EVALUATION OF ELECTRONIC ENFORCEMENT OF MOTOR CARRIER COMPLIANCE AND SAFETY

Final Report

SPR 851

RESEARCH

Oregon Department of Transportation

EVALUATION OF ELECTRONIC ENFORCEMENT OF MOTOR CARRIER COMPLIANCE AND SAFETY

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16. Abstract

This study evaluates the implementation of electronic enforcement. A review of electronic enforcement technology was conducted, and best practices of electronic enforcement were documented. Using inspection and violation data, a statewide and site-specific analysis were conducted to determine violations that occurred most often. Upon identification of the most occurring violations, a series of site-specific benefit-cost analyses were conducted to identify electronic enforcement technologies that can be implemented with economic justification. Electronic enforcement technologies to address driver-related violations and vehicle-related violations were considered. The results from the benefit-cost analysis were used to rank-order locations for potential implementation based on the mean return-on-investment over a range of estimated implementation costs. This study concludes by providing a comprehensive conclusion and recommendations.

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SI* (Modern Metric) Conversion Factors
Approximate Conversions to SI Units

Physical Quantity	Symbol	When You Know	Multiply By	To Find	Symbol
Length	n	inches	25.4	millimeters	mm
Length	ft	feet	0.305	meters	m
Length	yd	yards	0.914	meters	m
Length	mi	miles	1.61	kilometers	km
Area	in2	square inches	645.2	square millimeters	mm2
Area	ft2	square feet	0.093	square meters	m2
Area	yd2	square yard	0.836	square meters	m2
Area	ac	acres	0.405	hectares	ha
Area	mi2	square miles	2.59	square kilometers	km2
Volume	fl oz	fluid ounces	29.57	milliliters	mL
Volume	gal	gallons	3.785	liters **	L
Volume	ft3	cubic feet	0.028	cubic meters	m3
Volume	yd3	cubic yards	0.765	cubic meters	m3
Mass	oz	ounces	28.35	grams	g
Mass	lb	pounds	0.454	kilograms	kg
Mass	T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
Temperature (exact degrees)	oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	oC
Illumination	fc	foot-candles	10.76	lux	lx
Illumination	fl	foot-Lamberts	3.426	candela/m2	cd/m2
Force and Pressure or Stress	lbf	poundforce	4.45	newtons	N
Force and Pressure or Stress	lbf/in2	poundforce per square inch	6.89	kilopascals	kPa

*SI is the symbol for the International System of Measurement
** Volumes greater than 1000 L shall be shown in m^3

SI* (Modern Metric) Conversion Factors
Approximate Conversions from SI Units

Physical Quantity	Symbol	When You Know	Multiply By	To Find	Symbol
Length	mm	millimeters	0.039	inches	in
Length	m	meters	3.28	feet	ft
Length	m	meters	1.09	yards	yd
Length	km	kilometers	0.621	miles	mi
Area	mm2	square millimeters	0.0016	square inches	in2
Area	m2	square meters	10.764	square feet	ft2
Area	m2	square meters	1.195	square yards	yd2
Area	ha	hectares	2.47	acres	ac
Area	km2	square kilometers	0.386	square miles	mi2
Volume	mL	milliliters	0.034	fluid ounces	fl oz
Volume	L	liters	0.264	gallons	gal
Volume	m3	cubic meters	35.314	cubic feet	ft3
Volume	m3	cubic meters	1.307	cubic yards	yd3
Mass	g	grams	0.035	ounces	oz
Mass	kg	kilograms	2.202	pounds	lb
Mass	Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
Temperature (exact degrees)	oC	Celsius	1.8C+32	Fahrenheit	oF
Illumination	lx	lux	0.0929	foot-candles	fc
Illumination	cd/m2	candela/m2	0.2919	foot-Lamberts	fl
Force and Pressure or Stress	N	newtons	0.225	poundforce	lbf
Force and Pressure or Stress	kPa	kilopascals	0.145	poundforce per square inch	lbf/in2

For More Information see: https://www.fhwa.dot.gov/publications/convtabl.cfm

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DISCLAIMER

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1.0 INTRODUCTION

Weigh stations are not open at all hours, and employment hours of enforcement personnel has declined from 103.5 FTE in 2010 to 86 FTE in 2021. Due to this, inspections and potential citations for violations are not occurring during these time periods. Implementation of electronic enforcement would enable the Oregon Department of Transportation to monitor truck movement and potential violations when scales are closed. Such enforcement technologies can increase enforcement of safety requirements outlined in the Federal Motor Carrier Administration Regulations (49 CFR Parts 300-399) without the need for additional FTE.

The mission of the Oregon Department of Transportation highlights safety and reliability as top priorities for Oregon's transportation system. Expanding enforcement of commercial freight movement outside of business hours would assess the Commerce and Compliance Division in improving motor carrier safety compliance, as well as areas of non-compliance. Electronic enforcement also has the potential to assist other agency initiatives, such as tolling and infrastructure preservation. With Departments of Transportation across the United States exploring electronic enforcement technologies, there is an opportunity to collect lessons learned and best practices from states that are leading such initiatives.

1.1 STUDY OBJECTIVES

This study aims to identify viable electronic enforcement technologies based on frequently occurring driver- and vehicle-related violations that result in citations. The intent is to assess if implementing an electronic enforcement technology is cost-effective and if investment by the Oregon Department of Transportation should be considered. These objectives are met by completing the following:

- Determine the current state of electronic enforcement in the United States and identify challenges that may exist for implementation by the Oregon Department of Transportation.

- Identify safety improvements and other benefits experienced in states currently using forms of electronic enforcement.

- Learn what worked well and what could be improved from states that are currently implementing some form of electronic enforcement.

- Identify electronic enforcement typologies that would benefit Oregon and locations where implementation should be considered to maximize Oregon's investment.

2.0 STATE OF ELECTRONIC ENFORCEMENT TECHNOLOGY ON SAFETY POLICIES AND INITIATIVES

This chapter provides a summary of a review on safety policies related to electronic enforcement of motor carrier compliance and safety. This summary will provide guidance to understanding approaches and methodologies used, and the feasibility of adopting such policies in Oregon.

2.1 POLAND

Rys (2019) investigated the accuracy of 77 operative weigh-in-motion (WIM) stations by analyzing steering axle load spectra. The study was conducted due to WIM data being used more frequently for varying purposes; thus, the quality needs to be assessed. The objectives of the analysis were: (1) determine the effect of WIM system inaccuracy on axle load spectra and (2) identify factors responsible for inaccurate WIM measurements based on steering axle load spectrum analysis. Data from January 1, 2014, through December 31, 2014, for 77 WIM stations located on motorways and national roads in Poland were used in the study. A total of 54 stations had quartz piezoelectric, and 23 stations had bending beam axle load sensors. The results of the analysis indicated that WIM stations with bending beam sensors are more sensitive to low temperatures and those with quartz piezoelectric sensors are more sensitive to vehicle speed. When air temperature decreases from 25°C to -5°C, the negative bias of axle load spectra equals 5% and 10% for quartz piezoelectric and bending beam load sensors, respectively. For 25% to 35% of cases, the random error increased at lower speeds of 35 km/h (21.75 mi/h) and remains constant at higher speeds of 50 km/h to 90 km/h (31 mi/h to 56 mi/h).

2.2 UNITED STATES

Cambridge Systematics, Inc. (2009) conducted a study for the Federal Highway Administration (FHWA) that focused on strategies for electronic enforcement implementation. The strategies can be used to overcome typical challenges confronting the deployment of virtual weigh stations and other roadside enforcement operations. Cambridge Systematics, Inc. (2009) describe the program support that FHWA needs to provide to jurisdictions looking to deploy virtual weigh stations and other operations, including training resources and funding. The major objective of the implementation plan was to make roadside enforcement more efficient and effective by facilitating the deployment of states' technology. For this study, FHWA and Cambridge Systematics interviewed stakeholders from nine states and conducted site visits in four of the states that deployed roadside enforcements.

Some of the standard applications of roadside technologies that were identified during these interviews and visits include traffic monitoring WIM systems, mobile screening at WIM sites, virtual weigh stations, fixed site-based mainline weight screening, and ramp sorting. There are several benefits in using these roadside technologies. Traffic monitoring WIM systems collect traffic information, travel patterns, vehicle dimension data, and several other information. This information is used for the analysis of travel and weight trends, pavement design, and development of emissions models. It can also be used to determine the most productive locations, days, and times for scheduling mobile enforcement teams, and to determine the most traveled freight corridors, heaviest annual loads, etc. Mobile screening at WIM sites is used to identify overweight trucks without disrupting the travel stream and ensuring an efficient delivery of enforcement actions through targeted intervention.

The benefits of the virtual weigh stations include focused enforcement on high-risk carriers and vehicles, improved monitoring of bypasses, secondary routes, remote routes, and urban routes. In such areas, fixed weigh stations would not be feasible without having an officer positioned at or near the WIM site, along with protection and preservation of the roadway infrastructure. When fixed site-based mainline weight screening is used as part of an electronic screening or bypass system, such as PrePass or the North American Pre-Clearance and Safety System (NORPASS), WIM provides real-time weight verification concurrent with safety regulations and credential verification for bypass eligibility that will also increase the effectiveness of an enforcement personnel. Available WIM data can also be used for freight planning and other State and Federal monitoring, tracking, and screening purposes. Ramp sorting helps to reduce delays for safe and legal carriers and vehicles.

The studied states faced several challenges during their attempt to deploy virtual weight enforcement systems. These include high costs (constructing, operating, and maintaining a weigh station), insufficient staffing, technology integration, interagency cooperation, data management (data retention, usage, and privacy), and lack of funding and standards. Some strategies have been employed successfully by states to overcome deployment challenges. These include developing a business case that reflects the adoption of new or modified size and weight enforcement strategies. This supports non-traditional enforcement operations in order to alleviate the high costs of weigh station construction and attendant manpower requirements. It also captures the best practices of states with differing approaches to utilizing technologies, developing a roadmap that will build on the business case by specifying technology solutions to help meet established goals within defined timelines, and identifying a special stakeholder. The stakeholder needs to be effective at promoting a program or initiative, forging partnerships between the State's enforcement and highway agencies, and maximizing funding sources by pairing technology purchases with sources that may be limited to certain uses.

Titus (1996) studied how the implementation of the Intelligent Transportation System Commercial Vehicle Operation (ITS-CVO) program increases efficiency in safety enforcement. Calculation of costs, such as industry costs, opportunity costs, etc., showed that these costs can be saved through preclearance of vehicles regarding electronic enforcement. Violation statistics can be used to identify vehicles with the highest probability of violation. The conclusion of the study was that 99.4% of safety and weight enforcement costs result from the inspection of the carriers in compliance with the regulations. Usage of ITS-CVO and violation data can reduce the number of carriers inspected, which will eventually eliminate any associated costs.

Brachman (2013) identified different types of enforcement techniques being employed in North Dakota, South Dakota, Montana, and Wyoming by identifying data availability, enforcement technique levels, and analyzing motor carrier safety rates. For each state, the study explored the Commercial Vehicle Safety Plan, levels of audits and inspections (using FMCSA's MCMIS data), traffic enforcement levels (traffic enforcement inspections and violations), excess weight fines, and funding levels. This information was used to identify the differences in the approaches used by the four states. The review found North Dakota's commercial motor vehicle enforcement levels to be at an all-time high, which was deemed appropriate based on the traffic conditions. The troopers and civilian safety inspectors from the North Dakota State Highway Patrol Motor Carrier Division routinely participated in commercial vehicle safety alliance enforcement events. The study concluded that North Dakota's enforcement efforts are comparable to the efforts its neighboring states (South Dakota, Wyoming, and Montana).

Miller et al. (2018) provide insights regarding compliance with hours-of-service regulations and if there can be compliance improvement by electronically monitoring drivers. The study further assessed if the relationship between compliance and electronic monitoring was linear. To carry out the study, a two-stage data collection methodology was completed. First, primary data was collected through a survey instrument. Second, data was extracted from public and commercial databases and combined with the primary dataset. Motor carrier compliance with hours-of-service was measured using FMCSA's hours-of-service compliance measure more than a year after the survey was administered. The authors found that motor carriers with low levels of electronic enforcement, with a minimal improvement below the "tipping point," fails to improve the compliance of the drivers with HOS. Even the large investment on electronic enforcement beyond the "plateau point" is considered wasteful. The relation between Electronic Monitoring Capability and HOS compliance is sigmoidal as hypothesized.

Rodier et al. (2006) studied the potential application of Virtual Compliance Stations (VCS) for the improvement of the enforcement with commercial vehicle operators (CVO) regulations in a cost-effective manner and investigated the legal and institutional challenges. There are several CVO electronic screening programs and emerging VCS programs in the US as well as more advanced VCS programs outside of the US.

In the US, electronic screening programs, such as the North American Pre-clearance and NORPASS and the PrePass^{TM} programs, are in operation. PrePass^{TM} operates in 25 states across the country from California to Virginia. The carriers involved in such programs have transponders in them. Roadside dedicated short-range communications (DSRC) antennas, installed at designated locations, communicate with transponders to identify trucks in the pre-screening database. The trucks that comply with the credentials and weight limits are given a green light in the transponder and can proceed. Otherwise, they have to go to the static weigh station for inspection. However, only large trucking firms tend to use these systems more frequently due to the high costs involved for participation.

2.3 KENTUCKY

The potential benefits of automated enforcement were estimated by Forlines et al. (2019). The authors estimated the weight-distance tax regulations in Kentucky using data from camera-equipped Kentucky Automated Truck Screening (KATS) Systems and PrePass weigh stations. The FTE (Full-Time Equivalent) employment of Kentucky Transportation Cabinet has declined 18% from 2000 to 2016. Currently, Kentucky State Police's Division of Commercial Vehicle Enforcement (CVE) runs Kentucky weigh stations. The study states that automated screening methods allow for the collection of larger volumes of data more effectively. The primary dataset used in the study is the Observations Universe dataset, which includes vehicle and screening message observations for every vehicle spotted at a KATS or PrePass-equipped weigh station, as well as truck plates or US DOT numbers manually entered by CVE inspectors or officers into the state's legacy system. Vehicles screened by the KATS system receive one of the four statuses (pass, warn, fault, or fail). In case of any status besides a pass, one or multiple screening messages may be generated for a single vehicle. USDOT number, license plate number and jurisdiction, Kentucky Highway Use (KYU) number, registered weight, carrier name, weigh station location, and date and time of the observation are also collected. Analysis by the authors indicate that automatic weigh station screening has a potential revenue of around $6.2 million per year. Also, it is estimated that KYU screening will increase the probability of receiving a citation by 60%, resulting in additional revenue of $4.2 million per year.

Kreeb et al. (2007) evaluated the potential benefits of assessing the vehicles electronically as compared to the physical roadside inspections. Potential benefits include reduction in crashes, injuries, and fatalities on highways and maintaining safety and legal requirements. In the study, the results of the Wireless Roadside Inspection (WRI) Program pilot testing (Phase II) were summarized. The results showed the capability to increase commercial vehicle inspections and significant improvement in commercial vehicle safety without overwhelming existing enforcement agencies. Three different communication pathway concepts, Dedicated Short-Range Communication (DSRC), Commercial Mobile Radio Services (CMRS), Universal Identification (Universal ID) one each in three different platforms (Tennessee, Kentucky, and New York) were evaluated in the pilot test.

DSRC Concept was implemented during the New York Pilot Test. New York's Commercial Vehicle Infrastructure Integration (CVII) system was used as the test bed for the pilot test. CVII initiatives require the credentials of a commercial motor vehicle driver to be validated prior to allowing a parked vehicle to be started. The communication components of this system include an onboard DSRC Mobile Communication Unit (DMCU), State Government Office System (GOS), and WRI Roadside Equipment. DMCU communicates with the roadside equipment and compiles a Safety Data Message (SDM). The GOS simulator simulates a State GOS that validates SDM information and generates an inspection report and serves as a communication link with the Federal GOS. The WRI Roadside Equipment provides the communication link between the State GOS and the DMCU. DSRC produced very limited results and the data were not formatted as required by the GOS. However, the limited performance was promising and worthy of further investigation.

CMRS Concept was implemented during the Tennessee Pilot Test by three telematics teams. Three inspection stations in east Tennessee actively participated in the test: two Knox County inspection stations located on I-40 and the Greene County inspection station located on I-81 southbound. All of the participating CMRS partners were provided with information that allowed them to build geofences around these inspection stations. The telematics office system monitored the onboard system at regular intervals and made a geofence determination based on the global positioning system (GPS) data received. The SDM was then assembled and submitted to the GOS if the vehicle was found to be within a designated geofence. The CMRS platform produced the most data, but also encountered data delivery challenges and relatively long latency times.

The Kentucky platform pilot test is an implementation of the Universal ID Concept. The local Performance and Registration Information Systems Management (PRISM) Automated Screening System included an automated license plate recognition (ALPR) system, a 915-megahertz (MHz) DSRC device to read transponders, and a scene camera to capture a digital image of each passing vehicle at the test period. The system sensors collect information from the passing CMV and communicate that information to the screening computer located in the scale house. Two images from the front of the truck, the license plate decode information, including the plate's alphanumeric string, jurisdiction, and confidence level, and a digital photograph of the truck are relayed to the screening computer. The screening computer correlates data from various sensors into a single transaction record which is displayed on the user interface for the enforcement personnel. The record is returned to the Kentucky GOS server and stored for enforcement access, follow-up action, and evaluation. The Universal ID (KY) platform produced some desirable results, but included manual steps that proved untenable, and the ALPR system was unsuitable in poor weather situations.

The potential benefits of wireless road inspection include: (1) safety benefits from reducing the number of CMV crashes, and (2) cost savings from avoidance of needed repairs due to infrastructure damage caused by overweight large trucks. These benefits were estimated by calculating percentage reductions in crashes using data from the Large Truck Crash Causation Study and applying these percentages to data on the current number of CMV crashes. The researchers estimated a large positive net benefit for deploying WRI due to cost reductions from decreased damage to roadway infrastructure that are much larger than the cost of the sensor technologies used.

2.4 AUSTRALIA

Australia (New South Wales) has deployed a VCS program where 100 cameras are installed on freight routes, weigh stations, and mobile inspection units. The cameras record speed, fatigue, and weight inspection offenses as a part of the TruckScan program. WIM detectors are installed at weight inspection locations on the mainline. An offense is detected and confirmed by the Roads and Traffic Authority. Some US states (Kentucky, Indiana, and Florida) and a Canadian Province (Saskatchewan) have also started research and development of VCS applications. These programs use image capturing and sensing technologies to increase compliance enforcement. The researchers suggested starting with smaller and less costly projects and including all CVO related agencies while establishing a multi-agency group early on in the process to overcome the stakeholder barriers during the implementation of automated enforcement. Further, the liability should also be specified to implement it in a cost-effective manner.

2.5 FRANCE

Cottineau et al. (2015) reported the findings from the ongoing Automated Overloads Control (AOC) project carried out by Institut français pour les sciences et technologies des transports, de l'aménagement et des réseaux (IFSTTAR) and Centre d'étude et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (CEREMA) and supported by the French Ministry of Transports (DGITM). The project studies the feasibility of automated overload enforcement with adapted existing WIM technologies to be certified. The authors also conducted a comprehensive review of the international studies and their experiences on AOC, to transpose the best practices to France. The study presents the results of the performance evaluation from laboratory and on-site tests of available WIM sensors in France. The laboratory test included vertical loading tests and 3-point bending tests of piezo-quartz and piezo-ceramic WIM sensors. They showed that sensor sensitivity varies longitudinally and depends on the vertical load application point. The study conducted an on-site test at IFSTTAR Nantes accelerated pavement testing facility for 10 WIM sensors that included piezo-ceramic sensors, piezo-quartz sensors, and piezo-polymer sensors. The preliminary observations from the study indicated that piezo-quartz sensors were less sensitive to pavement deformations compared to other sensors. Also, the temperature variations greatly affected the response of piezo-polymer sensors. The ongoing work included dynamic load variations on the fatigue test track, which will inform researchers on how to improve the sensor signals and increase accuracy of measurements. In addition, fiber optic sensors and bridge WIM methods were also considered as potential implementation methods to improve the existing enforcement mechanisms in the ongoing study. The study also focused on the partnership between WIM manufacturers and vendors with the scientific research team as a better way to achieve the compliance of heavy commercial vehicles weights and dimensions.

3.0 BEST PRACTICES

This chapter presents and summarizes best practices regarding electronic enforcement technology and implementation. This review considers best practices as implemented in the United States and those implemented internationally.

3.1 BEST PRACTICES IN THE UNITED STATES

Crabtree et al. (2005) described the steps that Kentucky followed to cover the enforcement of commercial vehicles on routes that are not monitored by fixed weigh stations. In order to do so, remote monitoring systems (RMS) and virtual weigh stations (VWS) were developed and implemented. The authors also discussed the concepts of RMS and VMS, and the results of the preliminary assessments of the performance of the RMS and VWS. It was found from the study that through the implementation of RMS, the images of USDOT numbers of more than 50% of the passing trucks could be captured very well, which could be used as a tool for enforcement to identify the trucks with credentials-related issues. They also reported that approximately 31% of the trucks detected by VWS on US-25 had violations. VWS was developed by combining RMS with WIM technology which was expected to have trucks weighed and have their USDOT number checked as well. However, the qualities of the captured images were poor compared to the images captured by RMS. Only 34% of the trucks with readable US DOT numbers were captured. Some of the limitations of these technologies are that they require a high number of staff for the images to be used as an enforcement tool. In addition, the US DOT numbers are not retro-reflective and placing bright lights can create a glare hazard. Further, the US DOT numbers are also not displayed in a standard form and mostly on the side of the trucks which increases the chances of images being blurred. The study recommended that future studies evaluate accuracy and reliability of license plate readers and USDOT number readers and implement one of them in the "next generation" VWS. The authors also recommended that the "next generation" VWS be fully automated with an alarm system to reduce staffing requirements.

Mimbela and Klein (2007) provided details about the various in-roadway and over-roadway sensor technologies, generally referred to as Intelligent Transportation Systems (ITS), including their principle, application, and advantages/disadvantages. In-roadway sensor technologies discussed included pneumatic road tubes, inductive loop detectors, magnetic sensors, piezoelectric sensors, and weigh-in-motion. Over-roadway sensor technologies included video image processor, microwave radar, infrared sensor, ultrasonic sensor, and passive acoustic array sensors. It was also mentioned that investing in ITS can reduce the cost of mitigating recurring congestion by 35% nationwide. For the study, the product and the user information were collected by conducting two different kinds of surveys among the vendors and manufacturers of the equipment. The vendor and manufacturer survey responses were organized according to the type of sensor technology utilized and a description of each sensor technology, including principles of operation, typical uses, relative costs, advantages and disadvantages, and other pertinent information, was provided. Finally, the information was compiled and organized into a three-ring binder format. Overall, this report is useful in understanding different technologies that are used for vehicle detection and surveillance, their accuracies, and the costs associated with those technologies.

Kwigizile et al. (2015) performed benefit-cost analyses of existing weigh stations in Michigan to help the Michigan Department of Transportation (MDOT) and Michigan State Police (MSP) decide on strategies for future commercial vehicle enforcement. The study aimed to determine the benefits of current fixed weigh stations (15 fixed weigh stations), the benefits of selected virtual weigh stations, costs required to upgrade, maintain, and enhance these weigh stations, and the cost of using alternative solutions. The safety impact of each strategy and the risk associated with the event when a weigh station is closed, were also evaluated. To identify the current practices of commercial vehicle enforcement in the United States and other countries, a literature review was performed, and online surveys were administered to all the US states' commercial vehicle enforcement agencies as well as some provinces in Canada. Further, to understand the current enforcement strategies in Michigan, existing MDOT and MSP reports that included crash data and cost data were reviewed. In addition, to identify the differences between fixed weigh stations in Michigan and Indiana, the Lowell fixed weigh station located on I-65 in Indiana was visited.

After the literature review it was concluded that fixed weigh stations still remain the major tool for enforcement of the commercial vehicles in many US states, as well as other countries. To increase the efficiency of these weigh stations, several improvements have been made, such as the use of mainline and ramp WIM systems, and preclearance systems. Using mainline WIM systems facilitates the use of a preclearance system that reduces the number of vehicles entering the weigh station. Using ramp or low-speed WIM systems facilitates the use of a bypass lane that increases the capacity and reduces the congestion at congested fixed weigh stations. To supplement or replace the fixed weigh stations, some US states and other countries have implemented VWS, automatic vehicle identification systems, use of cameras, and use of over-height detectors. It was also revealed that each place has their own state-specific preclearance system that helps enforcement officers to identify violators efficiently by reducing the number of trucks required to enter a fixed weigh station. For instance, Canada (British Columbia) uses Weigh2GoBC, North Carolina uses NCPASS, and Oregon uses Green Light.

Through the online survey it was found that 95% of the US states use fixed weigh stations for commercial vehicle enforcement. In order to improve efficiency of commercial vehicle enforcement operations, about one-third of states and provinces use mainline and low-speed WIM stations. 87.5% of US states and 60% of Canadian provinces do not plan to remove fixed weigh stations in the near future. More than 50% of participating states and provinces use virtual weigh stations to enforce commercial vehicle laws. 57% of US States and 80% of Canadian provinces that participated in the survey use mobile enforcement strategy. 87.7% of US states and 60% of Canadian provinces used preclearance systems. About a quarter of US states and 80% of Canadian provinces employ check-lane operations as a strategy for enforcing commercial vehicle laws. Similarly, 38% of the US states use safe enforcement sites with pavement cut-outs/notches to facilitate the use of portable scales, while 80% of Canadian provinces install pavement cut-outs/notches.

In the study, it was also stated that costs by fixed weigh station levels ranged from $2.3 million to $3.3 million, which was determined through the examination of the current Michigan commercial vehicle enforcement strategies. Similarly, analysis of the citations issued at the existing stations indicated an average of $1.6 millions of citation fines per year and the statewide citation fines average about $4.5 million per year.

Through the analysis of the 15 existing fixed weigh stations, it was found that all advanced level (advanced and most-advanced) fixed weigh stations that are economically beneficial. The advanced fixed weigh station consists of a static scale and low-speed WIM (for sorting traffic as well as a bypass lane). The most advanced fixed weigh station consists of a preclearance system in addition to all features of the advanced level fixed weigh stations. The two most advanced fixed weigh stations (Monroe NB and New Buffalo EB) are economically beneficial with Benefit Cost Ratio values of 8.86 and 12.77, respectively. Fowlerville and Ionia have intermediate fixed weigh stations and may be generating greater disbenefits due to their inability to handle the present truck volume.

Upgrading fixed weigh stations by adding preclearance systems adds installation and maintenance costs. The authors suggest that the addition of a preclearance system does not significantly change the number of violators caught to justify the additional financial investment. The improvement due to the preclearance systems will not be significantly different from when just a bypass lane is added. When the benefits gained by improving Ionia eastbound and Ionia west bound to the most advanced (adding preclearance) to just advanced (adding a bypass lane only) was compared, the results showed that adding a preclearance system would reduce economic benefits. Adding a preclearance system along with a bypass lane to the Pontiac fixed weigh station reduced economic benefits compared to when just a bypass lane is added. It could be economically beneficial to add just a preclearance system than adding both a bypass lane and a preclearance system to the existing basic and intermediate fixed weigh stations.

Mobile enforcement strategy tends to deter potential violation of commercial vehicle laws as it increases the visibility of law enforcement officers. Further, this also deters potential use of routes that bypass a given fixed weigh station. This strategy is most beneficial in an area where criteria for locating a fixed weigh station are not met.

The study recommended the removal of fixed weigh stations from routes with Commercial Vehicle Average Daily Traffic less than 2,200. Similarly, on potential bypass routes with higher potential violation rates, mobile screening should be continued to be used. The enforcement site should depend on the potential violation rate and coverage. Further research on integration of technologies and consolidation of data should be made to enhance commercial vehicle enforcement.

3.2 INTERNATIONAL BEST PRACTICES

Honefanger et al. (2007) evaluated various technologies used in European countries (Belgium, France, Germany, the Netherlands, Slovenia, and Switzerland) for enforcing commercial vehicle size and weight laws. The report found that European countries implemented motor vehicle size and weight enforcement effectively using bridge WIM systems.

Slovenia uses roving enforcement vehicles and does not have fixed-weight facilities. These vehicles have equipment to check emissions, perform a full safety check, and communicate with the central office for credential checks. These vehicles use integrated technology, including bridge WIM systems (SiWIM) into their operations. The operations support real-time preselection for mobile enforcement and to support scheduling time and location of mobile enforcement activities. Germany uses a system of about 40 WIM sites that support mobile enforcement efforts, as well as data gathering. The WIM sites commonly use sensors in the right lane or right two lanes, where only traffic sensors (i.e., electronic loops) are installed across all lanes. The German Autobahn system has 300 "toll checker" gantries strategically located throughout the country and equipped with IR detection equipment and high-resolution cameras able to profile trucks and record number plates that are used in prescreening for potentially oversized vehicles. In Belgium, enforcement officials rely only on fixed and mobile enforcement, using shared public or private static weigh bridges or low-speed WIM systems and vehicle size limits are not usually checked unless there is a recognized problem. France has two prototype VIDEO-WIM systems, with plans for expanded implementation at 10 to 40 sites.

Using these systems, a picture of a suspected overloaded vehicle determined by the WIM sensors is immediately transmitted by radio waves or telephone lines to enforcement officials at a static weighing area. Once identified, enforcement officials escort the vehicle to the static site for further inspection and evaluation. There are 219 mobile enforcement units that require a space 30 meters long with nearby parking lots or rest areas for vehicle storage. The authors mentioned that fully automated commercial motor vehicle size and weight enforcement using high-speed WIM is estimated to be 5 to 20 years in the future, according to officials in France and the Netherlands.

The authors also made a comparison between the practices prevalent in Europe and the United States. The economic interests, as well as the focus on coordinated research, seem uniform in the European nations, whereas the US states operate independently. The team identified seven unique European implementation opportunities as the ones with the greatest potential benefit to US motor vehicle enforcement. These opportunities include the Slovenia bridge WIM (Slovenia, France), the Swiss heavy goods vehicle control facility (Switzerland), prescreening for mobile enforcement (Slovenia, Switzerland, the Netherlands, France), applying WIM for direct enforcement: a template for implementation and certification (France), behavior-based enforcement activities (the Netherlands, France), synthesis of safety implications of oversize/overweight commercial vehicles (Belgium), and the effective use of WIM data: the Dutch case study (the Netherlands). Specific strategies for advancing these implementation opportunities were also identified in the report. Implementation strategy for Slovenia Bridge WIM includes the following:

- Obtaining detailed site layout specification from Slovenian contacts.
- Synthesizing the French experience and analyzing the accuracy and performance results.
- Preparing and deploying a one-page information sheet presenting a compelling case for pursuing B-WIM implementation in the United States.
- Presentation of findings at the American Association of State Highway and Transportation Officials' Bridge Conference.

Implementation strategies for Swiss heavy goods vehicle control facility in Switzerland includes the following:

- Obtaining control facility weigh bridge and laser scanner gantry specifications from Swiss contacts (i.e., number and type of load cell scales, number, and type of laser scanners)

- Evaluating domestic or international land-crossing locations as possible candidates for a model deployment pilot site

Implementation strategies for prescreening for mobile enforcement includes the following:

- Surveying US States on mobile enforcement program components and aspects
- Obtaining specific details on mobile enforcement tools and techniques in use from European contacts
- Identifying demonstration site(s) for a European mobile enforcement approach

Implementation strategy for applying WIM stations for direct enforcement includes the following

- Characterizing the US climate toward the use of WIM stations for direct enforcement
- Identifying issues that must be addressed to gain metrological and judicial acceptance in the United States
- Identifying and reviewing successful European practices on direct weight enforcement using WIM technology
- Establishing a legal basis and gaining judicial support for citing overweight trucks directly from low-speed WIM stations initially and later from high-speed WIM

Implementation strategy for behavior-based enforcement activities includes the following:

- Obtaining specific details on the behavior-based enforcement approach from Dutch and French contacts
- Obtaining estimates of approach effectiveness (i.e., percentage of reduction in the proportion of overweight trucks) from Dutch and French contacts
- Coordinating with FMCSA officials to gain understanding of their behavior-based approach to commercial vehicle safety enforcement

Implementation strategies for synthesis of safety implications of oversize/overweight commercial vehicles include the following:

- Inviting university research communities, via the University Transportation Research Consortium (UTRC) initiative, to conduct a synthesis effort on the linkages of overweight commercial motor vehicles and safety
- Obtaining detailed information on the use of safety as a compelling case for commercial motor vehicle weight enforcement from Belgium contacts

Implementation strategy for effective use of WIM data (the Dutch case study) includes the following:

- Obtaining detailed information on the architecture and system specifications for the data model used in the Netherlands from Dutch contacts

- Conducting a comparative scan of data management operations employed in the United States

- Proposing a National Cooperative Highway Research Program synthesis topic on WIM database management and potential enhancements

Hill (2018) stated that On-Board Mass (OBM) systems are being used to record the mass as well as configuration of the combinations of heavy vehicles in Australia. OBM Systems are used to manage commercial obligations and conformance with regulatory loading and mass regulations. Over 75% of non-bulk domestic freight are carried on roads due to which the performance of road freight transport is very important in Australia. OBM System Functional and Technical Specification recognizes three categories of the OBM systems which include Category A, Category B, and Category C. OBM systems in 'Category A' display mass information to drivers and/or loaders electronically. Additionally, OBM systems in 'Category B' collect and transmit mass information. Lastly, OBM Systems in 'Category C', in accordance with Transport Certification Australia's Interconnectivity Specification, collect and transmit mass information in a standardized way to telematics devices permitting the ability to 'plug and play'.

OBM Systems have facilitated a reengineering of road networks in Australia in various ways, along with improvement in freight performance. An 'A-Double' combination was introduced in 2011 by the Queensland Government to improve the efficient and productive transport of export grain produce from rural locations to a major port. These combinations were monitored through the IAP (Intelligent Access Program) for route and speed compliance (maximum of 100km/h) and were fitted with OBM Systems. The use of OBM Systems has enabled a reduction in bridge load factors on bridges without which these vehicles would not have been able to operate. Similarly, Higher Productivity Freight Vehicles, which are longer than the standard 'B-Double' combinations (up to 30 meters in length) was introduced by the Victorian Government in 2013. These vehicle combinations are also monitored through the IAP for route and speed compliance and are able to operate on parts of the road network that were not previously available due to the 'Moving More with Less' policy in Victoria.

Data provided by OBM Systems can be linked with available data such as vehicle configuration, vehicle location at a particular time, and vehicle speed as needed. This helps in using the mass data, in addition to other contextual information, to assist in the regulation and operations of heavy vehicles and in the road networks.

4.0 DATA

This chapter summarizes the data used for the current study. To complete the study objectives, two primary data sources were considered: (1) inspection/violation data and (2) cost data. The following subchapters will detail the two data sources.

4.1 INSPECTION/VIOLATION DATA

To determine the number of inspections taking place in Oregon, as well as the resulting number of violations resulting in citations, inspection and violation data were obtained. This data was obtained in collaboration with the Oregon Department of Transportation Commerce and Compliance Division.

The data included violations that occurred from January 1, 2018, through December 31, 2021. The carrier operations included interstate, intrastate hazmat, and intrastate non-hazmat operations. The violation data was provided in two parts, where the first part was related to vehicle-reports (the violation part and section number were specific to the vehicle) and the second part was related to driver-reports (the violation part and section number were specific to the driver). Information within the vehicle reports included:

- Inspection date and time.
- Inspection level and description.
- Location and county.
- Inspected unit type, unit make, unit year, and unit state of registration.
- Gross vehicle weight rating of inspected vehicles.
- If inspection led to a violation (given through violation part and section numbers).
- Brief violation code description.

Information within the driver reports included:

- Inspection date and time.
- Inspection level and description.
- Location and county.
- Driver type (primary vs. secondary).

- If inspection led to a violation (given through violation part and section numbers).
- Brief violation code description.

The driver- and vehicle-level reports were used to determine the locations in Oregon that experience that highest number of violations, where the focus of the benefit-cost analysis is on those locations.

4.2 COST DATA

The other important data element was that of costs; specifically, costs related to labor and costs related to implementation of a proposed electronic enforcement technology. Electronic enforcement costs were obtained primarily through the literature, where previous studies had reported the costs explicitly or had reported the type of equipment required to implement. For the latter, this allowed for investigation of vendors to determine a range of costs for different electronic enforcement technology items. Full details on the costs of the proposed electronic enforcement technologies are provided in Chapter 6.3.

Labor costs were determined through collaboration with the Oregon Department of Transportation Commerce and Compliance Division. In Oregon, inspections are conducted by Compliance Specialists and/or Motor Carrier Enforcement Officers. Based on information provided by the Commerce and Compliance Division, the monthly and hourly salaries are given in Table 4.1. The salary range provided by the Commerce and Compliance Division was given based on monthly salaries. The hourly salary ranges were determined by assuming a 40-hour work week.

Table 4.1: Monthly and Hourly Wages for Compliance Specialists and Enforcement Officers

Enforcement Officer Designation	Monthly Salary	Hourly Salary
Compliance Specialists	$4,534 to $6,947	$26.16 to $40.08
Motor Carrier Enforcement Officer	$4,100 to $5,700	$23.65 to $32.88

In addition to providing salary ranges, the Commerce and Compliance Division provided information on the number of workers that are on-site at any given time. It was determined that at any given time, as many as three inspectors are on-site during a day shift, while the evening shift typically has just one inspector on-site. Due to the potential variety in compliance specialists and enforcement officers present during a day shift (e.g., two compliance specialists and one enforcement officer, three enforcement officers, three compliance specialists, etc.), different scenarios were considered in the analysis. For full details on the scenarios considered, see Chapter 6.3.

5.0 METHODS

Two distinct methods were considered for analysis: (1) a descriptive analysis of the inspection/violation data and (2) a benefit-cost analysis of proposed electronic enforcement technologies. This chapter will provide details on the two methodologies applied.

5.1 DESCRIPTIVE ANALYSIS

The descriptive analysis focused on the inspection/violation data. The analysis was used to understand overall inspection/violation trends in Oregon, including the following:

1. Number of violations by inspection level.
2. Number of violations by unit type.
3. Number of violations by unit make.
4. Number of violations by unit year.
5. Number of violations by unit license plate state (state of registration).
6. Number of violations by gross vehicle weight rating.
7. Number of violations by driver type (primary vs. secondary).
8. Number of violations by year.
9. Number of violations by month.
10. Number of violations by day of the week.
11. Number of violations by time-of-day.
12. Number of violations by location.

After summarizing statewide violation trends, the number of violations by location were used to determine locations where electronic enforcement technologies may be considered. For this work, the top nine locations were considered (locations rank-ordered 10th or greater did not experience enough violations to result in a return-on-investment).

5.2 BENEFIT-COST METHODOLOGY

To determine if implementing an electronic enforcement technology is cost-effective, a benefit-cost analysis was conducted. The benefit-cost analysis consisted of developing a benefit-cost ratio, where the expected benefits (in monetary terms) are divided by the implementation costs:

$$\textbf{Benefit} - \textbf{Cost Ratio} = \frac{\boldsymbol{B}}{\boldsymbol{C}} \tag{5.1}$$

where the benefit-cost ratio is the ratio of benefits to costs, B represents the benefit costs (e.g., labor costs reduced), and C represents the implementation costs (e.g., installation, equipment, training, etc.). A ratio greater than 1.0 indicates that implementing an electronic enforcement technology is cost-effective, a ratio less than 1.0 indicates that implementing an electronic enforcement technology is not cost-effective, and a ratio equal to 1.0 indicates that the costs of implementing an electronic enforcement technology are equal to the benefit costs. Overall, ratios greater than 1.0 are considered, as well as the point in which the ratio is equal to 1.0 (any additional implementation cost will result in the implementation not being cost-effective).

The benefits considered are in terms of labor only (i.e., the amount of FTE that can be reduced due to the implementation of an electronic enforcement technology). This work considers a Level 1 or Level 2 inspection happening with an anticipated time of approximately one hour. The assumption of a Level 1 or Level 2 inspection is based on the type of violations occurring most often, the majority of which require a Level 1 or Level 2 inspection to determine.

Using the costs provided by the Commerce and Compliance Division, ranges of potential benefits based on hourly wages are used as benefits. A summary of the individual labor costs considered in the benefit-cost analysis is given in Table 5.1.

Table 5.1: Hourly Labor Cost Ranges Considered for Benefit-Cost Analysis

Enforcement Officer Designation	Low Cost	Medium Cost	High Cost
Compliance Specialists	$26.16	$33.12	$40.08
Motor Carrier Enforcement Officer	$23.65	$28.27	$32.88

For implementation costs of proposed electronic enforcement technologies, see Chapter 6.3. The proposed electronic enforcement technologies were chosen based on results from the descriptive analysis; therefore, the costs associated with the proposed technologies are presented when presenting the results of the benefit-cost analysis.

6.0 RESULTS

This chapter presents the results of the descriptive analysis and the results of a series of benefit-cost analyses by location and by proposed electronic enforcement technology.

6.1 STATEWIDE DESCRIPTIVE ANALYSIS RESULTS

The following subchapter presents the results of a descriptive analysis on the inspection/violation data. Each characteristic considered is presented independently.

6.1.1 Inspection Levels

The number and proportion of inspections by inspection level are given in Figure 6.1. The "Driver" indication refers to the driver report and the "Vehicle" indication refers to the vehicle report. The most occurring inspection level was walk-around, accounting for approximately 47% of inspections in the driver report and 73% of inspections in the vehicle report. Full inspections accounted for a small percentage in the driver report (9.7%) compared to the vehicle report (21.8%). Driver-only inspection levels were primarily represented in the driver report, but there were 4.3% driver-only inspections indicated in the vehicle report.

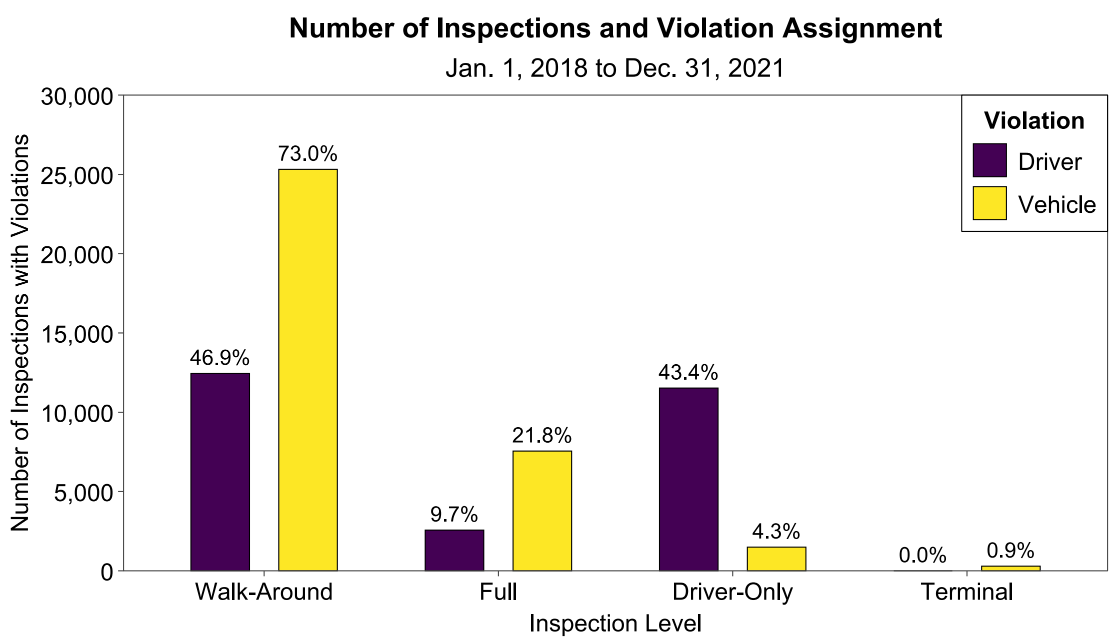

Figure 6.1: Frequency and Proportion of Inspections by Inspection Level and Report

6.1.2 Unit Type

The number and proportion of inspections by unit type is given in Figure 6.2. The unit types inspected most often were semi-trailers (40.8%) and truck tractors (41.0%), accounting for more than 80% of all unit types. Straight trucks accounted for 11.8% of inspections and full trailers accounted for 2.7% of inspections. All other unit types accounted for less than 2% of inspections.

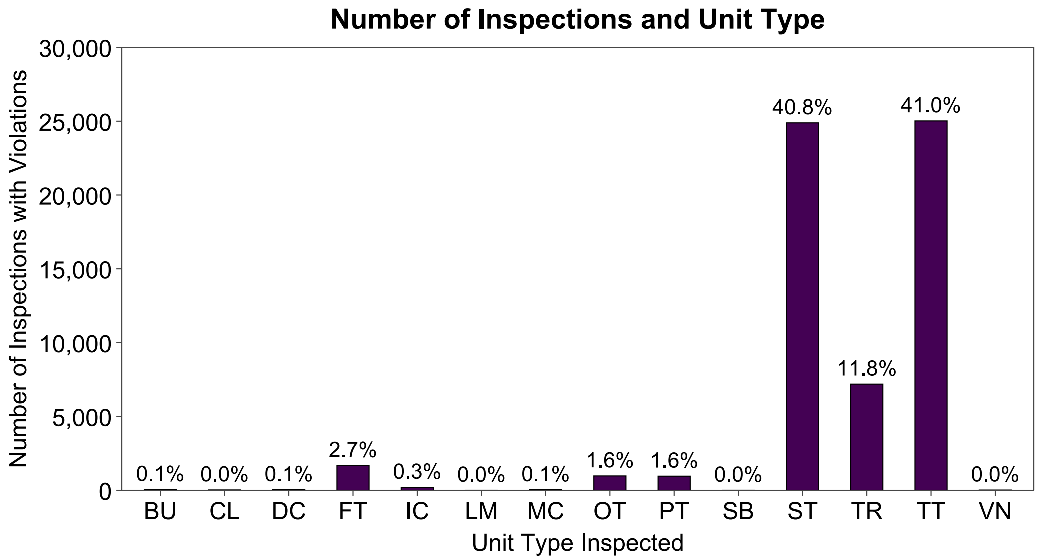

Figure 6.2: Frequency and Proportion of Inspections by Unit Type

6.1.3 Unit Make

The number and proportion of inspections by unit make is given in Figure 6.3. The unit makes presented in Figure 6.3 were the most occurring; therefore, the percentages do not sum to 100%. Freightliner units accounted for the highest percentage of inspections (18.1%), followed by Utility Trailers (9.8%) and Kenworth (9.1%). Peterbilt accounted for 7.7% and no other unit make accounted for more than 7%.

