas that may have a high demand for delivery services, but also have limited parking space.

The traffic disruptions associated with these deliveries, as a result of loading and unloading trucks blocking traffic lanes, bike lanes, or sidewalks, or drivers circling city blocks in search of proper parking, have negative impacts on productivity, quality of life, and air quality.¹⁵⁹ The COVID-19 pandemic exacerbated these conflicts as overall e-commerce activity increased, and the overall movement of goods shifted from centralized in-store purchases to dispersed at-home deliveries.

Deliveries and impacts at the curbside: With the growth of e-commerce, unloading or loading delivery vehicles are increasingly in conflict with other uses of curb space on local streets, such as street parking, bus stops, bicycle lanes, and passenger pickups and drop offs for taxis and ridesharing services. Many urban roadway configurations are also not designed for large volumes of trucks, making truck operations in some areas difficult. To make urban freight delivery more efficient, companies are experimenting with “micro-freight” modes – light-duty vans, passenger vehicles, motorcycles, and bicycles (Figure 47).

Figure 47: Urban micro-freight modes



Source: WSDOT

Innovations in Curbside Management

The city of Seattle installed sensors on central business district curbs to understand the duration of delivery parking. This information was used to establish appropriate fee schedules and dynamic pricing for use of

¹⁵⁹ NCHRP Report 49 Understanding and Using New Data Sources to Address Urban and Metropolitan Freight Challenges, Transportation Research Board (TRB), 2019. <https://www.ncfrp49-newfreightdata.com/>

downtown curb space. The City also sets priorities for curbside functions based on surrounding land uses. Other cities across the U.S. and Canada are also seeking to encourage off-street loading bays through code changes and other form-based ordinances for industrial developments.

Impacts of e-commerce on land use

The increased demand for e-commerce shipments has also impacted land use: additional warehouses and distribution centers with varying size and functional specialization have been developed to support increased e-commerce activity. The significant land use impacts of significant freight facilities such as warehouses and distribution centers mean that the impacts of these developments also need to be considered by regional and local planning partners.

Large warehouses and distribution centers at the edge of urban areas: One of the notable impacts of e-commerce on land use includes the creation of new, extremely large warehouses and distribution centers at the edge of urban areas. The creation of new freight facilities is increasing truck traffic in areas that may not have been initially designed to accommodate large volumes and contributing to congestion on first/last-mile connections between warehouses and major highways.

Amazon's mega distribution centers in Spokane County

In June 2020, Amazon opened its first 640,000 square-foot mega distribution center in West Plains (GEG1), Spokane. About a year later, the Seattle-based e-commerce giant opened the second mega fulfillment center of 1.3 million square feet in Spokane Valley (GEG2). The large fulfillment centers will enable faster shipping times for customers.

Twelve mega distribution centers have been built since 2014 or are in development in Washington. Six of these centers are or will be located in the Puget Sound region, while two are located in southwest Washington (Clark County). The remaining new mega distribution centers are geographically dispersed in south central Washington (Yakima, Benton, and Adams Counties), and Spokane.

“Micro” distribution centers in urban neighborhoods: The pressure to meet promises of reliable and rapid delivery has pushed e-commerce companies to create small “micro” distribution centers closer to consumers. The purpose of these facilities is often to facilitate same-day delivery of commonly purchased goods such as groceries. These “micro” distribution centers and package lockers are emerging in dense urban areas to serve specific neighborhoods. However, creation of these facilities can also create localized increases in truck traffic in areas not originally intended to serve large volumes of trucks.

Innovations in urban logistics facilities

A micro hub is a small, central drop-off and pick-up location for goods and services that effectively serves as an urban consolidation center or a delivery transfer point. Seattle piloted a “common micro hub” to enable more efficient last-mile delivery by zero or near-zero emission vehicles and alternative modes of freight movements, such as electric cargo bikes. The pilot found that this type of micro hub has the potential to reduce energy consumption, noise pollution, congestion, and cost for last-mile freight delivery. The University of Washington's Urban Freight Lab piloted an open network locker system in Seattle's Belltown to reduce delivery vehicle dwell time and carbon emissions and increase the productivity of load/unload parking spaces.

Increased demand for air cargo facilities: The rapid shipping speed of air cargo is key to the success of e-commerce companies that promise fast delivery. E-commerce was estimated to account for 18 percent of air cargo volumes in 2019, and this share is expected to rise to 22 percent in 2022.¹⁶⁰ With Washington's air-dependent commodity tonnage projected to double from 2022 to 2050, the state is expected to see an increased demand for air cargo facilities. For example, the Spokane International Airport (GEG) Business Park is a key air cargo transshipment and distribution center and is adding new facilities to fulfill e-commerce air cargo needs.¹⁶¹

Emerging e-commerce freight technologies

Government agencies, universities, and companies in Washington are experimenting with innovative solutions to adapt to the changing landscape of freight delivery and land use under the impact of e-commerce. These solutions range from the adoption of sustainable modes of urban cargo delivery and smart locker systems to innovations in drone and autonomous driving technologies, and more. If successful, these innovations may not only have the potential to mitigate some of the negative impacts of e-commerce growth on freight infrastructure and land use, but also unlock new opportunities for Washington state's economy and environmental sustainability.