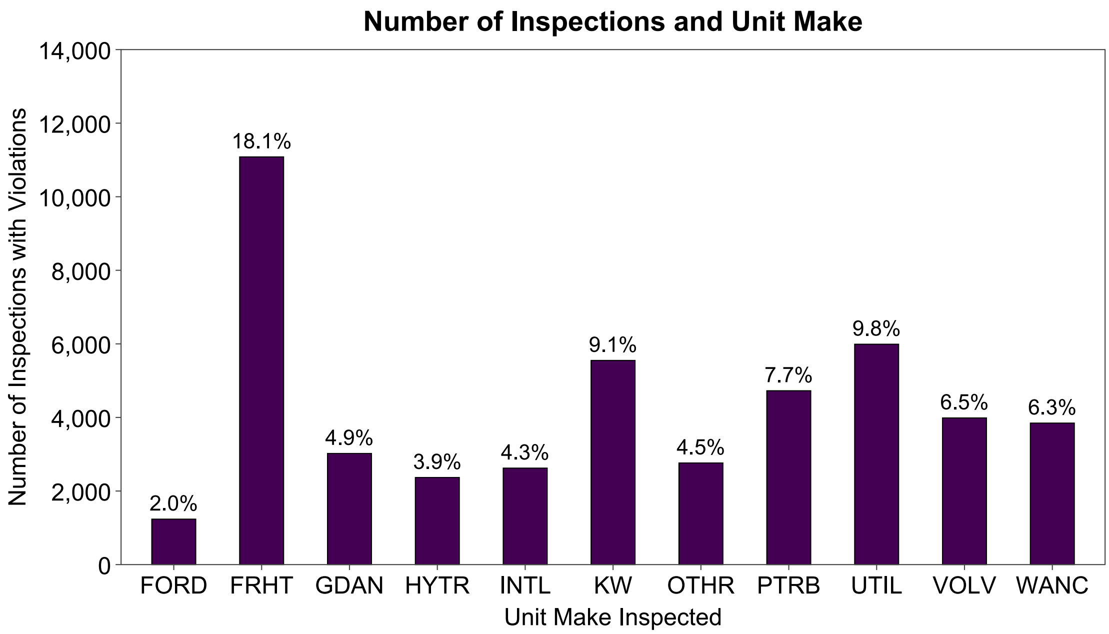

Figure 6.3: Frequency and Proportion of Inspections by Unit Make

6.1.4 Unit Year

The number and proportion of inspections by unit year is given in Figure 6.4. The distribution is left-skewed, as indicated with the clustering on the right of the figure. The majority of units inspected are 2010 models or newer.

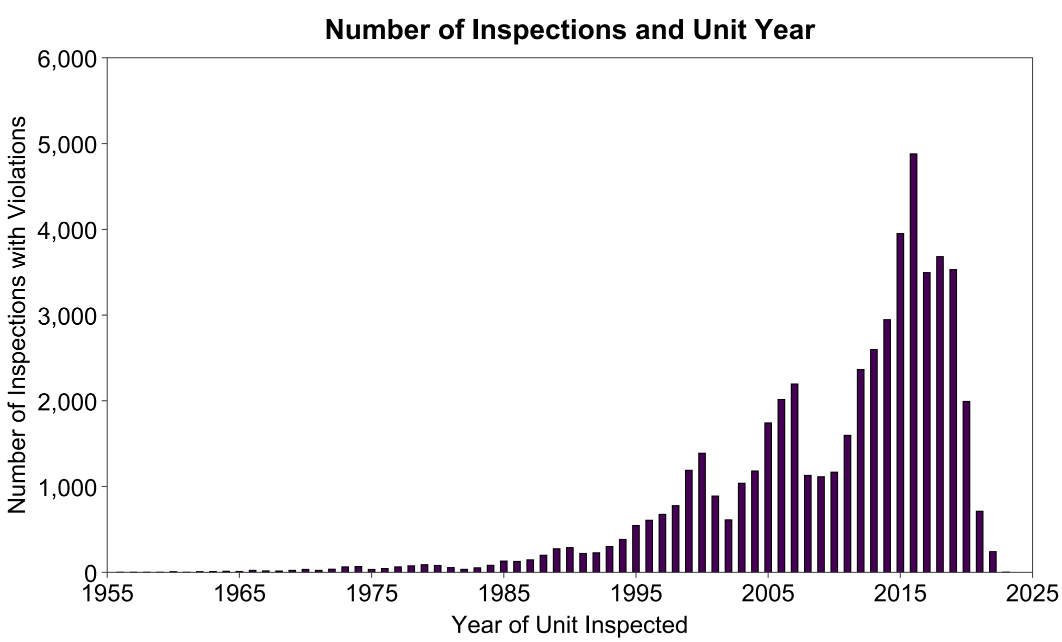

Figure 6.4: Frequency and Proportion of Inspections by Unit Year

6.1.5 State of Registration

The number and proportion of inspections by state of registration (based on the license plate) is given in Figure 6.5. The states presented in Figure 6.5 were the most occurring; therefore, the percentages do not sum to 100%. Oregon accounted for the highest proportion (31.2%), followed by neighboring states California (15.6%) and Washington (11.8%). The remaining states that make up a moderate proportion are in the Midwest (Indiana at 8.0%, Illinois at 4.3%) or in the South/Southwest (Florida at 1.5%, Tennessee at 2.1%, Oklahoma at 2.5%, and Texas at 2.6%).

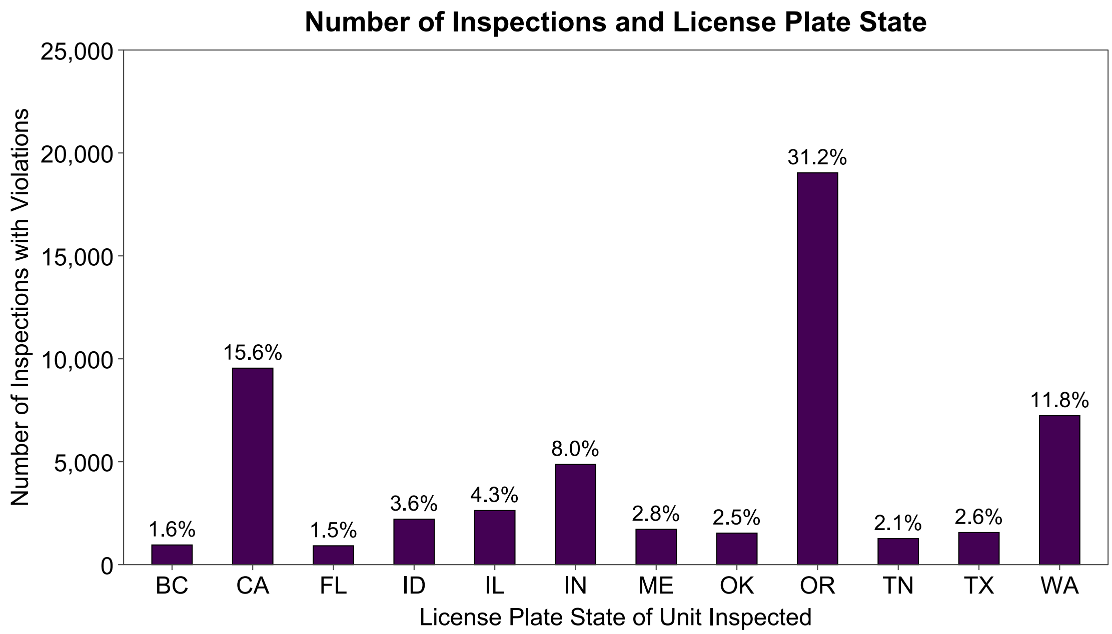

Figure 6.5: Frequency and Proportion of Inspections by State of Registration

6.1.6 Gross Vehicle Weight Rating

The number of inspections by gross vehicle weight rating is given in the distribution in Figure 6.6. The most occurring gross vehicle weight rating was 52,000 pounds (8,474 inspections), followed by 52,350 pounds (2,370 inspections), and 80,000 pounds (3,321 inspections).

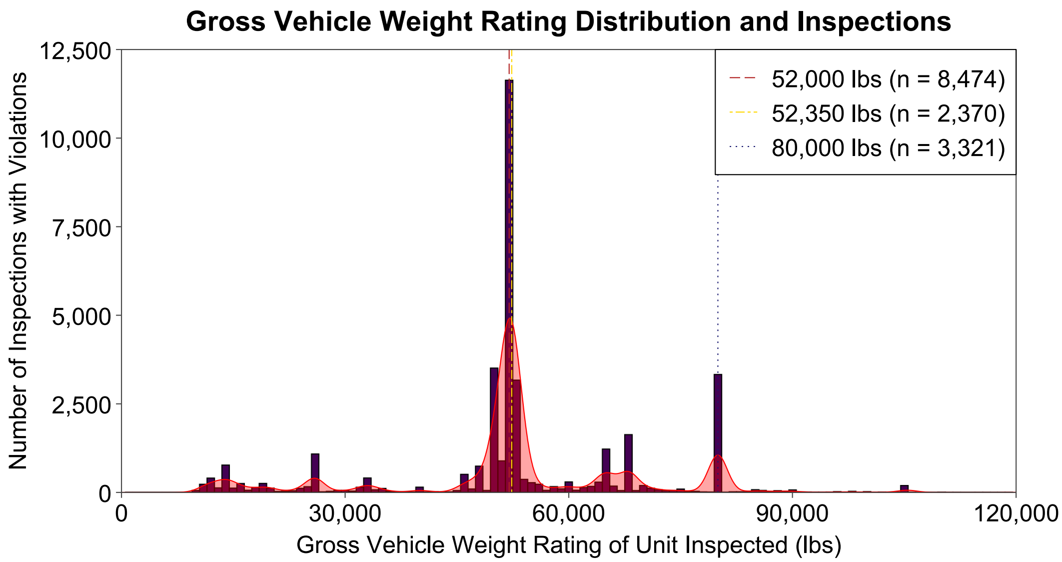

Figure 6.6: Frequency of Inspections and Gross Vehicle Weight Rating

6.1.7 Inspection Year

The number and proportion of inspections by year are given in Figure 6.7. In each year, the inspections from the vehicle report outnumber the inspections in the driver report. Additionally, the drop in the number and proportion of inspections in 2020 and 2021 is notable. During this time period, trucking regulations were relaxed due to the pandemic. The lower number of inspections during this time period may be reflecting pandemic-related conditions. Additional temporal trends are shown in appendix A.

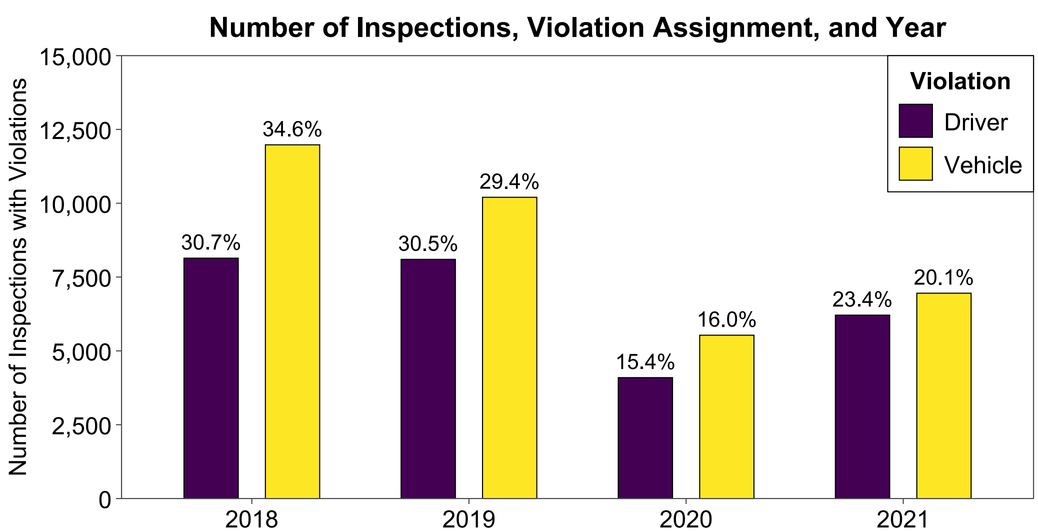

Figure 6.7: Frequency and Proportion of Inspections by Year

6.1.8 Inspections and Location

The number and proportion of inspections by location is shown in Figure 6.8. Figure 6.8 shows only the top locations; therefore, the percentages may not add to 100%. Based on the driver report, Woodburn POE had the most inspections, followed by Clackamas County Roadways/Highways, Ashland POE, and Umatilla POE. Based on the vehicle reports, Woodburn POE had the most inspections, followed by Clackamas County Roadways/Highways, Washington County Roadways/Highways, and Ashland POE. The representation of the County Roadways/Highways is primarily observed during the years in which the Oregon Motor Carrier Safety Action Plan was in progress (Hernandez et al., 2022).

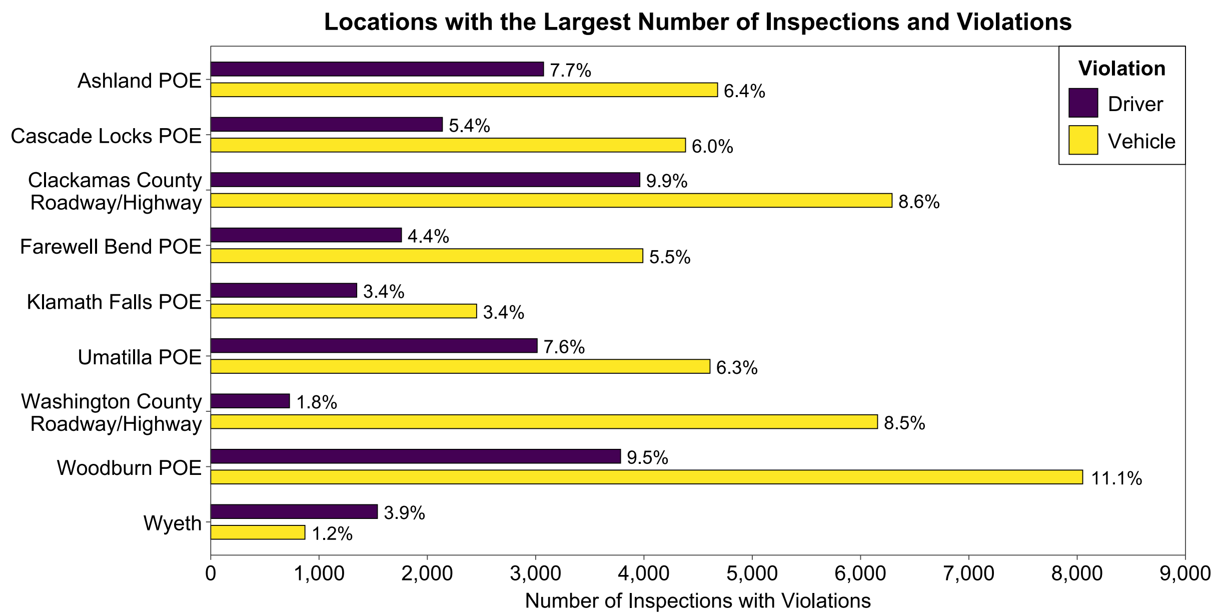

Figure 6.8: Frequency and Proportion of Inspections by Location

6.1.9 Locations Considered for Analysis

Based on the results given in Figure 6.8, the following locations were considered for analysis:

- Ashland POE
- Woodburn POE
- Farewell Bend POE
- Cascade Locks POE
- Wyeth
- Umatilla POE

- Klamath Falls POE
- Clackamas County Roadways/Highways
- Washington County Roadways/Highways

A map of the locations considered is given in Figure 6.9.

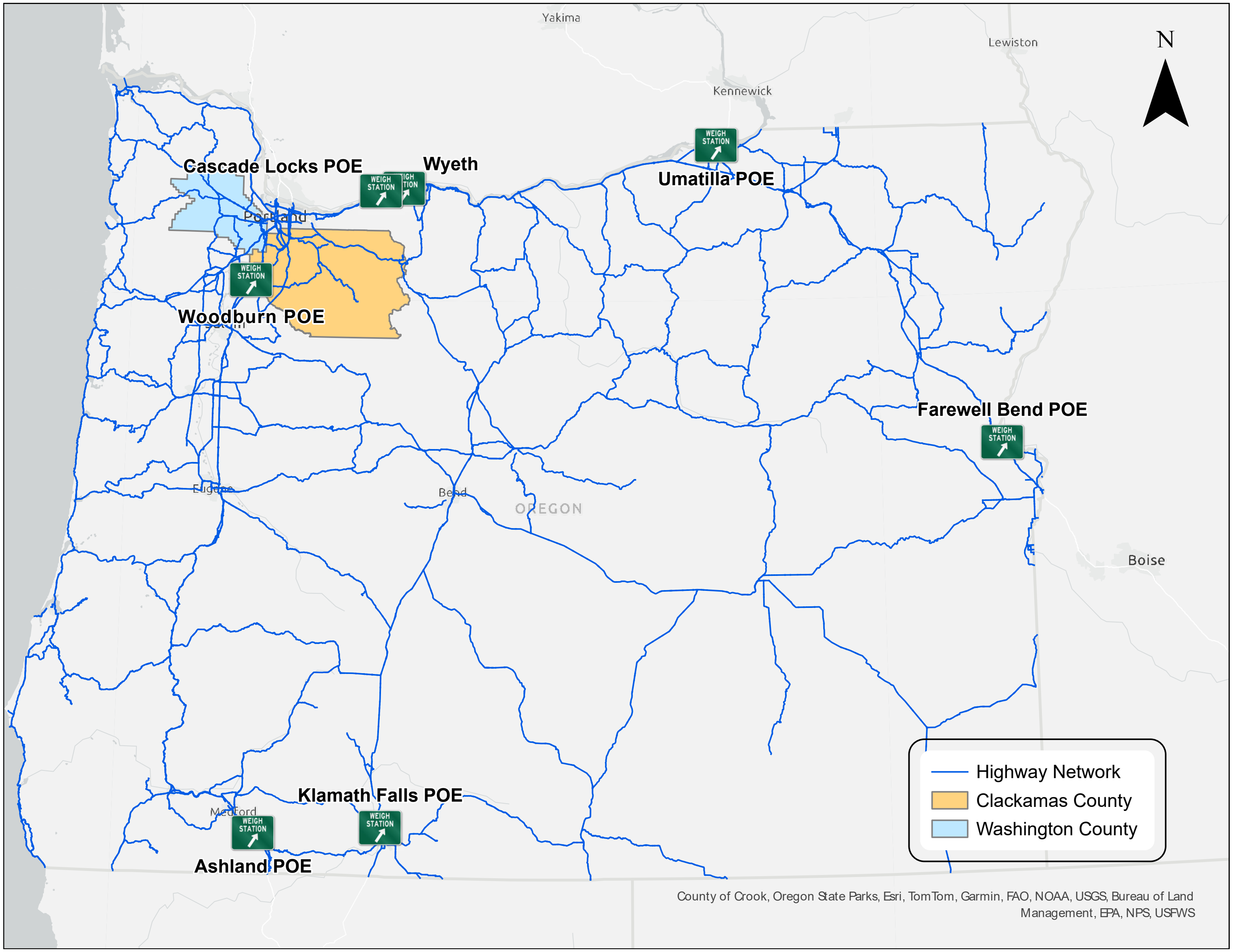

Figure 6.9: Locations Considered for Benefit-Cost Analysis

6.2 LOCATION-BASED DESCRIPTIVE ANALYSIS RESULTS

The following subchapter summarizes the number of violations by location and provides the definition of the given violations using the FMCSA Part and Section No. Additionally, any notes provided in the data by the inspection officer are summarized. For full descriptions of the FMCSA Part and Section No., see Appendix B (driver-related violations) and Appendix C (vehicle-related violations).

6.2.1 Ashland POE

The most occurring driver- and vehicle-related violations at Ashland POE are given in Table 6.1 and Table 6.2, respectively. Graphical representations are given in Figure 6.10 and Figure 6.11. For driver-related violations, the most occurring are 395-8(a)(1), 395-8(e)(1), and 383-51(a), which relate to no record of duty status, false record of duty status, and driving while commercial driver license is suspended. For vehicle-related violations, the most occurring is 393-75, which is related to tires; for example, flat tires, fabric being exposed, audible leaks, cut tires, tread depth violations, and others.

Table 6.1: Most Occurring Driver-Related Violations by Year at Ashland POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
383-23(a)(2)	25	44	16	57	142
383-51(a)	89	61	38	40	228
392-2	91	39	15	68	213
395-22(h)	101	19	7	16	143
395-3(a)(3)	16	18	25	42	101
395-8(a)(1)	106	135	137	233	611
395-8(e)(1)	125	123	176	431	855

Table 6.2: Most Occurring Vehicle-Related Violations by Year at Ashland POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
392-2	110	83	59	320	572
393-11	19	15	49	157	240
393-47	41	11	83	96	231
393-55	85	34	79	108	306
393-75	222	177	156	236	791
393-9(a)	72	49	90	174	385
396-3(a)(1)	60	23	94	97	274

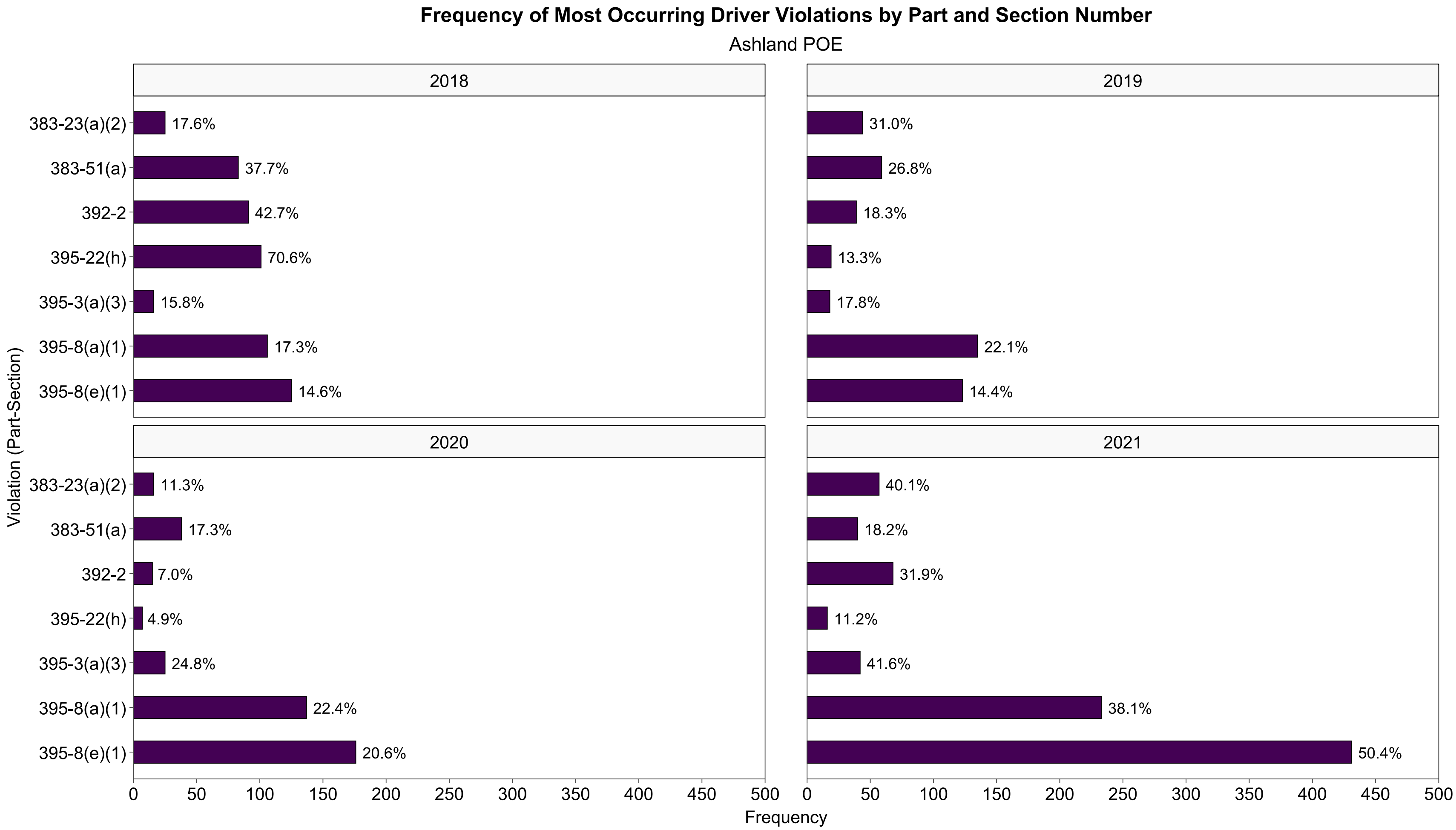

Figure 6.10: Most Occurring Driver-Related Violations by Year, Part, and Section Number at Ashland POE

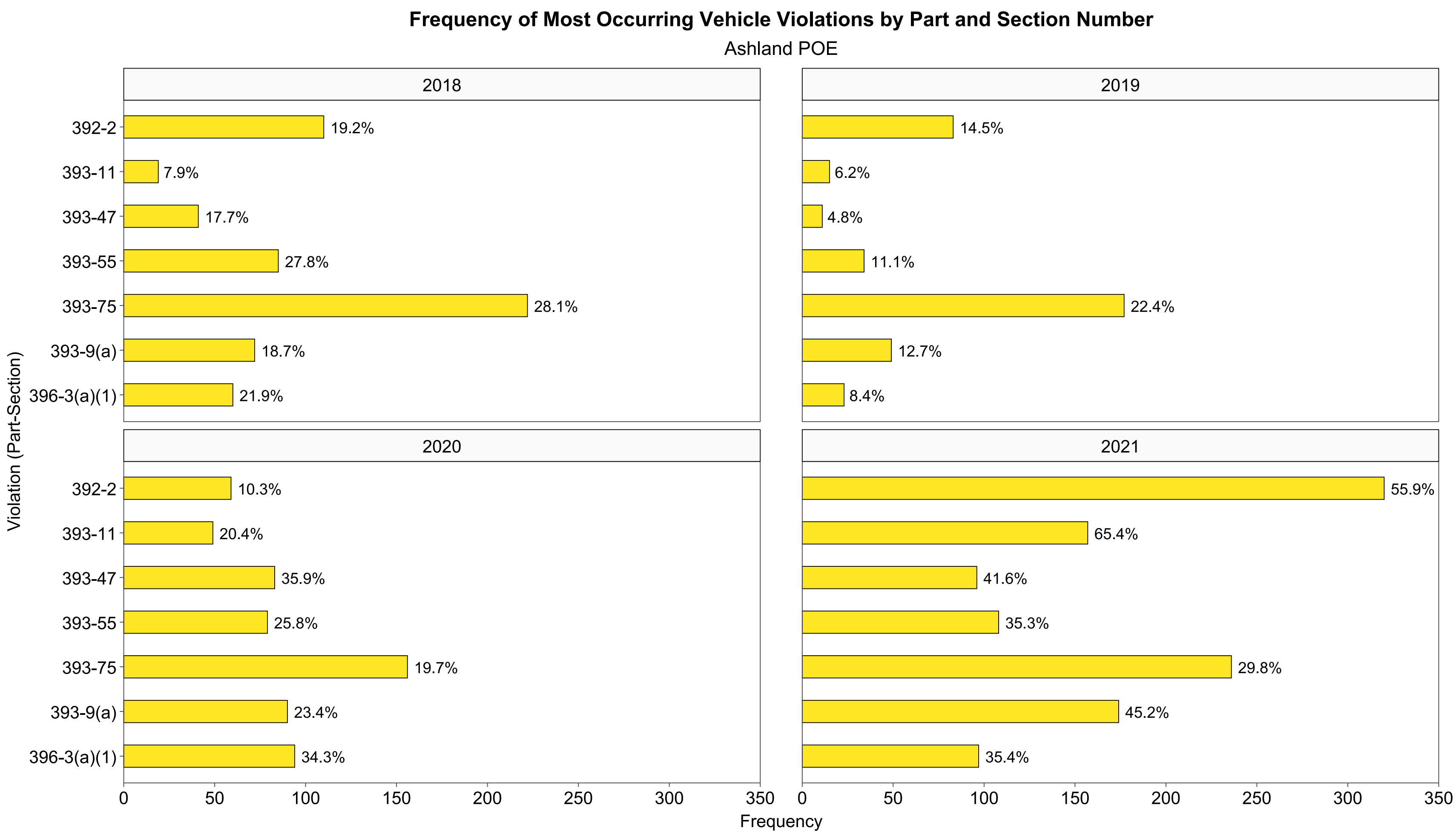

Figure 6.11: Most Occurring Vehicle-Related Violations by Year, Part, and Section Number at Ashland POE

6.2.2 Woodburn POE

The most occurring driver- and vehicle-related violations at Woodburn POE are given in Table 6.3 and Table 6.4. Graphical representations are given in Figure 6.12 and Figure 6.13. For driver-related violations, the most occurring are 395-8(a)(1), 395-8(e)(1), and 392-2, which relate to no record of duty status, false record of duty status, and state operating authority. For vehicle-related violations, the most occurring is 393-75, which is related to tires; for example, flat tires, fabric being exposed, audible leaks, cut tires, tread depth violations, and others.

Table 6.3: Most Occurring Driver-Related Violations by Year at Woodburn POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
383-23(a)(2)	38	52	15	22	127
383-51(a)	69	70	25	26	190
392-2	97	50	26	86	259
395-22(h)	30	14	80	73	197
395-3(a)(2)	31	56	29	68	184
395-3(a)(3)	68	71	30	72	241
395-8(a)(1)	135	222	139	196	692
395-8(e)(1)	222	286	250	308	1,066

Table 6.4: Most Occurring Vehicle-Related Violations by Year at Woodburn POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
392-2	128	138	59	91	416
393-45	56	134	92	92	374
393-47	231	234	173	237	875
393-53(b)	136	151	113	153	553
393-55	55	88	58	80	281
393-75	403	629	360	404	1,796
393-9(a)	204	213	186	193	796
396-3(a)(1)	218	325	207	241	991

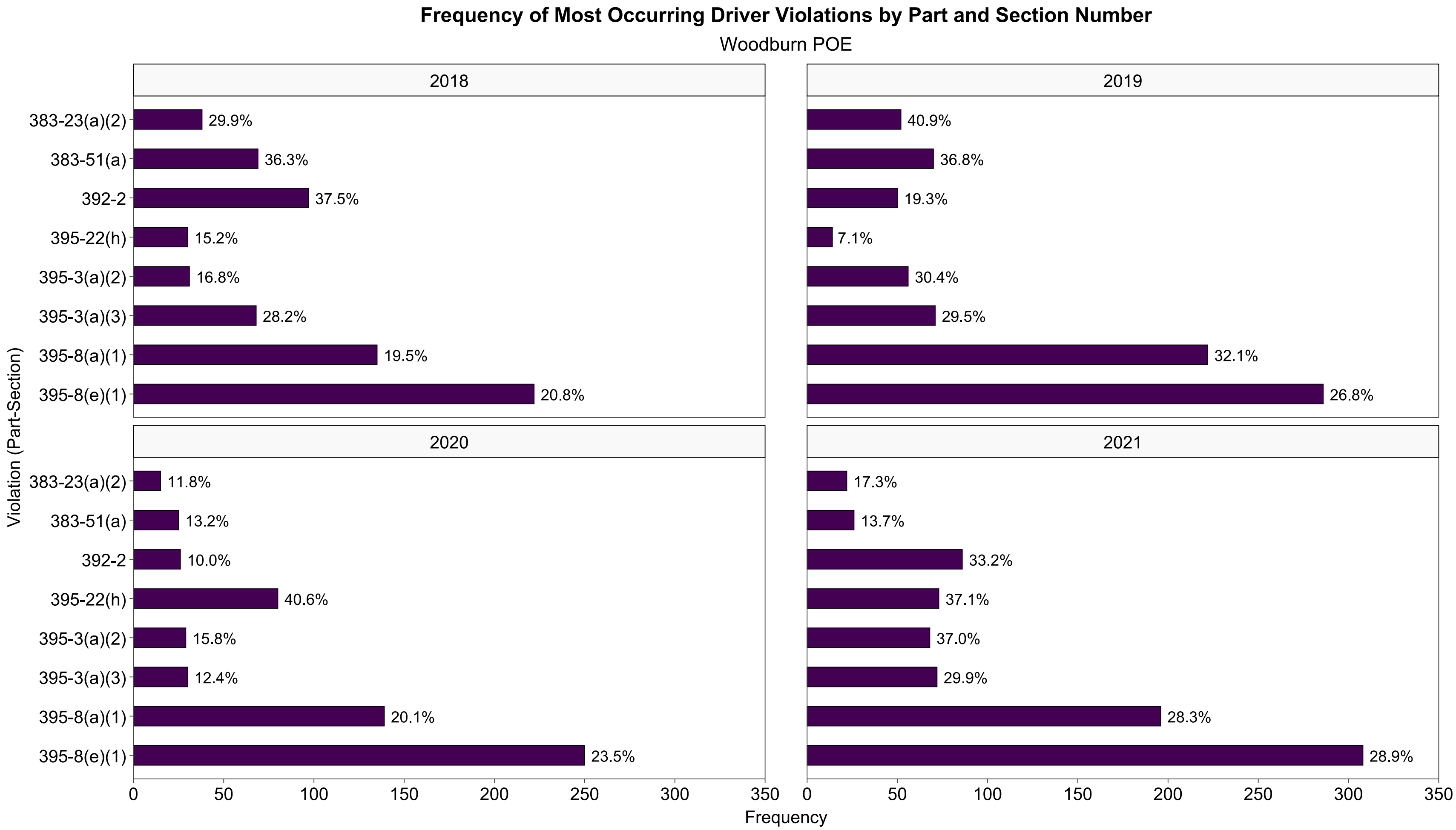

Figure 6.12: Most Occurring Driver-Related Violations by Year, Part, and Section Number at Woodburn POE

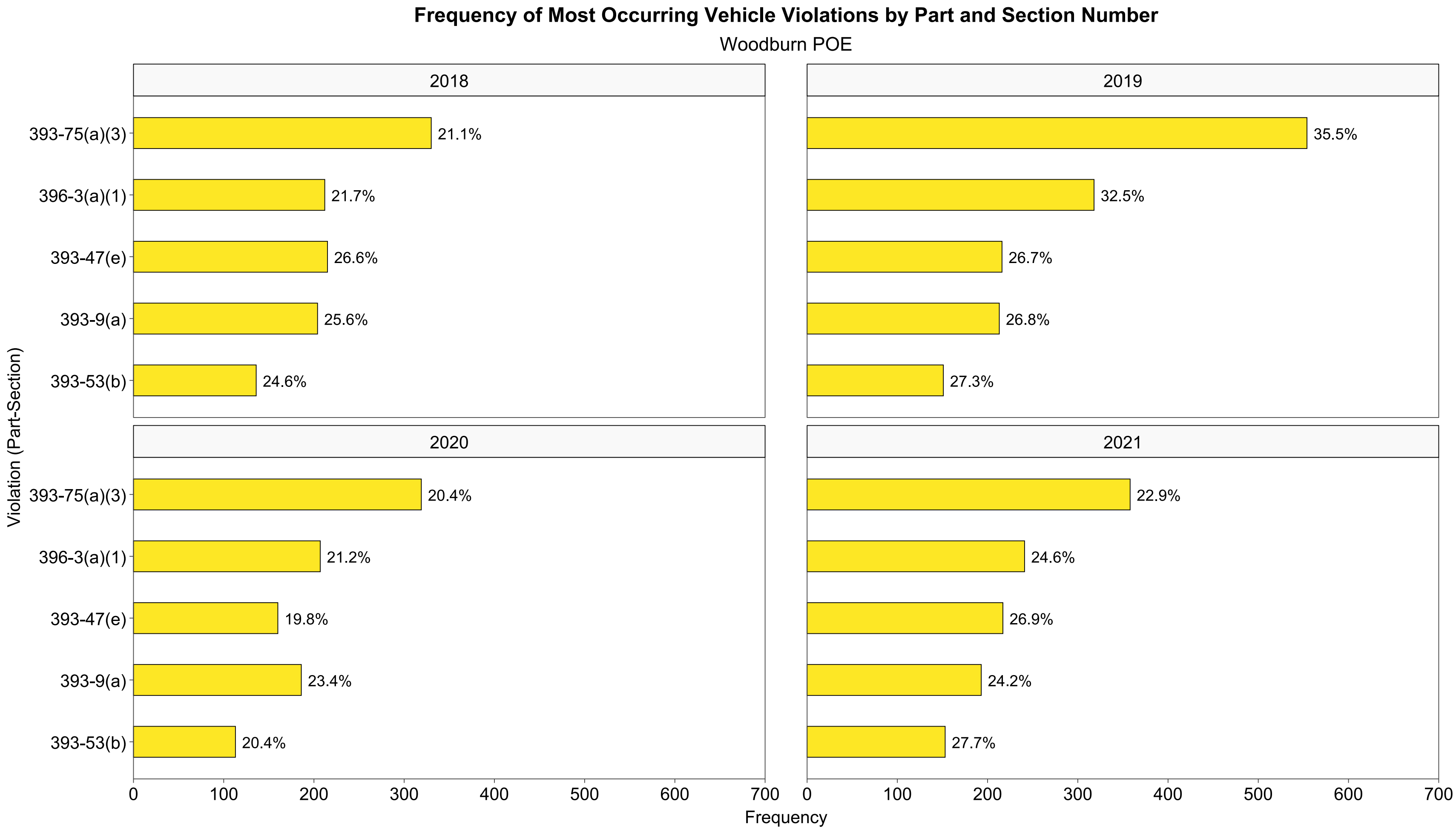

Figure 6.13: Most Occurring Vehicle-Related Violations by Year, Part, and Section Number at Woodburn POE

6.2.3 Farewell Bend POE

The most occurring driver- and vehicle-related violations at Farewell Bend POE are given in Table 6.5 and Table 6.6. Graphical representations are given in Figure 6.14 and Figure 6.15. For driver-related violations, the most occurring are 395-8(a)(1), 395-8(e)(1), and 383-51(a), which relate to no record of duty status, false record of duty status, and driving with a suspended commercial driver license. For vehicle-related violations, the most occurring is 393-75, which is related to tires; for example, flat tires, fabric being exposed, audible leaks, cut tires, tread depth violations, and others.

Table 6.5: Most Occurring Driver-Related Violations by Year at Farewell Bend POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
383-23(a)(2)	31	16	17	21	85
383-51(a)	156	133	62	78	429
392-2	65	50	38	96	249
395-22(h)	34	3	0	1	38
395-3(a)(3)	14	6	16	26	62
395-8(a)(1)	59	46	37	88	230
395-8(e)(1)	70	67	80	171	388

Table 6.6: Most Occurring Vehicle-Related Violations by Year at Farewell Bend POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
392-2	108	59	34	111	312
393-205	83	68	69	126	346
393-207	73	68	38	87	266
393-47	116	138	101	98	453
393-75	307	292	151	251	1,001
393-9(a)	45	49	42	78	214
396-3(a)(1)	121	92	87	78	378

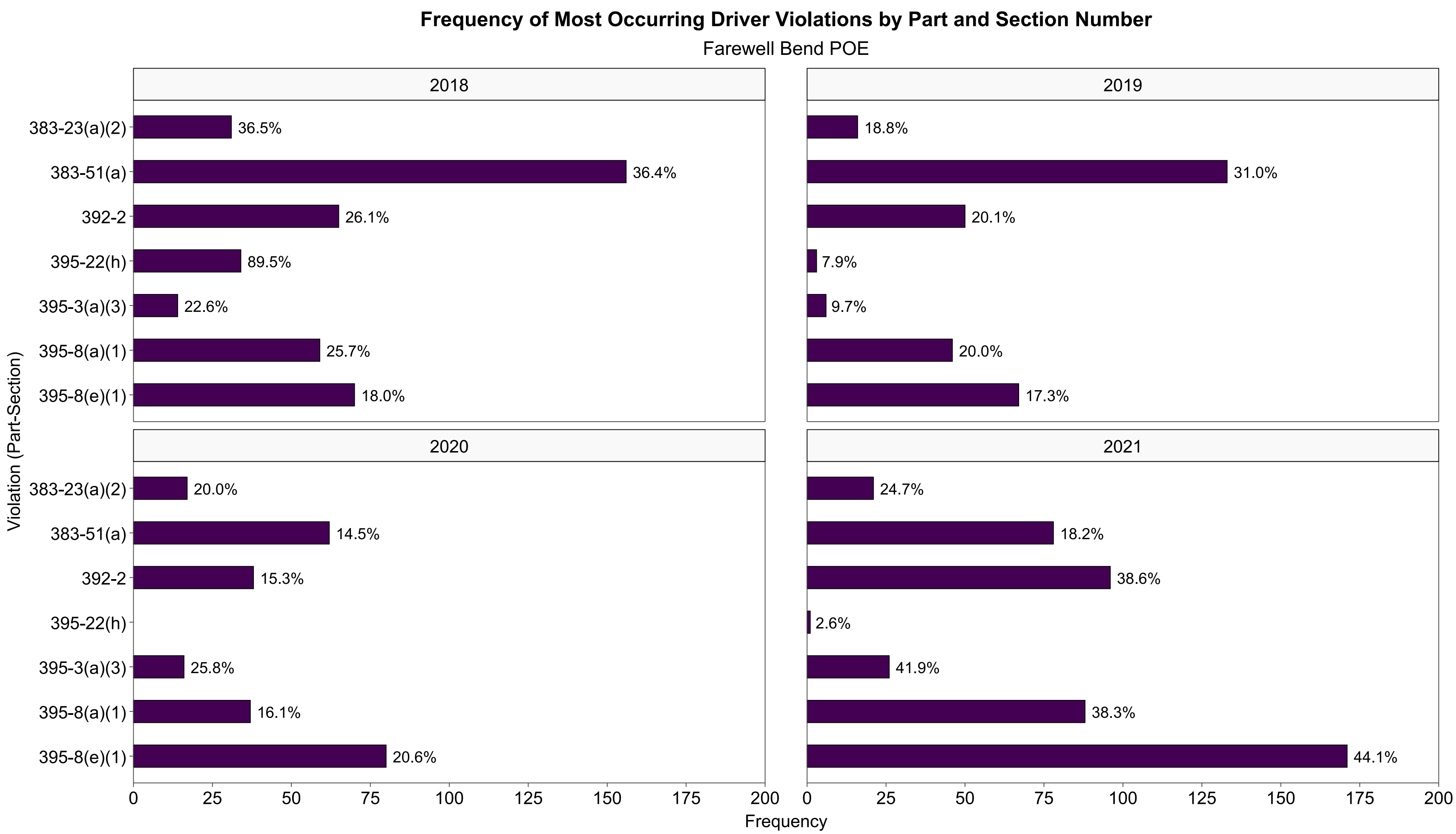

Figure 6.14: Most Occurring Driver-Related Violations by Year, Part, and Section Number at Farewell Bend POE

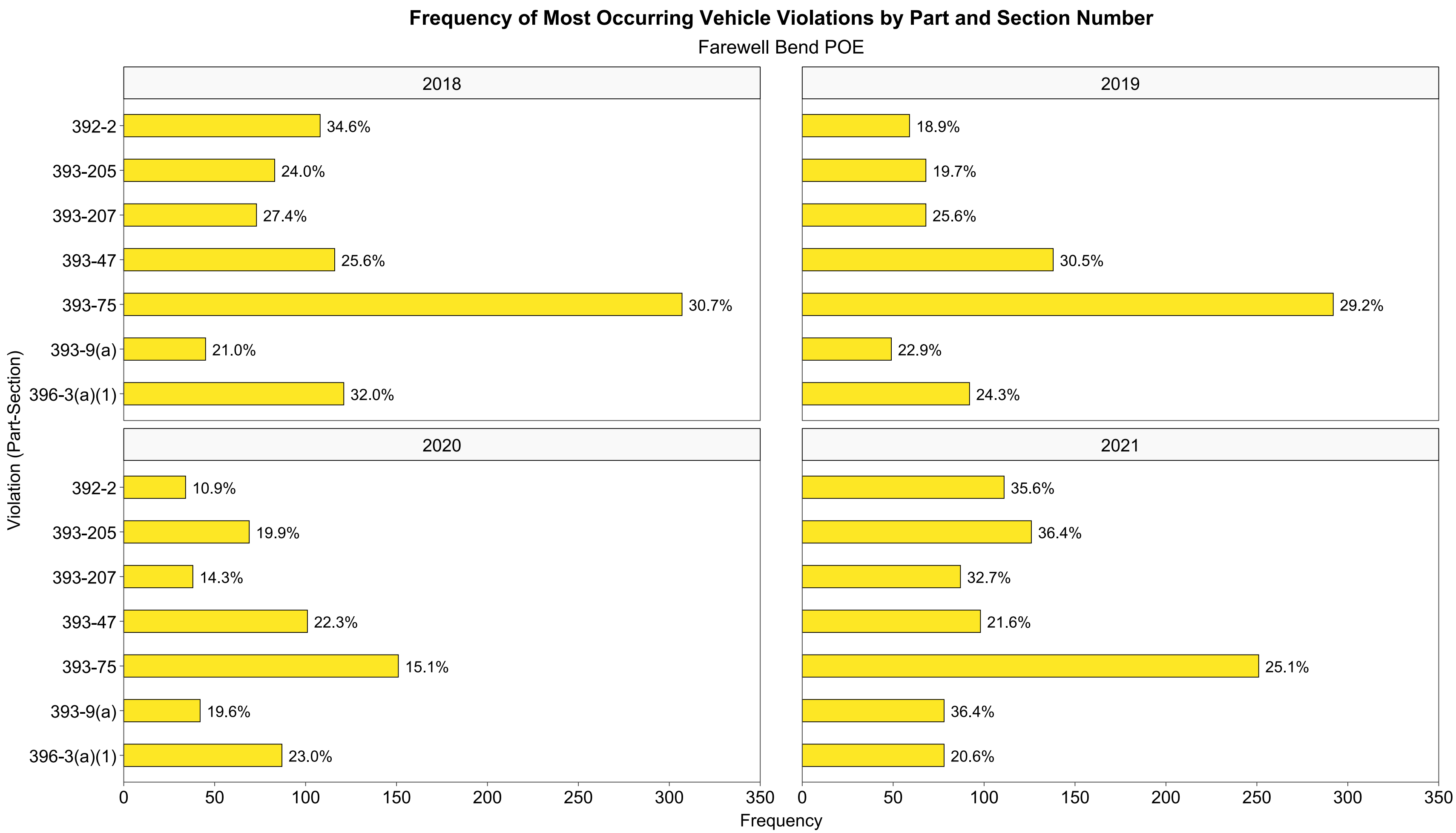

Figure 6.15: Most Occurring Vehicle-Related Violations by Year, Part, and Section Number at Farewell Bend POE

6.2.4 Cascade Locks POE

The most occurring driver- and vehicle-related violations at Cascade Locks POE are given in Table 6.7 and Table 6.8. Graphical representations are given in Figure 6.16 and Figure 6.17. For driver-related violations, the most occurring are 395-8(a)(1), 395-8(e)(1), and 383-51(a), which relate to no record of duty status, false record of duty status, and driving with a suspended commercial driver license. For vehicle-related violations, the most occurring is 393-75, which is related to tires; for example, flat tires, fabric being exposed, audible leaks, cut tires, tread depth violations, and others.

Table 6.7: Most Occurring Driver-Related Violations by Year at Cascade Locks POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
383-23(a)(2)	46	32	22	19	119
383-51(a)	81	104	30	18	233
392-2	52	48	22	33	155
395-24(d)	20	18	25	19	82
395-3(a)(2)	15	10	18	20	63
395-3(a)(3)	14	7	18	23	62
395-8(a)(1)	70	111	76	106	363
395-8(e)(1)	113	179	154	261	707

Table 6.8: Most Occurring Vehicle-Related Violations by Year at Cascade Locks POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
392-2	44	60	50	52	206
393-100	55	90	31	49	225
393-45	91	64	40	75	270
393-47	154	105	87	144	490
393-53(b)	87	58	49	83	277
393-75	262	204	164	191	821
393-9(a)	158	89	86	130	463
396-3(a)(1)	160	115	120	130	525

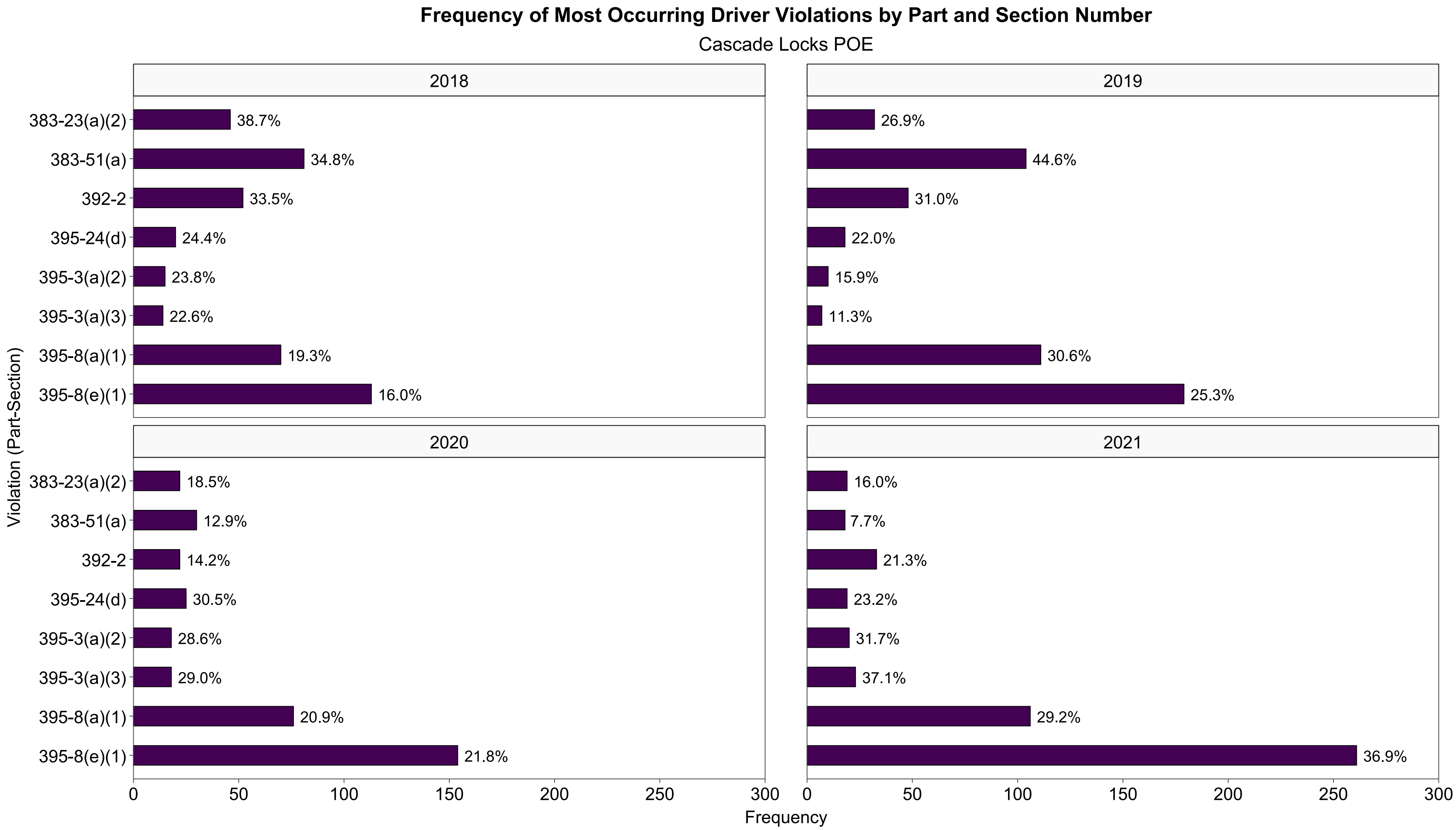

Figure 6.16: Most Occurring Driver-Related Violations by Year, Part, and Section Number at Cascade Locks POE

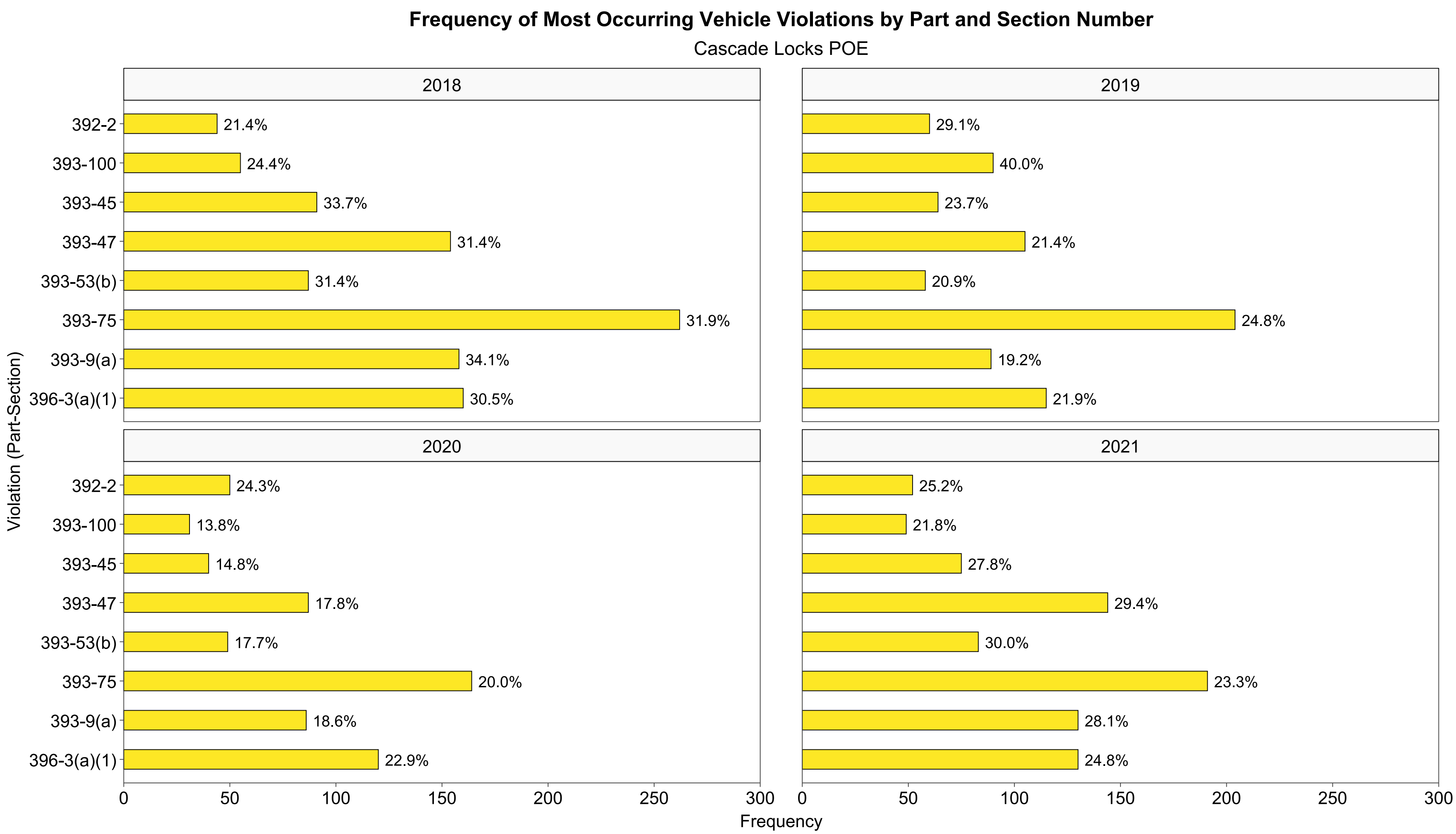

Figure 6.17: Most Occurring Vehicle-Related Violations by Year, Part, and Section Number at Cascade Locks POE

6.2.5 Wyeth

The most occurring driver- and vehicle-related violations at Wyeth are given in Table 6.9 and Table 6.10. Graphical representations are given in Figure 6.18 and Figure 6.19. For driver-related violations, the most occurring are 395-8(a)(1), 395-8(e)(1), and 383-51(a), which relate to no record of duty status, false record of duty status, and driving with a suspended commercial driver license. For vehicle-related violations, the most occurring is 393-75, which is related to tires; for example, flat tires, fabric being exposed, audible leaks, cut tires, tread depth violations, and others.

Table 6.9: Most Occurring Driver-Related Violations by Year at Wyeth

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
383-51(a)	42	37	23	10	112
392-2	23	31	19	36	109
395-24(d)	20	12	22	35	89
395-3(a)(2)	25	1	7	21	54
395-3(a)(3)	28	4	10	24	66
395-8(a)(1)	57	77	50	82	266
395-8(e)(1)	131	103	116	244	594

Table 6.10: Most Occurring Vehicle-Related Violations by Year at Wyeth

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
392-2	32	25	24	42	123
393-205	4	6	2	9	21
393-207	9	0	1	8	18
393-75	149	86	57	96	388
393-9(a)	37	29	15	27	108
393-95(a)	11	1	4	9	25

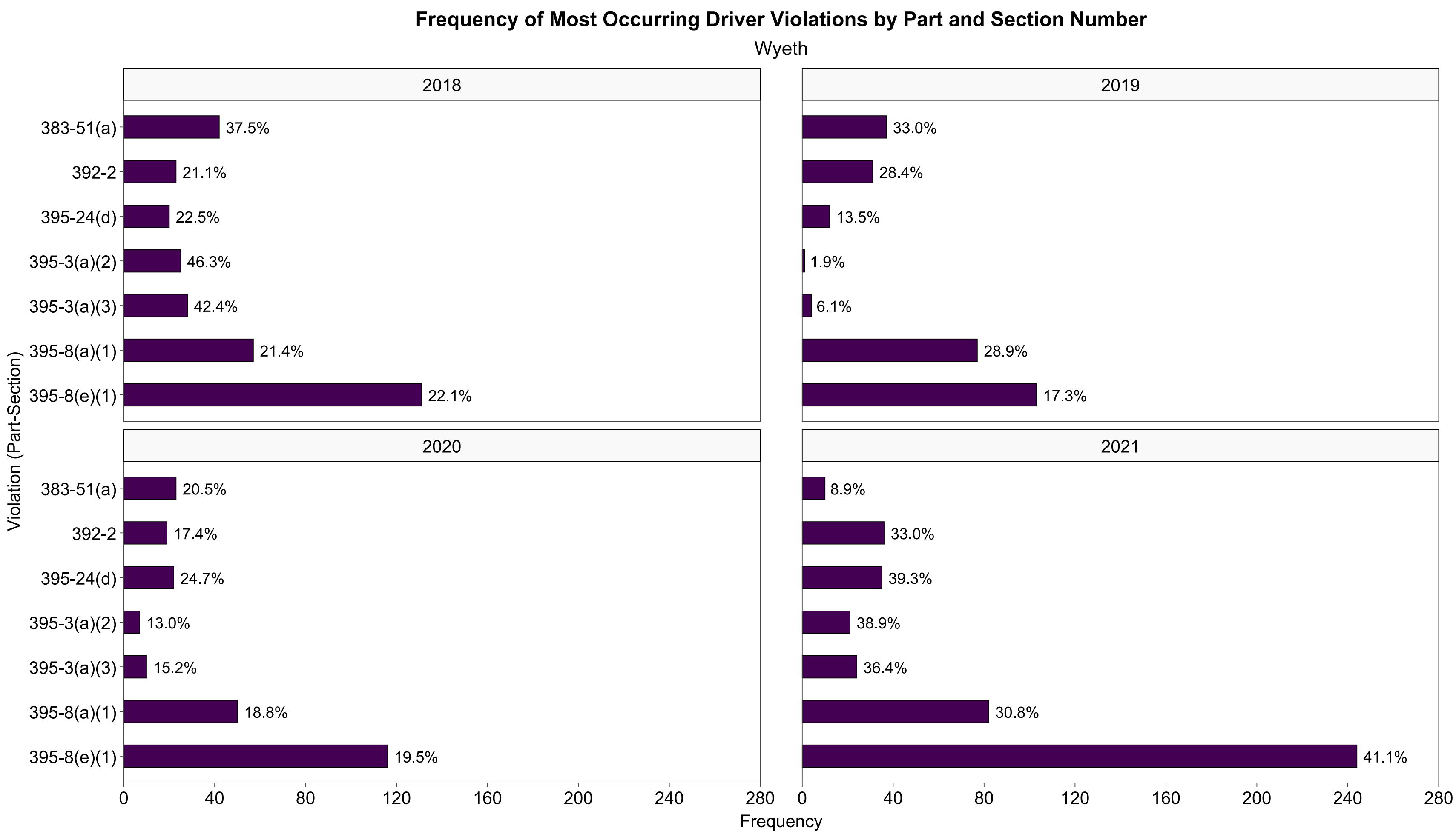

Figure 6.18: Most Occurring Driver-Related Violations by Year, Part, and Section Number at Wyeth

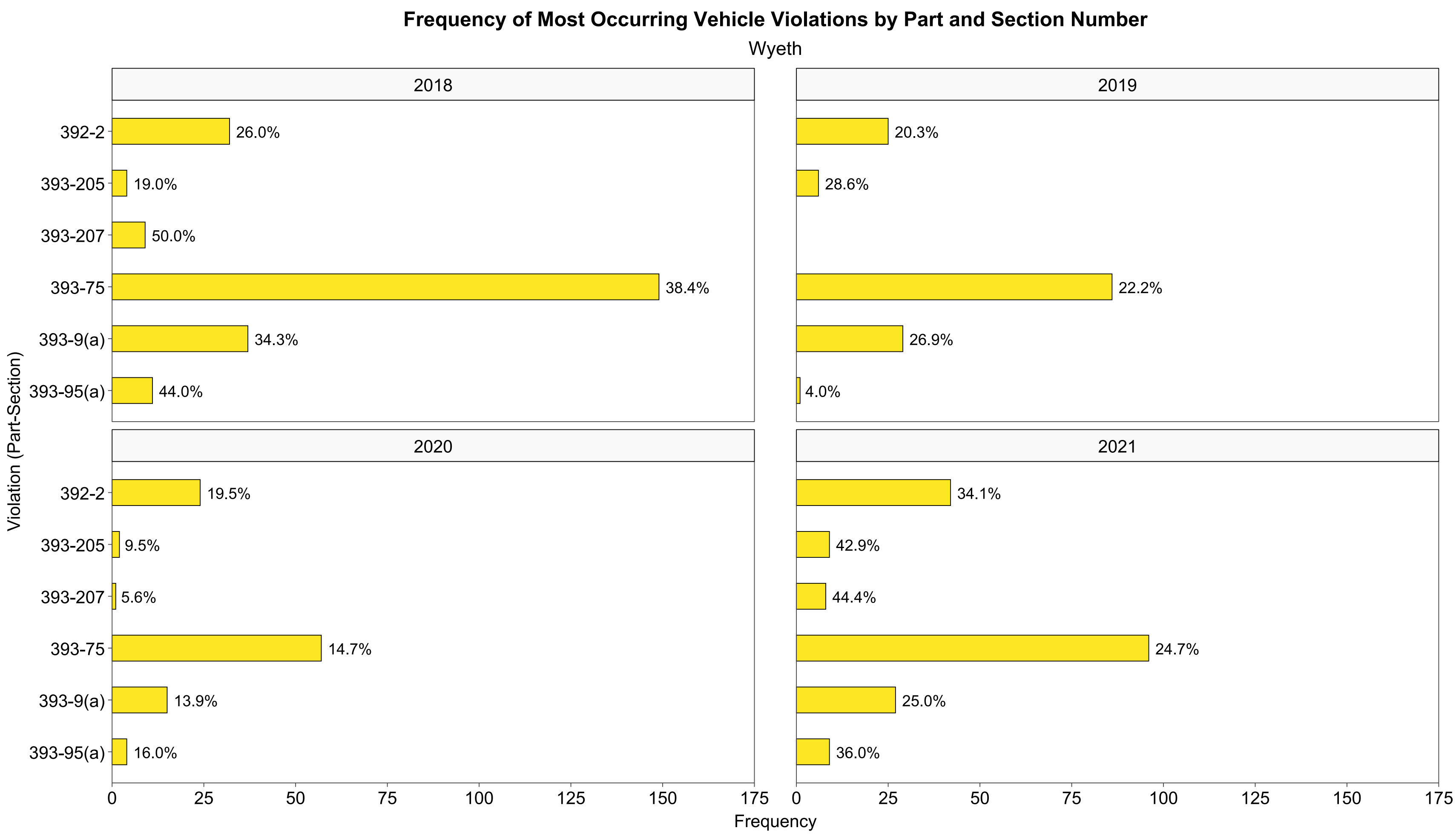

Figure 6.19: Most Occurring Vehicle-Related Violations by Year, Part, and Section Number at Wyeth

6.2.6 Umatilla POE

The most occurring driver- and vehicle-related violations at Umatilla POE are given in Table 6.11 and Table 6.12. Graphical representations are given in Figure 6.20 and Figure 6.21. For driver-related violations, the most occurring are 395-8(a)(1), 395-8(e)(1), and 383-51(a), which relate to no record of duty status, false record of duty status, and driving with a suspended commercial driver license. For vehicle-related violations, the most occurring is 393-75, which is related to tires; for example, flat tires, fabric being exposed, audible leaks, cut tires, tread depth violations, and others.

Table 6.11: Most Occurring Driver-Related Violations by Year at Umatilla POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
383-23(a)(2)	51	46	23	14	134
383-51(a)	118	127	59	27	331
392-2	111	105	17	100	333
395-3(a)(2)	42	19	17	32	110
395-3(a)(3)	43	25	7	45	120
395-30(b)(1)	2	0	1	53	56
395-8(a)(1)	89	137	63	181	470
395-8(e)(1)	205	280	125	403	1,013

Table 6.12: Most Occurring Vehicle-Related Violations by Year at Umatilla POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
392-2	74	22	6	17	119
393-130	95	60	28	49	232
393-47	123	84	33	74	314
393-53(b)	74	56	19	42	191
393-55	84	43	35	57	219
393-75	435	373	292	330	1,430
393-9(a)	131	86	64	87	368
396-3(a)(1)	134	105	34	62	335

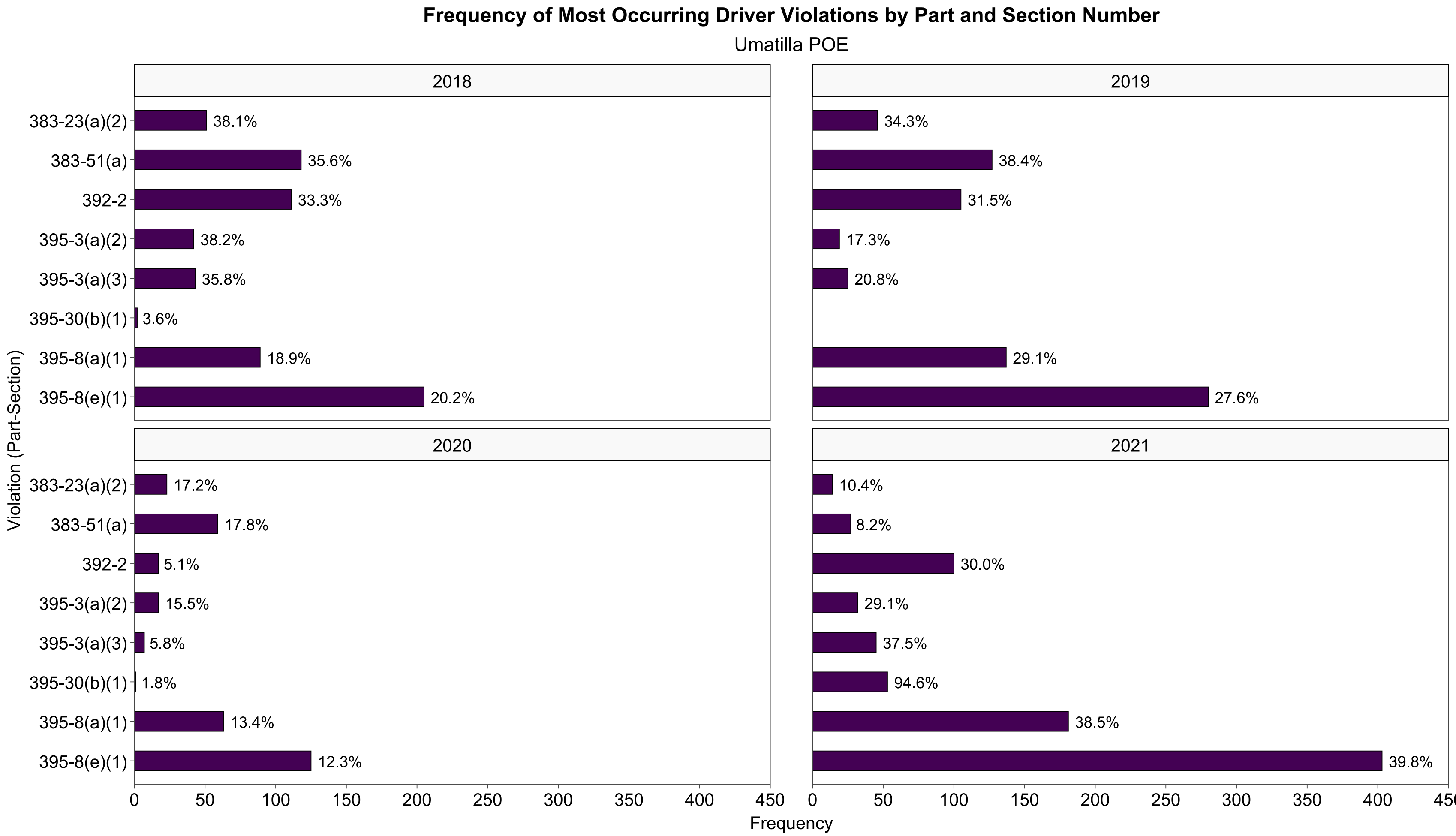

Figure 6.20: Most Occurring Driver-Related Violations by Year, Part, and Section Number at Umatilla POE

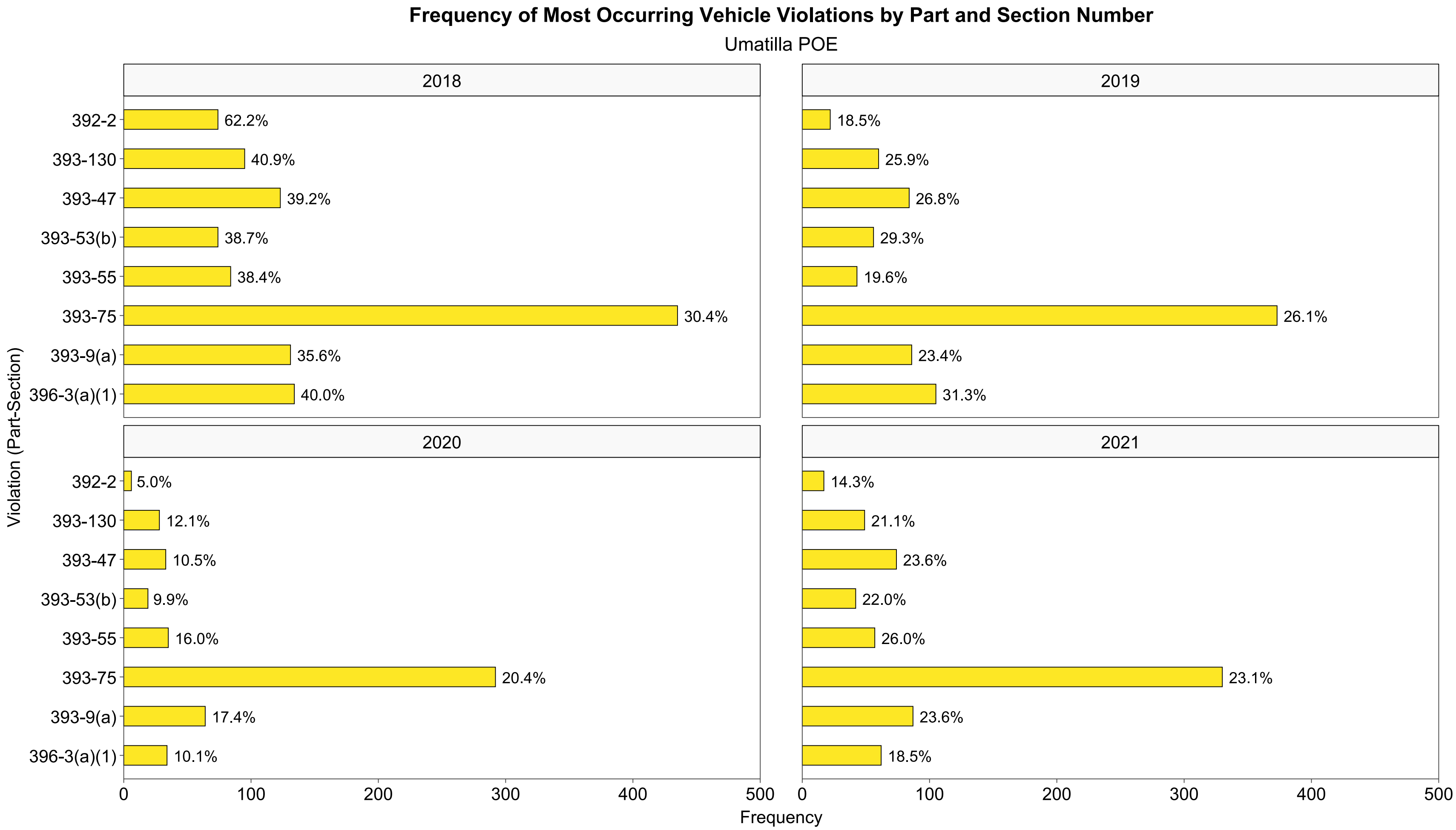

Figure 6.21: Most Occurring Vehicle-Related Violations by Year, Part, and Section Number at Umatilla POE

6.2.7 Klamath Falls POE

The most occurring driver- and vehicle-related violations at Klamath Falls POE are given in Table 6.13 and Table 6.14. Graphical representations are given in Figure 6.22 and Figure 6.23. For driver-related violations, the most occurring are 395-8(a)(1), 395-8(e)(1), and 395-22(h), which relate to no record of duty status, false record of duty status, and drivers not possessing ELD information packets. For vehicle-related violations, the most occurring is 393-75, which is related to tires; for example, flat tires, fabric being exposed, audible leaks, cut tires, tread depth violations, and others.

Table 6.13: Most Occurring Driver-Related Violations by Year at Klamath Falls POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
383-51(a)	34	33	6	13	86
392-2	11	12	21	82	126
395-22(h)	10	1	27	105	143
395-3(a)(2)	4	8	7	47	66
395-3(a)(3)	8	6	3	33	50
395-8(a)(1)	44	109	38	121	312
395-8(e)(1)	45	54	32	144	275

Table 6.14: Most Occurring Vehicle-Related Violations by Year at Klamath Falls POE

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
393-45	72	5	11	79	167
393-47	45	36	12	50	143
393-55	12	3	6	50	71
393-75	222	256	108	176	762
393-9(a)	51	32	16	76	175
393-95(a)	11	19	14	55	99
396-17(c)	10	0	10	148	168
396-3(a)(1)	69	23	24	87	203

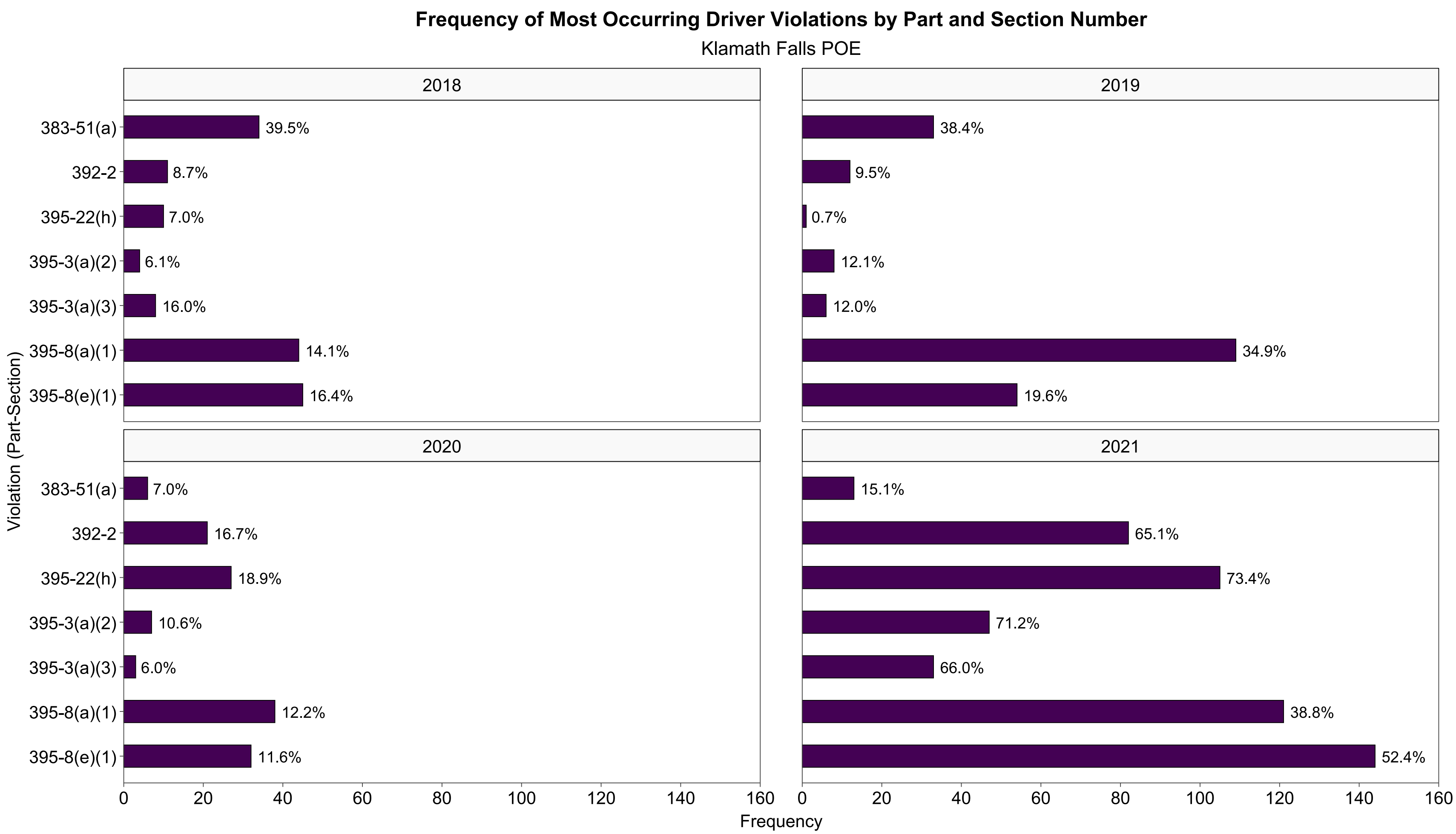

Figure 6.22: Most Occurring Driver-Related Violations by Year, Part, and Section Number at Klamath Falls POE

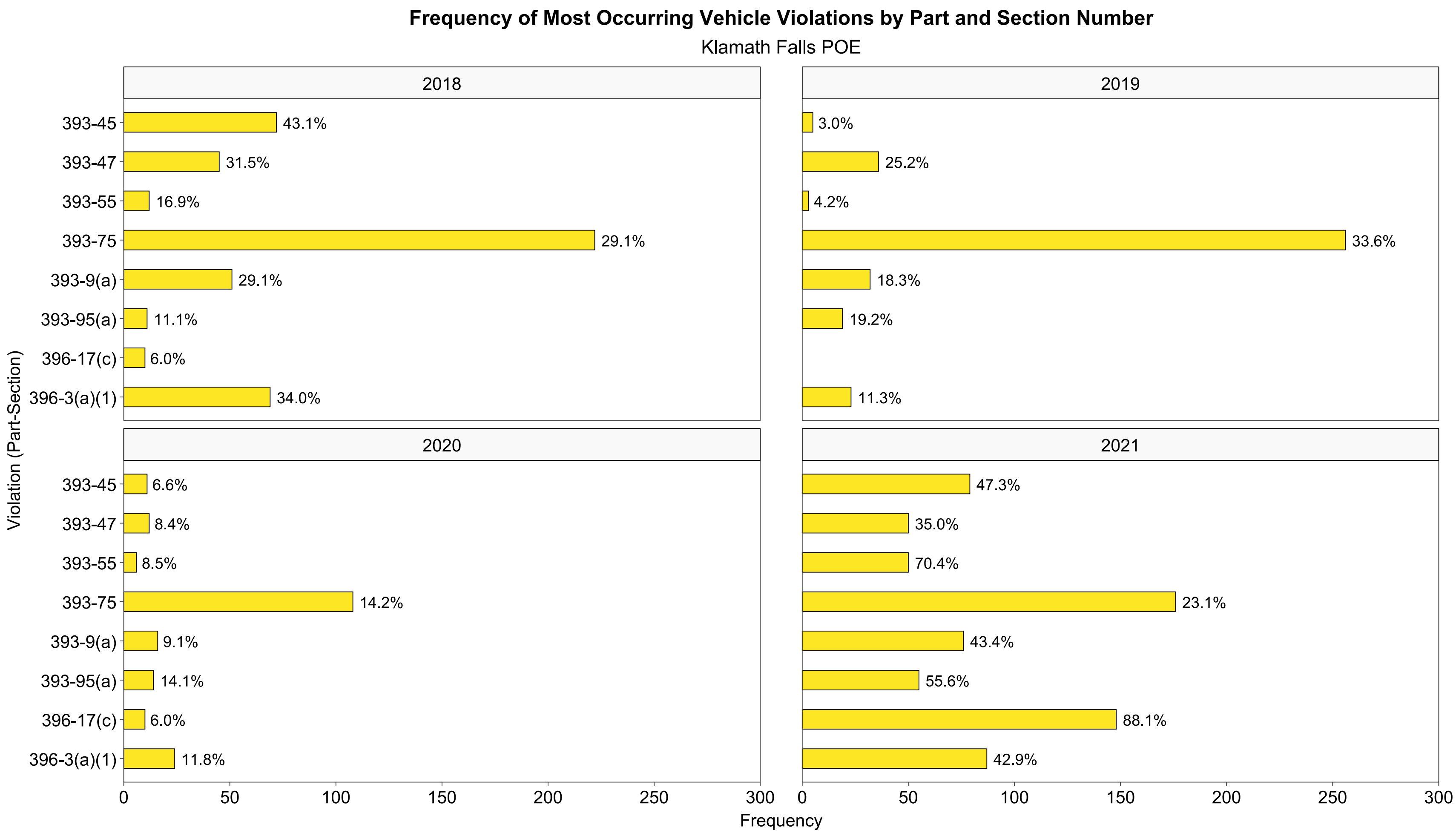

Figure 6.23: Most Occurring Vehicle-Related Violations by Year, Part, and Section Number at Klamath Falls POE

6.2.8 Clackamas County Roadways/Highways

The most occurring driver- and vehicle-related violations on Clackamas County Roadways/Highways are given in Table 6.15 and Table 6.16. Graphical representations are given in Figure 6.24 and Figure 6.25. For driver-related violations, the most occurring is 392-2, which relates to state operating authority. For vehicle-related violations, the most occurring is 393-9(a), which relates to all lamps being operable.

Table 6.15: Most Occurring Driver-Related Violations by Year on Clackamas County Roadways/Highways

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
391-11(b)	20	33	11	11	75
391-41(a)	12	34	8	40	94
392-16	38	18	4	8	68
392-2	598	1,361	378	593	2,930
395-3(a)(3)	35	25	7	7	74
395-8(a)(1)	23	22	19	33	97
395-8(e)(1)	23	33	26	34	116

Table 6.16: Most Occurring Vehicle-Related Violations by Year on Clackamas County Roadways/Highways

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
390-21	76	60	43	50	229
392-2	224	288	142	181	835
393-207	75	54	16	20	165
393-75	105	88	51	48	292
393-9(a)	545	627	168	171	1,511
393-95(a)	238	238	84	117	677
393-95(f)	152	149	50	70	421
396-17(c)	34	44	34	238	350

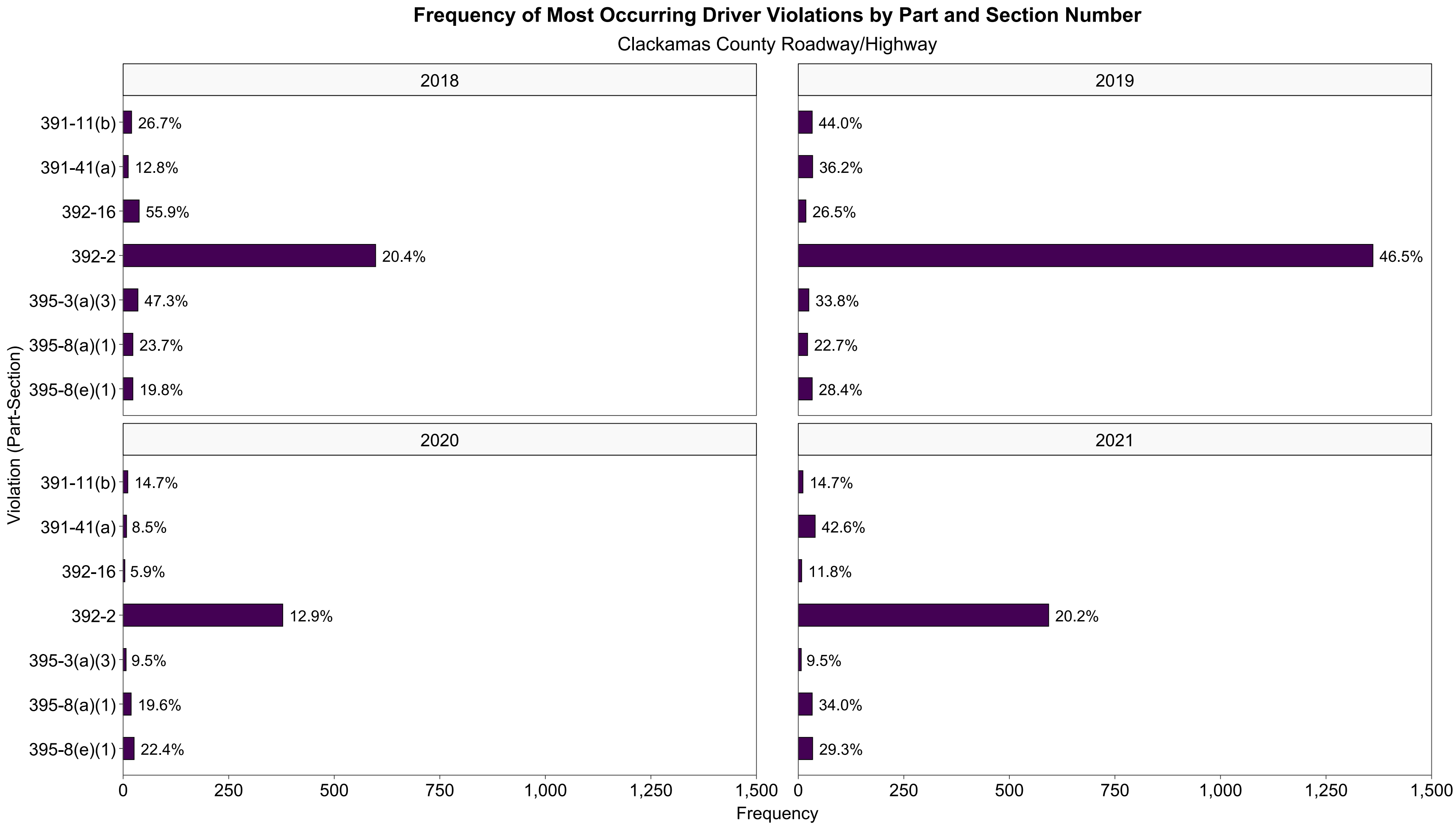

Figure 6.24: Most Occurring Driver-Related Violations by Year, Part, and Section Number Clackamas County Roadways/Highways

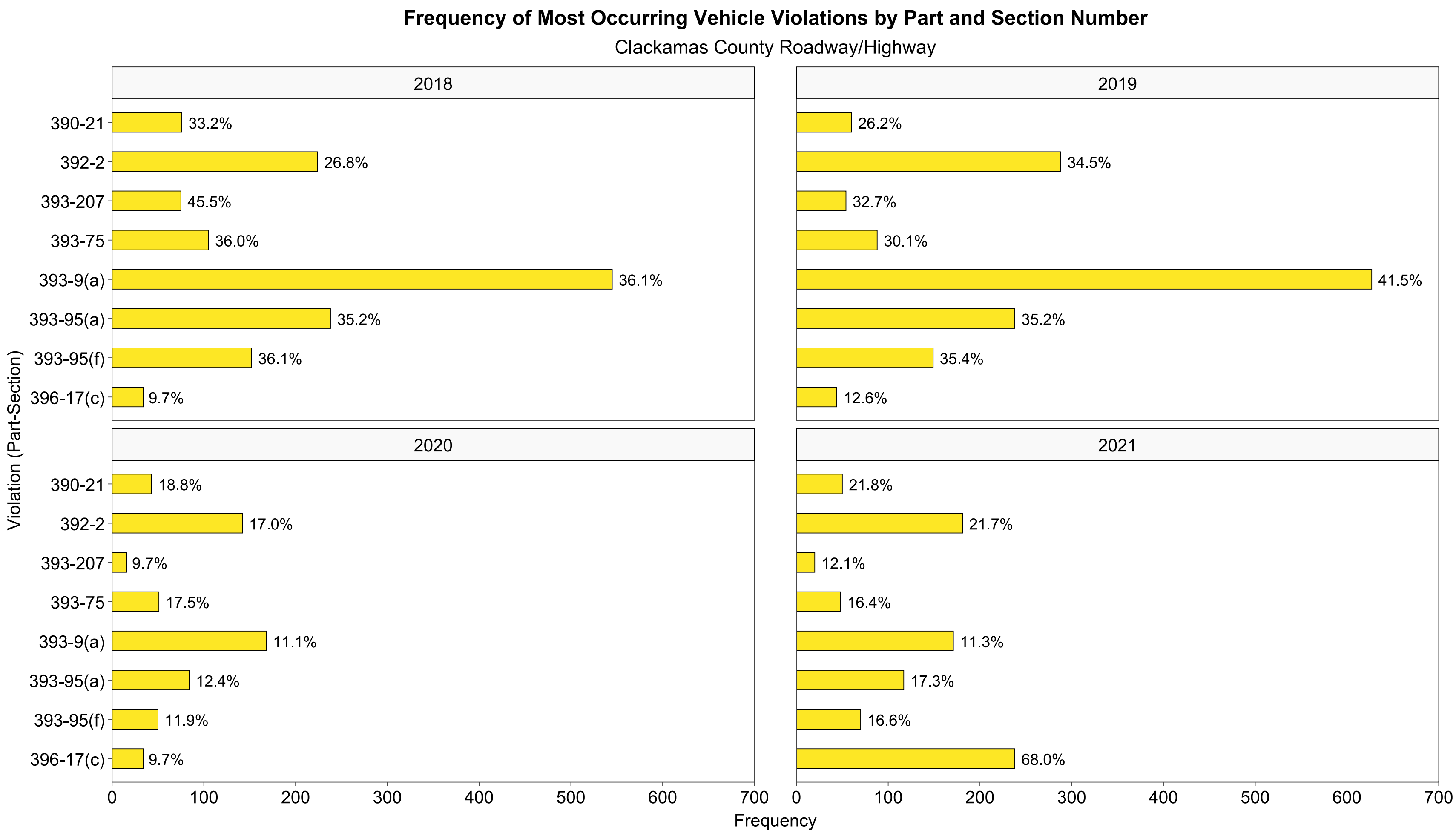

Figure 6.25: Most Occurring Vehicle-Related Violations by Year, Part, and Section Number on Clackamas County Roadways/Highways

6.2.9 Washington County Roadways/Highways

The most occurring driver- and vehicle-related violations on Clackamas County Roadways/Highways are given in Table 6.17 and Table 6.18. Graphical representations are given in Figure 6.26 and Figure 6.27. For driver-related violations, the most occurring is 392-2, which relates to state operating authority. For vehicle-related violations, the most occurring is 393-9(a), which relates to all lamps being operable.