E-cargo bikes: In early 2021, UPS conducted a pilot for a Seattle-based zero-emission hub for last-mile deliveries, in collaboration with the University of Washington Urban Freight Lab. The study found that an e-cargo bike can replace a truck mile for a mile, and the use of e-cargo bikes reduced CO2 emissions by 30 percent for each package delivered. Networked neighborhood delivery hubs were also effective in reducing truck traffic.¹⁶²

Open network locker system: In August 2020, the University of Washington's Urban Freight Lab opened a package pick-up solution in Seattle's Belltown to reduce delivery vehicle dwell time and carbon emissions and increase the productivity of load/unload parking spaces through a U.S. Department of Energy research project. The solution functions as an open network locker system where all retailers and delivery companies can drop off packages in smart lockers for residents, dwellers, workers, and commuters.¹⁶³

Sidewalk drones: In 2019, Amazon tested delivery robots in Snohomish County that were able to maneuver around sidewalk obstructions to deliver packages to customers. The pilot occurred during daylight hours and robots were accompanied by an employee. Personal Delivery Devices (PDDs) like these drones may become more commonplace in the future, though they are still being studied across the country. Namely, some studies are focusing on ADA requirements to ensure that persons in wheelchairs have sidewalk priority over drones as well as equitable distribution of the benefits of

¹⁶⁰Is E-commerce the air cargo industry's one bright spot? The STAT Trade Times. April 2022. <https://www.stattimes.com/latest-news/is-e-commerce-the-air-cargo-industrys-one-bright-spot-1345029>

¹⁶¹Amazon to lease air cargo facility at Spokane International Airport. The Spokesman Review. March 2021. <https://www.spokesman.com/stories/2021/mar/18/amazon-to-lease-air-cargo-facility-at-spokane-inte/>

¹⁶²"The Seattle Neighborhood Delivery Hub Pilot Project" The Seattle Neighborhood Delivery Hub Pilot Project, University of Washington, 2019. http://depts.washington.edu/sctlctr/sites/default/files/research_pub_files/UFL-Sea-Neighborhood-Delivery-Hub_Final-Report.pdf

¹⁶³ University of Washington, "Urban Freight Lab Opens Package Pick-Up Solution in Seattle's Belltown" University of Washington Supply Chain Transportation & Logistics Center, August 2020. ¹⁶³ Urban Freight Lab Opens Package Pick-Up Solution in Seattle's Belltown, University of Washington Supply Chain Transportation & Logistics Center, August 2020. <https://depts.washington.edu/sctlctr/news-events/announcements/belltown-lockers>

PDD technologies.^{164,165} There is a need for the public sector to be a part of planning efforts while facilitating new freight innovation.

Autonomous trucks: Autonomous technologies can lead to improved road safety, increased operational efficiency, reduced labor costs, increased fuel efficiency, and reduced impacts on the environment.¹⁶⁶ An increasing number of stakeholders are actively involved in bringing this technology to on-road commercial vehicles—especially tractor-trailers. Current challenges in the development of autonomous trucking include cost, data and security, liability, communication networks, government support, and consumer acceptance.¹⁶⁷

Washington state is working on assessing the potential impacts autonomous vehicles (AV) will have on its state and seeks to identify policy and regulatory and public education needs to prepare for the operation of AVs on their roadways in the future. In 2018, the Washington Legislature directed the Washington State Transportation Commission (WSTC) to convene a work group to gather information and develop policy recommendations to accommodate and prepare for AVs on public roadways.¹⁶⁸ EO17-02, signed by the Governor, allows companies to self-certify themselves to conduct, test, and operate autonomous vehicles on the state’s roads. AVs are being tested on the state’s roadways today, with BMW of North America LLC, NVIDIA Corporation, Waymo LLC, and Zoox Inc being self-certified.¹⁶⁹ WSDOT also has a Connected and Autonomous Technologies (CAT) working group to support the safe operation of these technologies on public roadways in the state.

PACCAR, a global leader in the manufacturing of light-, medium-, and heavy-duty trucks, based out of Bellevue, Washington, has teamed up with Aurora, a leading autonomous driving technology company, and FedEx, to pilot autonomous trucks in linehaul trucking operations.¹⁷⁰ This pilot is currently hauling FedEx loads between Dallas and Houston operating autonomously with a backup driver. Amazon has also ventured into autonomous trucks by ordering 1,000 autonomous truck-driving systems from self-driving trucking startup Plus.¹⁷¹

To improve final delivery to consumers and businesses, WSDOT will continue to support local jurisdictions with last-mile freight planning support and best practices. Potential tactics and suggestions are included below.