Table 6.17: Most Occurring Driver-Related Violations by Year on Washington County Roadways/Highways

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
383-23(a)(2)	19	21	21	28	89
391-41(a)	3	17	9	28	57
392-16	41	33	28	20	122
392-2	66	153	31	34	284
392-82(a)(1)	14	7	13	15	49
395-8(a)(1)	6	14	2	6	28
395-8(e)(1)	1	14	0	12	27

Table 6.18: Most Occurring Vehicle-Related Violations by Year on Washington County Roadways/Highways

Violation (Part-Section)	Year				Total
	2018	2019	2020	2021	
392-2	231	221	161	169	782
392-9b(a)	54	60	77	73	264
393-43	75	76	78	41	270
393-75	153	116	102	104	475
393-9(a)	371	302	224	178	1,075
393-95(a)	113	107	93	79	392
393-95(f)	106	89	80	61	336
396-3(a)(1)	70	82	84	52	288

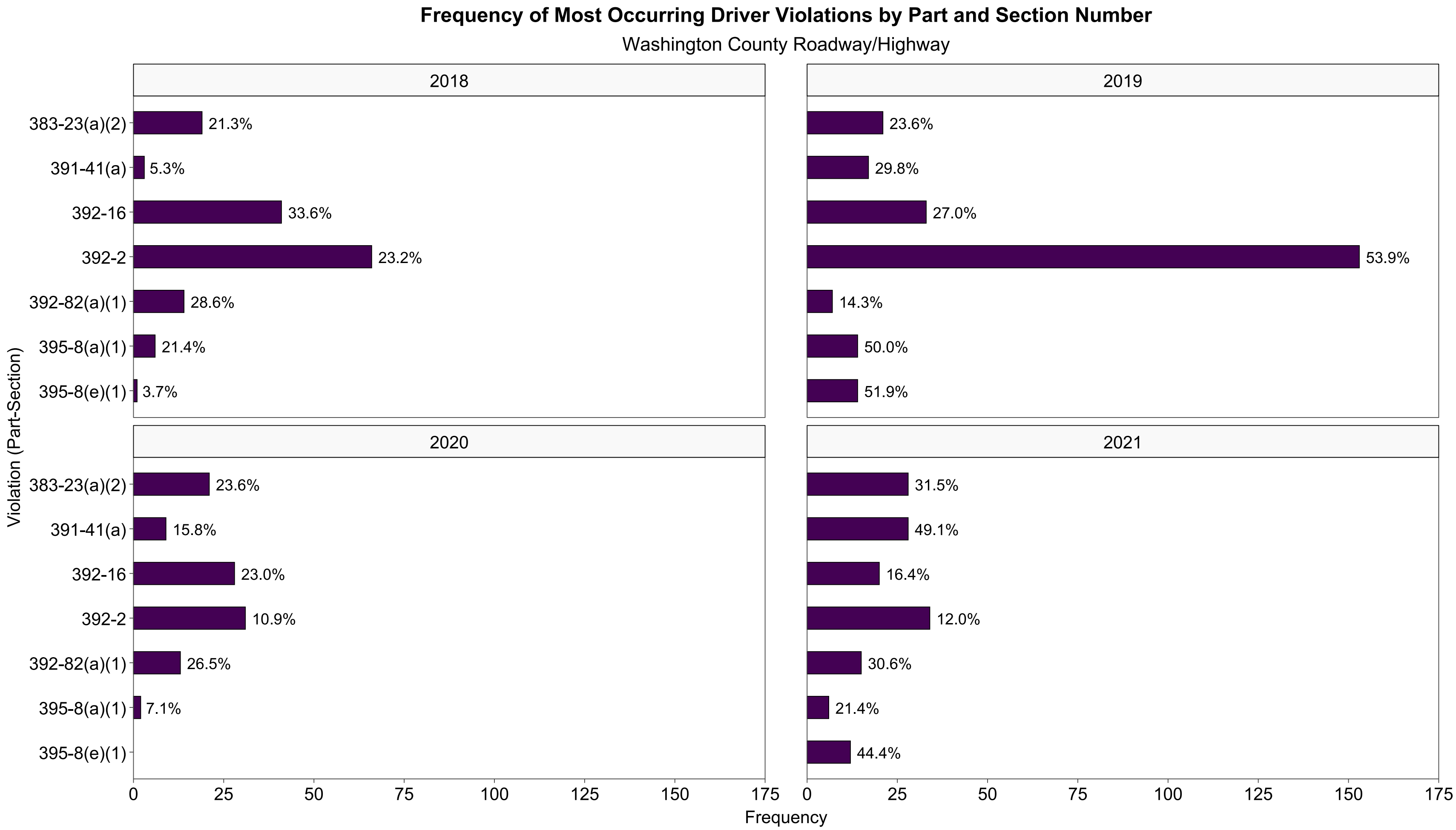

Figure 6.26: Most Occurring Driver-Related Violations by Year, Part, and Section Number on Washington County Roadways/Highways

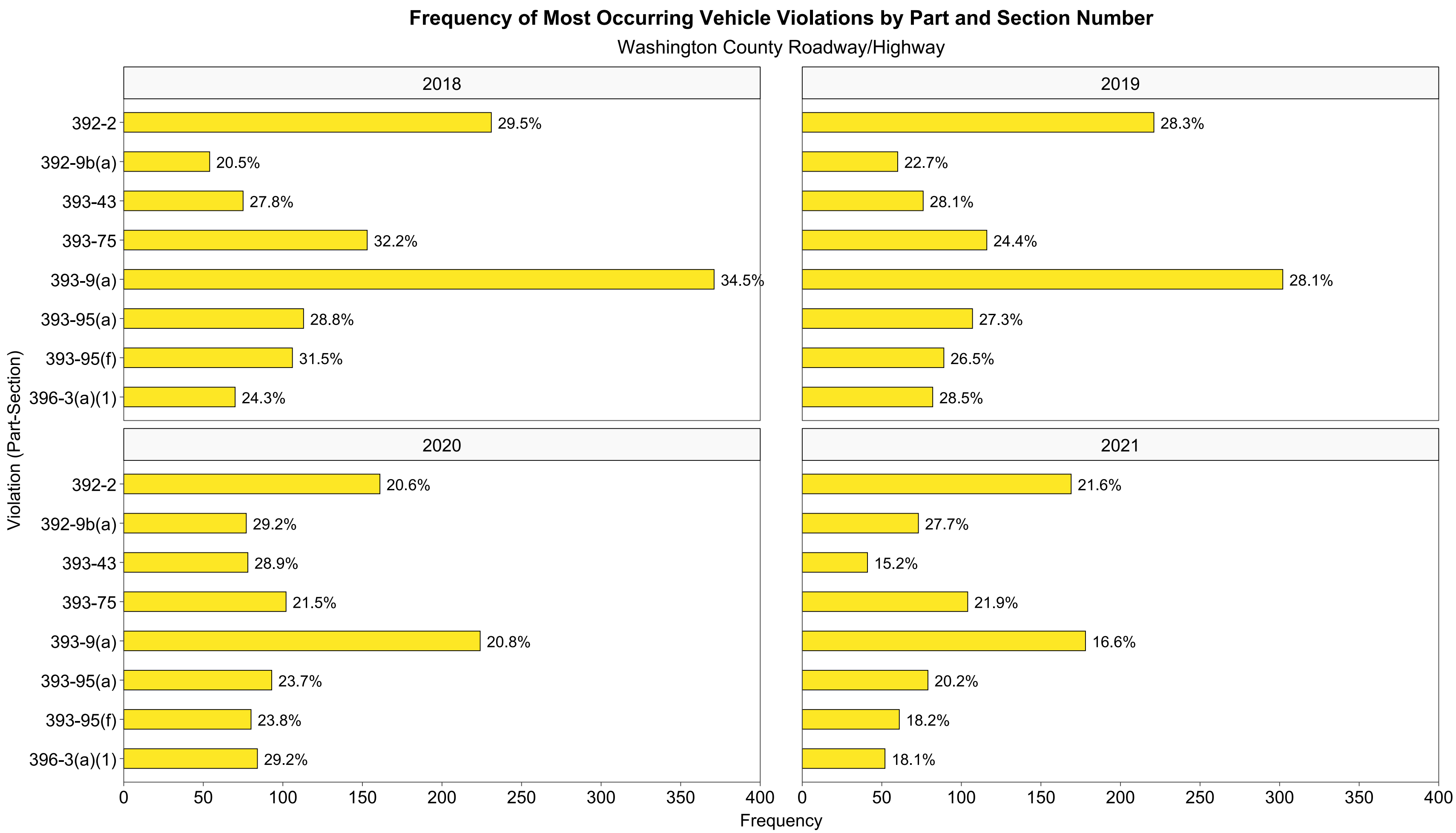

Figure 6.27: Most Occurring Vehicle-Related Violations by Year, Part, and Section Number on Washington County Roadways/Highways

6.3 BENEFIT-COST ANALYSIS RESULTS

Based on the results of the location-based descriptive analysis, the driver- and vehicle-related violations that occurred most often across all locations were considered for electronic enforcement intervention. Despite Clackamas County and Washington County being locations that experience a high number of violations (both driver and vehicle), these locations were not considered in the benefit-cost analysis. The data provided does not give exact locations within these counties that can be used to identify where electronic enforcement should be implemented. The majority of violations are related to state operating authority (lane restriction violations, speeding, etc.) or inoperable lamps, which require detailed locations to implement appropriate enforcement technologies.

The remainder of this chapter presents the results for each of the electronic enforcement technologies considered.

6.3.1 Real-Time Electronic Logging Device Data Access

The most occurring driver violations across the locations considered for the benefit-costs analysis were related to duty status and commercial driver license (CDL) status; specifically:

- 395-8(a)1 – no record of duty status.
- 395-8(e)1 – false record of duty status.
- 395-51(a) – driving a commercial motor vehicle while commercial driver license is suspended.

These violations accounted for the vast majority of violations, as shown in Table 6.19. Of the seven locations considered, over 70% of all violations were due to no record of duty status, false record of duty status, or driving with a suspended commercial driver license (CDL). The lowest proportion was observed at Klamath Falls POE, which still accounted for nearly 64% of all violations. Based on these numbers, the electronic enforcement technology proposed is real-time electronic logging device (ELD) data access.

Table 6.19: Proportion of Total Violations for 395-8(a)(1), 395-8(e)(1), and 383-51(a)

Location	Proportion of Total Violations
Ashland POE	73.9%
Woodburn POE	65.9%
Farewell Bend POE	70.7%
Cascade Locks POE	73.0%
Wyeth	75.3%
Umatilla POE	70.7%
Klamath Falls POE	63.6%

This technology can instantly monitor hours-of-service and duty status, making it challenging to falsify duty status records due to improved detection of false logs. The technology can be used to immediately give citations for violations, which can improve compliance, enforcement efficiency, and safety. In addition to monitoring hours-of-service and duty status, the technology can be used to cross-reference, or integrate, with current databases to flag and cite drivers who are driving with a suspended CDL. This technology has not experienced widespread implementation and can be fully automated once it is implemented.

To determine the costs of implementing such a technology, costs were obtained directly from previous work or were derived based on information provided in previous work (e.g., manufacturer, system type, equipment type, software type, etc.). If no direct link could be made, similar products, systems, equipment, etc. were used to derive implementation costs. Estimated costs for real-time ELD data access are given in Table 6.20.

Hardware costs include devices, data terminals, computers, and network infrastructure. Software costs include access licenses and integration with Federal Motor Carrier Safety Administration systems, integration with existing weigh station systems, and integration with existing weigh station databases. Training and implementation costs include training staff to be familiar with the system, system installation, and system setup. Operation costs include data fees, maintenance, and upgrades/updates.

Table 6.20: Estimated Implementation Costs for Real-Time Electronic Logging Device Data Access

Cost Item[a]	Cost Range	
	Lower	Upper
Hardware	$10,000	$15,000
Software	$25,000	$55,000
Training and Implementation	$7,000	$20,000
Annual Operational Costs	$6,000	$13,000
Total	$42,000	$83,000

[a] (Kamyab et al., 1998; Green et al., 2002; Crabtree et al., 2005b; Rakha et al., 2006; Wade et al., 2020)

Considering the labor costs given in Table 5.1 and the estimated implementation costs given in Table 6.20, a benefit-cost analysis was conducted based on the following scenarios:

- Three compliance specialists are present.
- Three motor carrier enforcement officers are present.
- Two compliance specialists and one motor carrier enforcement officer are present.
- One compliance specialist and two motor carrier enforcement officers are present.

6.3.1.1 Ashland POE

Figure 6.28 shows the results of the benefit-cost analysis at Ashland POE. As observed, real-time electronic logging device data access is economically justified for each potential implementation cost. This is true for scenarios in which three workers are present at the weigh station.

For the scenario in which a single person is working at the weigh station, the implementation costs need to be lower to be economically justified (see Table 6.21 and Figure 6.29). In the evening shift, where just one worker is present, implementation of real-time ELD data access is economically viable if the one worker is a compliance specialist and labor cost is low, medium, or high. If labor cost is low, max implementation cost needs to be $45,000 or less. If labor cost is medium, max implementation cost needs to be $56,000 or less. Lastly, if labor cost is high, max implementation cost needs to be $68,000 or less. If the one worker on the evening shift is a motor carrier enforcement officer, real-time ELD data access is economically justified at low implementation costs, relative to the maximum implementation cost. If labor cost is low, there is no economic justification (all benefit-cost ratios are less than 1.0). If labor cost is medium, max implementation cost needs to be $48,000 or less. If labor cost is high, max implementation cost needs to be $55,000 or less.

Table 6.21: Maximum Implementation Cost for Real-Time ELD Data Access to be Economically Justified at Ashland POE (Evening Shift)

Scenario	Labor Cost	Max Implementation Cost
One Compliance Specialist	Low	$44,500
	Medium	$56,000
	High	$68,000
One Motor Carrier Enforcement Officer	Low	—
	Medium	$48,000
	High	$55,500

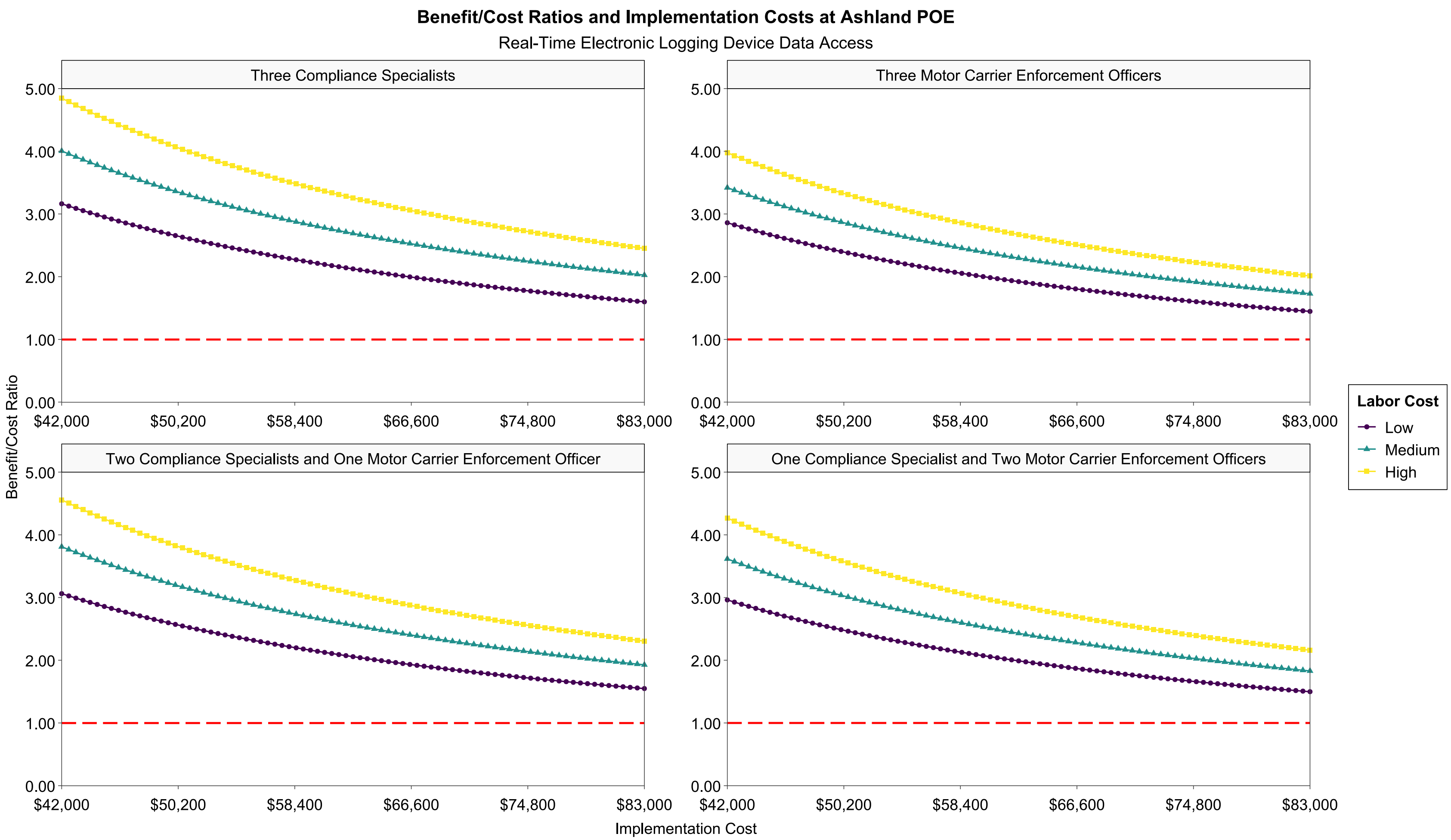

Figure 6.28: Benefit-Cost Results for Real-Time ELD Data Access at Ashland POE (Day Shift)

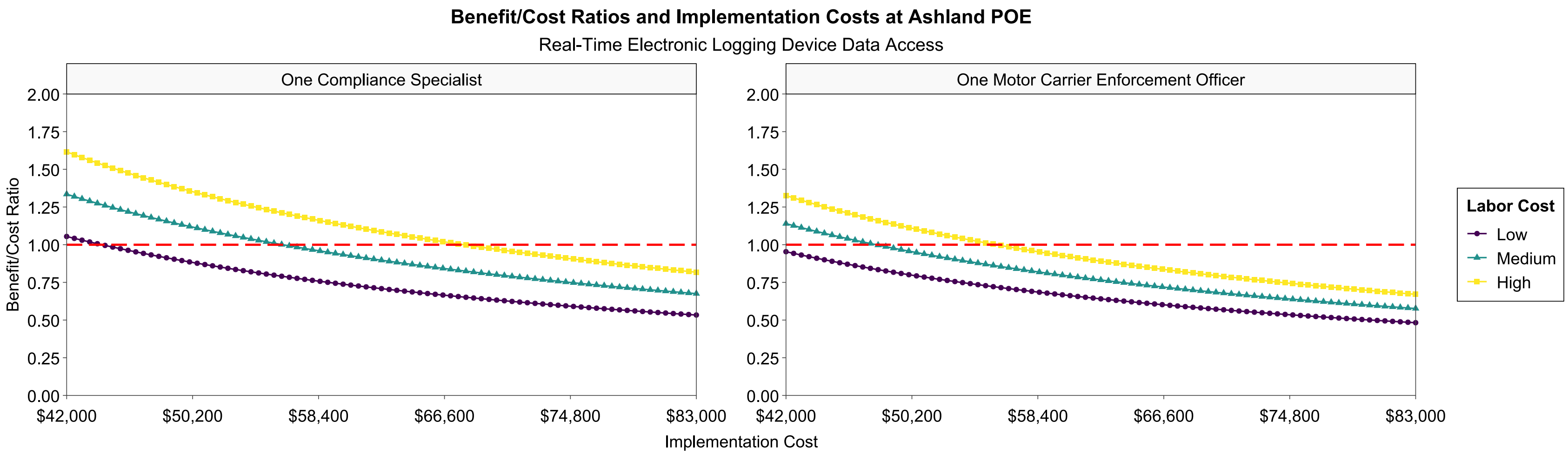

Figure 6.29: Benefit-Cost Results for Real-Time ELD Data Access at Ashland POE (Evening Shift)

6.3.1.2 Woodburn POE

Figure 6.30 shows the results of the benefit-cost analysis at Woodburn POE. As observed, real-time electronic logging device data access is economically justified for each potential implementation cost. This is true for scenarios in which three workers are present at the weigh station.

For the scenario in which a single person is working at the weigh station, the implementation costs need to be lower, depending on the worker present and the labor cost, to be economically justified (see Table 6.22 and Figure 6.31). If the one worker is a compliance specialist, and labor cost is high, the max implementation cost needs to be $78,000 or less. If labor cost is medium, the max implementation cost needs to be $64,000 or less. If labor cost is low, the max implementation cost needs to be $51,000 or less.

If the one worker on the evening shift is a motor carrier enforcement officer, real-time ELD data access is economically justified at low implementation costs. If labor cost is low, the max implementation cost needs to be $46,000 or less. If labor cost is medium, the max implementation cost needs to be $55,000 or less. If labor cost is high, the max implementation cost needs to be $64,000 or less.

Table 6.22: Maximum Implementation Cost for Real-Time ELD Data Access to be Economically Justified at Woodburn POE (Evening Shift)

Scenario	Labor Cost	Max Implementation Cost
One Compliance Specialist	Low	$51,000
	Medium	$64,500
	High	$78,000
One Motor Carrier Enforcement Officer	Low	$46,000
	Medium	$55,000
	High	$64,000

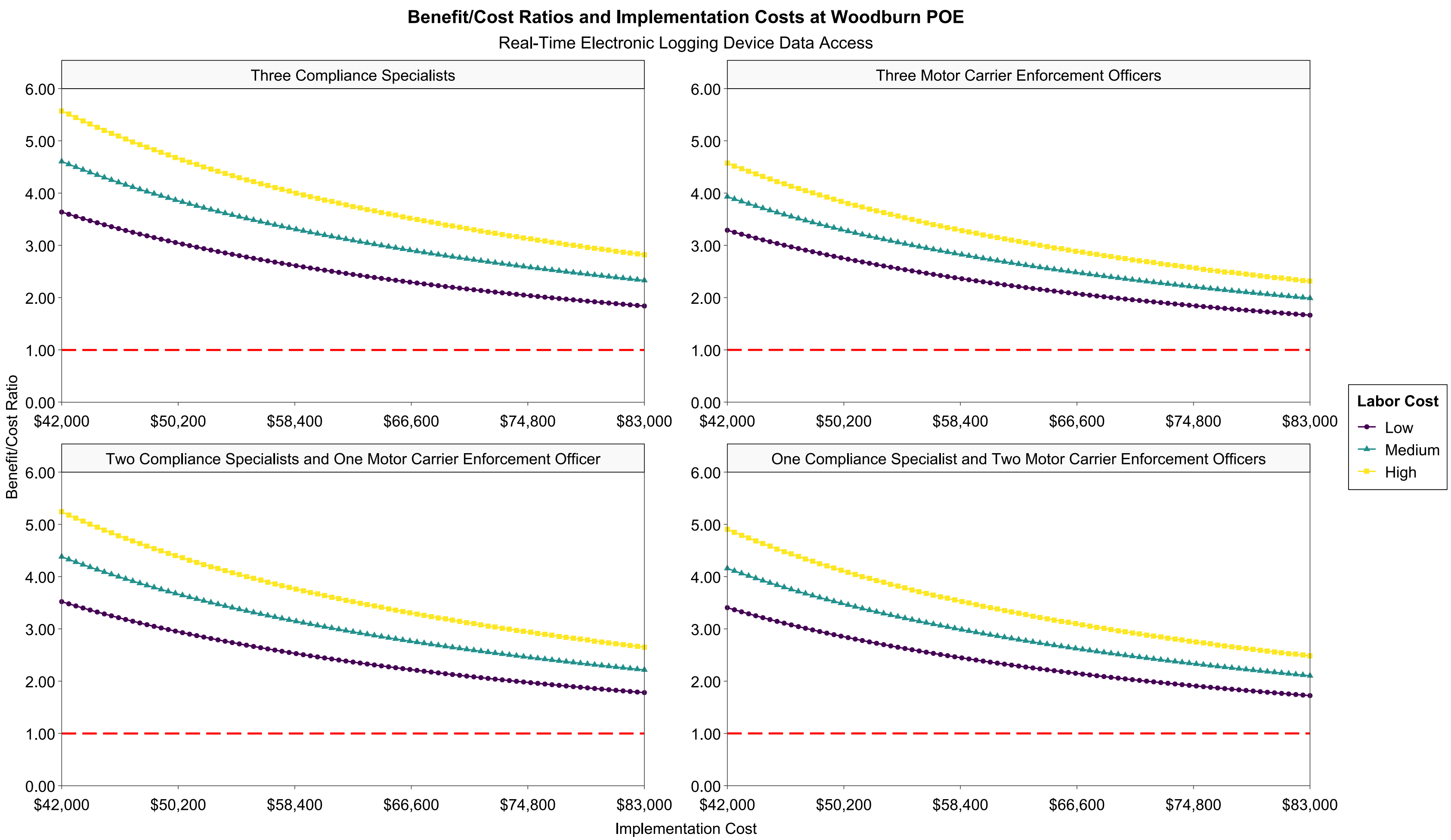

Figure 6.30: Benefit-Cost Results for Real-Time ELD Data Access at Woodburn POE (Day Shift)

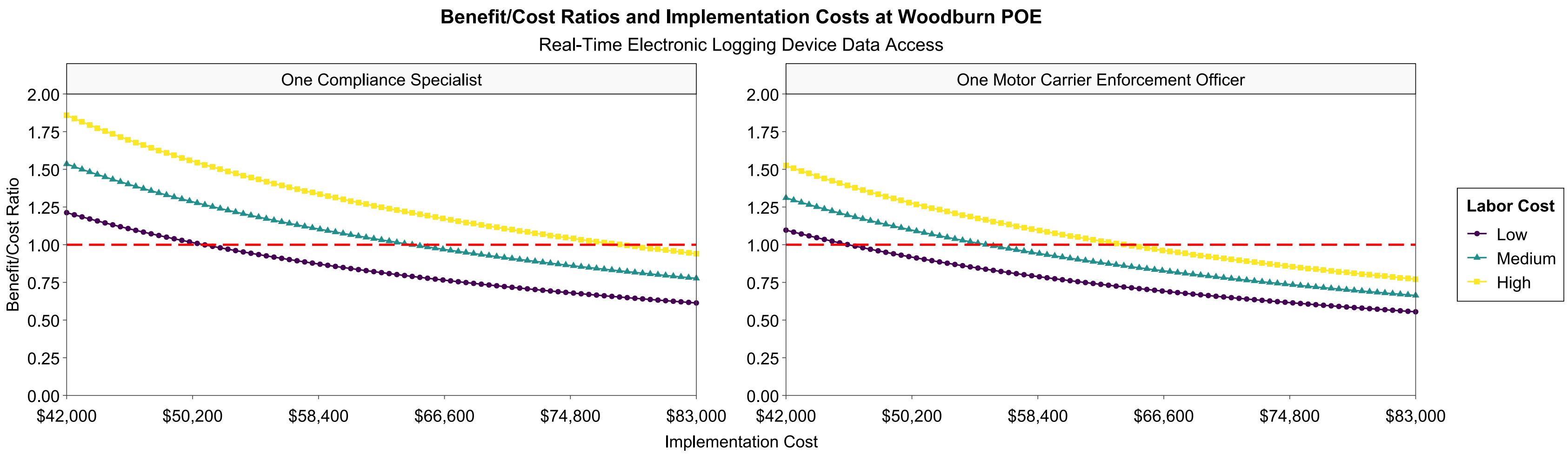

Figure 6.31: Benefit-Cost Results for Real-Time ELD Data Access at Woodburn POE (Evening Shift)

6.3.1.3 Farewell Bend POE

Figure 6.32 shows the results of the benefit-cost analysis at Farewell Bend POE. Results indicate that real-time ELD data access is economically justified in all four scenarios when considering medium or high labor costs (see Table 6.23). If three compliance specialists are present, and labor cost is low, the maximum implementation cost needs to be $82,000 or less (this is $1,000 under the upper range of implementation costs). If three motor carrier enforcement officers are present, and labor cost is low, the maximum implementation cost needs to be $74,000 or less. If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is low, the maximum implementation cost needs to be $79,500 or less. If one compliance specialist and two motor carrier enforcement officers are present, and labor cost is low, the maximum implementation cost needs to be $77,000 or less. Overall, real-time ELD data access is economically viable at Farewell Bend POE, with implementation cost cutoffs being present under low labor assumptions and only slightly under the upper range of implementation costs.

For the scenario in which a single person is working at the weigh station, real-time ELD data access is not economically justified (see Figure 6.33).

Table 6.23: Maximum Implementation Cost for Real-Time ELD Data Access to be Economically Justified at Farewell Bend POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$82,000
	Medium	—
	High	—
Three Motor Carrier Enforcement Officers	Low	$74,500
	Medium	—
	High	—
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$79,500
	Medium	—
	High	—
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$77,000
	Medium	—
	High	—

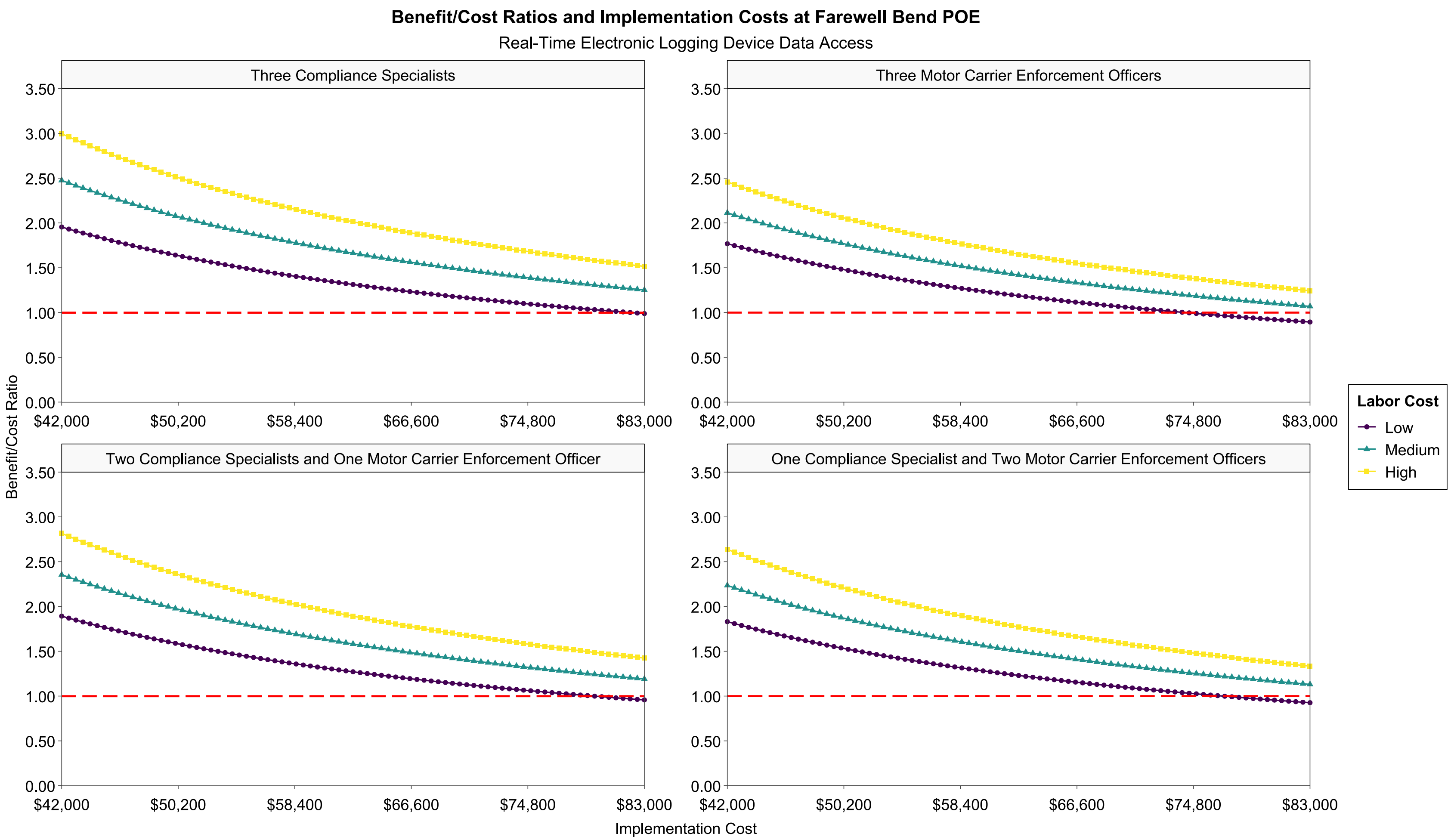

Figure 6.32: Benefit-Cost Results for Real-Time ELD Data Access at Farewell Bend POE (Day Shift)

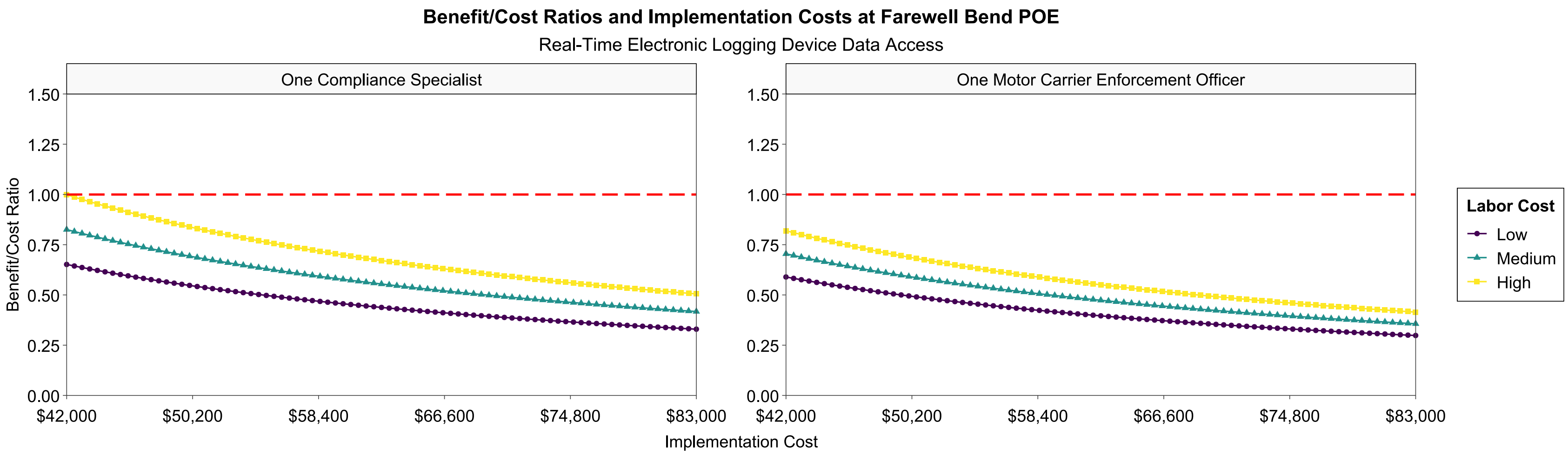

Figure 6.33: Benefit-Cost Results for Real-Time ELD Data Access at Farewell Bend POE (Evening Shift)

6.3.1.4 Cascade Locks POE

Figure 6.34 shows the results of the benefit-cost analysis at Cascade Locks POE. As observed, real-time electronic logging device data access is economically justified for each potential implementation cost. This is true for all scenarios in which three workers are present at the weigh station.

For the scenario in which a single person is working at the weigh station, real-time ELD data access is economically justified under one scenario (see Table 6.24 and Figure 6.35). Although results do suggest economic viability at medium labor costs when one compliance specialist is present, and at high labor costs when one motor carrier enforcement officer is present, the max implementation cost is $43,000 (this is just $1,000 greater than the lower range of implementation costs). If one compliance specialist is working and labor cost is high, the maximum implementation cost needs to be $52,000 or less to be economically justified.

Table 6.24: Maximum Implementation Cost for Real-Time ELD Data Access to be Economically Justified at Cascade Locks POE (Evening Shift)

Scenario	Labor Cost	Max Implementation Cost
One Compliance Specialist	Low	—
	Medium	$43,000
	High	$52,000
One Motor Carrier Enforcement Officer	Low	—
	Medium	—
	High	$43,000

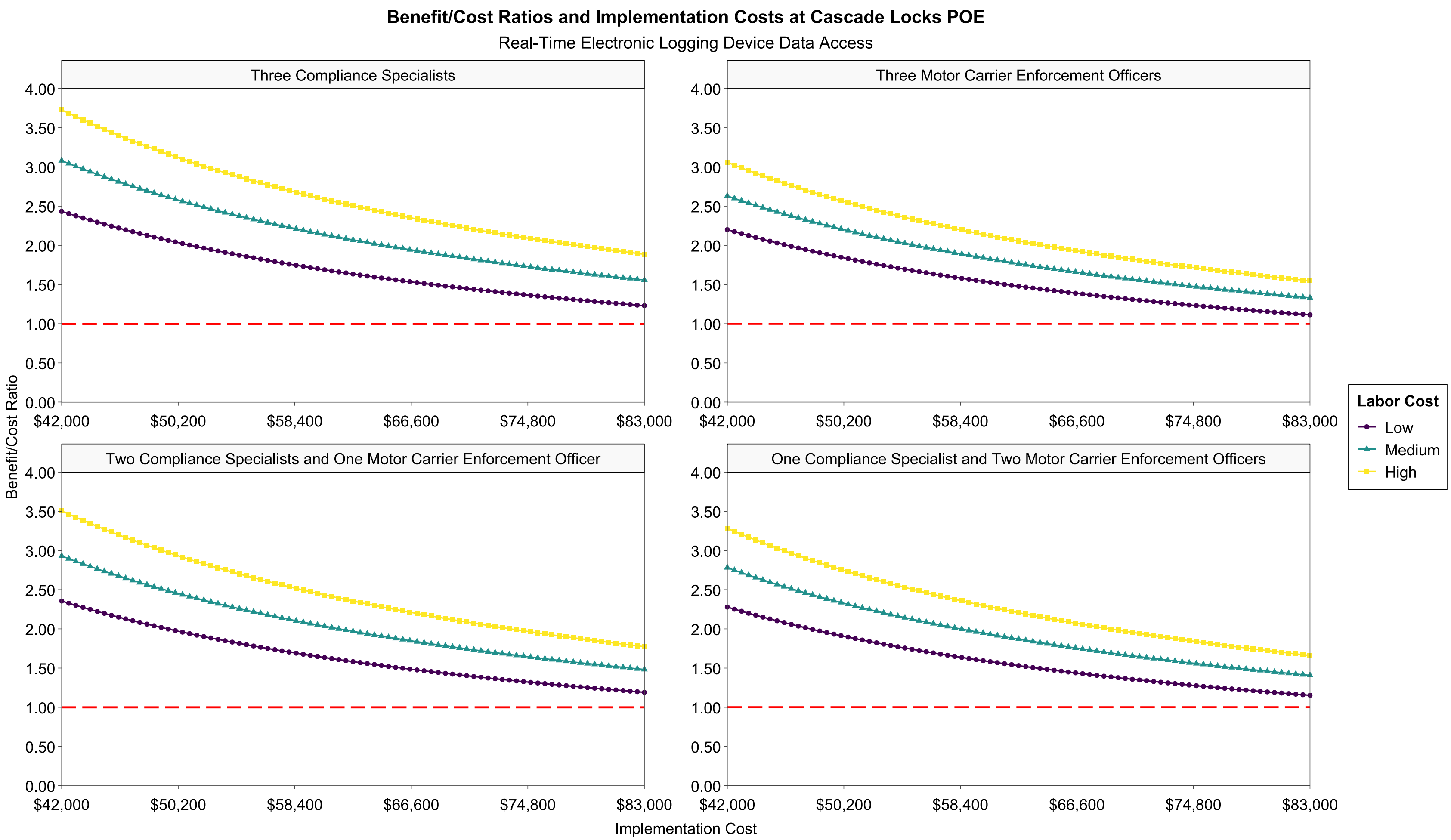

Figure 6.34: Benefit-Cost Results for Real-Time ELD Data Access at Cascade Locks POE (Day Shift)

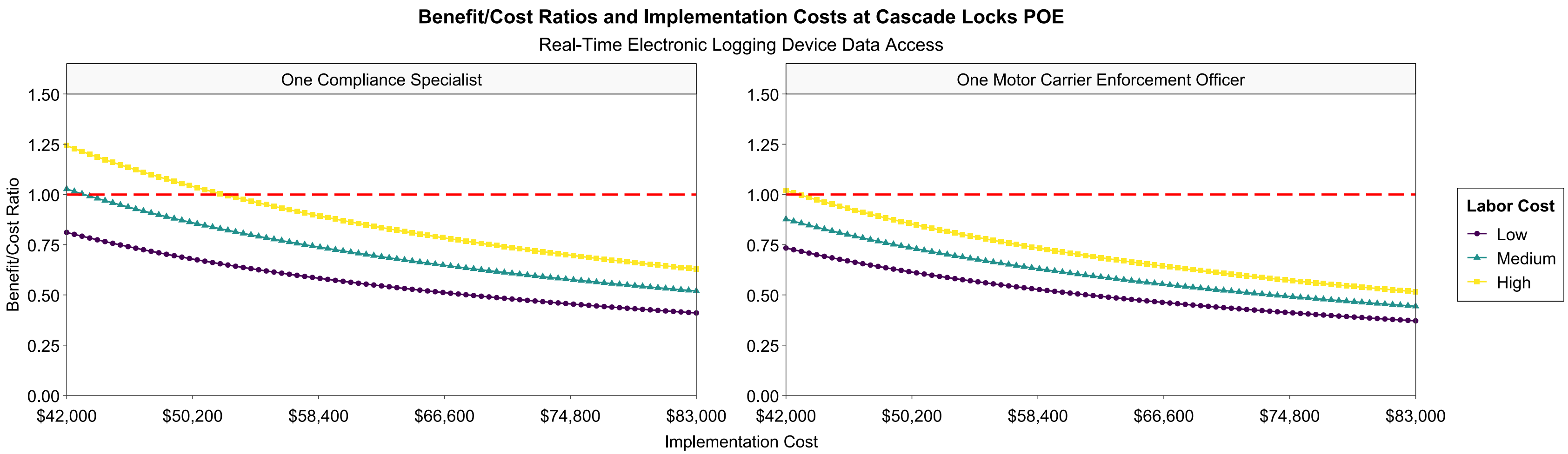

Figure 6.35: Benefit-Cost Results for Real-Time ELD Data Access at Cascade Locks POE (Evening Shift)

6.3.1.5 Wyeth

Figure 6.36 shows the results of the benefit-cost analysis at Wyeth. Results indicate that real-time ELD data access is economically justified in all four scenarios when considering medium or high labor costs (see Table 6.25). If three compliance specialists are present, and labor cost is low, the maximum implementation cost needs to be $76,500 or less. If three motor carrier enforcement officers are present, and labor cost is medium, the maximum implementation cost needs to be $85,500 or less (this is just $500 under the upper range of implementation costs). If three motor carrier enforcement officers are present, and labor cost is low, the maximum implementation cost needs to be $69,000 or less. If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is low, the maximum implementation cost needs to be $74,000 or less. If one compliance specialist and two motor carrier enforcement officers are present, and labor cost is low, the maximum implementation cost needs to be $71,500 or less. Overall, real-time ELD data access is economically viable at Wyeth, with implementation cost cutoffs being present under low labor assumptions and only slightly under the upper range of implementation costs.

For the scenario in which a single person is working at the weigh station, real-time ELD data access is not economically justified (see Figure 6.37).

Table 6.25: Maximum Implementation Cost for Real-Time ELD Data Access to be Economically Justified at Wyeth (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$76,500
	Medium	—
	High	—
Three Motor Carrier Enforcement Officers	Low	$69,000
	Medium	$82,500
	High	—
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$74,000
	Medium	—
	High	—
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$71,500
	Medium	—
	High	—

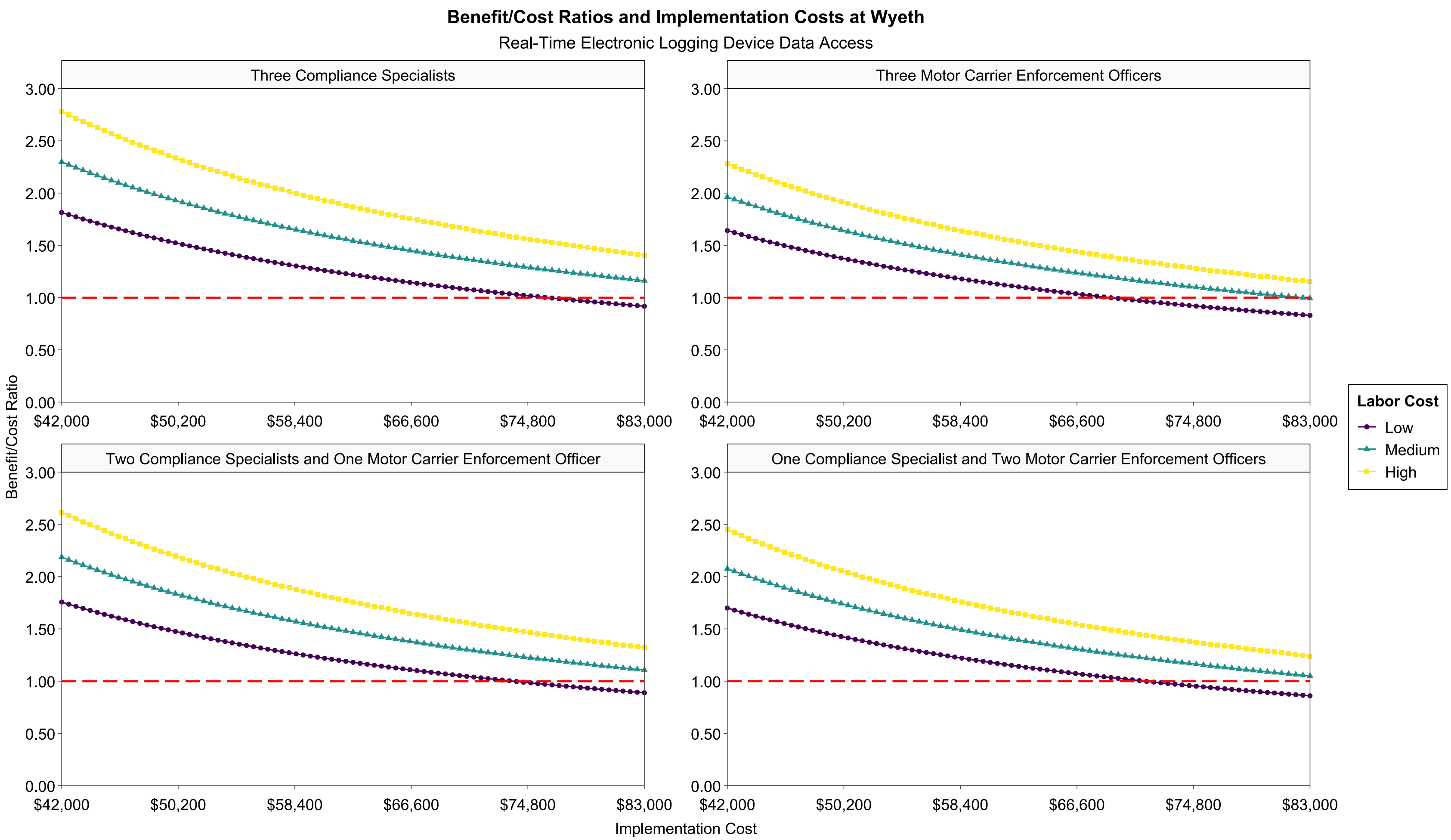

Figure 6.36: Benefit-Cost Results for Real-Time ELD Data Access at Wyeth (Day Shift)

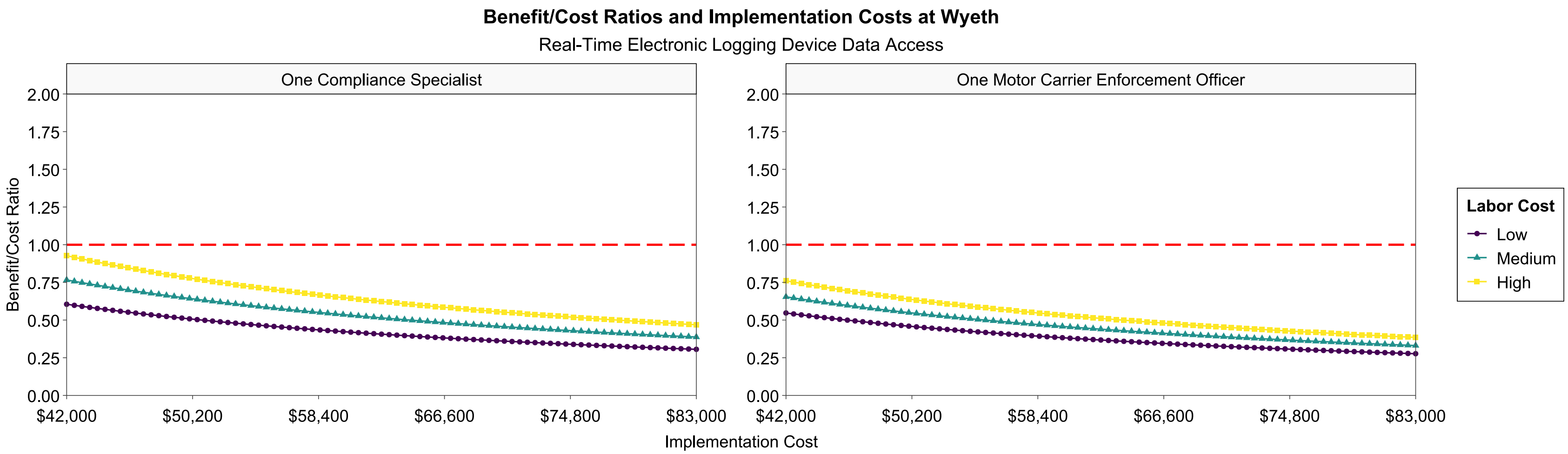

Figure 6.37: Benefit-Cost Results for Real-Time ELD Data Access at Wyeth (Evening Shift)

6.3.1.6 Umatilla POE

Figure 6.38 shows the results of the benefit-cost analysis at Umatilla POE. As observed, real-time electronic logging device data access is economically justified for each potential implementation cost. This is true for all scenarios in which three workers are present at the weigh station (the day shift).

For the scenario in which a single person is working at the weigh station (evening shift), the maximum implementation cost to be considered economically viable varies based on who is working and the assumed labor cost (see Table 6.26 and Figure 6.39). If the one worker is a compliance specialist, and labor cost is low, medium, or high, the maximum implementation cost needs to be $47,500, $60,000, or $72,500 or less, respectively.

If the one worker is a motor carrier enforcement officer, real-time ELD data access is economically justified at low implementation costs. If labor cost is low, the maximum implementation cost needs to be $43,000 or less. If labor cost is medium, the maximum implementation cost needs to be $51,000 or less. If labor cost is high, the maximum implementation cost needs to be $59,500 or less.

Table 6.26: Maximum Implementation Cost for Real-Time ELD Data Access to be Economically Justified at Umatilla POE (Evening Shift)

Scenario	Labor Cost	Max Implementation Cost
One Compliance Specialist	Low	$47,500
	Medium	$60,000
	High	$72,500
One Motor Carrier Enforcement Officer	Low	$43,000
	Medium	$51,500
	High	$59,500

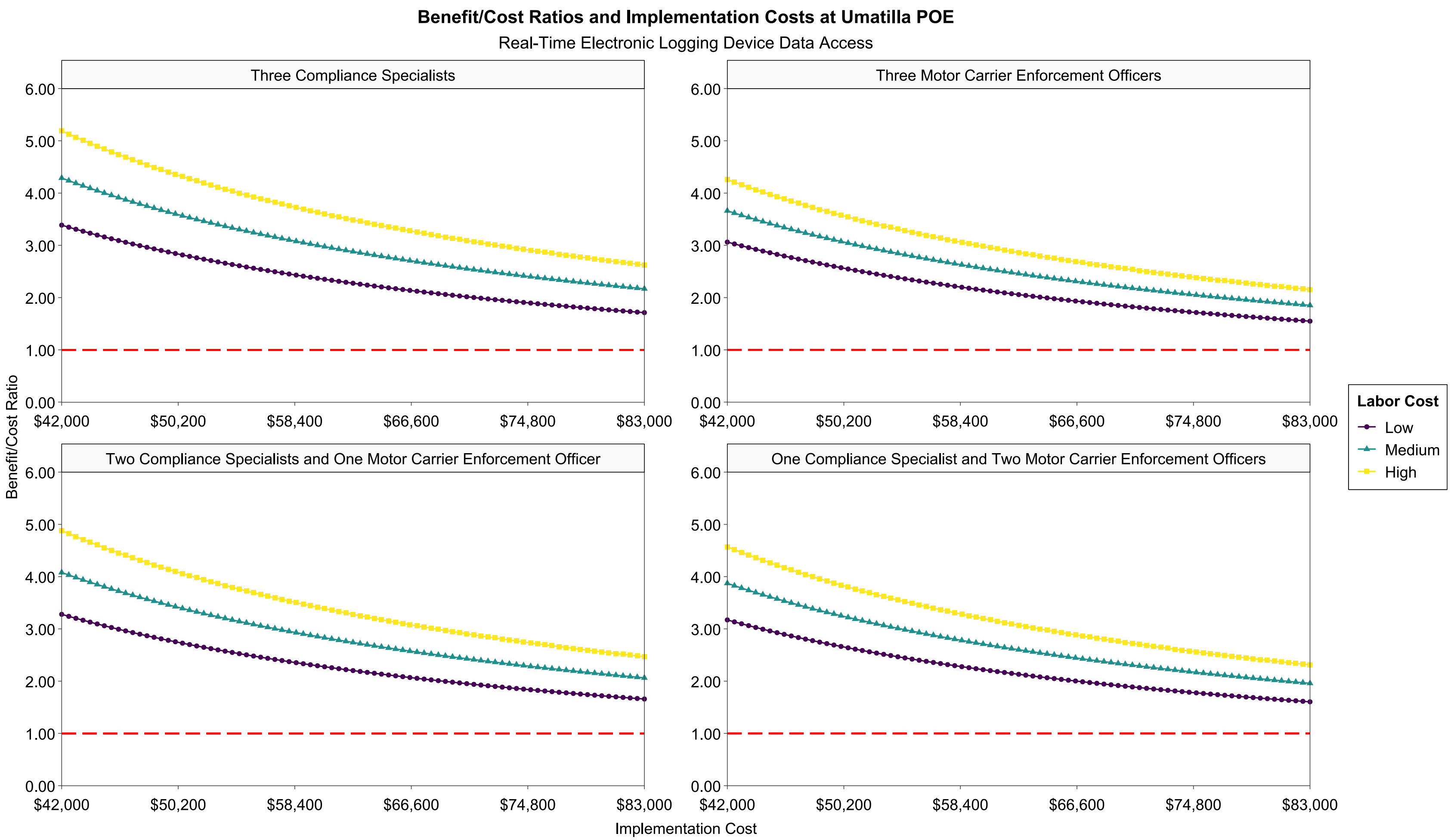

Figure 6.38: Benefit-Cost Results for Real-Time ELD Data Access at Umatilla POE (Day Shift)

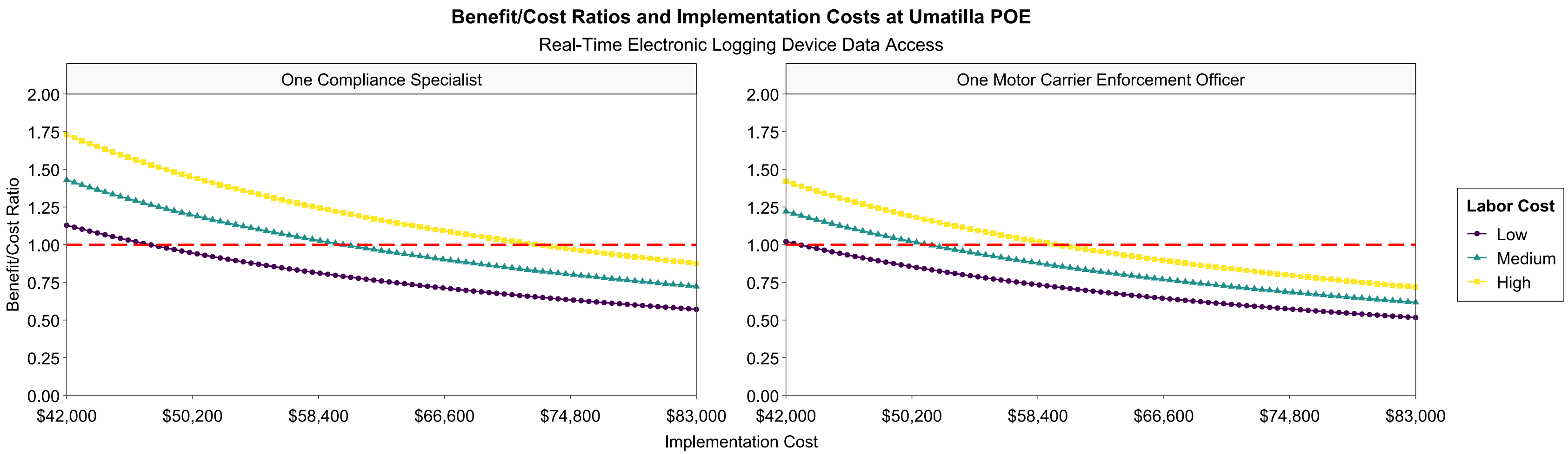

Figure 6.39: Benefit-Cost Results for Real-Time ELD Data Access at Umatilla POE (Evening Shift)

6.3.1.7 Klamath Falls POE

Figure 6.40 shows the results of the benefit-cost analysis at Klamath Falls POE. Results indicate that real-time ELD data access is economically justified, primarily, when labor costs are assumed to be medium or high (see Table 6.27).

If three compliance specialists are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $53,000 or less, $67,000 or less, or $81,000 or less, respectively. For high labor cost, real-time ELD data access is economically justified nearly all implementation costs, as the $81,000 is just $2,000 under the upper limit of implementation costs. If three motor carrier enforcement officers are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $48,000 or less, $57,000 or less, or $66,500 or less, respectively.

If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $51,000 or less, $63,500 or less, or $76,000 or less, respectively. If one compliance specialist and two motor carrier enforcement officers are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $49,500 or less, $60,500 or less, or $71,000 or less, respectively.

Overall, real-time ELD data access is economically viable at Klamath Falls POE if labor is medium-to-high and the workers present are primarily compliance specialists.

For the scenario in which a single person is working at the weigh station, real-time ELD data access is not economically justified (see Figure 6.41).

Table 6.27: Maximum Implementation Cost for Real-Time ELD Data Access to be Economically Justified at Klamath Falls POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$53,000
	Medium	$67,000
	High	$81,000
Three Motor Carrier Enforcement Officers	Low	$48,000
	Medium	$57,000
	High	$66,500
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$51,000
	Medium	$63,500
	High	$76,000
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$49,500
	Medium	$60,500
	High	$71,000

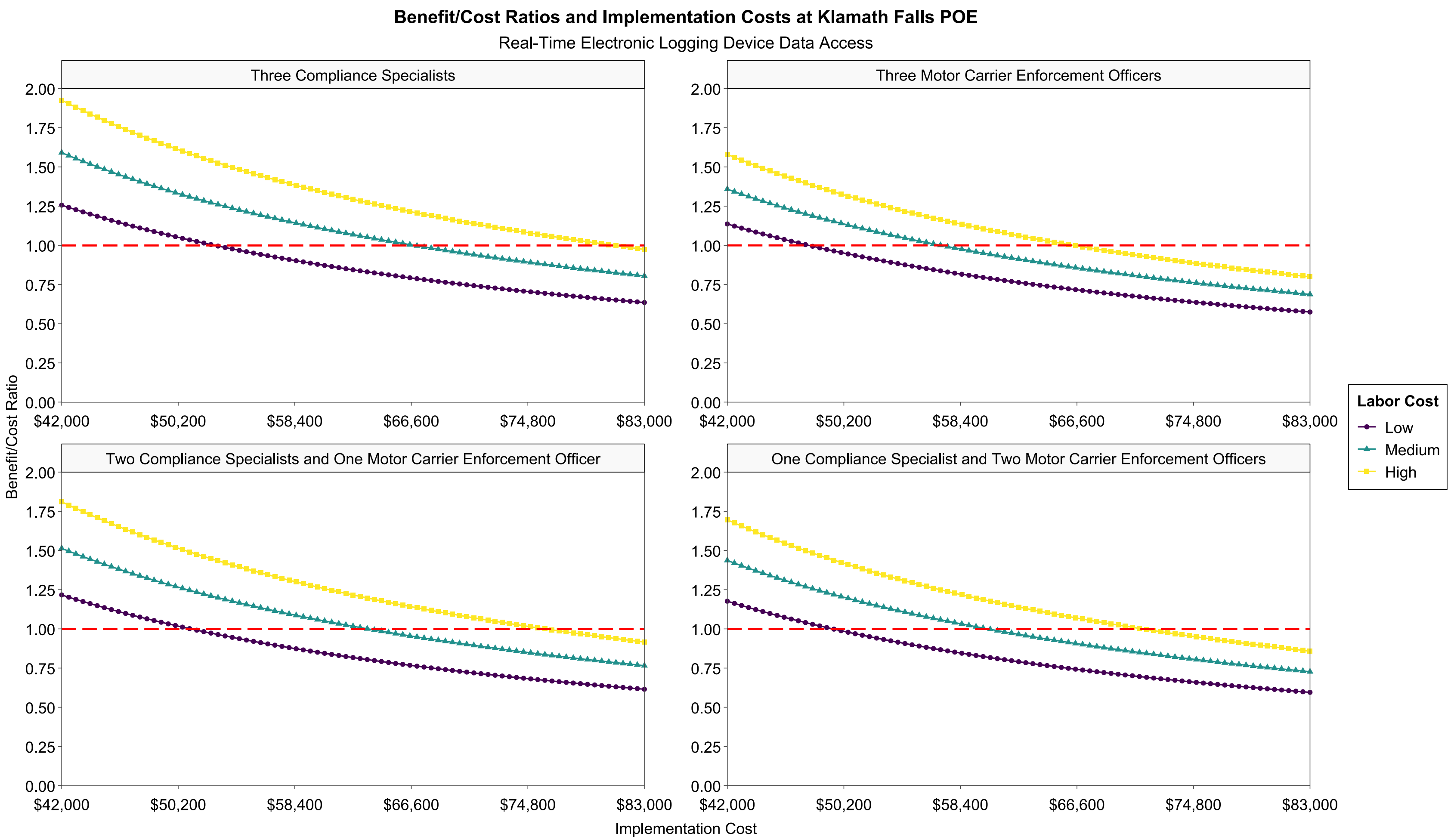

Figure 6.40: Benefit-Cost Results for Real-Time ELD Data Access at Klamath Falls POE (Day Shift)

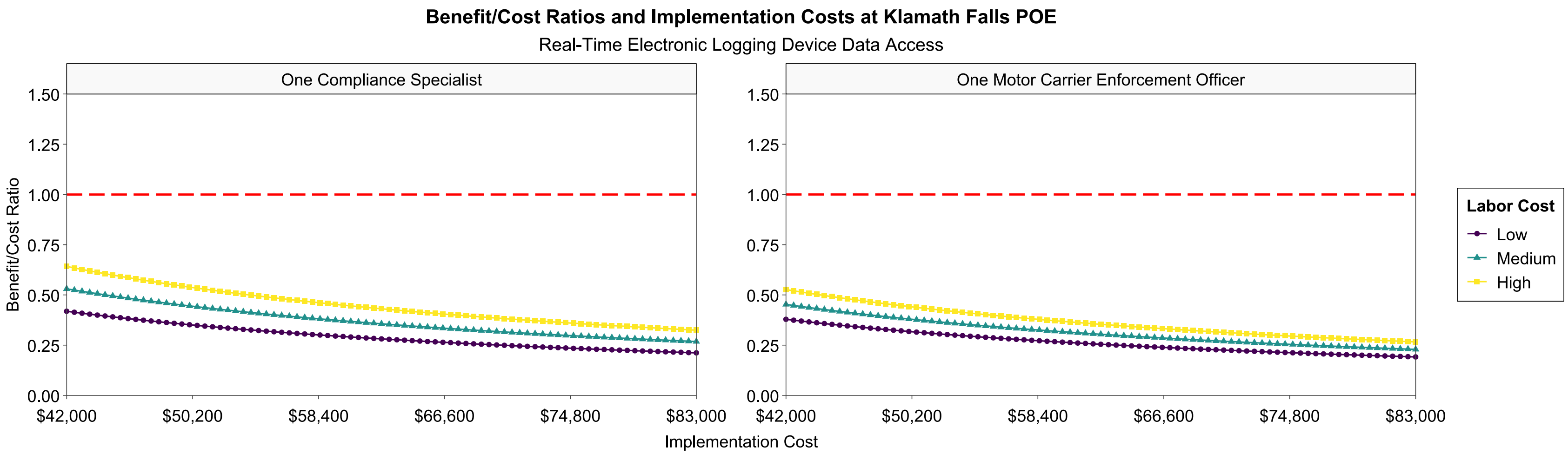

Figure 6.41: Benefit-Cost Results for Real-Time ELD Data Access at Klamath Falls POE (Evening Shift)

6.3.2 Laser Vision System to Assess Tires

The most occurring vehicle violation across the locations considered for the benefit-costs analysis was related to tires; specifically: 393-75. Common violations consisted of flat tires, tires in which fabric was exposed, audible leaks, cut tires. and tread depth violations.

Unlike the driver-related violations, tires accounted for the majority of vehicle-related violations at just a single location (Wyeth), as shown in Table 6.28. The lowest proportion was 25.1% and was observed at Cascade Locks POE. There were other vehicle-related violations, but they could not be considered for one of the following two reasons: (1) not enough information was provided or (2) the violations still require human inspection making electronic enforcement not viable at this time. Regarding not enough information, this was primarily due to "State Operating Authority Violation" being listed without any further information on the reason for violation. Regarding violations that still require human inspection, these were mostly related to mechanical items, such as brakes, connections, hoses, tubing, leaks, and others.

Based on these numbers, the electronic enforcement technology proposed is laser vision cameras to assess tire conditions.

Table 6.28: Proportion of Total Violations for 393-75

Location	Proportion of Total Violations
Ashland POE	28.3%
Woodburn POE	29.5%
Farewell Bend POE	33.7%
Cascade Locks POE	25.1%
Wyeth	56.8%
Umatilla POE	44.6%
Klamath Falls POE	42.6%

This technology can instantly classify tires and identify defects. It can measure tire tread depth, deformation due to loads, and conduct quick and efficient tire inspections. If violations are detected, the technology can immediately cite drivers for the detected violations. Through immediate citations, this technology can improve compliance, enforcement efficiency, and safety. This is a new and emerging technology, and its real-world applications are limited.

To determine the costs of implement such a technology, costs were obtained directly from previous work or were derived based on information provided in previous work (e.g., manufacturer, system type, equipment type, software type, etc.). If no direct link could be made, similar products, systems, equipment, etc. were used to derive implementation costs. The estimated implementation costs are given in Table 6.29.

Hardware costs include the laser vision units, protective housing for the laser vision units, any required support equipment (e.g., lighting, integration), and computing hardware. Software costs include laser data processing software, applicable licensing/subscriptions, and software integration with existing weigh station systems, databases, and enforcement tools. Installation costs include mounting and calibration the laser vision units and supporting equipment, and any required weigh station modifications (e.g., weigh station layout, additional power, network infrastructure).

Maintenance costs include cleaning the laser vision units, calibrating the laser vision units, software updates, any laser vision unit repairs or replacements, and any component replacements. Training costs include training staff to be familiar with the system and be able to operate/maintain if required.

Table 6.29: Estimated Implementation Costs for Laser Vision System

Category	Cost Item[a]	Cost Range	
		Lower	Upper
Hardware	Laser Vision Units	$5,000	$20,000
	Protective Housing	$1,000	$5,000
	Supporting Equipment	$2,000	$10,000
	Computing	$2,000	$10,000
Software	Laser Scan Analysis Software	$5,000	$15,000
	Licensing/Subscription Fees	$1,000	$3,000
	Integrate with Existing Weigh Station System	$10,000	$30,000
Installation	Mounting/Calibrating Laser Vision Units	$2,000	$5,000
	Infrastructure Modifications	$10,000	$50,000
Maintenance	Cleaning/Calibrating/Software	$1,000	$3,000
	Repairs/Replacements	$500	$2,000
Training	Train Staff	$2,000	$5,000
	Total	$41,500	$158,000

[a] (Kotchon et al., 2012; Yang and He, 2013; Brady et al., 2014; Andrews et al., 2019; Prabhakara et al., 2020; Han et al., 2023)

Considering the labor costs given in Table 5.1 and the estimated implementation costs given in Table 6.29, a benefit-cost analysis was conducted based on the following scenarios:

- Three compliance specialists are present.
- Three motor carrier enforcement officers are present.
- Two compliance specialists and one motor carrier enforcement officer are present.
- One compliance specialist and two motor carrier enforcement officers are present.

6.3.2.1 Ashland POE

Figure 6.42 shows the results of the benefit-cost analysis at Ashland POE. Results indicate that laser vision systems are economically justified if implementation costs are on the low end (see Table 6.30). If three compliance specialists are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $62,470 or less, $78,780 or less, or $95,090 or less, respectively. If three compliance specialists are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $56,645 or less, $61,130 or less, or $77,615 or less, respectively. If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $60,140 or less, $75,285 or less, or $89,265 or less, respectively. If one compliance specialist and two motor carrier enforcement officers are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $57,810 or less, $70,625 or less, or $83,440 or less, respectively. Overall, a laser vision system is economically viable at Ashland POE if implementation costs are low.

For the scenario in which a single person is working at the weigh station, a laser vision system is not economically justified (see Figure 6.43).

Table 6.30: Maximum Implementation Cost for Laser Vision System to be Economically Justified at Ashland POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$62,470
	Medium	$78,780
	High	$95,090
Three Motor Carrier Enforcement Officers	Low	$56,645
	Medium	$67,130
	High	$77,615
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$60,140
	Medium	$75,285
	High	$89,265
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$57,810
	Medium	$70,625
	High	$83,440

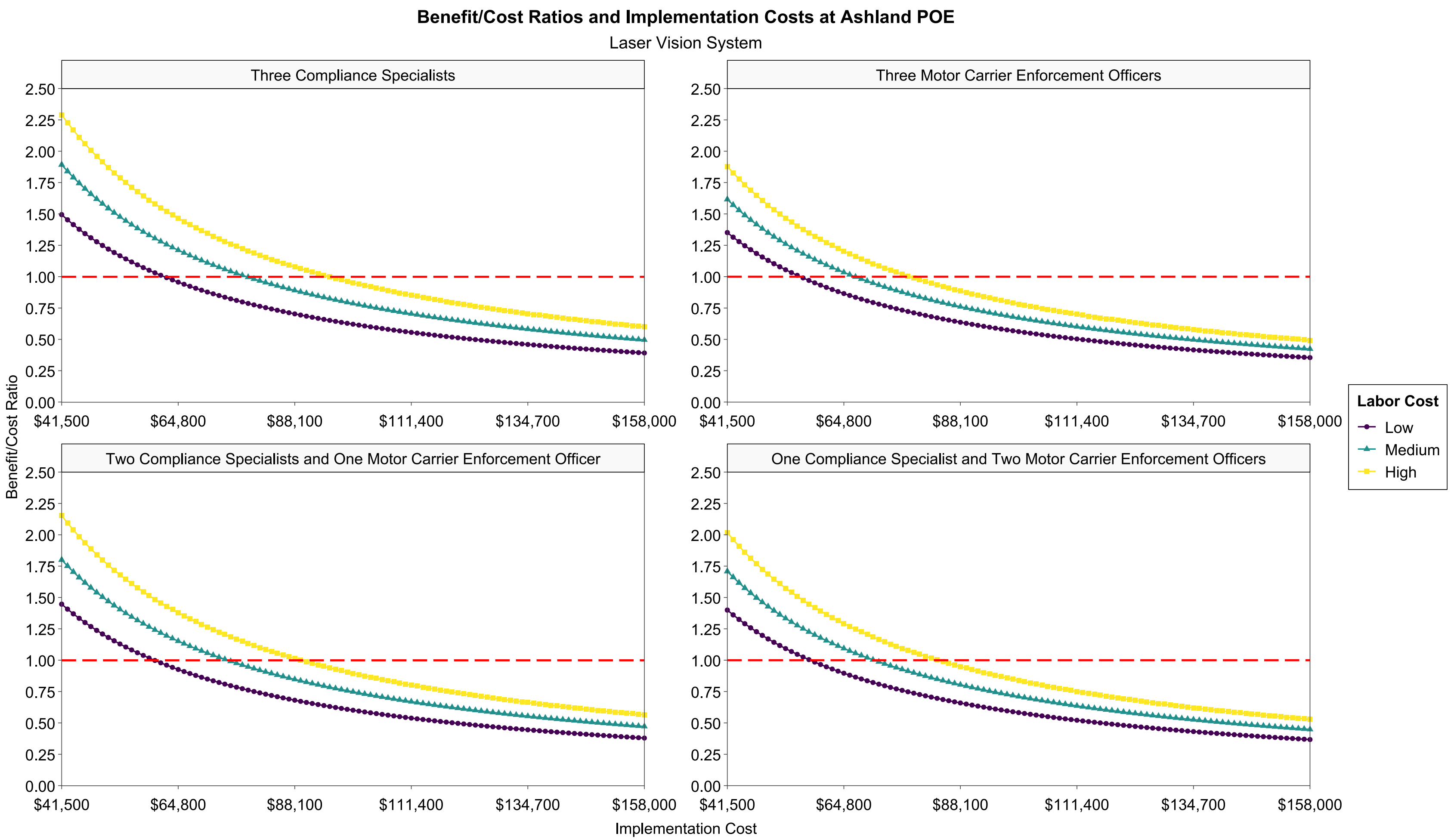

Figure 6.42: Benefit-Cost Results for Laser Vision System at Ashland POE (Day Shift)

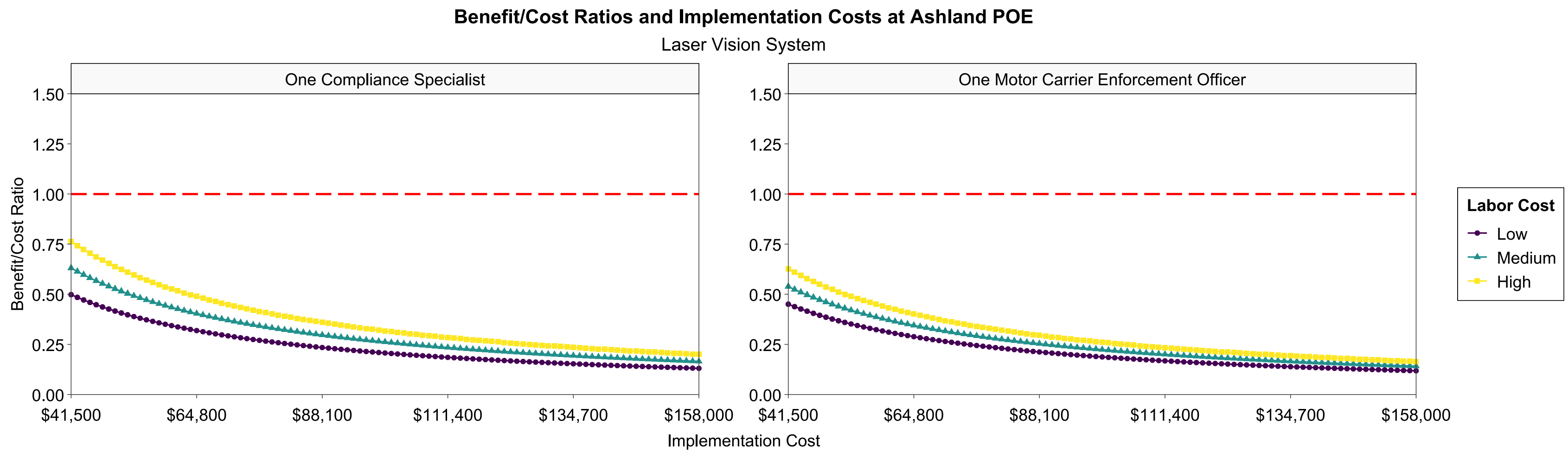

Figure 6.43: Benefit-Cost Results for Laser Vision System at Ashland POE (Evening Shift)

6.3.2.2 Woodburn POE

Figure 6.44 shows the results of the benefit-cost analysis at Woodburn POE. Results indicate that laser vision systems are economically justified if labor costs are medium or high (see Table 6.31). If three compliance specialists are present, and labor cost is low, the maximum implementation cost needs to be $140,525 or less. If three motor carrier enforcement officers are present, and labor cost is low or medium, the maximum implementation cost needs to be $127,710 or less or $152,175 or less. If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is low, the maximum implementation cost needs to be $135,865 or less. If one compliance specialist and two motor carrier enforcement officers are present, and labor cost is low, the maximum implementation cost needs to be $132,370 or less. Overall, a laser vision system is economically viable at Woodburn POE.

For the scenario in which a single person is working at the weigh station, a laser vision system is economically justified at lower implementation costs (see Table 6.32 and Figure 6.45). If the one worker is a compliance specialist, and labor cost is low, medium, or high, the maximum implementation cost needs to be $47,325 or less, $58,975 or less, or $71,790 or less, respectively.

If the one worker is a motor carrier enforcement officer, a laser vision system is economically justified at lower implementation costs. If labor cost is low, the maximum implementation cost needs to be $42,665 or less. If labor cost is medium, the maximum implementation cost needs to be $50,820 or less. If labor cost is high, the maximum implementation cost needs to be $58,975 or less.

Table 6.31: Maximum Implementation Cost for Laser Vision System to be Economically Justified at Woodburn POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$140,525
	Medium	—
	High	—
Three Motor Carrier Enforcement Officers	Low	$127,710
	Medium	$152,175
	High	—
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$135,865
	Medium	—
	High	—
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$132,370
	Medium	—
	High	—

Table 6.32: Maximum Implementation Cost for Laser Vision to be Economically Justified at Woodburn POE (Evening Shift)

Scenario	Labor Cost	Max Implementation Cost
One Compliance Specialist	Low	$47,325
	Medium	$58,975
	High	$71,790
One Motor Carrier Enforcement Officer	Low	$42,665
	Medium	$50,820
	High	$58,975

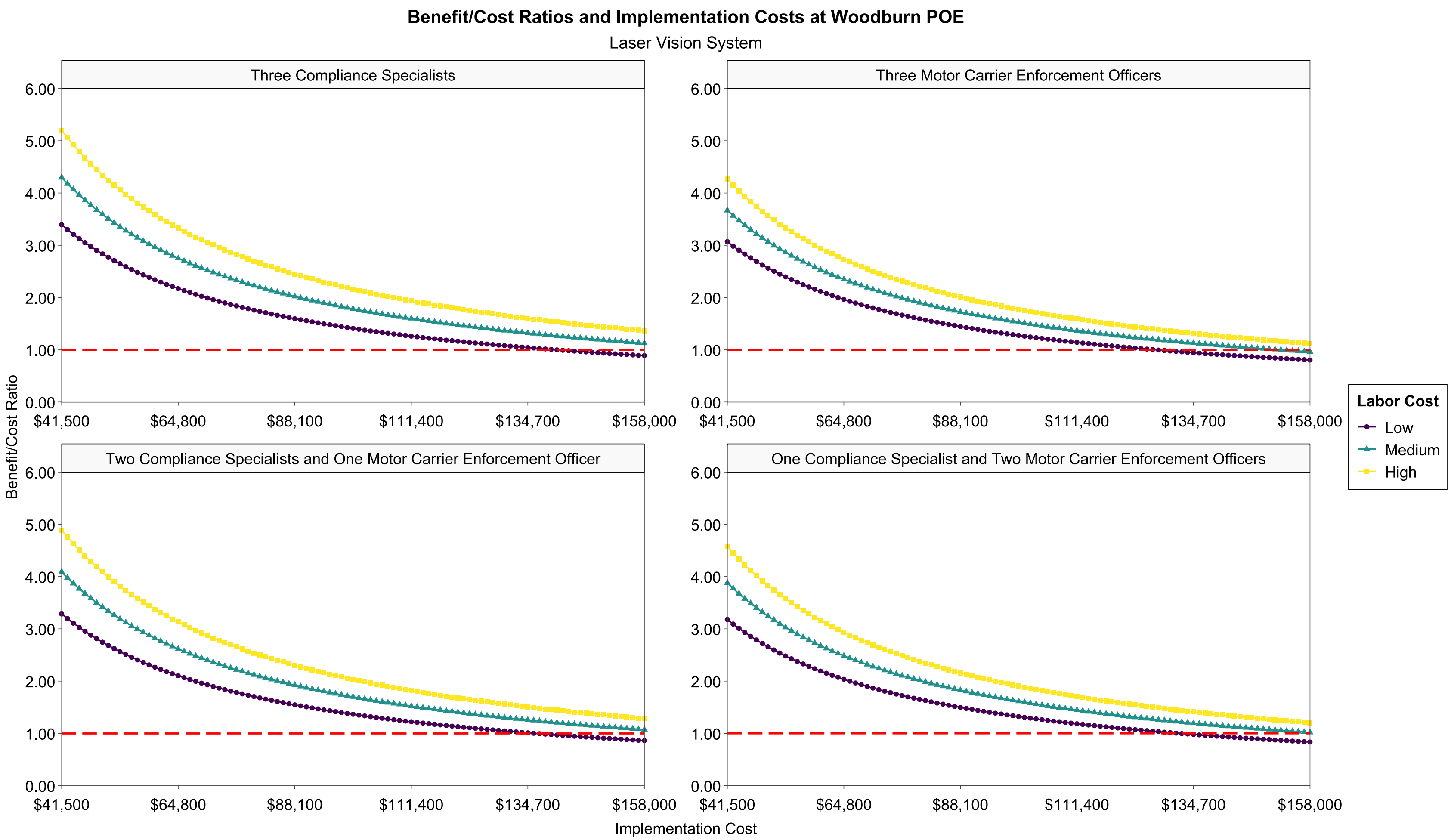

Figure 6.44: Benefit-Cost Results for Laser Vision System at Woodburn POE (Day Shift)

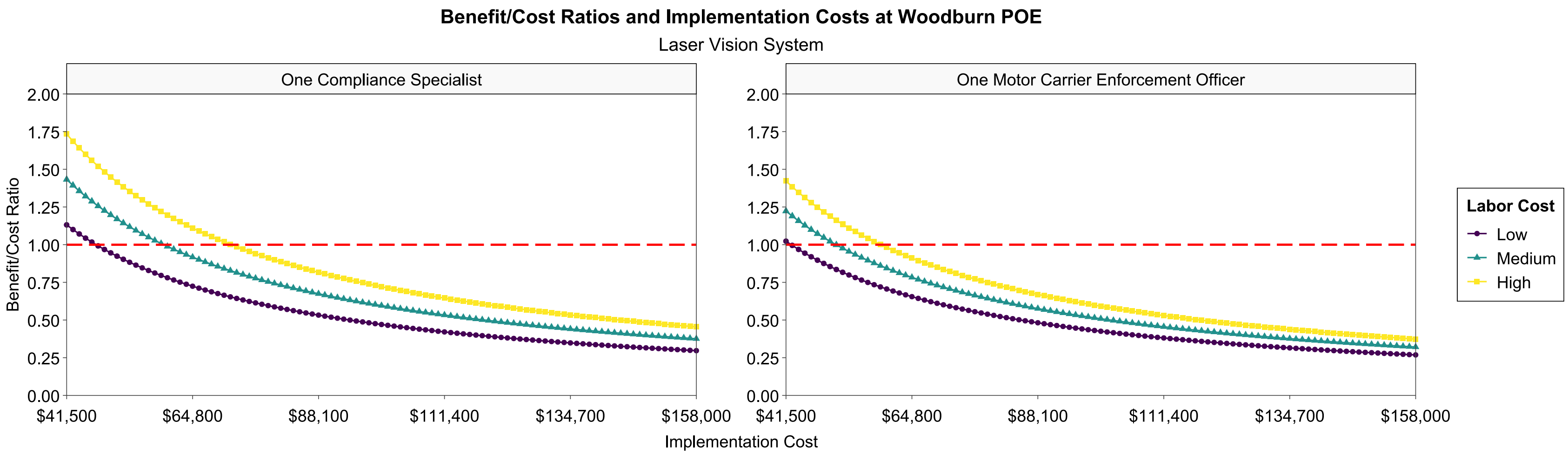

Figure 6.45: Benefit-Cost Results for Laser Vision System at Woodburn POE (Evening Shift)

6.3.2.3 Farewell Bend POE

Figure 6.46 shows the results of the benefit-cost analysis at Farewell Bend POE. Results indicate that laser vision systems are economically justified if implementation costs are medium to low, relative to the maximum implementation cost of $158,000 (see Table 6.33). If three compliance specialists are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $78,780 or less, $99,750 or less, or $120,720 or less, respectively. If three compliance specialists are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $70,625 or less, $84,605 or less, or $98,585 or less, respectively. If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $76,450 or less, $95,090 or less, or $113,730 or less, respectively. If one compliance specialist and two motor carrier enforcement officers are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $74,120 or less, $89,265 or less, or $105,575 or less, respectively. Overall, a laser vision system is economically viable at Farewell Bend POE if implementation costs are around $80,000 or less (exceptions where labor cost is high, allowing for implementation costs to be higher).

For the scenario in which a single person is working at the weigh station, a laser vision system is not economically justified (see Figure 6.47).

Table 6.33: Maximum Implementation Cost for Laser Vision System to be Economically Justified at Farewell Bend POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$78,780
	Medium	$99,750
	High	$120,720
Three Motor Carrier Enforcement Officers	Low	$70,625
	Medium	$84,605
	High	$98,585
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$76,450
	Medium	$95,090
	High	$113,730
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$74,120
	Medium	$89,265
	High	$105,575

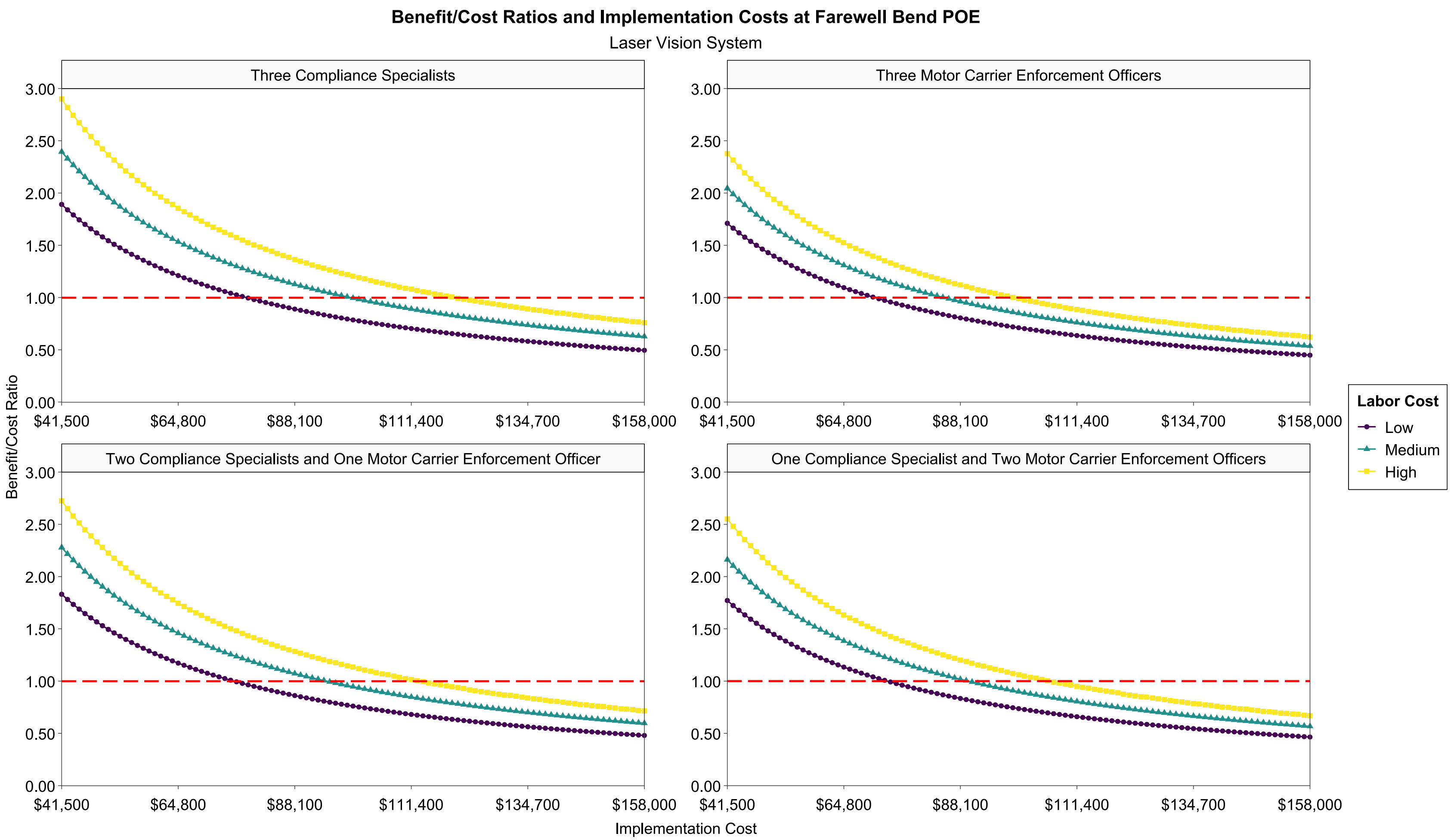

Figure 6.46: Benefit-Cost Results for Laser Vision System at Farewell Bend POE (Day Shift)

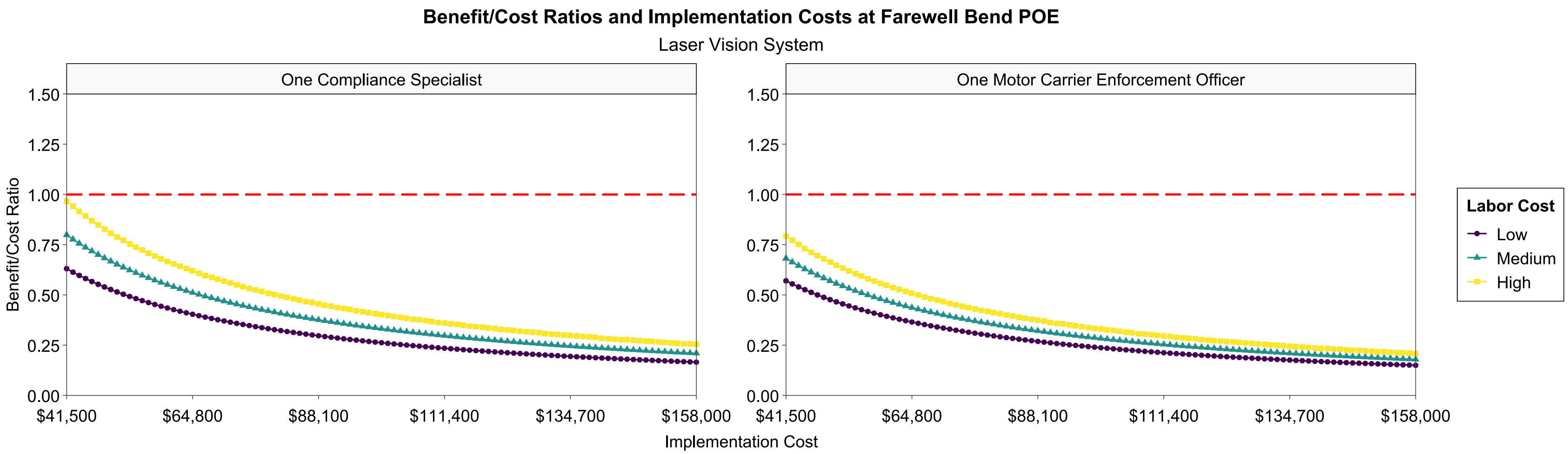

Figure 6.47: Benefit-Cost Results for Laser Vision System at Farewell Bend POE (Evening Shift)

6.3.2.4 Cascade Locks POE

Figure 6.48 shows the results of the benefit-cost analysis at Cascade Locks POE. Results indicate that laser vision systems are economically justified if implementation costs low, relative to the maximum implementation cost of $158,000 (see Table 6.34). If three compliance specialists are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $64,800 or less, $81,110 or less, or $98,585 or less, respectively. If three motor carrier enforcement officers are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $57,810 or less, $69,460 or less, or $81,110 or less, respectively. If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $62,470 or less, $77,615 or less, or $92,760 or less, respectively. If one compliance specialist and two motor carrier enforcement officers are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $60,140 or less, $74,120 or less, or $86,935 or less, respectively. Overall, a laser vision system is economically viable at Cascade Locks POE if implementation costs are low.

For the scenario in which a single person is working at the weigh station, a laser vision system is not economically justified (see Figure 6.49).

Table 6.34: Maximum Implementation Cost for Laser Vision System to be Economically Justified at Cascade Locks POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$64,800
	Medium	$81,110
	High	$98,585
Three Motor Carrier Enforcement Officers	Low	$57,810
	Medium	$69,460
	High	$81,110
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$62,470
	Medium	$77,615
	High	$92,760
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$60,140
	Medium	$74,120
	High	$86,935

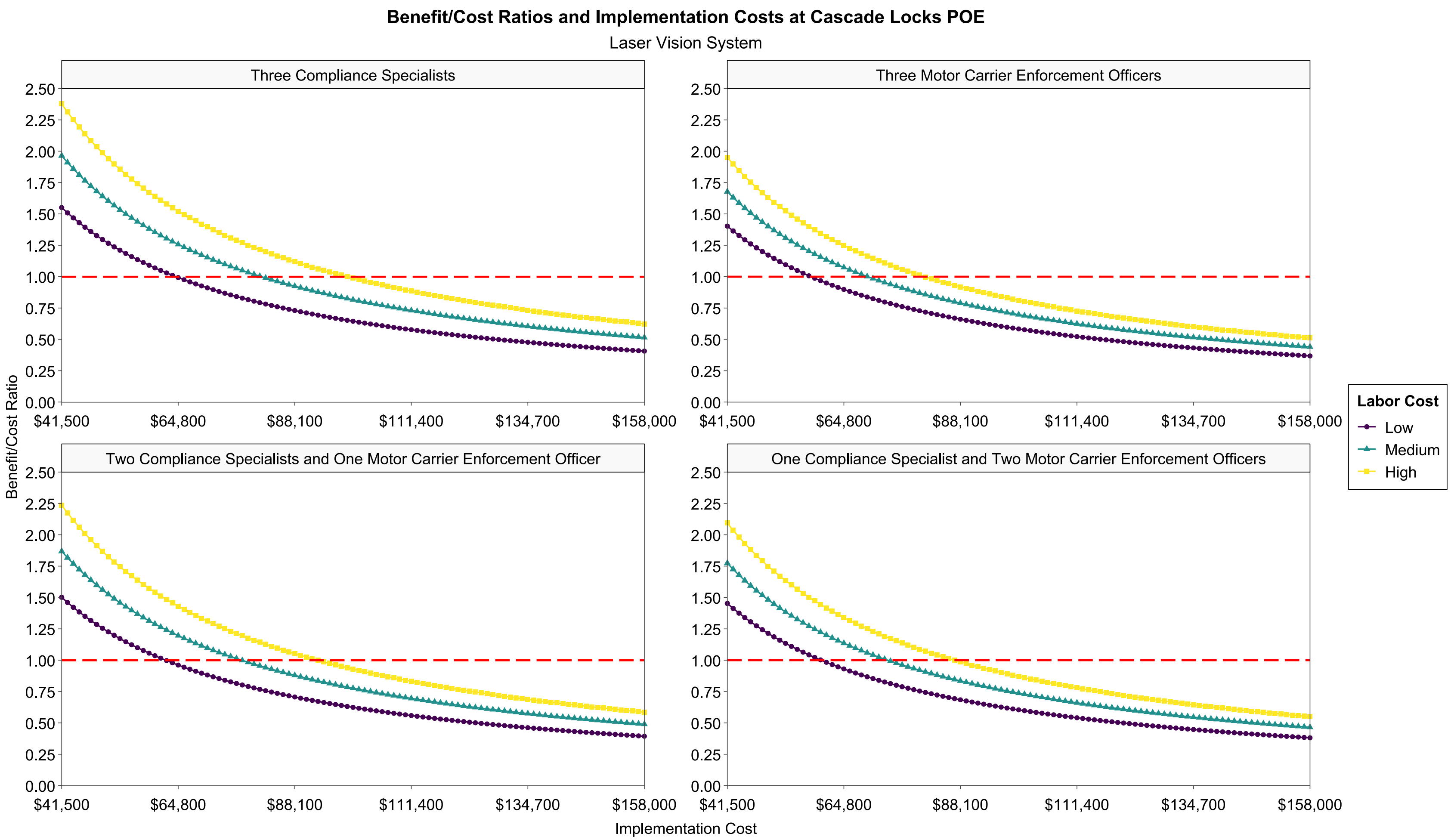

Figure 6.48: Benefit-Cost Results for Laser Vision System at Cascade Locks POE (Day Shift)

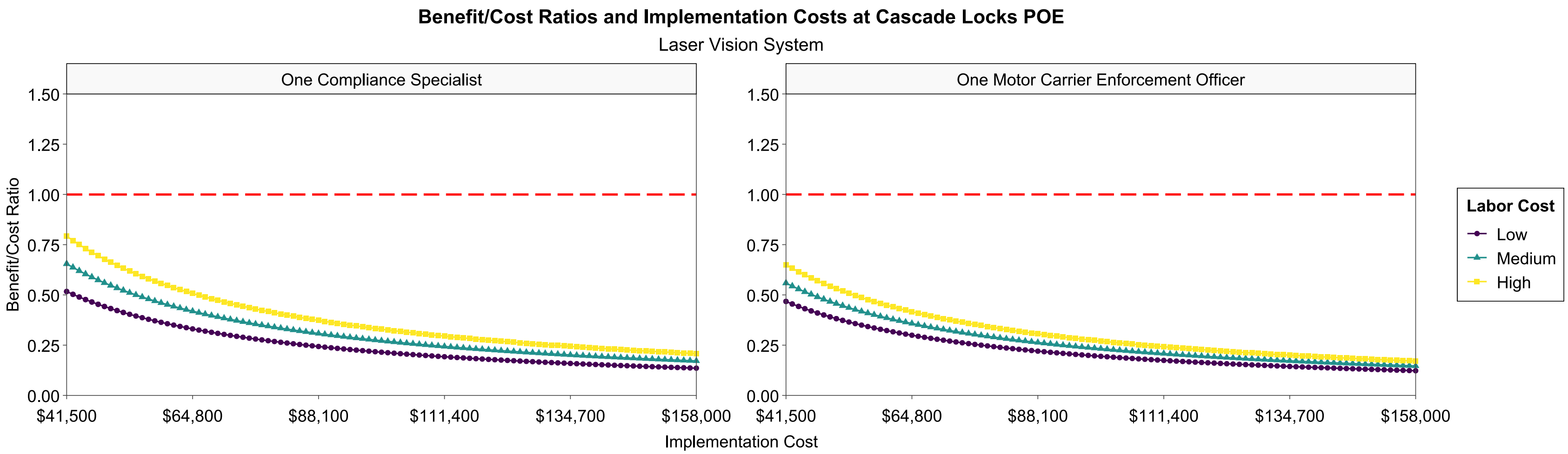

Figure 6.49: Benefit-Cost Results for Laser Vision System at Cascade Locks POE (Evening Shift)

6.3.2.5 Wyeth

Figure 6.50 shows the results of the benefit-cost analysis at Wyeth. Results indicate that laser vision systems are not economically justified at this location, with two exceptions (see Table 6.35). If three compliance specialists are present, and labor cost is high, the maximum implementation cost needs to be $46,160 or less (this is approximately $5,000 more than the lower bound of the implementation cost range). If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is high, the maximum implementation cost needs to be $43,830 or less (this is approximately $2,000 more than the lower bound of the implementation cost range). Overall, a laser vision system is not economically viable at Wyeth.