Potential Strategy and Tactics

Potential Strategy: Support local jurisdictions with last-mile freight planning support and best practices.

¹⁶⁴ Regulating Personal Delivery Devices, H.B. 1325, Washington 66th Legislature, 2019. <https://app.leg.wa.gov/billsummary?BillNumber=1325&Year=2019>

¹⁶⁵ Personal Delivery Devices, Minnesota Department of Transportation, February 2021. <https://dot.state.mn.us/automated/docs/personal-delivery-device-white-paper.pdf>

¹⁶⁶ Automation in the Long Haul: Challenges and Opportunities of Autonomous Heavy-Duty Trucking in the United States pg. 30, International Council on Clean Transportation, Peter Slowik, and Ben Sharpe, March 2018.

¹⁶⁷ Autonomous Trucks: An Opportunity to Make Road Freight Safer, Cleaner and More Efficient World Economic Forum, March 2021, https://www3.weforum.org/docs/WEF_Autonomous_Vehicle_Movement_Goods_2021.pdf.

¹⁶⁸ Autonomous Vehicles 101, Washington State Autonomous Vehicle Work Group, (n.d.), <https://avworkgroupwa.org/AV-101>.

¹⁶⁹ “Autonomous Vehicles: Self-Certification for testing in Washington state, Washington State Department of Licensing, (n.d.). State of Washington DOL, (n.d.). <https://www.dol.wa.gov/vehicleregistration/autonomous-self-cert.html>

¹⁷⁰ PACCAR, Aurora and FedEx Launch Autonomous Truck Commercial Pilot, PACCAR, September 2021.

<https://www.paccar.com/news/current-news/2021/paccar-aurora-and-fedex-launch-autonomous-truck-commercial-pilot/>.

¹⁷¹ Amazon Is reportedly buying 1,000 autonomous truck-driving systems, which could pave the way for one day ditching drivers, Business Insider, Grace Kay, June 2021. <https://www.businessinsider.com/amazon-orders-autonomous-self-driving-semi-truck-delivery-systems-report-2021-6>

- ➔ Integrate urban freight delivery safety considerations such as slowing freight vehicle operators in population centers, improving detection through automation to supplement driver attention, and optimizing turn radius solutions to promote safety and conspicuity for vulnerable users.
- ➔ Develop curbside management strategies to accommodate both commercial and residential deliveries, as well as bicyclists, pedestrians, and passenger vehicle drivers.
- ➔ Harmonize technology solutions to facilitate e-commerce deliveries, including autonomous trucking pilot projects, to better understand cost and infrastructure needs, create a liability framework that can establish under which conditions a truck operator, technology provider, or autonomous system is liable for an incident, and continue monitoring of technology and industry developments with engagement with manufacturers, technology providers, and fleet operators.

Freight workforce shortages

The freight industry continues to wrestle with long-standing workforce shortages across all freight modes.

The aging workforce in Washington, along with other factors such as labor skills and retention challenges, is affecting the state's economy, and in particular, the freight-related industries. The labor shortage resulting from these factors affects every aspect of the freight industry, from inventory levels to supplier costs, shipping schedules, and consumer prices. The resilience of supply chains, which is the ability to prepare for and adapt to unexpected events, is also affected by workforce shortage. An example is the COVID-19 pandemic, which, apart from affecting the market demands and consumer behavior, disrupted the supply chains by exacerbating the workforce issues. These shortages have only become more pronounced during the COVID-19 pandemic and are resulting in inflationary impacts on the economy. The highest levels of need include truck driving and warehousing.

Truck driver shortages have been a challenge in Washington since 2006 and are the number one issue facing the trucking industry according to the American Transportation Research Institute. The American Trucking Association estimates that there is a nationwide shortage of 80,000 drivers that will double by 2030 as the aging workforce retires and relatively fewer people choose trucking as a career.¹⁷² The average driver age in the for-hire, over-the-road truckload industry is 46.¹⁷³ Roughly 54 percent of truck drivers on the road today are 45 years or older.¹⁷⁴ The trucking workforce is one of the oldest workforce groups in the country and only getting older. With the average retirement age for truck drivers estimated to be between 62 to 67 years old, there will be 600,000 truck drivers retiring between 2019 and 2028.¹⁷⁵ In other words, the industry needs to find nearly 70,000 new truck drivers every year just to fill the void left by drivers retiring. Driver shortage is most acute in the longer-haul, for-hire truckload market and affects the reliability and the cost of trucking: without enough drivers,

¹⁷² ATA Chief Economist Pegs Driver Shortage at Historic High, American Trucking Association, October 2021, <https://www.trucking.org/news-insights/ata-chief-economist-pegs-driver-shortage-historic-high>

¹⁷³ Truck Driver Shortage Analysis 2019, American Trucking Associations, July 2021, <https://www.trucking.org/sites/default/files/2020-01/ATAs%20Driver%20Shortage%20Report%202019%20with%20cover.pdf>