For the scenario in which a single person is working at the weigh station, a laser vision system is not economically justified (see Figure 6.51).

Table 6.35: Maximum Implementation Cost for Laser Vision System to be Economically Justified at Wyeth (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	NA[a]
	Medium	NA
	High	$46,160
Three Motor Carrier Enforcement Officers	Low	NA
	Medium	NA
	High	NA
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	NA
	Medium	NA
	High	$43,830
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	NA
	Medium	NA
	High	NA

[a] NA indicates no maximum implementation cost (all implementation costs result in a benefit-cost ratio < 1)

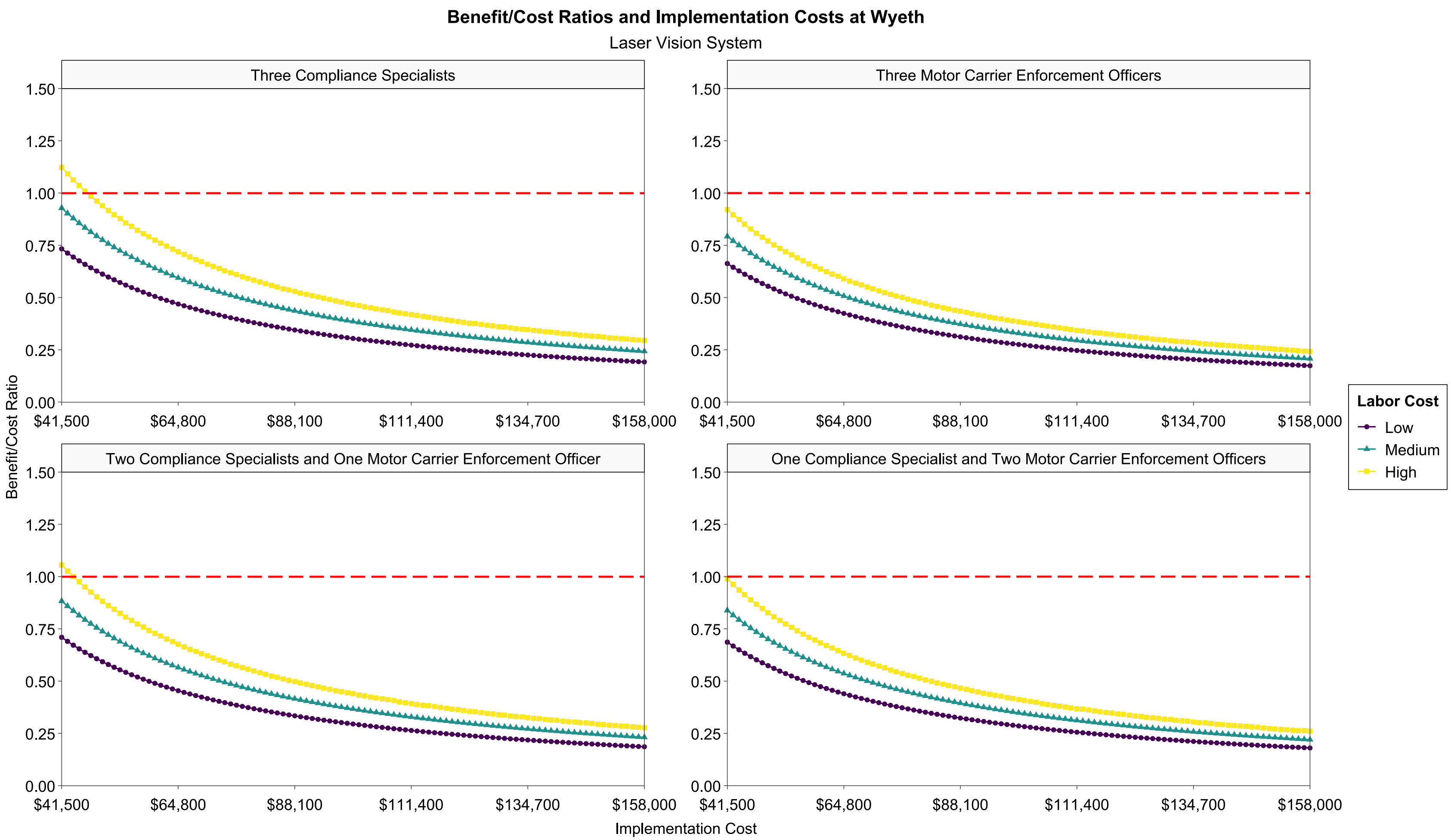

Figure 6.50: Benefit-Cost Results for Laser Vision System at Wyeth (Day Shift)

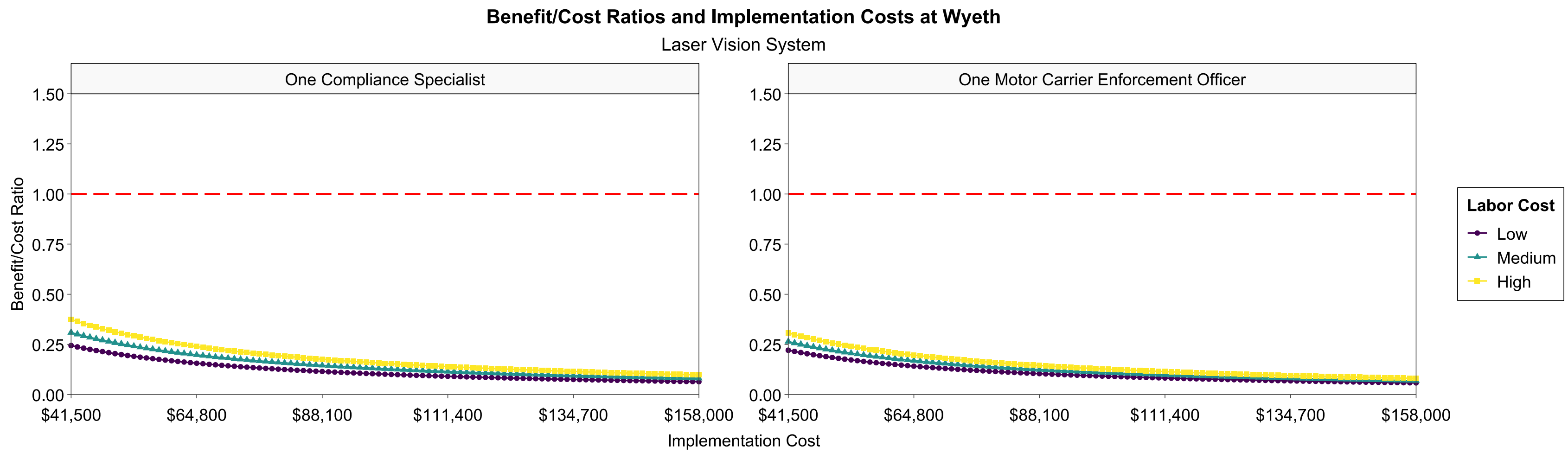

Figure 6.51: Benefit-Cost Results for Laser Vision System at Wyeth (Evening Shift)

6.3.2.6 Umatilla POE

Figure 6.52 shows the results of the benefit-cost analysis at Umatilla POE. Results indicate that laser vision systems are economically justified with medium to high implementation costs (see Table 6.36). If three compliance specialists are present, and labor cost is low or medium, the maximum implementation cost needs to be $112,565 or less or $141,690 or less. If three motor carrier enforcement officers are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $100,915 or less or $120,720 or less, or $140,525 or less, respectively. If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is low or medium, the maximum implementation cost needs to be $109,070 or less or $134,700 or less. If one compliance specialist and two motor carrier enforcement officers are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $105,575 or less or $127,710 or less, or $151,010 or less, respectively. Overall, a laser vision system is economically viable at Umatilla POE for medium to high implementation costs and medium to high labor cost.

For the scenario in which a single person is working at the weigh station, a laser vision system is economically justified at lower implementation costs (see Table 6.37 and Figure 6.53). If the one worker is a compliance specialist, and labor cost is medium or high, the maximum implementation cost needs to be $47,325 or less or $57,810 or less. If labor cost is low, a laser vision system is not economically viable.

If the one worker is a motor carrier enforcement officer, a laser vision system is economically justified at very low implementation costs and high labor costs. If labor cost is high, the maximum implementation cost needs to be $47,325 or less.

Table 6.36: Maximum Implementation Cost for Laser Vision System to be Economically Justified at Umatilla POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$112,565
	Medium	$141,690
	High	—
Three Motor Carrier Enforcement Officers	Low	$100,915
	Medium	$120,720
	High	$140,525
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$109,070
	Medium	$134,700
	High	—
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$105,575
	Medium	$127,710
	High	$151,010

Table 6.37: Maximum Implementation Cost for Laser Vision to be Economically Justified at Umatilla POE (Evening Shift)

Scenario	Labor Cost	Max Implementation Cost
On Compliance Specialist	Low	—
	Medium	$47,325
	High	$57,810
One Motor Carrier Enforcement Officer	Low	—
	Medium	—
	High	$47,325

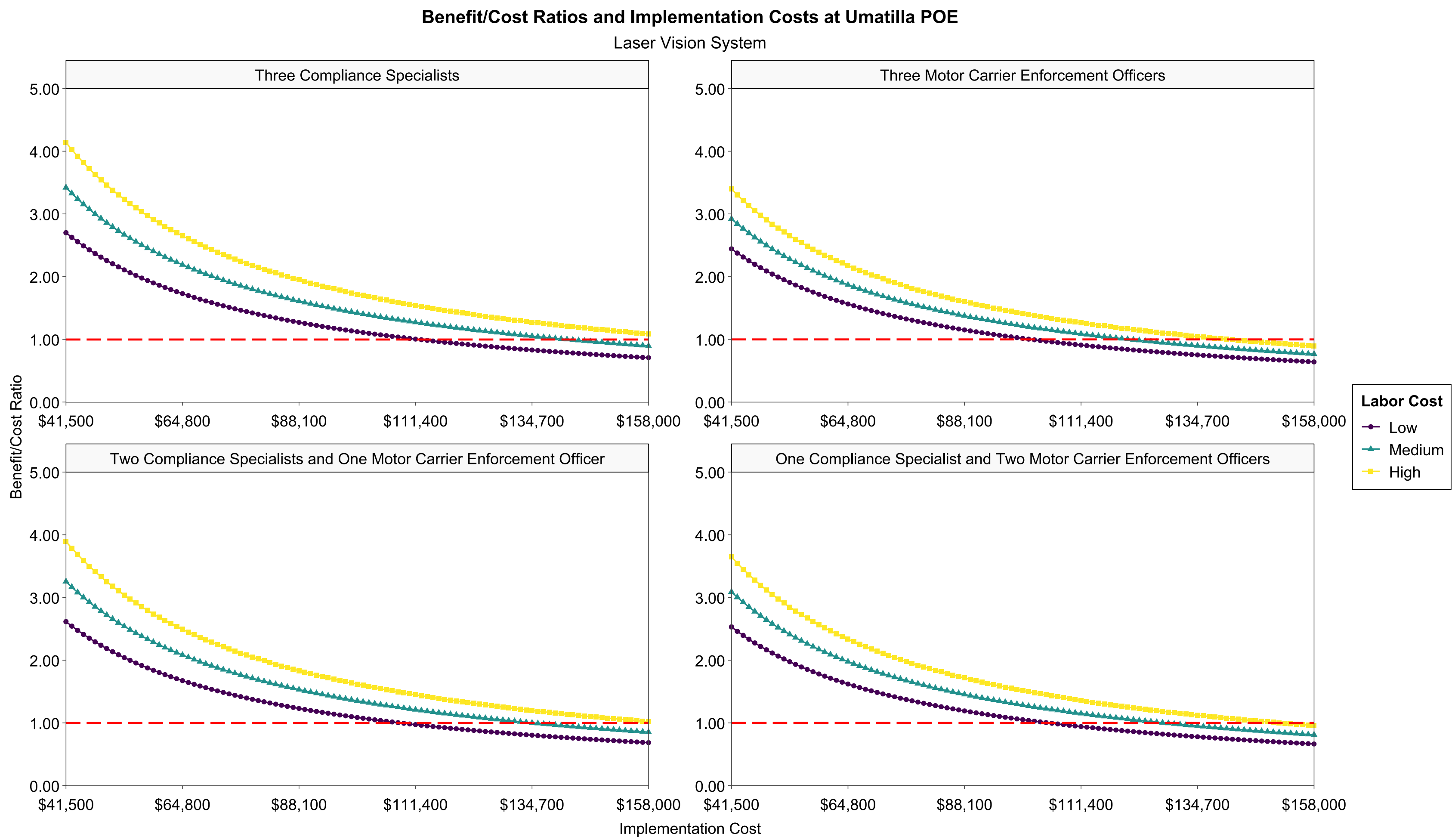

Figure 6.52: Benefit-Cost Results for Laser Vision System at Umatilla POE (Day Shift)

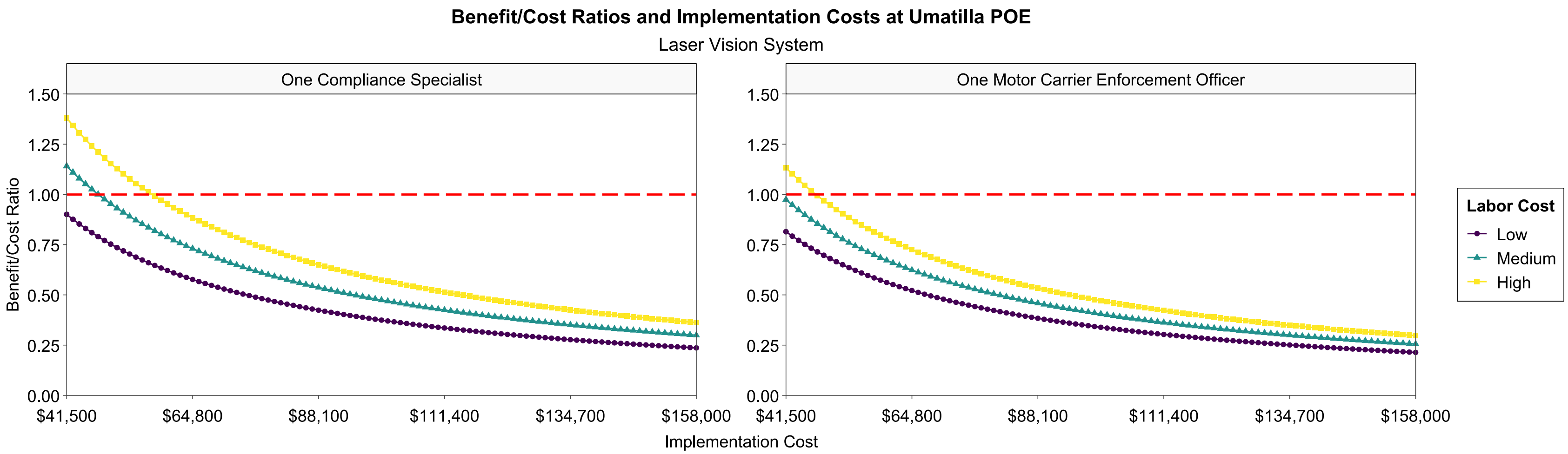

Figure 6.53: Benefit-Cost Results for Laser Vision System at Umatilla POE (Evening Shift)

6.3.2.7 Klamath Falls POE

Figure 6.54 shows the results of the benefit-cost analysis at Klamath Falls POE. Results indicate that laser vision systems are economically justified if implementation costs are low, relative to the maximum implementation cost of $158,000 (see Table 6.38). If three compliance specialists are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $60,140 or less, $75,285 or less, or $91,595 or less, respectively. If three motor carrier enforcement officers are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $54,315 or less, $64,800 or less, or $75,285 or less, respectively. If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $57,810 or less, $71,790 or less, or $85,770 or less, respectively. If one compliance specialist and two motor carrier enforcement officers are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $55,480 or less, $68,295 or less, or $81,110 or less, respectively. Overall, a laser vision system is economically viable at Klamath Falls POE if implementation costs are low.

For the scenario in which a single person is working at the weigh station, a laser vision system is not economically justified (see Figure 6.55).

Table 6.38: Maximum Implementation Cost for Laser Vision System to be Economically Justified at Klamath Falls POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$60,140
	Medium	$75,285
	High	$91,595
Three Motor Carrier Enforcement Officers	Low	$54,315
	Medium	$64,800
	High	$75,285
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$57,810
	Medium	$71,790
	High	$85,770
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$55,480
	Medium	$68,295
	High	$81,110

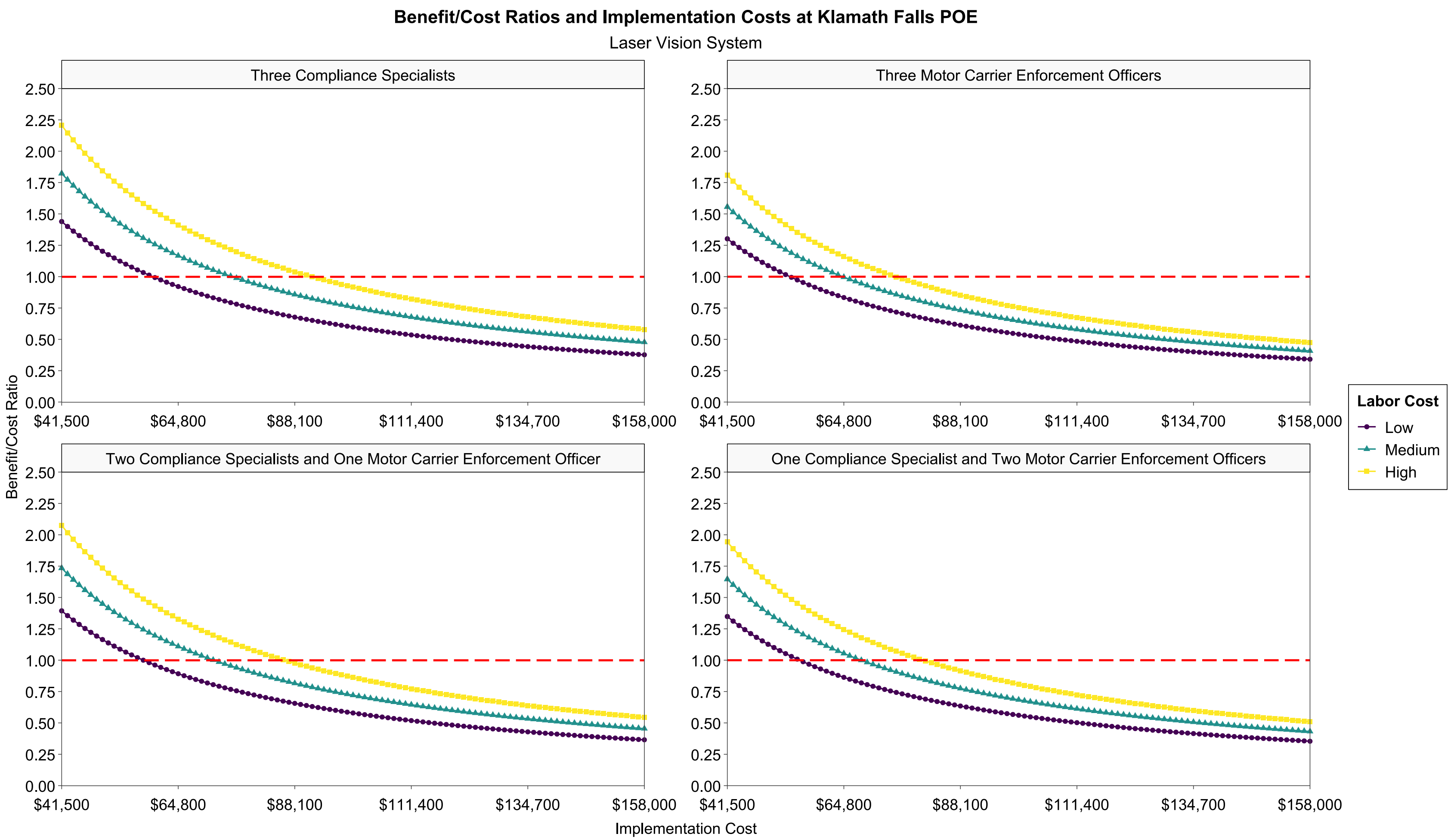

Figure 6.54: Benefit-Cost Results for Laser Vision System at Klamath Falls POE (Day Shift)

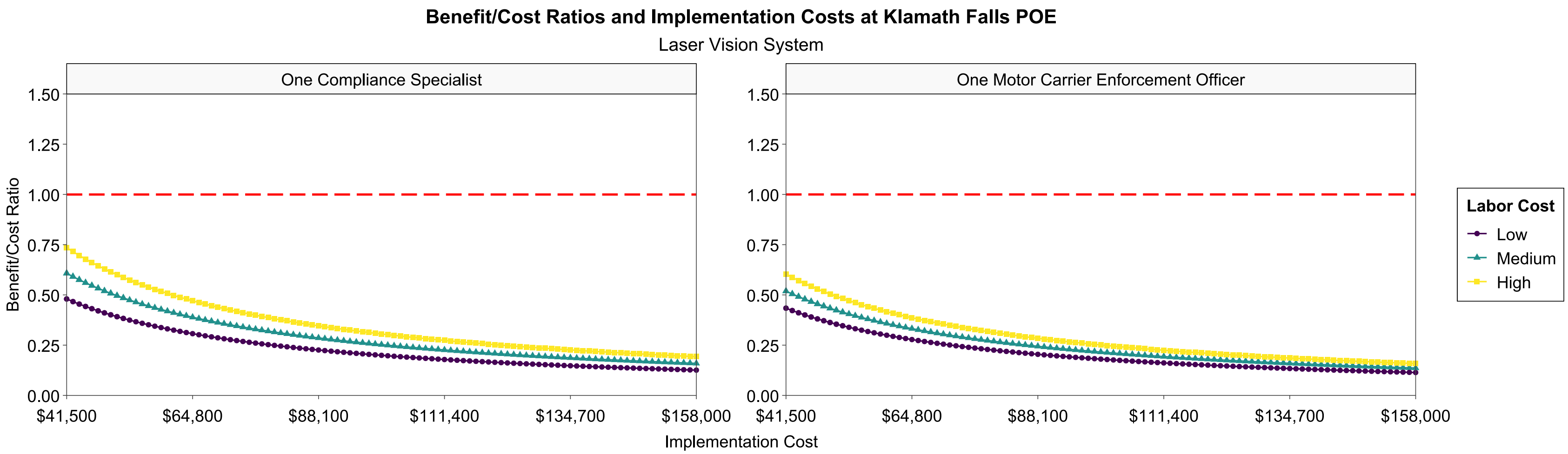

Figure 6.55: Benefit-Cost Results for Laser Vision System at Klamath Falls POE (Evening Shift)

6.3.3 Drive-Over Tire Measurement System

The most occurring vehicle violation across the locations considered for the benefit-cost analysis was related to tires; specifically: 393-75. Common violations consisted of flat tires, tires in which fabric was exposed, audible leaks, cut tires. and tread depth violations.

Due to the high implementation costs for laser vision systems, drive-over tire measurement systems were also considered. The numbers, based on proportions, are the same as those given in Table 6.28.

This technology can instantly alert on tire issues, providing quick and efficient tire inspections. If violations are detected, the technology can immediately cite drivers for the detected violations. Through immediate citations, this technology can improve compliance, enforcement efficiency, and safety.

To determine the costs of implementing such a technology, costs were obtained directly from previous work or were derived based on information provided in previous work (e.g., manufacturer, system type, equipment type, software type, etc.). If no direct link could be made, similar products, systems, equipment, etc. were used to determine implementation costs. Estimated implementation costs are given in Table 6.39.

Hardware costs include the drive-over tire measurement equipment, including sensors, cameras, and software required for measurements. Installation costs consider whether minimal or extensive groundwork is required (surface-mounted system vs. a flush-mounted system). Maintenance costs include regular checks and software updates, as well as calibration and occasional repairs. Training costs include training staff to be familiar with the system and any training required to manage data/integrate with existing systems.

Table 6.39: Estimated Implementation Costs for Drive-Over Tire Measurement System

Category	Cost Item[a]	Cost Range	
		Lower	Upper
Hardware	Equipment	$20,000	$40,000
Installation	Surface-Mounted System	$5,000	$10,000
	Flush-Mounted System	$10,000	$20,000
Maintenance	Annual Maintenance	$3,000	$5,000
	Calibration/Repairs	$1,000	$3,000
Training	Initial Staff Training	$1,000	$3,000
	Integration with Existing Systems	$2,000	$5,000
	Total	$42,000	$86,000

[a] (All Tire Supply, 2024a, 2024b; Bullworthy, 2024; Jevol, 2024; Sensata Technologies, 2024; WheelRight, 2024)

Considering the labor costs given in Table 5.1 and the estimated implementation costs given in Table 6.39, a benefit-cost analysis was conducted based on the following scenarios:

- Three compliance specialists are present.

- Three motor carrier enforcement officers are present.
- Two compliance specialists and one motor carrier enforcement officer are present.
- One compliance specialist and two motor carrier enforcement officers are present.

6.3.3.1 Ashland POE

Figure 6.56 shows the results of the benefit-cost analysis at Ashland POE. Results indicate that drive-over tire measurement systems are economically justified if implementation costs are low to medium, or labor cost is high (see Table 6.40). If three compliance specialists are present, and labor cost is low or medium, the maximum implementation cost needs to be $62,000 or less or $78,500 or less. If three compliance specialists are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $56,000 or less, $67,000 or less, or $78,000 or less, respectively. If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is low or medium, the maximum implementation cost needs to be $60,000 or less or $75,000 or less. If one compliance specialist and two motor carrier enforcement officers are present, and labor costs are low, medium, or high, the maximum implementation cost needs to be $58,000 or less, $71,000 or less, or $83,500 or less, respectively. Overall, a drive-over tire measurement system is economically viable at Ashland POE if implementation costs are low to medium, or when labor costs are high.

For the scenario in which a single person is working at the weigh station, a drive-over tire measurement system is not economically justified (see Figure 6.57).

Table 6.40: Maximum Implementation Cost for Drive-Over Tire Measurement System to be Economically Justified at Ashland POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$62,000
	Medium	$78,500
	High	—
Three Motor Carrier Enforcement Officers	Low	$56,000
	Medium	$67,000
	High	$78,000
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$60,000
	Medium	$75,000
	High	—
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$58,000
	Medium	$71,000
	High	$83,500

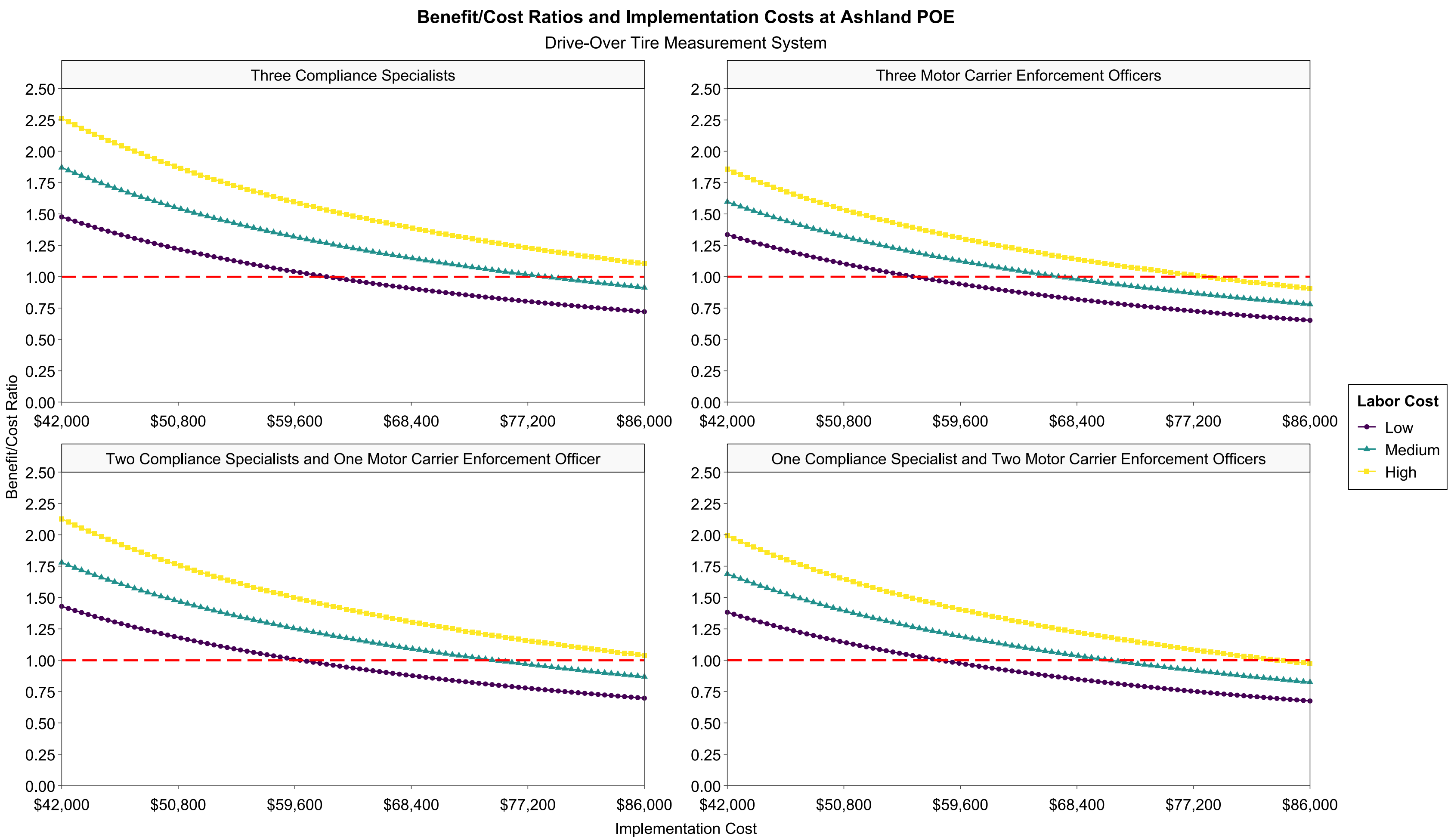

Figure 6.56: Benefit-Cost Results for Drive-Over Tire Measurement System at Ashland POE (Day Shift)

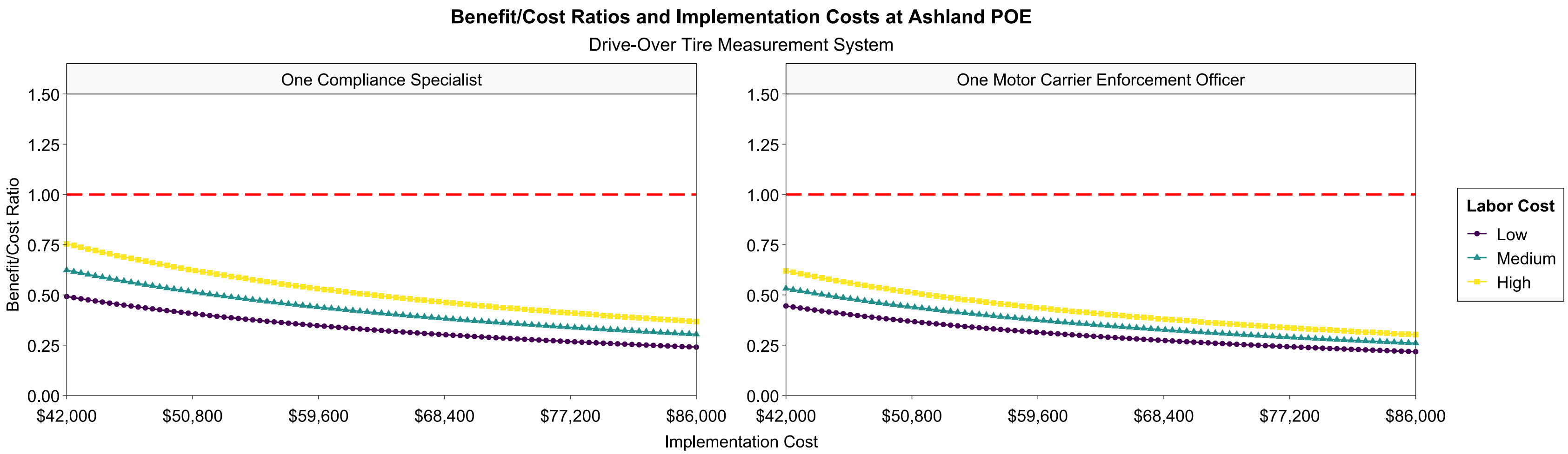

Figure 6.57: Benefit-Cost Results for Drive-Over Tire Measurement System at Ashland POE (Evening Shift)

6.3.3.2 Woodburn POE

Figure 6.58 shows the results of the benefit-cost analysis at Woodburn POE. As observed, real-time electronic logging device data access is economically justified for each potential implementation cost. This is true for scenarios in which three workers are present at the weigh station.

For the scenario in which a single person is working at the weigh station, the implementation costs need to be lower to be economically justified (see Table 6.41 and Figure 6.59). If the one worker is a compliance specialist, and labor cost is low, medium, or high, the maximum implementation cost needs to be \$47,000 or less, \$59,500 or less, or \$72,000 or less, respectively.

If the one worker is a motor carrier enforcement officer, a drive-over tire measurement system is economically justified at lower implementation costs. If labor cost is low, the maximum implementation cost needs to be \$42,500 or less. If labor cost is medium, the maximum implementation cost needs to be \$51,000 or less. If labor cost is high, the maximum implementation cost needs to be \$59,000 or less.

Table 6.41: Maximum Implementation Cost for Drive-Over Tire Measurement System to be Economically Justified at Woodburn POE (Evening Shift)

Scenario	Labor Cost	Max Implementation Cost
On Compliance Specialist	Low	\$47,000
	Medium	\$59,500
	High	\$72,000
One Motor Carrier Enforcement Officer	Low	\$42,500
	Medium	\$51,000
	High	\$59,000

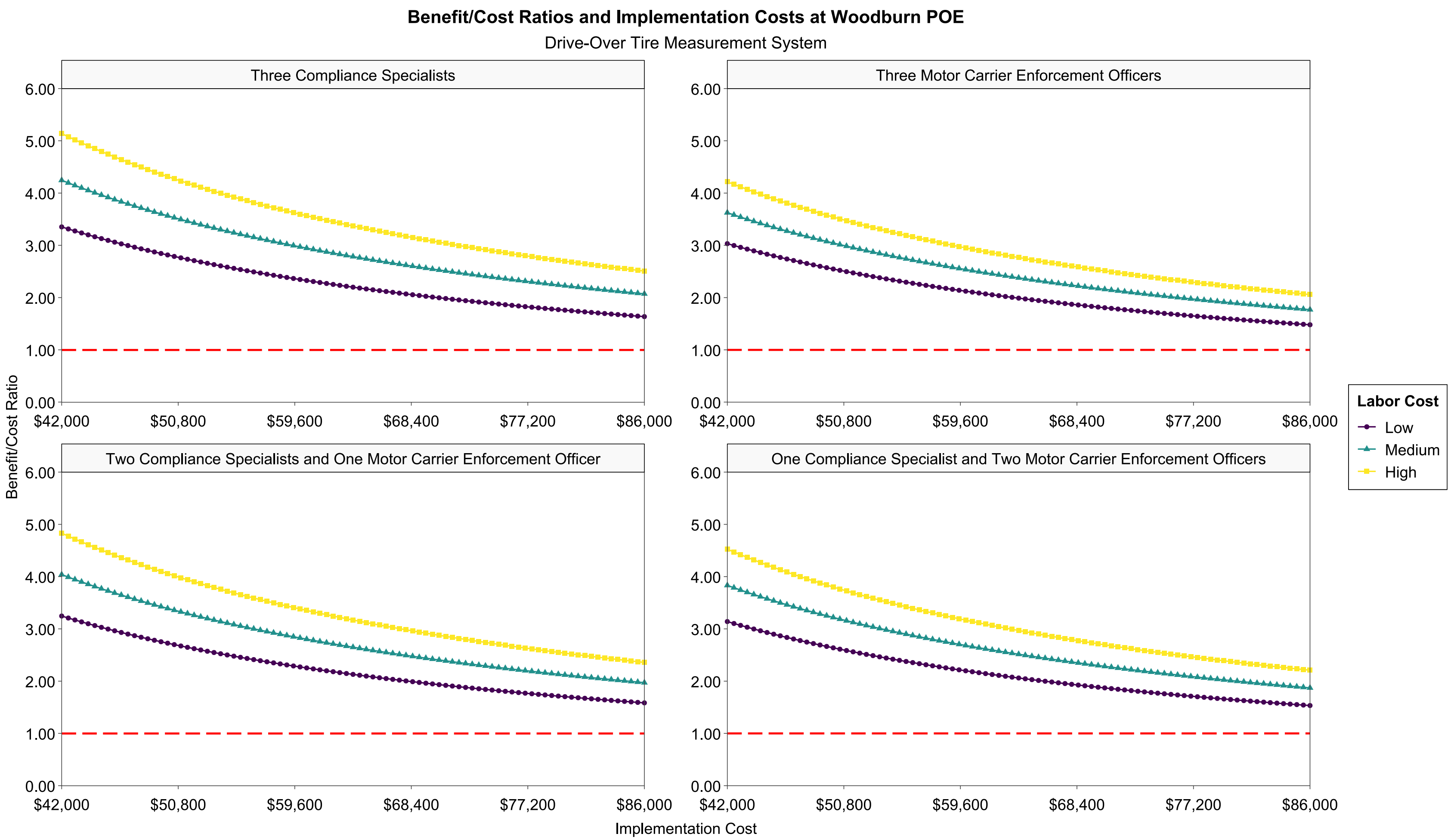

Figure 6.58: Benefit-Cost Results for Drive-Over Tire Measurement System at Woodburn POE (Day Shift)

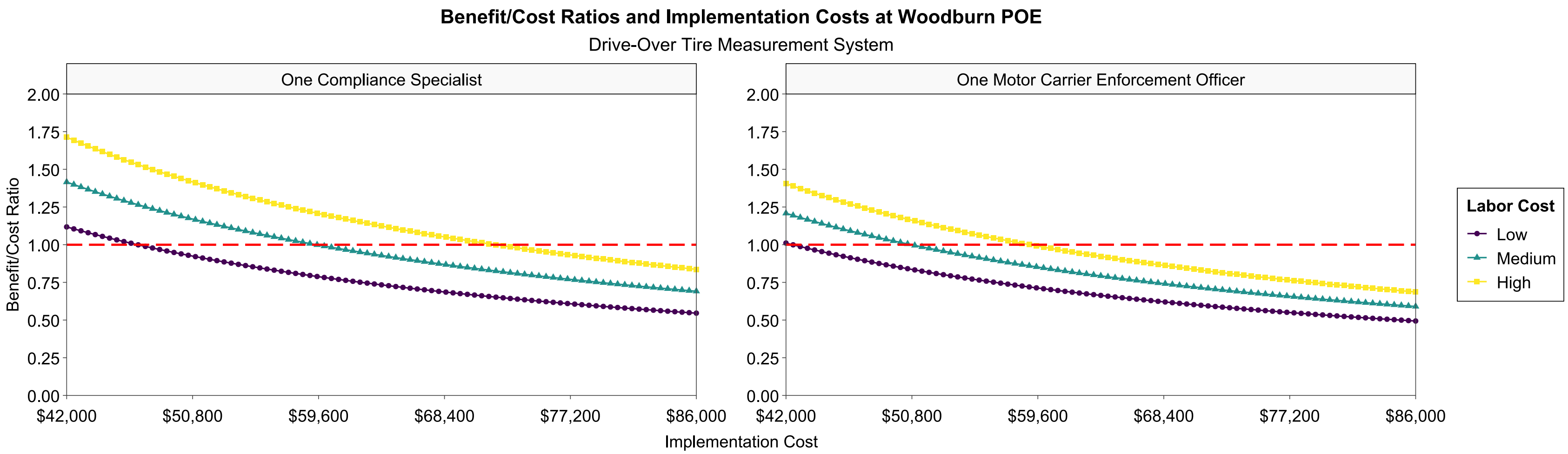

Figure 6.59: Benefit-Cost Results for Drive-Over Tire Measurement System at Woodburn POE (Evening Shift)

6.3.3.3 Farewell Bend POE

Figure 6.60 shows the results of the benefit-cost analysis at Farewell Bend POE. Results indicate that drive-over tire measurement systems are economically justified if labor costs are high (see Table 6.42). If three compliance specialists are present, and labor cost is low, the maximum implementation cost needs to be $78,500 or less. If three compliance specialists are present, and labor cost is low or medium, the maximum implementation cost needs to be $71,000 or less or $85,000 or less.

If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is low, the maximum implementation cost needs to be $76,000 or less. If one compliance specialist and two motor carrier enforcement officers are present, and labor cost is low, the maximum implementation cost needs to be $73,500 or less. Overall, a drive-over tire measurement system is economically viable at Farewell Bend POE, with the exception of low labor cost and high implementation costs.

For the scenario in which a single person is working at the weigh station, a drive-over tire measurement system is not economically justified (see Figure 6.61).

Table 6.42: Maximum Implementation Cost for Drive-Over Tire Measurement System to be Economically Justified at Farewell Bend POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$78,500
	Medium	—
	High	—
Three Motor Carrier Enforcement Officers	Low	$71,000
	Medium	$85,000
	High	—
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$76,000
	Medium	—
	High	—
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$73,500
	Medium	—
	High	—

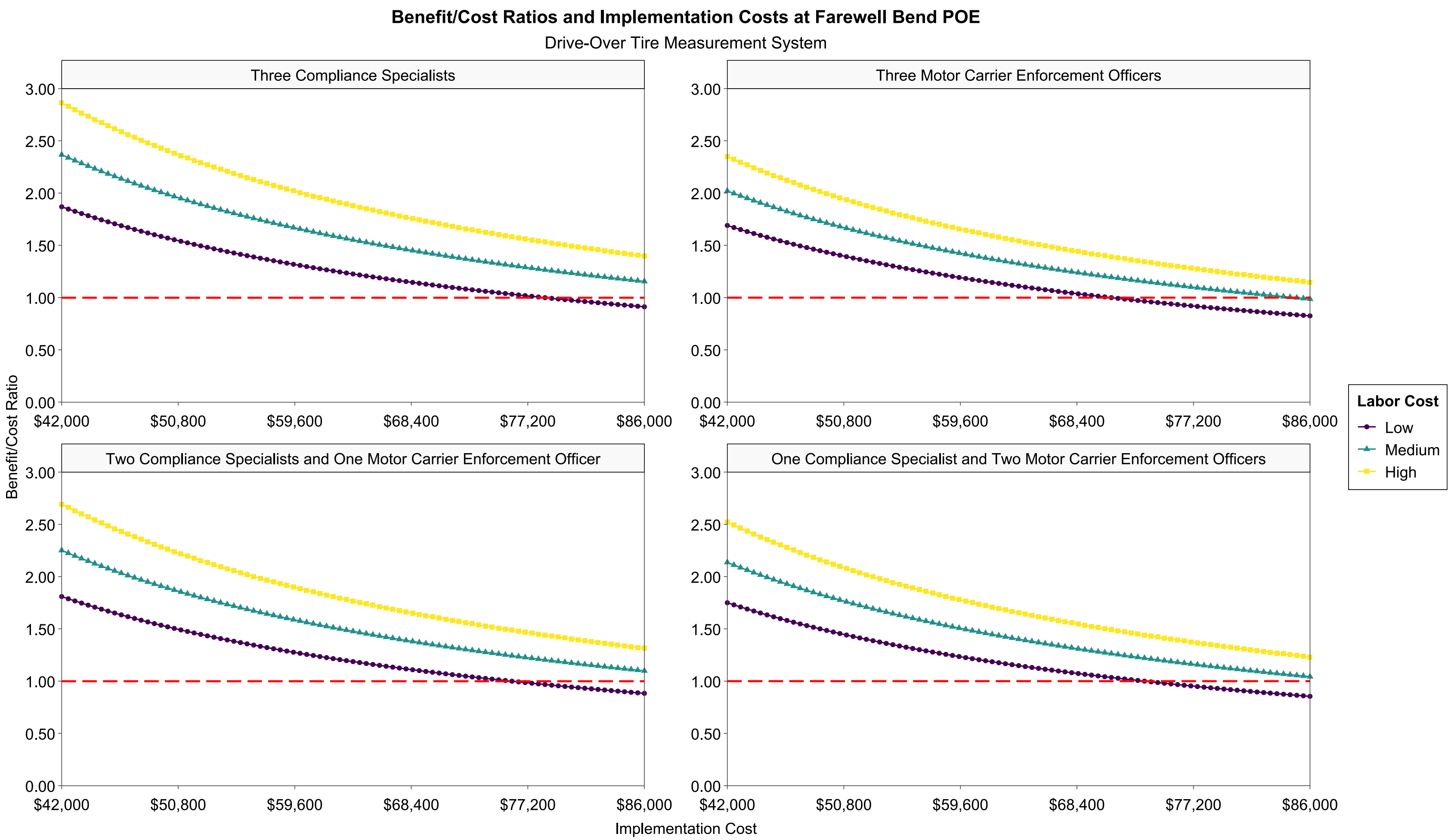

Figure 6.60: Benefit-Cost Results for Drive-Over Tire Measurement System at Farewell Bend POE (Day Shift)

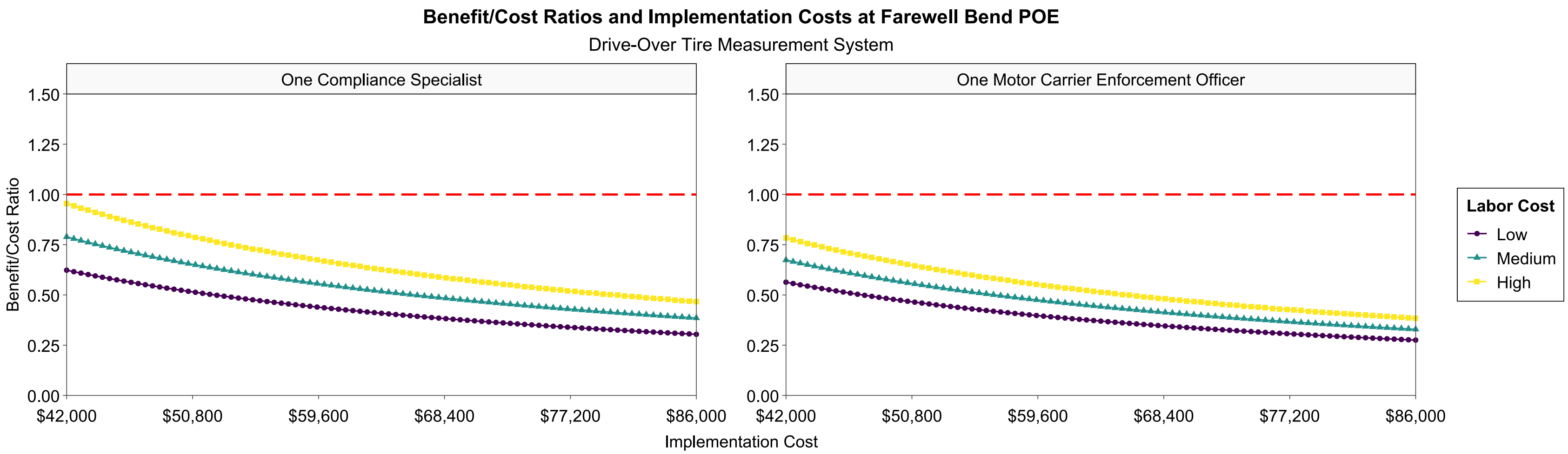

Figure 6.61: Benefit-Cost Results for Drive-Over Tire Measurement System at Farewell Bend POE (Evening Shift)

6.3.3.4 Cascade Locks POE

Figure 6.62 shows the results of the benefit-cost analysis at Cascade Locks POE. Results indicate that drive-over tire measurement systems are economically justified if implementation costs are low and labor costs are low, or labor costs are high (see Table 6.43). If three compliance specialists are present, and labor costs are low or medium, the maximum implementation cost needs to be $64,500 or less or $81,500 or less. If three motor carrier enforcement officers are present, and labor costs are low, medium, or high, the maximum implementation cost needs to be $58,500 or less, $69,500 or less, or $81,000 or less, respectively.

If two compliance specialists and one motor carrier enforcement officer are present, and labor costs are low or medium, the maximum implementation cost needs to be $62,500 or less or $77,500 or less. If one compliance specialist and two motor carrier enforcement officers are present, and labor costs are low or medium, the maximum implementation cost needs to be $60,500 or less or $73,500 or less. Overall, a drive-over tire measurement system is economically viable at Cascade Locks POE if implementation costs are low and labor costs are low, or labor costs are high.

For the scenario in which a single person is working at the weigh station, a laser vision system is not economically justified (see Figure 6.63).

Table 6.43: Maximum Implementation Cost for Drive-Over Tire Measurement System to be Economically Justified at Cascade Locks POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$64,500
	Medium	$81,500
	High	—
Three Motor Carrier Enforcement Officers	Low	$58,500
	Medium	$69,500
	High	$81,000
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$62,500
	Medium	$77,500
	High	—
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$60,500
	Medium	$73,500
	High	—

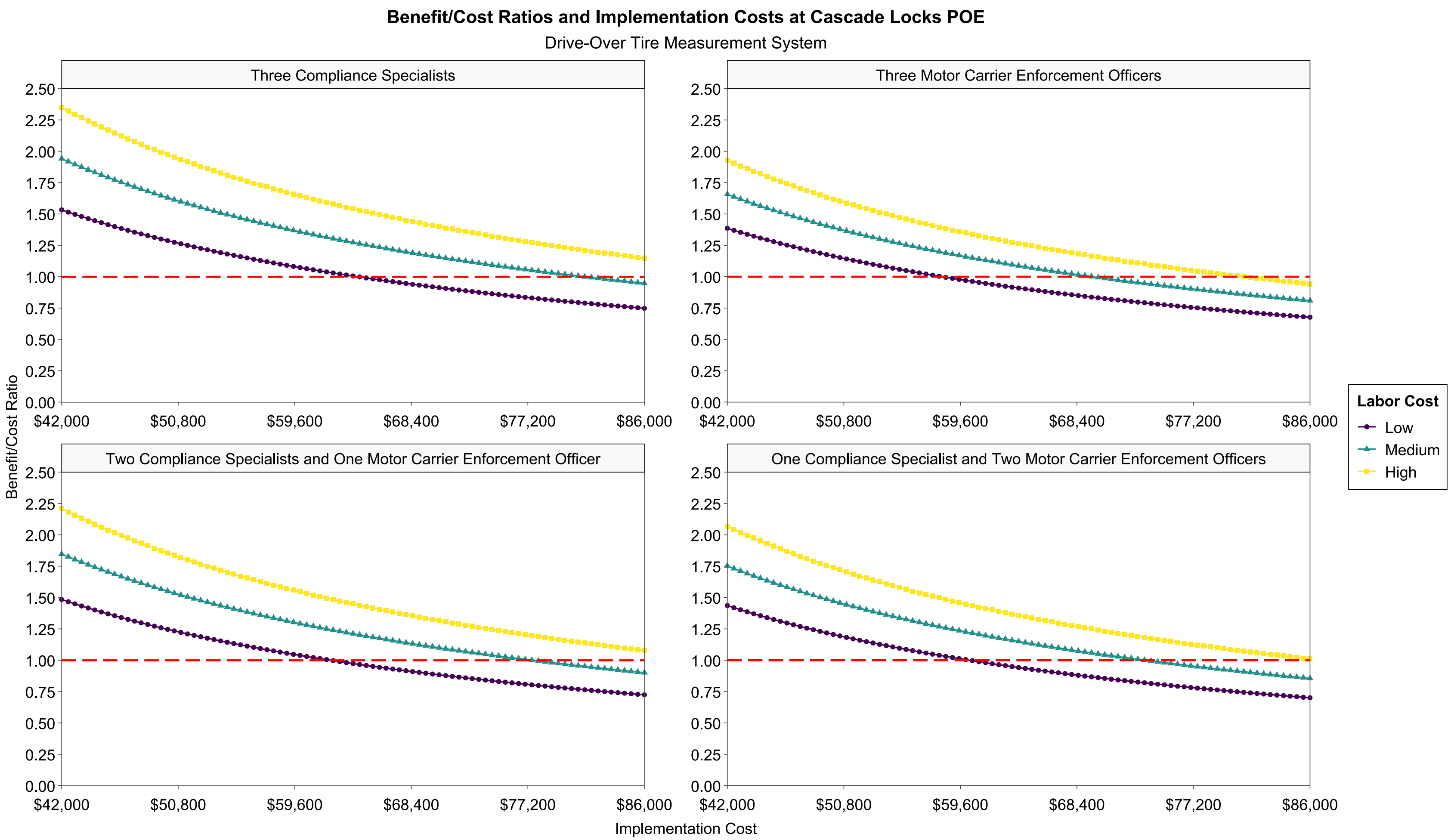

Figure 6.62: Benefit-Cost Results for Drive-Over Tire Measurement System at Cascade Locks POE (Day Shift)

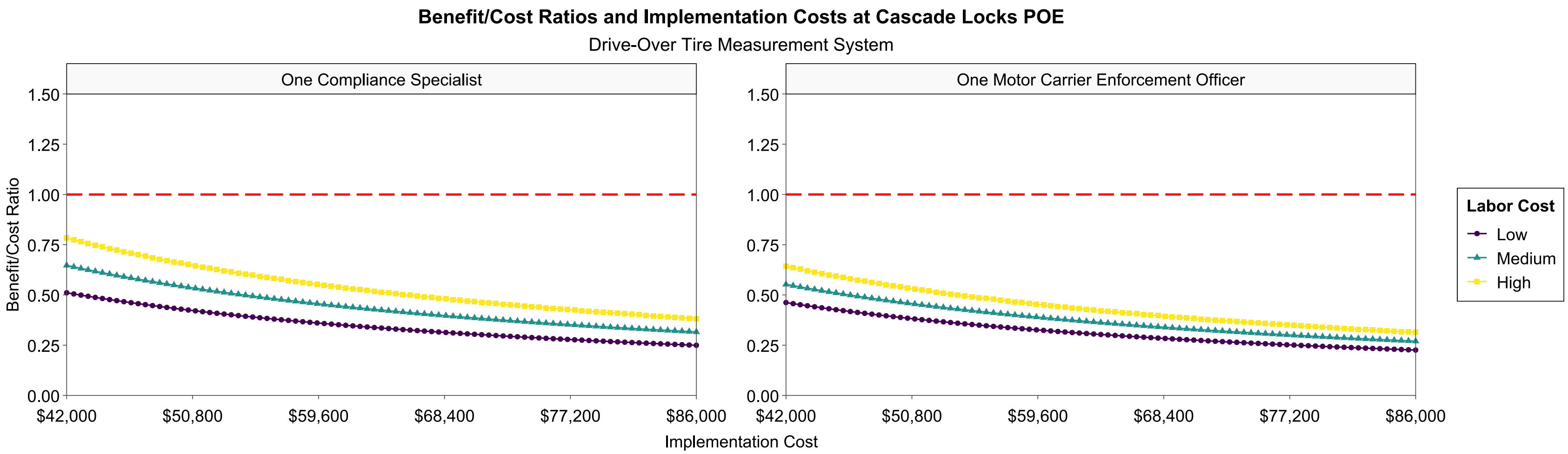

Figure 6.63: Benefit-Cost Results for Drive-Over Tire Measurement System at Cascade Locks POE (Evening Shift)

6.3.3.5 Wyeth

Figure 6.64 shows the results of the benefit-cost analysis at Wyeth. Results indicate that drive-over tire measurement systems are not economically justified at this location, with two exceptions (see Table 6.44). If three compliance specialists are present, and labor cost is high, the maximum implementation cost needs to be $46,500 or less (this is approximately $5,000 more than the lower bound of the implementation cost range). If two compliance specialists and one motor carrier enforcement officer are present, and labor cost is high, the maximum implementation cost needs to be $44,000 or less (this is $2,000 more than the lower bound of the implementation cost range). Overall, a drive-over tire measurement system is not economically viable at Wyeth.

For the scenario in which a single person is working at the weigh station, a drive-over tire measurement system is not economically justified (see Figure 6.65).

Table 6.44: Maximum Implementation Cost for Drive-Over Tire Measurement System to be Economically Justified at Wyeth (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	NA[a]
	Medium	NA
	High	$46,500
Three Motor Carrier Enforcement Officers	Low	NA
	Medium	NA
	High	NA
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	NA
	Medium	NA
	High	$44,000
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	NA
	Medium	NA
	High	NA

[a] NA indicates no maximum implementation cost (all implementation costs result in a benefit-cost ratio < 1)

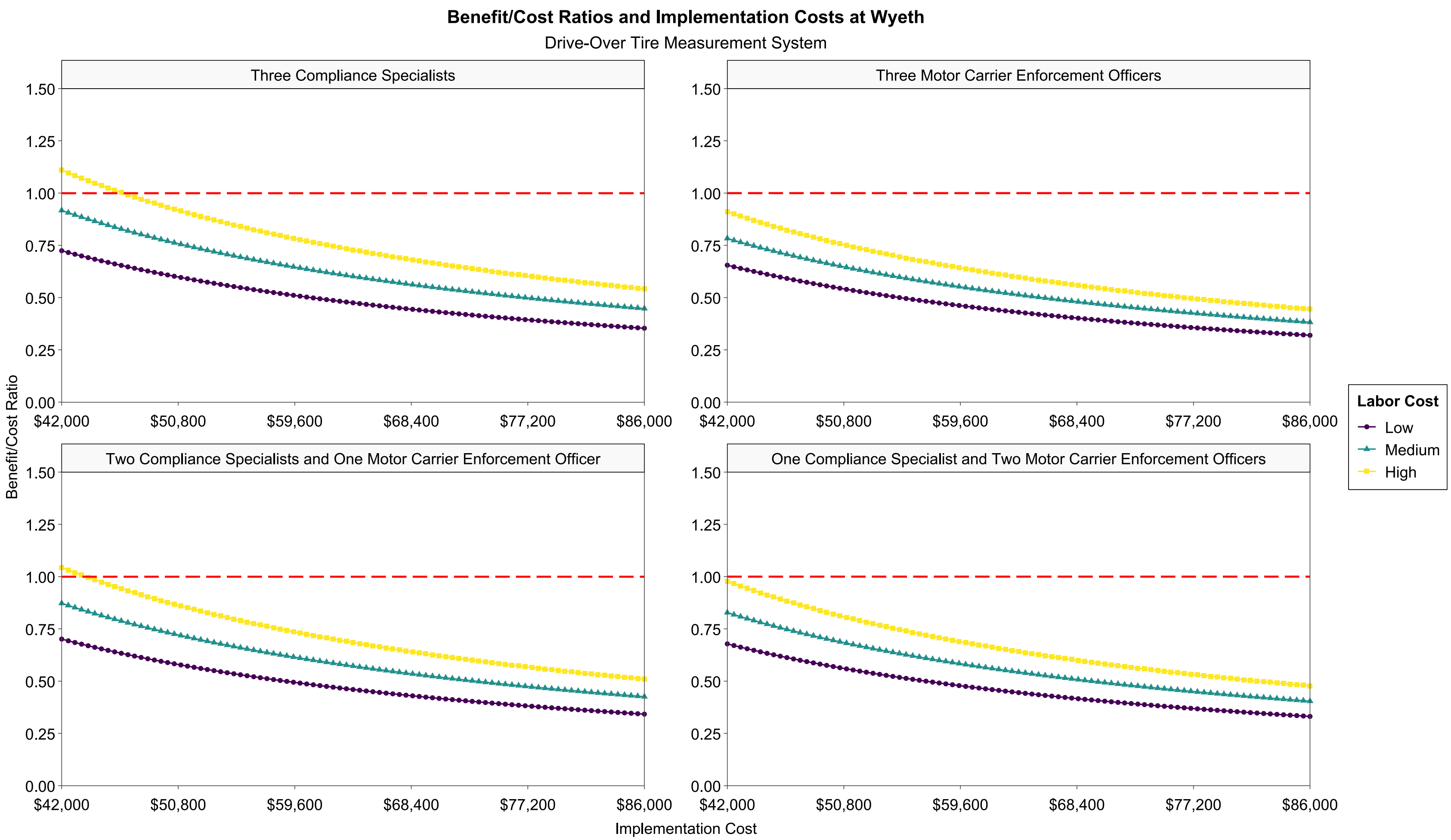

Figure 6.64: Benefit-Cost Results for Drive-Over Tire Measurement System at Wyeth (Day Shift)

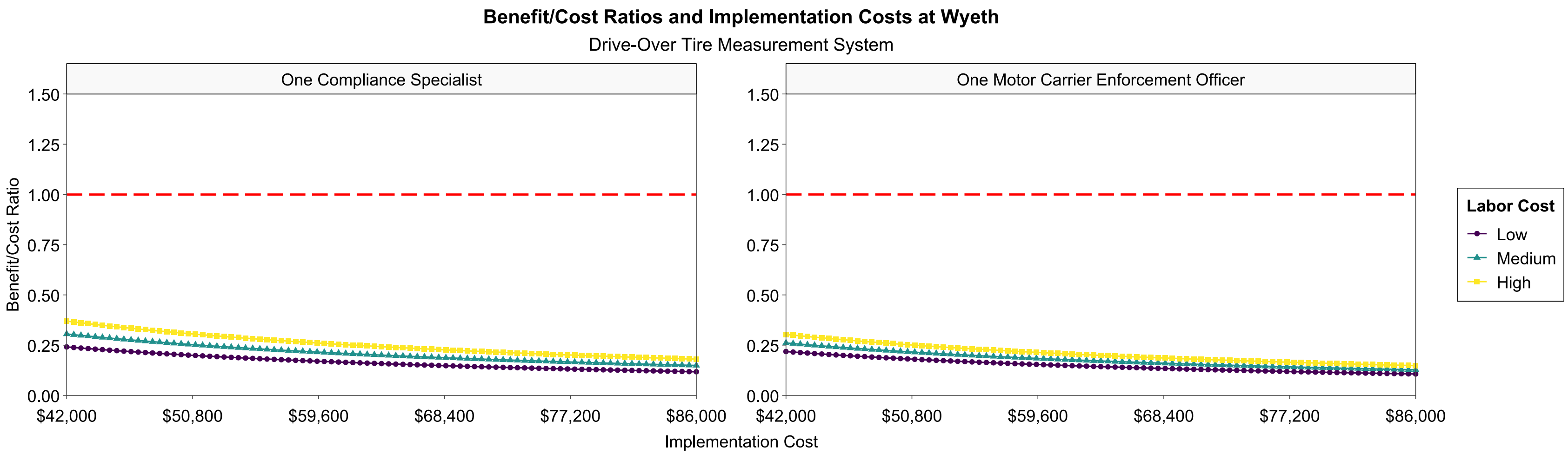

Figure 6.65: Benefit-Cost Results for Drive-Over Tire Measurement System at Wyeth (Evening Shift)

6.3.3.6 Umatilla POE

Figure 6.66 shows the results of the benefit-cost analysis at Umatilla POE. As observed, drive-over tire measurement systems are economically justified for each potential implementation cost. This is true for scenarios in which three workers are present at the weigh station.

For the scenario in which a single person is working at the weigh station, the implementation costs need to be low, with high labor costs, to be economically justified (see Table 6.45 and Figure 6.67). If the one worker is a compliance specialist, and labor cost is medium or high, the maximum implementation cost needs to be $47,500 or less or $57,500 or less.

If the one worker is a motor carrier enforcement officer, a drive-over tire measurement system is economically justified, if labor costs are high, when the maximum implementation cost is $47,000 or less.

Table 6.45: Maximum Implementation Cost for Drive-Over Tire Measurement System to be Economically Justified at Umatilla POE (Evening Shift)

Scenario	Labor Cost	Max Implementation Cost
One Compliance Specialist	Low	NA[a]
	Medium	$47,500
	High	$57,500
One Motor Carrier Enforcement Officer	Low	NA
	Medium	NA
	High	$47,000

[a] NA indicates no maximum implementation cost (all implementation costs result in a benefit-cost ratio < 1)

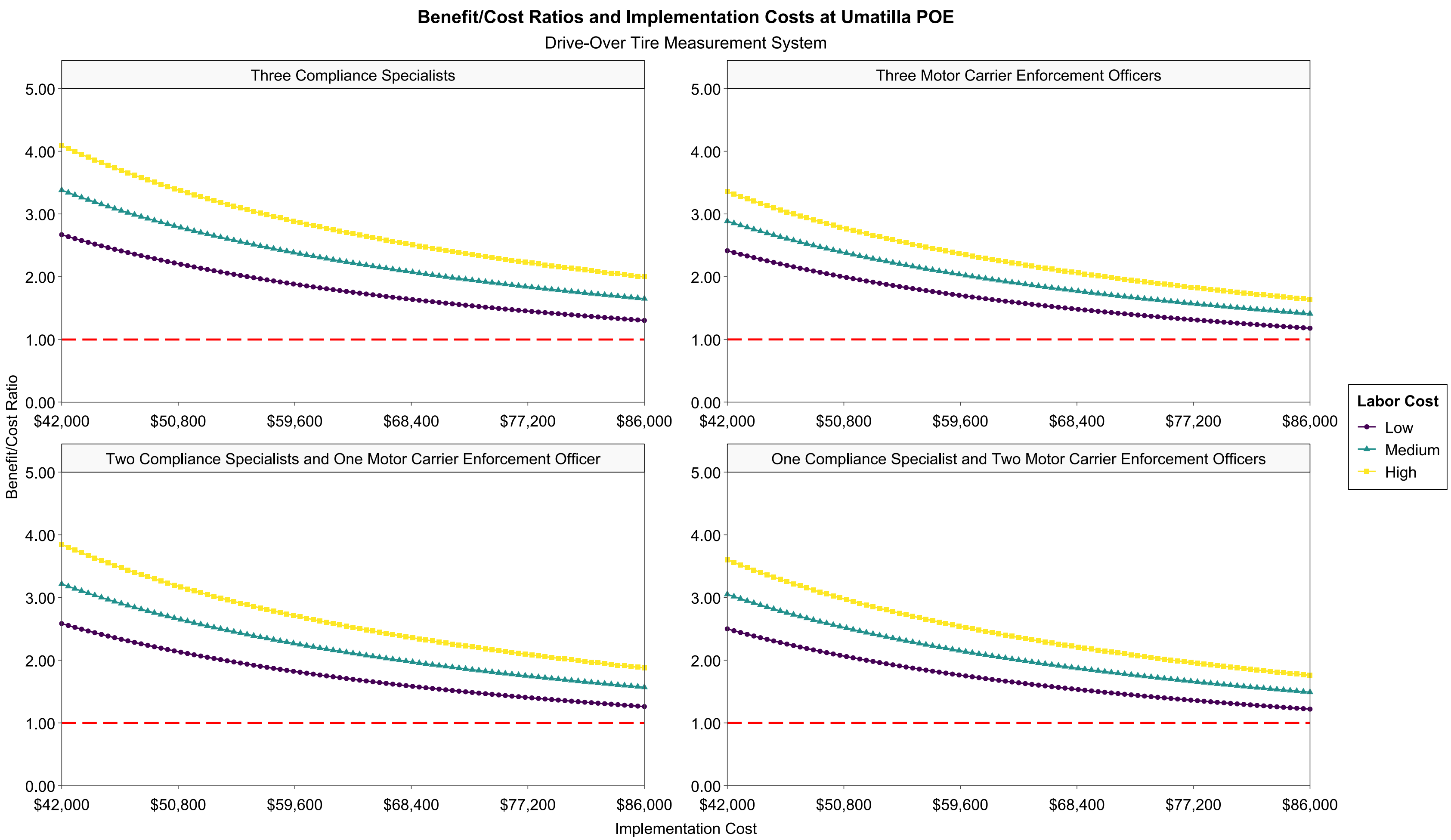

Figure 6.66: Benefit-Cost Results for Drive-Over Tire Measurement System at Umatilla POE (Day Shift)

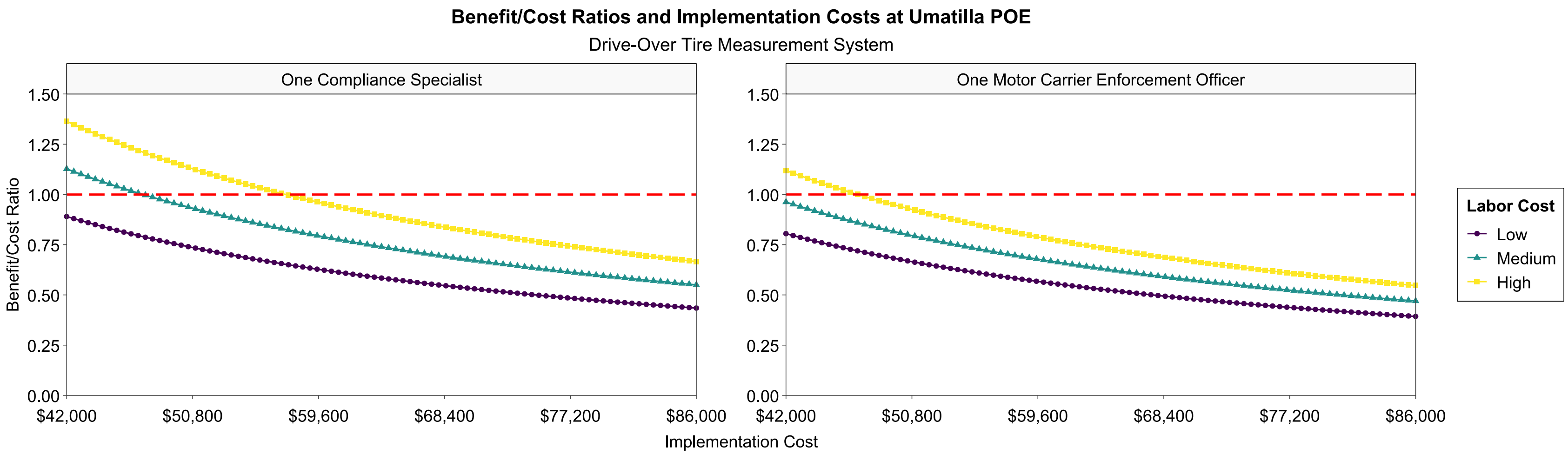

Figure 6.67: Benefit-Cost Results for Drive-Over Tire Measurement System at Umatilla POE (Evening Shift)

6.3.3.7 Klamath Falls POE

Figure 6.68 shows the results of the benefit-cost analysis at Klamath Falls POE. Results indicate that drive-over tire measurement systems are economically justified if implementation costs are low and labor costs are low, or if labor costs are high (see Table 6.46). If three compliance specialists are present, and labor costs are low or medium, the maximum implementation cost needs to be $60,000 or less or $75,500 or less. If three motor carrier enforcement officers are present, and labor cost is low, medium, or high, the maximum implementation cost needs to be $54,000 or less, $64,500 or less, or $75,000 or less, respectively.

If two compliance specialists and one motor carrier enforcement officer are present, and labor costs are low or medium, the maximum implementation cost needs to be $58,000 or less or $72,000. If one compliance specialist and two motor carrier enforcement officers are present, and labor costs are low, medium, or high, the maximum implementation cost needs to be $56,000 or less, $68,500 or less, or $80,500 or less, respectively.

For the scenario in which a single person is working at the weigh station, a laser vision system is not economically justified (see Figure 6.69).

Table 6.46: Maximum Implementation Cost for Drive-Over Tire Measurement System to be Economically Justified at Klamath Falls POE (Day Shift)

Scenario	Labor Cost	Max Implementation Cost
Three Compliance Specialists	Low	$60,000
	Medium	$75,500
	High	—
Three Motor Carrier Enforcement Officers	Low	$54,000
	Medium	$64,500
	High	$75,000
Two Compliance Specialists and One Motor Carrier Enforcement Officer	Low	$58,000
	Medium	$72,000
	High	—
One Compliance Specialist and Two Motor Carrier Enforcement Officers	Low	$56,000
	Medium	$68,500
	High	$80,500

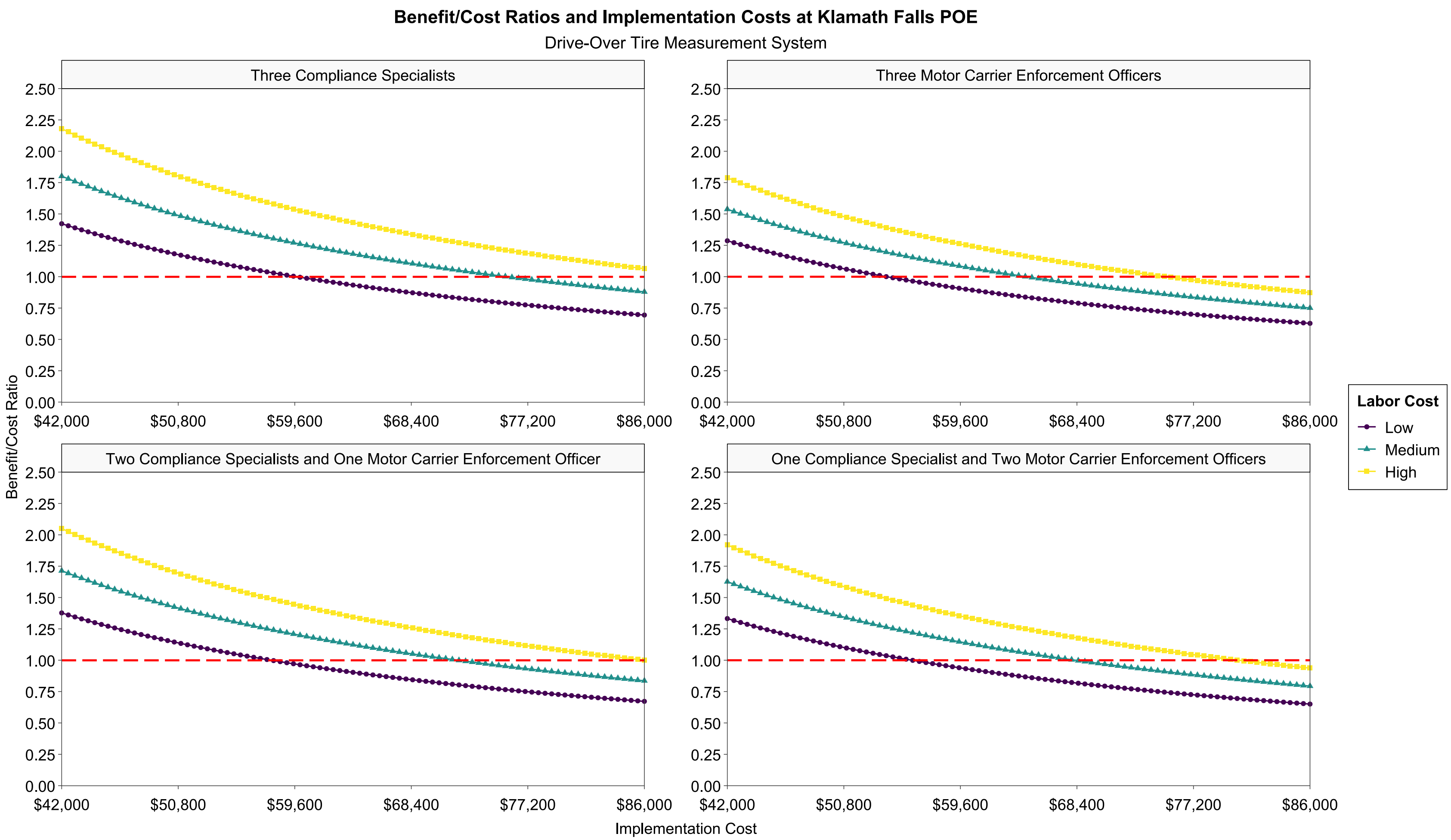

Figure 6.68: Benefit-Cost Results for Drive-Over Tire Measurement System at Klamath Falls POE (Day Shift)

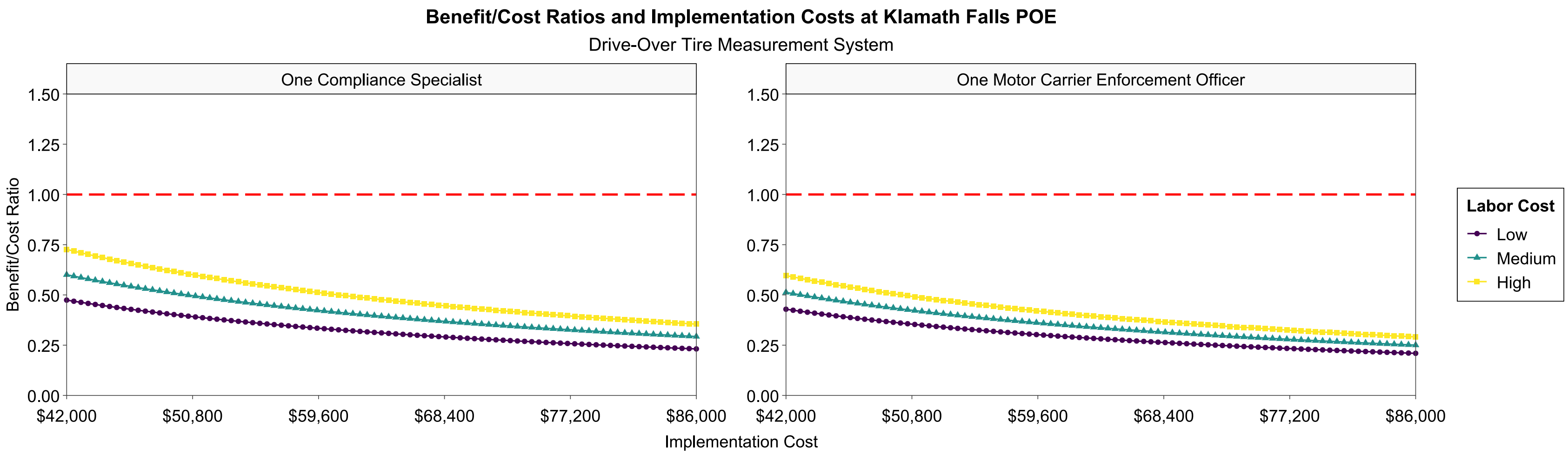

Figure 6.69: Benefit-Cost Results for Drive-Over Tire Measurement System at Klamath Falls POE (Evening Shift)

6.4 ANALYSIS SUMMARY

The following subchapter will provide a summary for the three distinct analyses conducted: (1) statewide descriptive analysis, (2) site-specific descriptive analysis, and (3) site-level benefit-cost analysis.

6.4.1 Statewide Descriptive Analysis

The first of three analyses consisted of a statewide assessment regarding violations. The majority of inspection types that lead to violations are walk-arounds and driver-only inspections. Semi-trailers and truck tractors are the most inspected unit types, accounting for more than 80% of all inspections. Unit makes are varied, but the highest proportion represent the makes that have a solid market share (e.g., Freightliner, Kenworth, Peterbilt). The majority of units are made post-2000, with some dating back to the mid-1960s. The states of registration are primarily located on the I-5 corridor (California, Oregon, and Washington), while there are moderate proportions originating in the Midwest. Gross vehicle weight rating is made up of, primarily, 52,000-pound trucks and 80,000-pound trucks. Of the four years considered (two pre-pandemic year, one during pandemic year, and one during pandemic year with back-to-normal traffic conditions), the pre-pandemic years accounted for a much larger proportion of inspections and violations. The pandemic years, which coincide with trucking regulatory relaxations had a much smaller proportion, particularly 2020.

Lastly, the locations that experienced the most inspections and violations were identified and considered for analysis. Two of the locations were identified at the county-level and were not included in the analysis. Regarding the county-level locations, specific locations where the violations occurred were not provided. For example, in Clackamas County, land restriction violations and speeding were the most occurring violations; however, exact locations of these violations were not provided. Without knowing the locations where these most often occur, a site-level benefit-cost analysis cannot be conducted. A summary of the sites considered for analysis is shown in Figure 6.70.

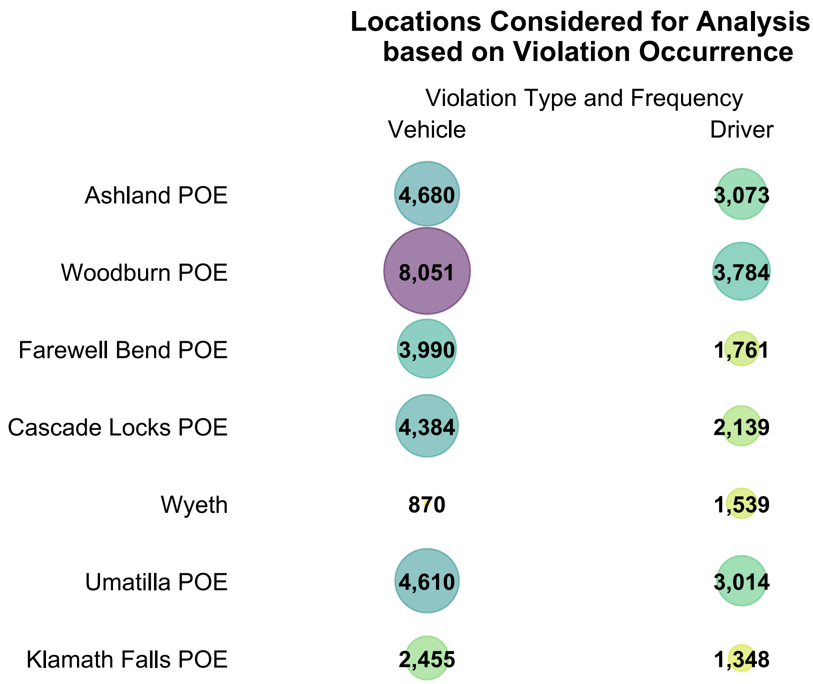

Figure 6.70: Summary of Locations Considered for Analysis and Violation Occurrence

6.4.2 Site-Level Descriptive Analysis

The site-level descriptive analysis identified overrepresented violations at the locations given in Figure 6.70. The violations were considered based on driver-related violations and vehicle-related violations.

Driver-related violations had a fair amount of consistency across all locations, being that the majority of driver-related violations were the same; specifically, 395-8(a)(1), 395-8(e)(1), and 383-51(a). These violations relate to drivers having no record of duty status, a driver falsifying a record of duty status, or driving a commercial motor vehicle while their commercial driver license is suspended, respectively. A summary of the proportions is given in Figure 6.71.

Vehicle-related violations had less consistency, but one violation did occur more than others: 395-75, which relates to tires. Common violations were flat tires, exposed fabric, audible leaks, cut tires, and tread depth violations. While other vehicle-related violations occurred, not enough information was provided or still required human inspection. A summary of the proportions is given in Figure 6.72.

Based on the results of the site-level descriptive analysis, the following enforcement technologies were considered for the benefit-cost analysis: (1) Real-time ELD data access, (2) Laser vision systems to monitor tires, and (3) Drive-over tire measurement systems.

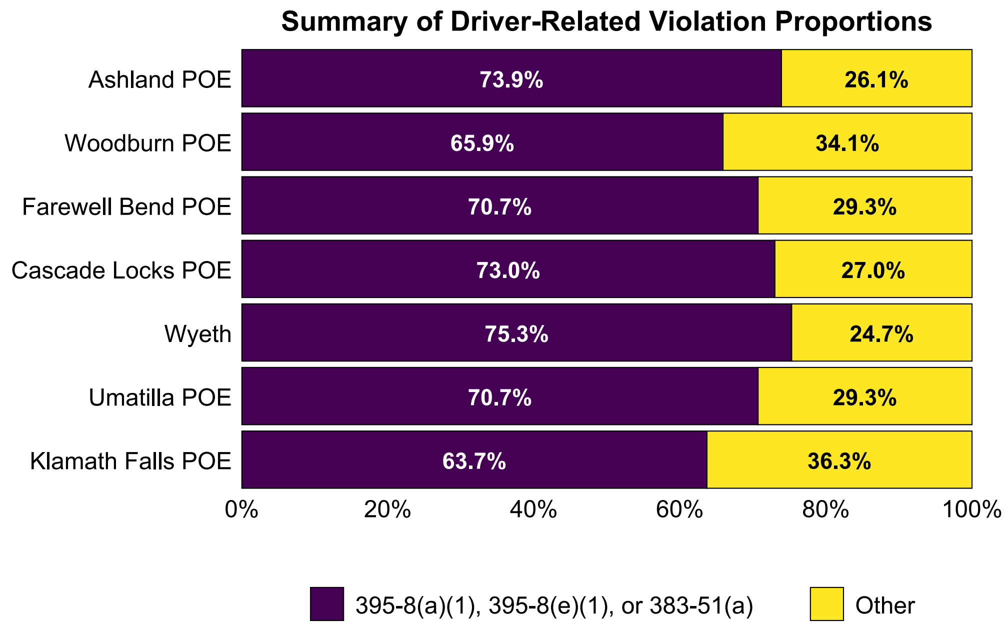

Figure 6.71: Summary of Driver-Related Violation Proportions

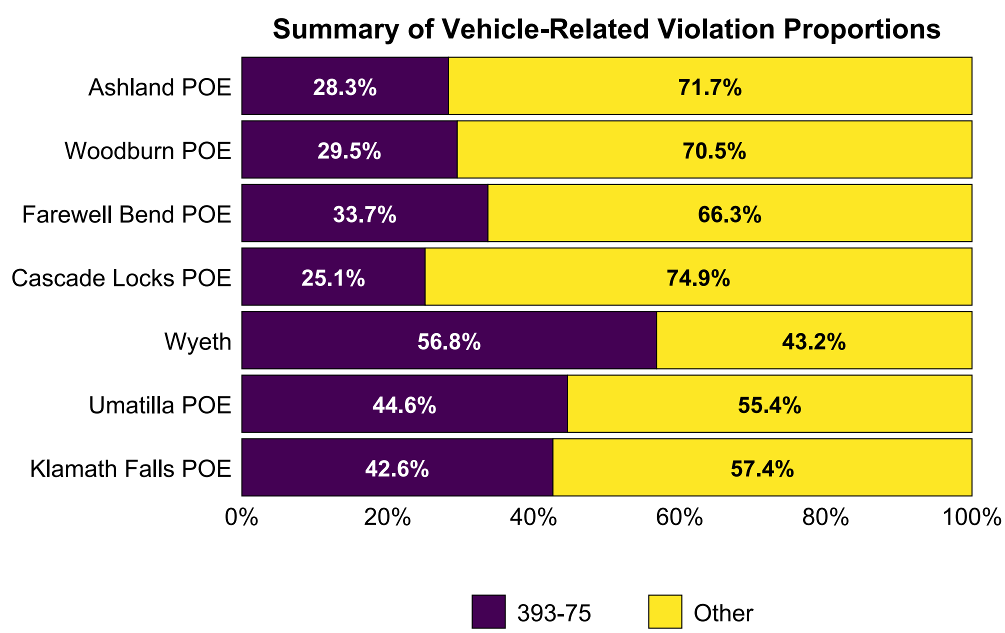

Figure 6.72: Summary of Vehicle-Related Violation Proportions

6.4.3 Benefit-Cost Analysis

Using hourly labor costs for compliance specialists and motor carrier enforcement officers, and implementation costs for different electronic enforcement technology, site-level benefit-cost analyses were conducted to determine economic viability. The labor costs were considered in three different scales: (1) low, (2) medium, and (3) high. In addition to the labor cost scenarios, the number of workers (day vs. evening shift, compliance specialists and motor carrier enforcement officers on the same shift) and their job title were considered, resulting in different potential scenarios at a respective site. The end objective was to rank-order the locations based on their economically viability as a result of the benefit-cost analysis. Locations were rank-ordered based on the electronic enforcement technology, time-of-day (day shift vs. evening shift), and the mean benefit-cost ratio considering all potential implementation costs.

6.4.3.1 Real-Time ELD Data Access

Figure 6.73 summarizes the results of the benefit-cost analysis for real-time ELD data access. Benefits are greater during the day shift, as labor costs are higher due to there being more workers present during this shift. Based on mean benefit-cost ratios across all implementation costs (mean return-on-investment), Woodburn POE, Umatilla POE, and Ashland POE are economically viable options for real-time ELD data access implementation.

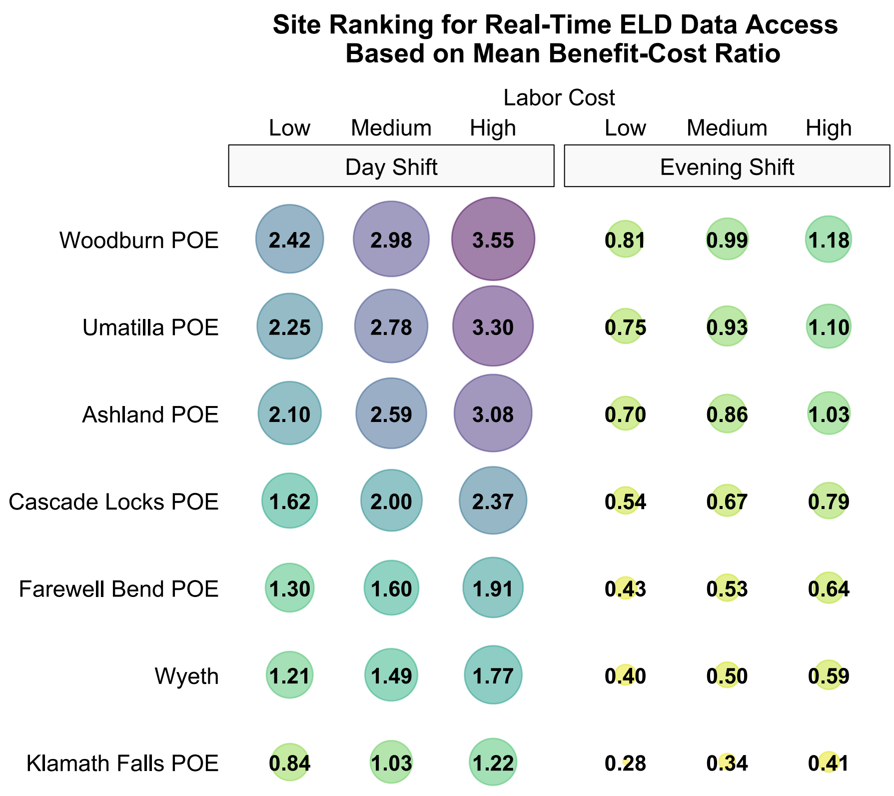

Figure 6.73: Rank-Ordered Sites for Real-Time ELD Data Access

6.4.3.2 Laser Vision System

Figure 6.74 summarizes the results of the benefit-cost analysis for laser vision systems. Benefits are greater during the day shift, as labor costs are higher due to there being more workers present during this shift. Based on mean benefit-cost ratios across all implementation costs (mean return-on-investment), Woodburn POE and Umatilla POE are economically viable options for laser vision system implementation.