¹⁷⁴ Labor Force Statistics from the Current Population Survey. U.S. Bureau of Labor Statistics, August 2022, <https://www.bls.gov/cps/cpsaat18b.htm>

¹⁷⁵ How Aging Truck Drivers Impact the Industry, DriveTeks, December 2020, <https://driveteks.com/how-aging-truck-drivers-impact-the-industry/>

companies may have to pay a premium to move goods or may be unable to move them on schedule.¹⁷⁶

Driver retention is impacted by salary, job satisfaction, frequency of being at home, availability of amenities, transportation issues, and public respect. Specifically, driver amenities include access to food and beverages, places to pull off the road for a quick break, WiFi access, restroom availability, and other needs. Truck parking areas are also sometimes closed due to crowding, illegal activities, homelessness, shortage of rest area workers, and lack of security. Closure of roads, pavement quality, and traffic bottlenecks affecting the ability of drivers to complete trips within hours of service (HOS) requirements also affect driver retention.

Licensing for truck drivers can also discourage new entrants into the workforce. Truck drivers must possess a commercial driver's license (CDL) and insurance and take background checks to operate a commercial vehicle. In some industries, insurance carriers impose other restrictions on who can drive. During the COVID-19 pandemic, many state licensing offices have been closed or faced extensive backlogs. The new federal Safe Driver Apprenticeship Pilot Program, as part of the Infrastructure Investment and Jobs Act, in November 2021 will allow 18-year-olds and above to drive semi-trucks across state lines with a state-issued commercial driver's license, under the direct supervision of an experienced driver. However, increased attention to safety may be warranted as some stakeholders are concerned with inexperienced drivers operating commercial vehicles.

The ongoing workforce shortages for freight-related professions also present opportunities for new groups such as women and people of color to enter the freight workforce, but further work may be needed to educate groups like these about career opportunities in these industries and the educational pathways into the industry. WSDOT’s own strategic plan has significant goals of workforce development and diversity, equity, and inclusion, and the department has engaged in multiple efforts to support increasing women and diverse communities’ participation in the transportation workforce. To address truck driver workforce issues, the Washington Trucking Association (WTA) and its partners may consider facilitating growth in the workforce by increasing diversity, removing barriers to training, and providing more training options. Some of the potential tactics to accomplish this are included below.

Potential Strategy and Tactics
Potential Strategy: Facilitate growth in the freight system workforce through increasing diversity, removing barriers to training, and providing more training options.
➔ Expand the number of community colleges offering truck driver training programs.
➔ Establish a truck driver tuition revolving loan program, similar to Oregon’s program.
➔ Prioritize inclusion of women, BIPOC, and younger truck drivers into the workforce.
➔ Recommend implementation of overtime pay to truck drivers.
➔ Coordinate with regulators on the classification of independent contractor warehousing workers.
➔ Explore opportunities to scale insurance and licensing requirements to remove barriers for new drivers and small trucking companies, while maintaining safety standards.

¹⁷⁶ A Forecast of The Trucking Crisis As We Head Into 2022. Forbes, March 2022. <https://www.forbes.com/sites/forbestechcouncil/2022/03/30/a-forecast-of-the-trucking-crisis-as-we-head-into-2022/?sh=1537295d4475>

Reference Chapter A: Potential strategy and tactics summary

Policy Goal Area: Preservation	
Trend Area	Potential Strategy and Tactics
Roads	<p>Potential Strategy: Continue to invest in road preservation and encourage partners to invest in road preservation.</p> <p>Potential Strategy: Continue to include freight traffic volumes and FGTS designations in prioritization of preservation projects.</p>
	<p>➔ If full preservation funding is not available, WSDOT will need to continue making trade-off decisions such as prioritizing preservation activities using the FGTS designations (T1, T2, T3, T4, and T5) and speed limits.</p>
	<p>➔ Proactively rehabilitate and maintain pavements and bridges on the National Highway Freight Network and critical urban/rural freight corridors, with priority given to assets with higher daily truck traffic.</p>
	<p>➔ Focus on enforcement of truck weights through weigh-in-motion e-screening technology.</p>
State Rest Areas	<p>➔ Develop and share forecasts of freight volumes to better understand maintenance/operation needs.</p>
	<p>Continue to raise awareness of the need for increased state investment in maintenance and preservation.</p>
	<p>➔ Reduce maintenance backlog at safety rest areas, with priorities given to facilities on National Highway Freight Network and critical urban/rural freight corridors to ensure the efficient movement of goods.</p>
Freight Rail	<p>➔ Consider public-private partnerships to supplement public funding for safety rest areas to ensure trucks have safe and secure locations for truck parking.</p>
	<p>Preserve the condition of state- and publicly-owned and operated rail lines and continue to provide funding for preserving other rail lines through FRIB and FRAP</p>
	<p>➔ Seek to preserve abandoned rail lines such as through railbanking for “rails-with-trails” projects to allow the possibility of rebuilding a line for rail service in the future.</p>
Maritime	<p>➔ Work with short lines to address deferred maintenance and compatibility with Class I railroad, especially to increase short line track capacity to 286,000 pounds.</p>
	<p>➔ Improve the condition of the state-owned PCC rail system through rehabilitation and improvement projects.</p>
	<p>Potential Strategy: Continue to maintain navigable waterways and sufficiently maintained public ports as well as preserve, maintain, and enhance state and interstate route access to seaports.</p>
Aviation	<p>➔ Support federal prioritization of maintenance dredging of the lower Columbia River, Grays Harbor, Swinomish Channel, and the Seattle and Tacoma harbors while monitoring environmental impacts.</p>
	<p>➔ Collaborate with public ports to ensure sufficient maintenance of docks, piers, bulkheads, anchorages, dolphins, and other infrastructure.</p>
Aviation	<p>Maintain airport facilities at established airport classification level and preserve, maintain, and enhance state and interstate route access to airports</p>
	<p>➔ Legislatively direct aviation taxes and fees to fund investments in airport infrastructure.</p>

	→ Plan for new capabilities to meet emerging requirements, including next-generation technologies and on-airport air cargo facilities.
	→ Support aviation capacity as a resource from the Legislature and WSDOT by preserving, protecting, and enhancing capacity through strategies focusing on airport operations, technology, safety, and land use.
	→ Emphasize as a priority and continue partnering with the FAA, Washington State Transportation Commission, and others to develop viable solutions to provide adequate future capacity to accommodate growth in air cargo demand.
	→ Continue to provide funding support for pavement, including preservation and maintenance, to continue stewardship of the most critical infrastructure element of the airport system.

Policy Goal Area: Safety	
Trend Area	Potential Strategy and Tactics
Highway	Implement the Target Zero plan with focus on truck-involved fatalities and serious injuries.
	→ Continue analysis of summary crash data to identify focus areas and priorities, assess individual fatalities and serious injuries to identify factors present, assess roadway networks for the presence of factors, and develop prioritized roadway locations where such factors are present.
	→ Identify countermeasures to address prioritized locations, such as lane departures, intersections, etc.
	→ Maintain traffic safety culture and carrier safety management with the freight industry through collaborations with Washington Trucking Association, Washington State Patrol’s Commercial Vehicle Enforcement Bureau, and individual trucking companies.
	→ Increase enforcement of heavy truck inspections, high crash corridors, and the Ticket Aggressive Cars and Trucks (TACT) Program.
	→ Increase education and outreach to heavy truck drivers, passenger car drivers, and motorcycle drivers.
	→ Implement transportation systems management and operations (TSMO) strategies to maximize the efficiency, safety, and utility of freight transportation infrastructure.
	→ Address low-cost enhancement projects that improve safety, such as signage for low-height bridges.
	→ Continue to research causes of truck-related crashes, including through multistate corridor partnerships.
Truck Parking	Expand truck parking capacity by keeping existing state rest areas open and facilitating the development of new truck parking sites statewide.
	→ Establish and facilitate a Truck Parking Implementation Workgroup, comprised of legislative, agency, community, and industry leaders, to maintain focus on the JTC Action Plan and assure accountability for implementation.
	→ Identify most-feasible sites for truck parking facilities.
	→ Better utilize existing parking in urban areas, including identifying and evaluating opportunities to expand truck parking at safety rest areas.
	→ Coordinate with the city of North Bend and PSRC to evaluate truck parking feasibility on city land adjacent to I-90.

Policy Goal Area: Safety	
	➔ Better utilize existing infrastructure along mountain passes and convert vacant land owned by WSDOT near Snoqualmie ski areas to truck parking facilities.
	➔ Develop a concept of operations to expand the pilot TPAS (truck parking availability system) program across the state and disseminate real-time truck parking information through various applications.
	➔ Coordinate with other state, regional, and local planning partners to integrate truck parking into all planning efforts and decision-making processes.
	➔ Collaborate with neighboring states and pursue opportunities for pooled fund study with California and Oregon to address truck parking issues.
Freight Rail	Work with relevant authorities to address rising cases of trespassing, at-grade rail crossing collisions, rail cargo theft, and sabotage.
	➔ Study at-grade rail crossing traffic control system needs, with minimal treatments, including crossbucks, emergency notification system signs, and advance warning signs, along with stop/yield signs for crossings that do not have flashing lights and/or gates.
	➔ Develop a federally required rail crossing safety action plan and use Section 103 funding to invest in crossing upgrades.
	➔ Work with local jurisdictions to submit rail cargo theft data to the Uniform Crime Reporting system.
Maritime	Work with relevant federal agencies to facilitate continuous improvement in maritime safety and security.
	➔ Work with federal agencies to pilot maritime safety and security innovations in Washington and along its coastal and inland waters.
	➔ Facilitate port security measures such as regular security patrols, video surveillance of port roadways and terminals, restricted gate access, intrusive detection on port facilities, development of a robust incident reporting program, and ensure close collaboration with emergency responders.
Hazardous Materials	Work with regulated community and others to minimize the environmental threat of oil spills.
	➔ Study human procedural and organizational factors to minimize the environmental threat of oil spills from vessels, railroads, pipelines, and oil-handling facilities.
Complete Streets	➔ Track crude-by-rail movements throughout the state, disseminate information to local and tribal first responders and ensure preparedness for oil spill-related emergencies.
	Coordinate between WSDOT Rail, Freight, and Ports Division and Active Transportation Division to support incorporation of freight consideration in Complete Streets project implementation, when relevant.

Policy Goal Area: Mobility	
Trend Area	Potential Strategy and Tactics
Capacity	Assess methods to increase capacity on the multimodal state freight system, improve resiliency, and relieve freight bottlenecks.
	→ Prioritize mitigation of freight bottlenecks with an emphasis on the system: focus on improving flows on key routes rather than on individual bottlenecks (in other words, mitigating two medium bottlenecks on a major freight corridor may be more impactful than removing a single, large bottleneck elsewhere).
	→ Deploy technology that can monitor and share real-time travel times along various high-volume segments of the freight system.
	→ Consider developing a system resiliency plan with a planning grant through the Bipartisan Infrastructure Bill § 176. Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) program.
	→ Maintain/improve incident response programs to minimize nonrecurring congestion and improve reliability, including snow and storm debris removal.
	→ Develop corridors for overweight and oversize freight. Coordinate with regional work to establish and maintain region-wide, multimodal high, wide, and heavy routes.
	→ Facilitate growth in rail demand and support infrastructure development to allow operation of longer trains, train speed adjustments, directional running, removal of pinch points to allow for double-stack service and oversize cargo, and expansion of industry, yard, and terminal facilities.
	→ Lead, convene, and support work to identify needs and opportunities for alternative modes/shipping options; analyze value propositions; and secure funding (such as extending development of M-5).
	→ Continue and expand programs such as the Puget Sound Gateway that improve access and reliability for freight routes accessing maritime, air, and rail terminals, as well as logistics facility clusters.
	→ Partner with local jurisdictions, ports, airports, and others to deploy technology and maximize existing and new capacity to improve truck parking at and near these facilities.
→ Explore the viability of an inland port east of the Cascades to reduce truck movements in/out of the Northwest Seaport Alliance.	
Connectivity	Support infrastructure projects that maintain and enhance Washington shipper access to domestic and global markets.
	→ Partner with local and regional planning entities to identify places where existing freight routes now or soon could put freight in competition with other needs for limited capacity and develop solutions. Share lessons learned and develop case studies with regional and local entities across the state.
	→ Focus freight connectivity investments by using the Freight and Goods Transportation System’s designed first/last mile freight connectors.
	→ Develop funding programs or partnerships to help local ports, airports, economic development, and other agencies build transportation and other necessary infrastructure to unlock vacant, developable land on or near the freight system.
	→ Engage with regional and local planning and economic development agencies on freight needs. Support them in including intermodal freight connections in their planning activities and improve intermodal connector routes to ensure routes are designed for expected freight volumes.
→ Support development of special connectivity corridors and services such as the Washington Grain Train and the High, Wide, and	

	Heavy Corridor.
	→ Coordinate with British Columbia, Oregon, and federal partners to ensure Washington shippers have access to freight facilities in these locations.

Policy Goal: Environment

Trend Area	Potential Strategy and Tactics
Weather, Natural Disasters, and Resiliency Impacts	Develop a plan to address transportation assets and system vulnerabilities to current and future disruptions. Improve freight resiliency planning and develop freight resiliency approaches, techniques, and effective practices for implementation.
	Continue to participate in inter- and intra-agency planning coordination to amplify freight resiliency planning effectiveness.
	→ Improve enterprise-wide resilience through enhanced collaboration, training, and information dissemination to the broader freight community.
	→ Develop freight-specific climate vulnerability assessments to understand how supply chains shift under a changing climate and how the state should adapt its strategies to address and reduce the risk of hazards along freight corridors.
	→ Partner with local agencies to seek federal grant programs for freight resiliency and climate adaptation, such as the Building Resilient Infrastructure and Communities (BRIC) program or the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT).
Greenhouse Gas Emissions	Facilitate the replacement and upgrading of vehicles and technologies to reduce GHG emissions.
	→ Conduct statewide analysis to evaluate modal costs/benefits related to pollutant emissions, travel time, cost, and overall efficiency across all freight modes.
	→ Promote U.S. EPA SmartWay program to freight stakeholders, businesses, and logistics centers to improve supply chain sustainability.
Flooding and Stormwater	Continue to manage stormwater impacts in accordance with regulatory requirements and invest in mitigation measures, including stormwater retrofits to control the flow of and treat stormwater.
	→ Explore opportunities to include value-added stormwater management projects as part of freight investments.
	→ Continue to consider stormwater criteria as part of future National Highway Freight Program solicitations.
Wildlife	Coordinate with relevant authorities on strategies to minimize freight impacts on wildlife.
	→ Improve fish passage given existing and projected future stress to fish populations through highway improvements or route changes, per WSDOT’s Fish Barrier Correction Program.
	→ Construct wildlife corridors or passages to increase habitat connectivity and improve wildlife resilience to climate change while reducing road disruptions and incidence of wildlife mortality.
	→ Coordinate with the National Oceanic and Atmospheric Administration (NOAA) Fisheries and the U.S. Coast Guard on strategies to address vessel strikes.

Environmental Justice	Prioritize investments to mitigate negative freight impacts in areas where residents have been disproportionately impacted.
	→ Collaborate with community groups to identify opportunities for improved air quality through transportation system investments.
	→ Coordinate with local jurisdictions on industrial land-use decisions and community impacts, with specific evaluation of proposed decisions and their relationship to historically overburdened communities as identified in the Washington State Health Disparities tool.
	→ Coordinate with local jurisdictions to define, identify, and map preferred truck routes and focus resources on improving the efficiency, capacity, and condition of these routes to support freight movements towards minimizing or reducing further impacts in environmental justice communities.
	→ Consolidate loads and logistics, especially in congested urban areas.
	→ Mandate off-hour delivery and/or schedule during non-peak hours.
	→ Prioritize potential below or above-grade rail line crossing improvements at major intersections with main arterial roads.
	→ Create a screening tool to prioritize funding for natural gas or electric fleet programs along major freight corridors that traverse communities where residents have been disproportionately impacted by air quality.
	→ Coordinate with local jurisdictions to establish zero-emission delivery zones in overburdened communities.
	→ Coordinate with ports to incentivize and negotiate with port operators to use and require low or no-emission equipment within their operations and of their operators.
	→ Retrofit highways and roads with upgraded infrastructure to capture stormwater runoff.
	→ Coordinate with local jurisdictions to prioritize FRA “Quiet Zone” approvals at major railroad crossings among overburdened communities.
	→ Design facility flow and loading areas to minimize the use of OSHA-required backup signals and idling.
	→ Coordinate with local jurisdictions to identify freight routes with safety countermeasures that supports a safe system approach by protecting all roadway users, particularly pedestrians, bicyclists, and persons with disabilities, and to implement strategies such as traffic calming measures to deter trucks from using residential streets.
	→ Create a multilingual truck driver education campaign to increase driving safety awareness, particularly when sharing road right-of-way with pedestrians, bicyclists, and persons with disabilities.
	→ Prioritize opportunities to improve multimodal connectivity when investing in freight routes, such as improving sidewalks, bicycle facilities, and lighting on or adjacent to underpasses and bridges.
	→ Improve at-grade rail crossing safety technology, signage, and design to protect drivers, pedestrians, persons with disabilities, and bicyclists.
	→ Coordinate with local jurisdictions to improve/define overnight truck parking ordinances and layover areas.
→ Prioritize grant opportunities to improve visual aesthetics of public facilities (e.g., screening, foliage blocking views of truck parking, landscaping along truck routes).	
→ Partner with local jurisdictions and residents to develop infrastructure design guidelines reflective of their communities’ geographic and cultural identities.	

	→ Partner with local jurisdictions and residents to find opportunities to incorporate community art into new or updated facilities (e.g., community-designed murals or mosaic art).
	→ Retrofit lighting to reduce the impact of light and glare on proximate residential areas.
	→ Incorporate other infrastructure improvements (e.g., drainage, electrical, broadband) when making improvements to the freight system.
	→ Evaluate opportunities to relocate existing facilities away for overburdened communities.

Policy Goal Area: Stewardship	
Trend Area	Potential Strategy and Tactics
Funding	Raise awareness of freight funding and financing needs statewide.
	→ Identify alternative project delivery methods and proactively implement methods to raise capital for critical freight projects, such as engaging the private sector on Public-Private Partnership opportunities.
	→ Assist local agencies with funding and financing guidance and support for freight system investments, such as federal discretionary grant funding.
Tribal Relations	Provide local agencies with freight-related funding to address freight system needs through a data-driven prioritization process.
	Consult and coordinate with Tribal Nations on all relevant freight policies, programs, and projects early in the planning process.
Pacific Northwest Collaboration	→ Facilitate earlier consultations within a project schedule to identify issues and allow for strategies to be built into the project, such as small design revisions to reduce impacts to an acceptable level. Early coordination can also develop a higher level of trust and understanding to facilitate good and productive collaboration to identify acceptable mitigation strategies.
	→ Utilize cultural landscape and ethnographic studies to better understand and plan for impacts to resources important to Tribes.
	Collaborate with neighboring states and provinces on all freight decision-making impacting multiple states.
	→ Share and collaborate on investment plans to optimize freight mobility and maximize the impact of funding for capital projects. Align project so that investments in one state/province support investments in a neighboring state/province, particularly when they provide access to key freight and intermodal facilities.
	→ Convene key agencies (state/province DOTs, ports, airports, key government agencies [such as CBP and Canada Border Services]) along with shippers in an organized, PNW regional venue to bring people to the table.
	→ Identify priority regional issues that can be addressed jointly, such as truck parking.
	→ Collaborate on technology and information development and deployment to drive greater innovation and maximize investments, drawing on university and industry expertise to deliver system or industry-specific solutions.
	→ Coordinate and convene planning teams to deliver high-priority strategies and plans, such as a PNW-wide approach to delivering heavy-duty electric charging for heavy-duty trucks (or other alternative fuel approaches).
	→ Provide greater uniformity (to the extent possible) in terms of truck regulations, such as processes and requirements for high,

Policy Goal Area: Stewardship	
	wide, and heavy loads such that shippers and carriers can seamlessly move cargo through the PNW region.
	➔ Support maintenance and improvement of cross-border mobility solutions, such as the U.S.-Canada land and maritime border preclearance program.
	➔ Regular meetings of agency leadership (annually) and of freight offices across the states and British Columbia (twice per year) to discuss, identify, and coordinate on common and multistate/province issues.
	➔ Partner with Oregon, Idaho, other states, and the federal government to pursue development of a national freight strategy similar to Canada and create programs such as Canada’s National Trade Corridors Fund to help with infrastructure investments across freight modes.
State and Local Agency Cooperation	Provide state freight expertise, guidance, data, and support to regional and local agencies.
	➔ Work with regional and local agencies to identify freight data needs and provide processed, validated, ready-to-use data sets for them to use in their freight work.
	➔ Develop mechanisms to support small and mid-sized agencies to identify, study, and develop freight infrastructure, such as providing some level of funding for studies to get them ready for adoption into state and regional modal and transportation improvement plans (in order to make them eligible for state and federal funding).
	➔ Coordinate knowledge and best practice sharing with local planning entities.
	➔ Conduct studies to develop best practices (such as curbside delivery strategies) to be shared with local partners for them to incorporate into their freight planning work.
	➔ Allow local partners to contribute money to help fund studies and research to address common issues.
	➔ Convene a public-sector freight workgroup to share experiences, study and research results, and identify common issues for collaboration. Include leading in-state academic institutions as well as other related state and federal agencies.

Policy Goal Area: Economic Vitality	
Trend Area	Potential Strategy and Tactics
Sourcing	Facilitate engagement with the private sector and public partners to better support multimodal transportation options for shippers.
	➔ Invest in advanced supply chain tracking technologies to better track and optimize freight sourcing, production, manufacturing, and transportation.
	➔ Support state, regional, and local economic development of reshoring strategies.
Warehousing	Increase system efficiency in order to optimize freight system capacity.

Policy Goal Area: Economic Vitality	
	➔ Improve supply chain forecasting with supply chain partners to minimize inventory waste.
	➔ Facilitate supply chain cooperation through formal and informal information exchange channels.
	➔ Share truck routing and operational times to enable efficient movements to warehouses and rail-serviced facilities.
	➔ Prioritize and preserve industrial land located on or near the multimodal freight system for future industrial expansion needs.
E-Commerce	Support local jurisdictions with last-mile freight planning support and best practices.
	➔ Integrate urban freight delivery safety considerations such as slowing freight vehicle operators in population centers, improving detection through automation to supplement driver attention, and optimizing turn radius solutions to promote safety and conspicuity for vulnerable users.
	➔ Develop curbside management strategies to accommodate both commercial and residential deliveries, as well as bicyclists, pedestrians, and passenger vehicle drivers.
	➔ Harmonize technology solutions to facilitate e-commerce deliveries, including autonomous trucking pilot projects, to better understand cost and infrastructure needs, create a liability framework that can establish under which conditions a truck operator, technology provider, or autonomous system is liable for an incident, and continue monitoring of technology and industry developments with engagement with manufacturers, technology providers, and fleet operators.
Workforce	Facilitate growth in the freight system workforce through increasing diversity, removing barriers to training, and providing more training options.
	➔ Expand the number of community colleges offering truck driver training programs.
	➔ Establish a truck driver tuition revolving loan program, similar to Oregon’s program.
	➔ Prioritize inclusion of female, BIPOC, and younger truck drivers into the workforce.
	➔ Recommend implementation of overtime pay to truck drivers.
	➔ Coordinate with regulators on the classification of independent contractor warehousing workers.
	➔ Explore opportunities to scale insurance and licensing requirements to remove barriers for new drivers and small trucking companies, while maintaining safety standards