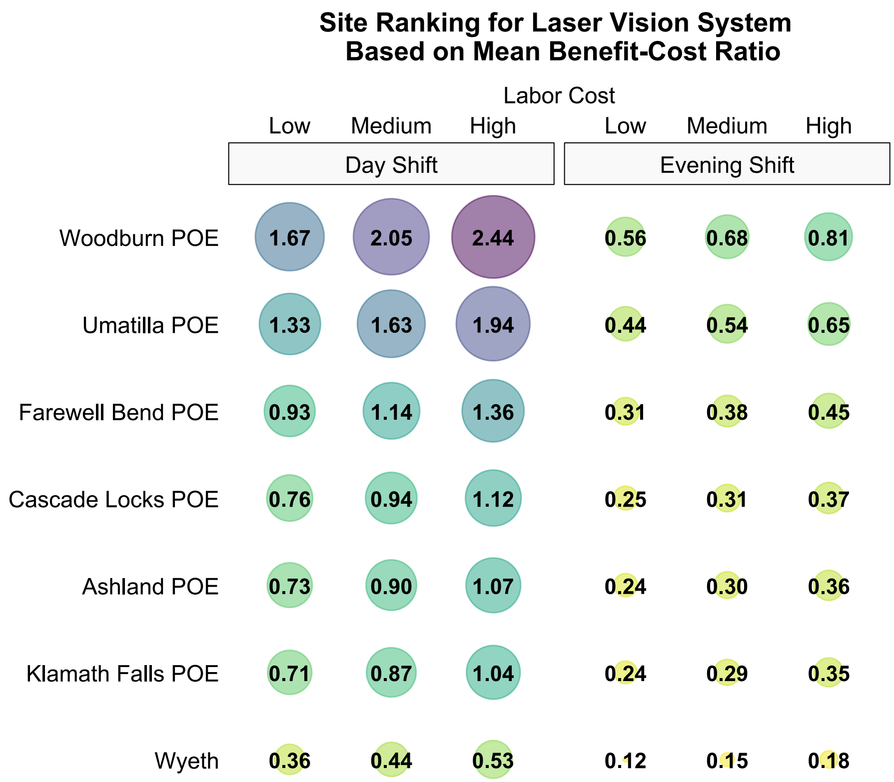

Figure 6.74: Rank-Ordered Sites for Laser Vision System

6.4.3.3 Drive-Over Tire Measurement System

Figure 6.75 summarizes the results of the benefit-cost analysis for drive-over tire measurement systems. Benefits are greater during the day shift, as labor costs are higher due to there being more workers present during this shift. Based on mean benefit-cost ratios across all implementation costs (mean return-on-investment), Woodburn POE, Umatilla POE, Farewell Bend POE, and Cascade Locks POE are economically viable options for drive-over tire measurement system implementation.

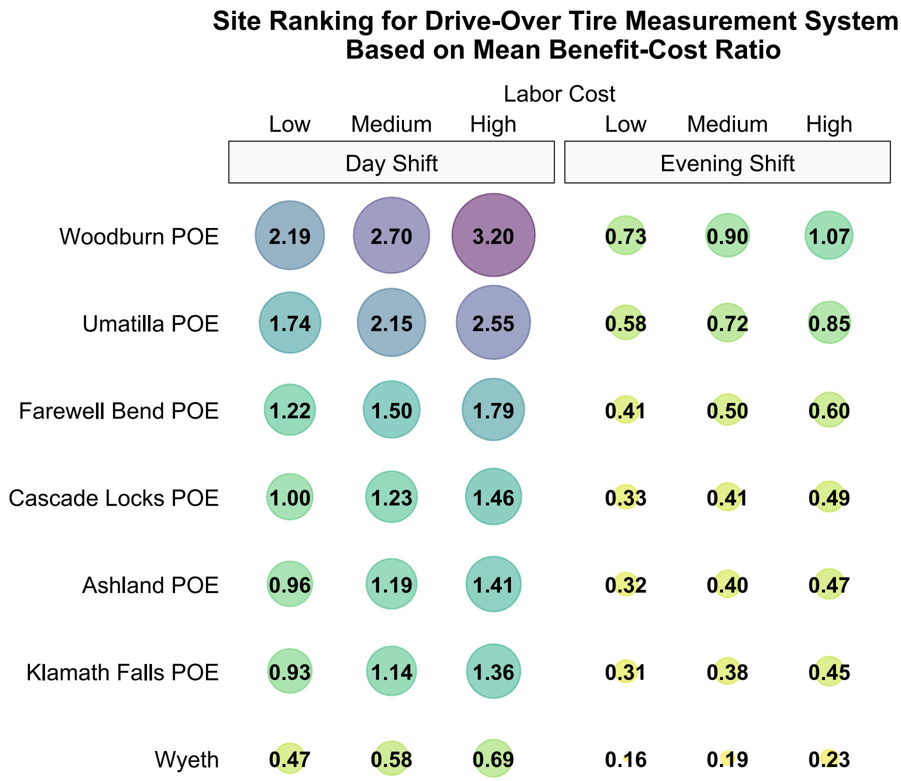

Figure 6.75: Rank-Ordered Sites for Drive-Over Tire Measurement System

7.0 CONCLUSIONS AND RECOMMENDATIONS

The objective of this study was to identify locations, based on violation occurrence, where electronic enforcement technologies could be implemented to supplement decreasing FTE. To accomplish this, a review of the state of electronic enforcement technology was conducted, which included electronic enforcement technologies implemented domestically and internationally. This was followed by a review of best practices, both domestically and internationally.

After reviewing the state of electronic enforcement technologies and best practices, an analysis was conducted on inspection and violation data to understand inspection and violation trends in Oregon. First, a statewide assessment of inspections and violations was conducted to understand general trends and to identify locations in which more inspections and violations happened. Next, a site-level descriptive analysis was conducted to determine the violations that were occurring most often. Upon identifying these locations, electronic enforcement technologies were selected to address driver-level violations and vehicle-level violations. Considering the proposed electronic enforcement technologies, a series of site-level benefit-cost analyses were conducted to determine if implementation of the proposed electronic enforcement technologies would be economically justified. The site-level benefit-cost analyses considered labor costs and implementation costs for different electronic enforcement technologies; specifically, (1) real-time ELD data access, (2) laser vision system for tire monitoring, and (3) drive-over tire measurement systems. The results from the site-level benefit-cost analyses were used to rank-order locations based on their mean return-on-investment across all potential implementation costs.

The following subchapters summarize the results of the data analyses, then followed by recommendations.

7.1 STATEWIDE DESCRIPTIVE ANALYSIS

The majority of inspection types that led to violations were walk-arounds and driver-only inspections. Semi-trailers and truck tractors were the most inspected unit types, accounting for more than 80% of all inspections. Unit makes varied, but the highest proportion represent the makes that have a solid market share (e.g., Freightliner, Kenworth, Peterbilt). The states of registration were primarily located on the I-5 corridor (California, Oregon, and Washington), while there were moderate proportions originating in the Midwest. Gross vehicle weight rating was made up of, primarily, 52,000-pound trucks and 80,000-pound trucks. Of the four years considered (two pre-pandemic year, one during pandemic year, and one during pandemic year with back-to-normal traffic conditions), the pre-pandemic years accounted for a much larger proportion of inspections and violations. The pandemic years, which coincide with trucking regulatory relaxations had a much smaller proportion, particularly 2020.

Two of the locations were identified at the county-level and were not included in the analysis. Specific locations where the violations occurred were not provided. For example, in Clackamas County, lane restriction violations and speeding were the most occurring violations; however, exact locations of these violations were not provided. Without knowing the locations where these most often occur, a site-level benefit-cost analysis was unable to be conducted.

7.2 SITE-LEVEL DESCRIPTIVE ANALYSIS

The site-level descriptive analysis identified overrepresented violations at the locations considered for analysis. Violations were considered based on driver-related violations and vehicle-related violations.

Driver-related violations had a fair amount of consistency across all locations, being that the majority of driver-related violations were the same; specifically, 395-8(a)(1), 395-8(e)(1), and 383-51(a). These violations relate to drivers having no record of duty status, a driver falsifying a record of duty status, or drivers who were driving a commercial motor vehicle while their commercial driver license was suspended, respectively.

Vehicle-related violations had less consistency, but one violation did occur more than others: 395-75, which relates to tires. Common violations were flat tires, exposed fabric, audible leaks, cut tires, and tread depth violations. While other vehicle-related violations occurred, not enough information was provided or still required human inspection (e.g., brakes, connections, hoses, tubing, leaks).

7.3 BENEFIT-COST ANALYSIS

Using hourly labor costs for compliance specialists and motor carrier enforcement officers, and implementation costs for different electronic enforcement technologies, site-level benefit-cost analyses were conducted to determine economic viability. The labor costs were considered in three different scales: (1) low, (2) medium, and (3) high. In addition to the labor cost scenarios, the number of workers (day vs. evening shift, compliance specialists vs. motor carrier enforcement officers on the same shift) and their job title were considered, resulting in different potential scenarios at a respective site. The results were a series of benefit-cost ratios over a variety of implementation costs. To rank-order locations based on their economic viability, mean benefit-cost ratios (mean return-on-investment) were used.

Regardless of the electronic enforcement technology, Woodburn POE was the highest ranked in terms of economic viability. This result is expected, as Woodburn POE experienced the highest truck traffic and had the most violations over the time period considered. Ranking second across all electronic enforcement technologies was Umatilla POE. After Umatilla POE, rankings changed based on the enforcement technology considered; for example, Ashland POE was ranked third when considering real-time ELD data access and Farewell Bend POE was ranked third when considering the tire-related technologies.

7.4 RECOMMENDATIONS AND FUTURE WORK

7.4.1 Descriptive Analysis

There were some challenges with the inspection/violation data that could improve analysis methods, inferences, and recommendations. While the data contains violation parts and section numbers, these are not consistently entered into the data and are often entered in shorthand. This can create challenges when summarizing and aggregating violations, leading to undercounting violations.

The inspection/violation data provides locations at very aggregate levels (e.g., weigh stations), making it challenging to identify potential violation-prone locations. In this work, roadways/highways in Clackamas County and Washington County were locations that experienced a high number of violations, but where within these counties was unknown. Additionally, various violations were coded with the same description, such as "State Operating Authority," but information on the violation was not provided. The violations that were known were related to speeding and lane restriction violations, making speed safety cameras or automated video enforcement (e.g., HOV lane enforcement) viable options. However, where these should be implemented is unknown without more specific data.

If feasible, it is recommended to standardize the data inputting process, as well as geocoding the location of the violation. The combination of these two would allow for a more detailed violation analysis, in addition to providing an opportunity for spatial fusion with alternate data sources, thereby expanding the use of the violation data. Specifically, this would allow for the correlation between crash-prone locations and locations with a high number of violations.

Despite these challenges, the inspection and violation data shows potential for integration into analytics platforms and real-time dashboards to enable visualization of enforcement data. This would allow the Commerce and Compliance Division to enhance strategic planning regarding compliance. It may also be beneficial to develop API-driven data pipelines that fuse CVIEW, SafeSpect, and inspection/violation databases to support compliance enforcement and long-term trend analysis, which aligns with the FMCSA guide on data-driven enforcement.

The rank-order of locations based on violation trends can be used as a decision framework for technology implementation, which supports more targeted implementation and can maximize resource efforts.

7.4.2 Benefit-Cost Analysis

The benefit-cost analysis results indicated that real-time ELD data access is economically justified at all locations under most scenarios. For this reason, systemic implementation of real-time ELD data access is recommended. In addition to its application of electronic enforcement, which improves compliance (about 70% of current violations can be addressed by this technology) and safety, the collected data can be used for other analyses. Specifically, real-time ELD data collected as part of enforcement can be used in crash analyses, such as crash prediction methodologies and safety action plans. Real-time data can also be used to implement dynamic safety treatments by integrating the real-time ELD data into traffic management systems, such as variable speed limit signs and dynamic messaging boards. Lastly, the data can be used in before-after studies (safety effectiveness evaluations) to determine its effectiveness on observed crashes.

Due to the high cost of laser vision systems, and it being a new technology in this context, systemic implementation of such a system would not be recommended at this time. Instead, it would be recommended to implement this type of system at a single location (e.g., Woodburn POE) that showed economic justification in the benefit-cost analysis. On the other hand, drive-over tire measurement systems can be a viable option to consider for systemic implementation, as all sites (with the exception of Wyeth) have economic justification under different scenarios. Although this technology will focus on a smaller proportion, compared to real-time ELD data access, it can improve compliance (about 30% of current violations can be addressed, and up to 60% at certain locations) and safety issues related to tires. Such a system may also improve inspection time when an inspection takes place, as the individual conducting the inspection would not have to inspect the tires.

It is also recommended to collect data on the number of tire failures, and whether they lead to a crash or not. This information can then be used to determine safety-related costs and cost incurred due to delays, which would be additional benefits to a drive-over (or laser vision) tire measurement system.

Moving forward, the presented benefit-cost methodology can be automated to continuously evaluate the economic justification of technology implementation. There may be opportunities to use the proposed methodology as a decision-support tool that could assist the Commerce and Compliance Division with prioritizing technology investments. Additionally, the methodology can be expanded to include costs related to safety and infrastructure, where data is available, to produce more comprehensive benefit-cost ratios. The rank-order of locations based on mean benefit-cost ratio can be used as a decision framework for technology implementation, which supports more targeted implementation and can maximize resource efforts. With continued refining of infrastructure at Points of Entry, these findings can lead to investment planning and system design, specifically for locations with limited evening coverage or during off-hours. During infrastructure refinement, site constraints can be evaluated and an implementation plan can be developed for enforcement technologies that require infrastructure upgrades.

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APPENDIX A

Appendix A provides additional temporal trends of inspections in Oregon. Figures illustrating these trends begin on the following page.

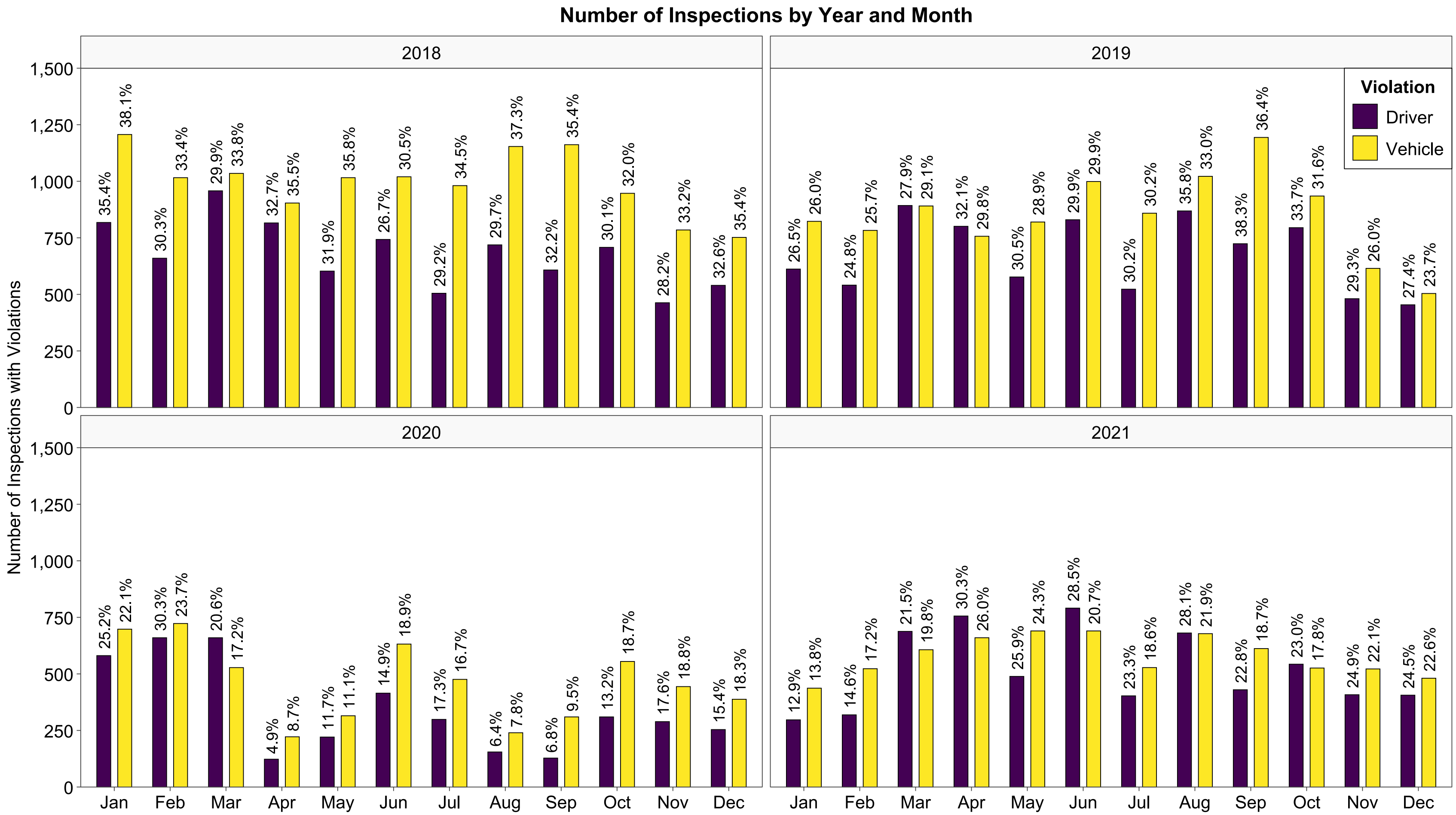

Figure A.1: Frequency and Proportion of Inspections by Year and Month

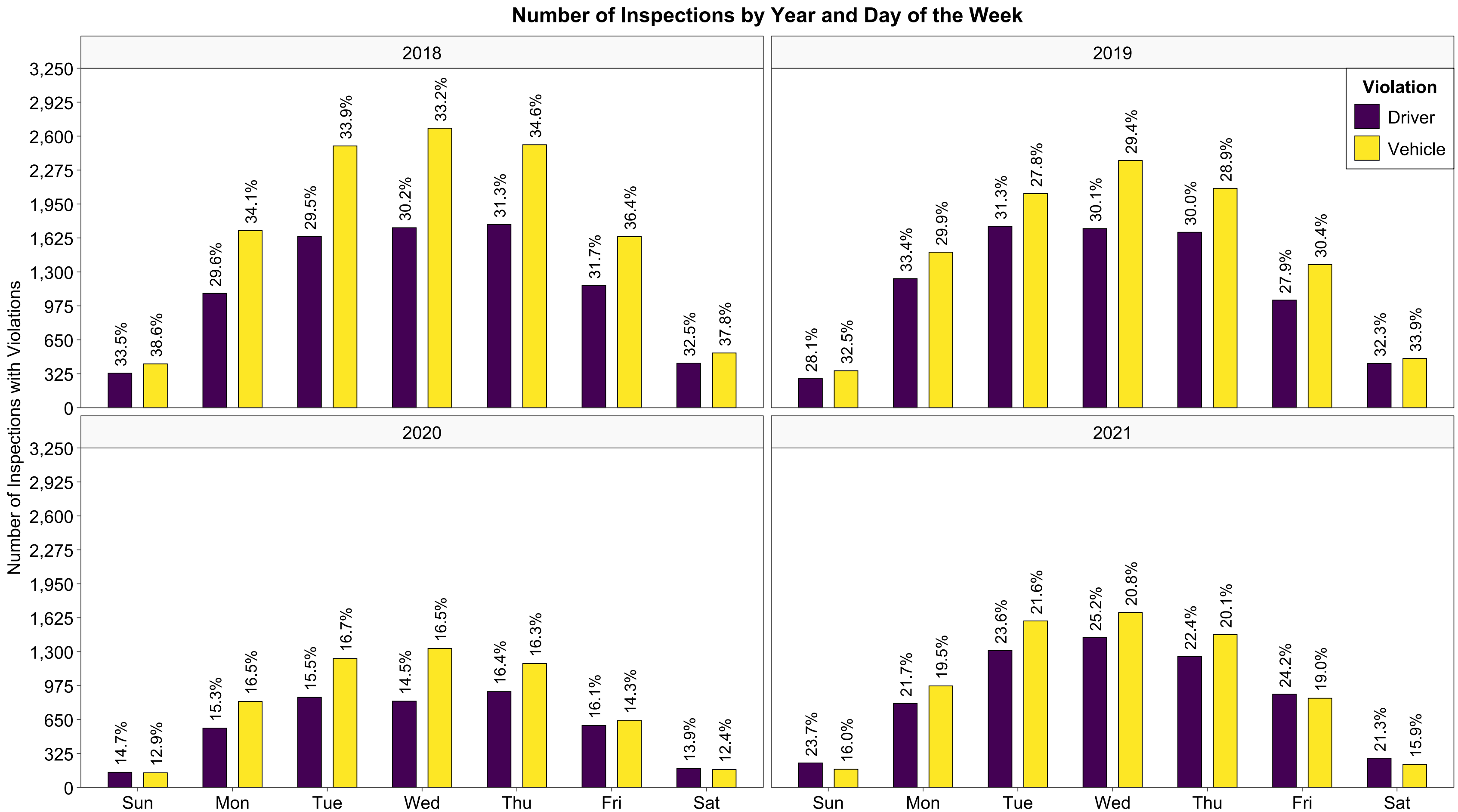

Figure A.2: Frequency and Proportion of Inspections by Year and Day of the Week

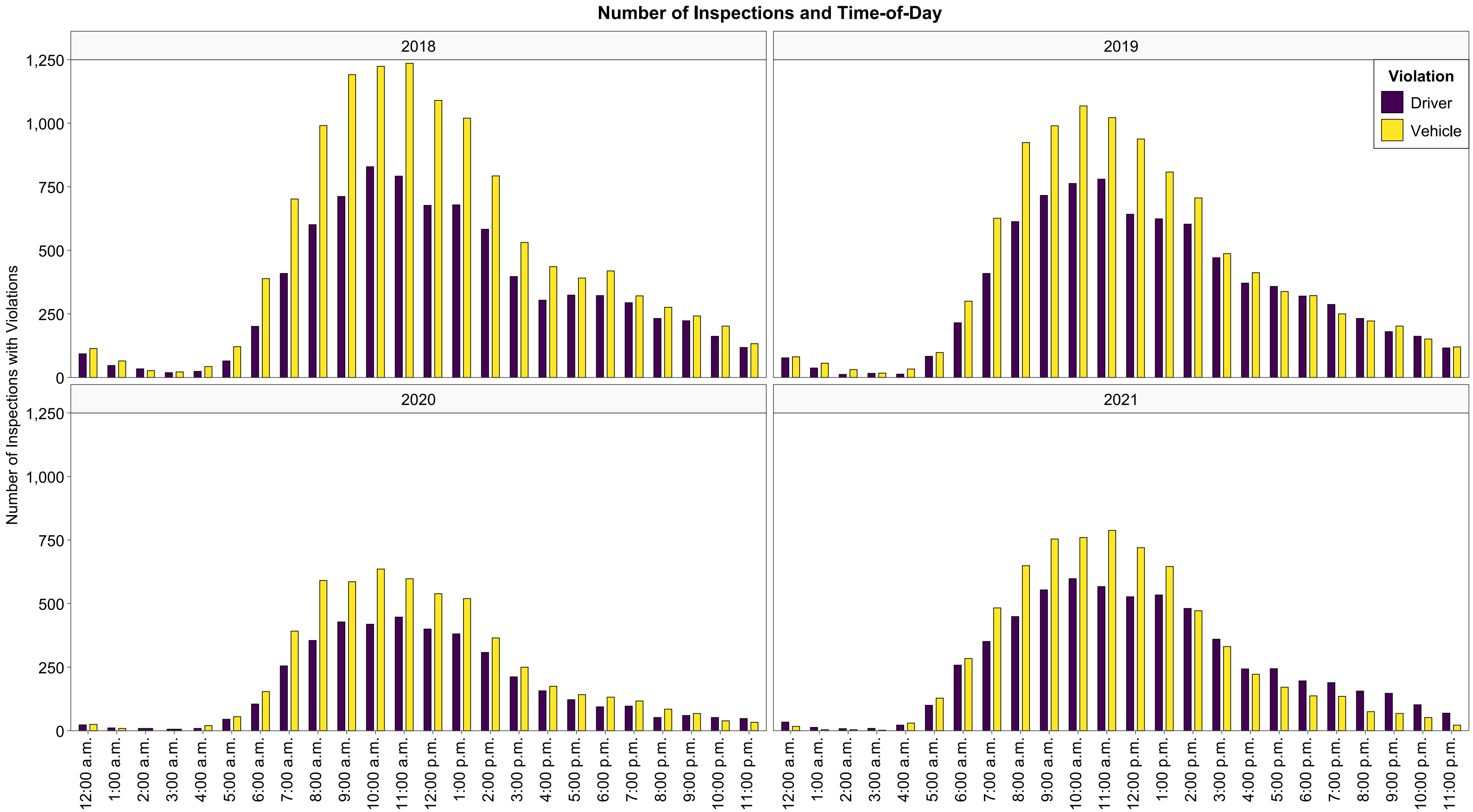

Figure A.3: Frequency of Inspections by Year and Time-of-Day

APPENDIX B

Appendix B provides driver-related violation descriptions for each of the locations considered for analysis.

Table B.1: Driver-Related Violation Descriptions at Ashland POE

Violation	Description
383-23(a)(2)	Commercial Driver's License: Except as provided in paragraph (b) of this section, no person may legally operate a CMV unless such person possesses a CDL which meets the standards contained in subpart J of this part, issued by his/her State or jurisdiction of domicile.
383-51(a)	Disqualification of Drivers: (1) A person required to have a CLP or CDL who is disqualified must not drive a CMV. (2) An employer must not knowingly allow, require, permit, or authorize a driver who is disqualified to drive a CMV. (3) A holder of a CLP or CDL is subject to disqualification sanctions designated in paragraphs (b) and (c) of this section, if the holder drives a CMV or non-CMV and is convicted of the violations listed in those paragraphs. (4) ***Determining first and subsequent violations***. For purposes of determining first and subsequent violations of the offenses specified in this subpart, each conviction for any offense listed in Tables 1 through 4 to this section resulting from a separate incident, whether committed in a CMV or non-CMV, must be counted. (5) The disqualification period must be in addition to any other previous periods of disqualification. (6) ***Reinstatement after lifetime disqualification***. A State may reinstate any driver disqualified for life for offenses described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) after 10 years, if that person has voluntarily entered and successfully completed an appropriate rehabilitation program approved by the State. Any person who has been reinstated in accordance with this provision and who is subsequently convicted of a disqualifying offense described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) must not be reinstated. (7) A foreign commercial driver is subject to disqualification under this subpart.
392-2	Applicable Operating Rules: Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.

Violation	Description
395-22(h)	Motor Carrier Responsibilities—In General: ***In-vehicle information***. (h) A motor carrier must ensure that its drivers possess onboard a commercial motor vehicle an ELD information packet containing the following items: (1) A user's manual for the driver describing how to operate the ELD. (2) An instruction sheet for the driver describing the data transfer mechanisms supported by the ELD and step-by-step instructions for the driver to produce and transfer the driver's hours-of-service records to an authorized safety official. (3) An instruction sheet for the driver describing ELD malfunction reporting requirements and recordkeeping procedures during ELD malfunctions. (4) A supply of blank driver's records of duty status graph-grids sufficient to record the driver's duty status and other related information for a minimum of 8 days.
395-3(a)(3)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (3) ***Driving time and interruptions of driving periods — (i) Driving time.*** A driver may drive a total of 11 hours during the period specified in paragraph (a)(2) of this section. ***(ii) Interruption of driving time.*** Except for drivers who qualify for either of the short-haul exceptions in § 395.1(e)(1) or (2), driving is not permitted if more than 8 hours of driving time have passed without at least a consecutive 30-minute interruption in driving status. A consecutive 30-minute interruption of driving status may be satisfied either by off-duty, sleeper berth or on-duty not driving time or by a combination of off-duty, sleeper berth and on-duty not driving time.
395-8(a)(1)	Driver's Record of Duty Status. Except for a private motor carrier of passengers (nonbusiness), as defined in § 390.5 of this subchapter, a motor carrier subject to the requirements of this part must require each driver used by the motor carrier to record the driver's duty status for each 24-hour period using the method prescribed in paragraphs (a)(1)(i) through (iv) of this section, as applicable. See additional subparts.
395-8(e)(1)	Driver's Record of Duty Status. No driver or motor carrier may make a false report in connection with a duty status.

Table B.2: Driver-Related Violation Descriptions at Woodburn POE

Violation	Description
383-23(a)(2)	Commercial Driver's License: Except as provided in paragraph (b) of this section, no person may legally operate a CMV unless such person possesses a CDL which meets the standards contained in subpart J of this part, issued by his/her State or jurisdiction of domicile.
383-51(a)	Disqualification of Drivers: (1) A person required to have a CLP or CDL who is disqualified must not drive a CMV. (2) An employer must not knowingly allow, require, permit, or authorize a driver who is disqualified to drive a CMV. (3) A holder of a CLP or CDL is subject to disqualification sanctions designated in paragraphs (b) and (c) of this section, if the holder drives a CMV or non-CMV and is convicted of the violations listed in those paragraphs. (4) ***Determining first and subsequent violations***. For purposes of determining first and subsequent violations of the offenses specified in this subpart, each conviction for any offense listed in Tables 1 through 4 to this section resulting from a separate incident, whether committed in a CMV or non-CMV, must be counted. (5) The disqualification period must be in addition to any other previous periods of disqualification. (6) ***Reinstatement after lifetime disqualification***. A State may reinstate any driver disqualified for life for offenses described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) after 10 years, if that person has voluntarily entered and successfully completed an appropriate rehabilitation program approved by the State. Any person who has been reinstated in accordance with this provision and who is subsequently convicted of a disqualifying offense described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) must not be reinstated. (7) A foreign commercial driver is subject to disqualification under this subpart.
392-2	Applicable Operating Rules: Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
395-22(h)	Motor Carrier Responsibilities—In General: ***In-vehicle information***. A motor carrier must ensure that its drivers possess onboard a commercial motor vehicle an ELD information packet containing the following items: (1) A user's manual for the driver describing how to operate the ELD. (2) An instruction sheet for the driver describing the data transfer mechanisms supported by the ELD and step-by-step instructions for the driver to produce and transfer the driver's hours-of-service records to an authorized safety official. (3) An instruction sheet for the driver describing ELD malfunction reporting requirements and recordkeeping procedures during ELD malfunctions. (4) A supply of blank driver's records of duty status graph-grids sufficient to record the driver's duty status and other related information for a minimum of 8 days.

Violation	Description
395-3(a)(2)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (2) ***14-hour period***. A driver may not drive after a period of 14 consecutive hours after coming on-duty following 10 consecutive hours off-duty.
395-3(a)(3)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (3) ***Driving time and interruptions of driving periods — (i) Driving time.*** A driver may drive a total of 11 hours during the period specified in paragraph (a)(2) of this section. ***(ii) Interruption of driving time.*** Except for drivers who qualify for either of the short-haul exceptions in § 395.1(e)(1) or (2), driving is not permitted if more than 8 hours of driving time have passed without at least a consecutive 30-minute interruption in driving status. A consecutive 30-minute interruption of driving status may be satisfied either by off-duty, sleeper berth or on-duty not driving time or by a combination of off-duty, sleeper berth and on-duty not driving time.
395-8(a)(1)	Driver's Record of Duty Status. Except for a private motor carrier of passengers (nonbusiness), as defined in § 390.5 of this subchapter, a motor carrier subject to the requirements of this part must require each driver used by the motor carrier to record the driver's duty status for each 24-hour period using the method prescribed in paragraphs (a)(1)(i) through (iv) of this section, as applicable. See additional subparts.
395-8(e)(1)	Driver's Record of Duty Status. No driver or motor carrier may make a false report in connection with a duty status.

Table B.3: Driver-Related Violation Descriptions at Farewell Bend POE

Violation	Description
383-23(a)(2)	Commercial Driver's License: Except as provided in paragraph (b) of this section, no person may legally operate a CMV unless such person possesses a CDL which meets the standards contained in subpart J of this part, issued by his/her State or jurisdiction of domicile.
383-51(a)	Disqualification of Drivers: (1) A person required to have a CLP or CDL who is disqualified must not drive a CMV. (2) An employer must not knowingly allow, require, permit, or authorize a driver who is disqualified to drive a CMV. (3) A holder of a CLP or CDL is subject to disqualification sanctions designated in paragraphs (b) and (c) of this section, if the holder drives a CMV or non-CMV and is convicted of the violations listed in those paragraphs. (4) ***Determining first and subsequent violations***. For purposes of determining first and subsequent violations of the offenses specified in this subpart, each conviction for any offense listed in Tables 1 through 4 to this section resulting from a separate incident, whether committed in a CMV or non-CMV, must be counted. (5) The disqualification period must be in addition to any other previous periods of disqualification. (6) ***Reinstatement after lifetime disqualification***. A State may reinstate any driver disqualified for life for offenses described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) after 10 years, if that person has voluntarily entered and successfully completed an appropriate rehabilitation program approved by the State. Any person who has been reinstated in accordance with this provision and who is subsequently convicted of a disqualifying offense described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) must not be reinstated. (7) A foreign commercial driver is subject to disqualification under this subpart.
392-2	Applicable Operating Rules: Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
395-22(h)	Motor Carrier Responsibilities—In General: ***In-vehicle information***. A motor carrier must ensure that its drivers possess onboard a commercial motor vehicle an ELD information packet containing the following items: (1) A user's manual for the driver describing how to operate the ELD. (2) An instruction sheet for the driver describing the data transfer mechanisms supported by the ELD and step-by-step instructions for the driver to produce and transfer the driver's hours-of-service records to an authorized safety official. (3) An instruction sheet for the driver describing ELD malfunction reporting requirements and recordkeeping procedures during ELD malfunctions. (4) A supply of blank driver's records of duty status graph-grids sufficient to record the driver's duty status and other related information for a minimum of 8 days.

395-3(a)(3)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (3) ***Driving time and interruptions of driving periods — (i) Driving time.*** A driver may drive a total of 11 hours during the period specified in paragraph (a)(2) of this section. ***(ii) Interruption of driving time.*** Except for drivers who qualify for either of the short-haul exceptions in § 395.1(e)(1) or (2), driving is not permitted if more than 8 hours of driving time have passed without at least a consecutive 30-minute interruption in driving status. A consecutive 30-minute interruption of driving status may be satisfied either by off-duty, sleeper berth or on-duty not driving time or by a combination of off-duty, sleeper berth and on-duty not driving time.
395-8(a)(1)	Driver's Record of Duty Status. Except for a private motor carrier of passengers (nonbusiness), as defined in § 390.5 of this subchapter, a motor carrier subject to the requirements of this part must require each driver used by the motor carrier to record the driver's duty status for each 24-hour period using the method prescribed in paragraphs (a)(1)(i) through (iv) of this section, as applicable. See additional subparts.
395-8(e)(1)	Driver's Record of Duty Status. No driver or motor carrier may make a false report in connection with a duty status.

Table B.4: Driver-Related Violation Descriptions at Cascade Locks POE

Violation	Description
383-23(a)(2)	Commercial Driver's License: Except as provided in paragraph (b) of this section, no person may legally operate a CMV unless such person possesses a CDL which meets the standards contained in subpart J of this part, issued by his/her State or jurisdiction of domicile.
383-51(a)	Disqualification of Drivers: (1) A person required to have a CLP or CDL who is disqualified must not drive a CMV. (2) An employer must not knowingly allow, require, permit, or authorize a driver who is disqualified to drive a CMV. (3) A holder of a CLP or CDL is subject to disqualification sanctions designated in paragraphs (b) and (c) of this section, if the holder drives a CMV or non-CMV and is convicted of the violations listed in those paragraphs. (4) ***Determining first and subsequent violations***. For purposes of determining first and subsequent violations of the offenses specified in this subpart, each conviction for any offense listed in Tables 1 through 4 to this section resulting from a separate incident, whether committed in a CMV or non-CMV, must be counted. (5) The disqualification period must be in addition to any other previous periods of disqualification. (6) ***Reinstatement after lifetime disqualification***. A State may reinstate any driver disqualified for life for offenses described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) after 10 years, if that person has voluntarily entered and successfully completed an appropriate rehabilitation program approved by the State. Any person who has been reinstated in accordance with this provision and who is subsequently convicted of a disqualifying offense described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) must not be reinstated. (7) A foreign commercial driver is subject to disqualification under this subpart.
392-2	Applicable Operating Rules: Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
395-24(d)	Driver Responsibilities—In General. (d) ***Driver use of ELD***. On request by an authorized safety official, a driver must produce and transfer from an ELD the driver's hours-of-service records in accordance with the instruction sheet provided by the motor carrier.
395-3(a)(2)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (2) ***14-hour period***. A driver may not drive after a period of 14 consecutive hours after coming on-duty following 10 consecutive hours off-duty.

Violation	Description
395-3(a)(3)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (3) ***Driving time and interruptions of driving periods — (i) Driving time.*** A driver may drive a total of 11 hours during the period specified in paragraph (a)(2) of this section. ***(ii) Interruption of driving time.*** Except for drivers who qualify for either of the short-haul exceptions in § 395.1(e)(1) or (2), driving is not permitted if more than 8 hours of driving time have passed without at least a consecutive 30-minute interruption in driving status. A consecutive 30-minute interruption of driving status may be satisfied either by off-duty, sleeper berth or on-duty not driving time or by a combination of off-duty, sleeper berth and on-duty not driving time.
395-8(a)(1)	Driver's Record of Duty Status. Except for a private motor carrier of passengers (nonbusiness), as defined in § 390.5 of this subchapter, a motor carrier subject to the requirements of this part must require each driver used by the motor carrier to record the driver's duty status for each 24-hour period using the method prescribed in paragraphs (a)(1)(i) through (iv) of this section, as applicable. See additional subparts.
395-8(e)(1)	Driver's Record of Duty Status. No driver or motor carrier may make a false report in connection with a duty status.

Table B.5: Driver-Related Violation Descriptions at Wyeth

Violation	Description
383-51(a)	Disqualification of Drivers: (1) A person required to have a CLP or CDL who is disqualified must not drive a CMV. (2) An employer must not knowingly allow, require, permit, or authorize a driver who is disqualified to drive a CMV. (3) A holder of a CLP or CDL is subject to disqualification sanctions designated in paragraphs (b) and (c) of this section, if the holder drives a CMV or non-CMV and is convicted of the violations listed in those paragraphs. (4) ***Determining first and subsequent violations***. For purposes of determining first and subsequent violations of the offenses specified in this subpart, each conviction for any offense listed in Tables 1 through 4 to this section resulting from a separate incident, whether committed in a CMV or non-CMV, must be counted. (5) The disqualification period must be in addition to any other previous periods of disqualification. (6) ***Reinstatement after lifetime disqualification***. A State may reinstate any driver disqualified for life for offenses described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) after 10 years, if that person has voluntarily entered and successfully completed an appropriate rehabilitation program approved by the State. Any person who has been reinstated in accordance with this provision and who is subsequently convicted of a disqualifying offense described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) must not be reinstated. (7) A foreign commercial driver is subject to disqualification under this subpart.
392-2	Applicable Operating Rules: Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
395-24(d)	Driver Responsibilities—In General. (d) ***Driver use of ELD***. On request by an authorized safety official, a driver must produce and transfer from an ELD the driver's hours-of-service records in accordance with the instruction sheet provided by the motor carrier.
395-3(a)(2)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (2) ***14-hour period***. A driver may not drive after a period of 14 consecutive hours after coming on-duty following 10 consecutive hours off-duty.

Violation	Description
395-3(a)(3)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (3) ***Driving time and interruptions of driving periods — (i) Driving time.*** A driver may drive a total of 11 hours during the period specified in paragraph (a)(2) of this section. ***(ii) Interruption of driving time.*** Except for drivers who qualify for either of the short-haul exceptions in § 395.1(e)(1) or (2), driving is not permitted if more than 8 hours of driving time have passed without at least a consecutive 30-minute interruption in driving status. A consecutive 30-minute interruption of driving status may be satisfied either by off-duty, sleeper berth or on-duty not driving time or by a combination of off-duty, sleeper berth and on-duty not driving time.
395-8(a)(1)	Driver's Record of Duty Status. Except for a private motor carrier of passengers (nonbusiness), as defined in § 390.5 of this subchapter, a motor carrier subject to the requirements of this part must require each driver used by the motor carrier to record the driver's duty status for each 24-hour period using the method prescribed in paragraphs (a)(1)(i) through (iv) of this section, as applicable. See additional subparts.
395-8(e)(1)	Driver's Record of Duty Status. No driver or motor carrier may make a false report in connection with a duty status.

Table B.6: Driver-Related Violation Descriptions at Umatilla POE

Violation	Description
383-23(a)(2)	Commercial Driver's License: Except as provided in paragraph (b) of this section, no person may legally operate a CMV unless such person possesses a CDL which meets the standards contained in subpart J of this part, issued by his/her State or jurisdiction of domicile.
383-51(a)	Disqualification of Drivers: (1) A person required to have a CLP or CDL who is disqualified must not drive a CMV. (2) An employer must not knowingly allow, require, permit, or authorize a driver who is disqualified to drive a CMV. (3) A holder of a CLP or CDL is subject to disqualification sanctions designated in paragraphs (b) and (c) of this section, if the holder drives a CMV or non-CMV and is convicted of the violations listed in those paragraphs. (4) ***Determining first and subsequent violations***. For purposes of determining first and subsequent violations of the offenses specified in this subpart, each conviction for any offense listed in Tables 1 through 4 to this section resulting from a separate incident, whether committed in a CMV or non-CMV, must be counted. (5) The disqualification period must be in addition to any other previous periods of disqualification. (6) ***Reinstatement after lifetime disqualification***. A State may reinstate any driver disqualified for life for offenses described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) after 10 years, if that person has voluntarily entered and successfully completed an appropriate rehabilitation program approved by the State. Any person who has been reinstated in accordance with this provision and who is subsequently convicted of a disqualifying offense described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) must not be reinstated. (7) A foreign commercial driver is subject to disqualification under this subpart.
392-2	Applicable Operating Rules: Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
395-3(a)(2)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (2) ***14-hour period***. A driver may not drive after a period of 14 consecutive hours after coming on-duty following 10 consecutive hours off-duty.

Violation	Description
395-3(a)(3)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (3) ***Driving time and interruptions of driving periods — (i) Driving time.*** A driver may drive a total of 11 hours during the period specified in paragraph (a)(2) of this section. ***(ii) Interruption of driving time.*** Except for drivers who qualify for either of the short-haul exceptions in § 395.1(e)(1) or (2), driving is not permitted if more than 8 hours of driving time have passed without at least a consecutive 30-minute interruption in driving status. A consecutive 30-minute interruption of driving status may be satisfied either by off-duty, sleeper berth or on-duty not driving time or by a combination of off-duty, sleeper berth and on-duty not driving time.
395-30(b)(1)	ELD Record Submissions, Edits, Annotations, and Data Retention. (b) ***Review of records and certification by driver.*** (1) A driver must review the driver's ELD records, edit and correct inaccurate records, enter any missing information, and certify the accuracy of the information.
395-8(a)(1)	Driver's Record of Duty Status. Except for a private motor carrier of passengers (nonbusiness), as defined in § 390.5 of this subchapter, a motor carrier subject to the requirements of this part must require each driver used by the motor carrier to record the driver's duty status for each 24-hour period using the method prescribed in paragraphs (a)(1)(i) through (iv) of this section, as applicable. See additional subparts.
395-8(e)(1)	Driver's Record of Duty Status. No driver or motor carrier may make a false report in connection with a duty status.

Table B.7: Driver-Related Violation Descriptions at Klamath Falls POE

Violation	Description
383-51(a)	Disqualification of Drivers: (1) A person required to have a CLP or CDL who is disqualified must not drive a CMV. (2) An employer must not knowingly allow, require, permit, or authorize a driver who is disqualified to drive a CMV. (3) A holder of a CLP or CDL is subject to disqualification sanctions designated in paragraphs (b) and (c) of this section, if the holder drives a CMV or non-CMV and is convicted of the violations listed in those paragraphs. (4) ***Determining first and subsequent violations***. For purposes of determining first and subsequent violations of the offenses specified in this subpart, each conviction for any offense listed in Tables 1 through 4 to this section resulting from a separate incident, whether committed in a CMV or non-CMV, must be counted. (5) The disqualification period must be in addition to any other previous periods of disqualification. (6) ***Reinstatement after lifetime disqualification***. A State may reinstate any driver disqualified for life for offenses described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) after 10 years, if that person has voluntarily entered and successfully completed an appropriate rehabilitation program approved by the State. Any person who has been reinstated in accordance with this provision and who is subsequently convicted of a disqualifying offense described in paragraphs (b)(1) through (8) of this section (Table 1 to § 383.51) must not be reinstated. (7) A foreign commercial driver is subject to disqualification under this subpart.
392-2	Applicable Operating Rules: Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
395-22(h)	Motor Carrier Responsibilities—In General: ***In-vehicle information***. A motor carrier must ensure that its drivers possess onboard a commercial motor vehicle an ELD information packet containing the following items: (1) A user's manual for the driver describing how to operate the ELD. (2) An instruction sheet for the driver describing the data transfer mechanisms supported by the ELD and step-by-step instructions for the driver to produce and transfer the driver's hours-of-service records to an authorized safety official. (3) An instruction sheet for the driver describing ELD malfunction reporting requirements and recordkeeping procedures during ELD malfunctions. (4) A supply of blank driver's records of duty status graph-grids sufficient to record the driver's duty status and other related information for a minimum of 8 days.
395-3(a)(2)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (2) ***14-hour period***. A driver may

Violation	Description
	not drive after a period of 14 consecutive hours after coming on-duty following 10 consecutive hours off-duty.
395-3(a)(3)	Maximum Driving Time for Property-Carrying Vehicles. (a) Except as otherwise provided in § 395.1, no motor carrier shall permit or require any driver used by it to drive a property-carrying commercial motor vehicle, nor shall any such driver drive a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, unless the driver complies with the following requirements: (3) ***Driving time and interruptions of driving periods — (i) Driving time.*** A driver may drive a total of 11 hours during the period specified in paragraph (a)(2) of this section. ***(ii) Interruption of driving time.*** Except for drivers who qualify for either of the short-haul exceptions in § 395.1(e)(1) or (2), driving is not permitted if more than 8 hours of driving time have passed without at least a consecutive 30-minute interruption in driving status. A consecutive 30-minute interruption of driving status may be satisfied either by off-duty, sleeper berth or on-duty not driving time or by a combination of off-duty, sleeper berth and on-duty not driving time.
395-8(a)(1)	Driver's Record of Duty Status. Except for a private motor carrier of passengers (nonbusiness), as defined in § 390.5 of this subchapter, a motor carrier subject to the requirements of this part must require each driver used by the motor carrier to record the driver's duty status for each 24-hour period using the method prescribed in paragraphs (a)(1)(i) through (iv) of this section, as applicable. See additional subparts.
395-8(e)(1)	Driver's Record of Duty Status. No driver or motor carrier may make a false report in connection with a duty status.

APPENDIX C

Appendix C provides vehicle-related violation descriptions for each of the locations considered for analysis.

Table C.1: Vehicle-Related Violation Descriptions at Ashland POE

Violation	Description
392-2	Applicable Operating Rules. Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
393-11	Lamps and Reflective Devices. (a): (1) ***Lamps and reflex reflectors***. Table 1 specifies the requirements for lamps, reflective devices and associated equipment by the type of commercial motor vehicle. The diagrams in this section illustrate the position of the lamps, reflective devices and associated equipment specified in Table 1. All commercial motor vehicles manufactured on or after December 25, 1968, must, at a minimum, meet the applicable requirements of 49 CFR 571.108 (FMVSS No. 108) in effect at the time of manufacture of the vehicle. Commercial motor vehicles manufactured before December 25, 1968, must, at a minimum, meet the requirements of subpart B of part 393 in effect at the time of manufacture. (2) ***Exceptions***: Pole trailers and trailer converter dollies must meet the part 393 requirements for lamps, reflective devices and electrical equipment in effect at the time of manufacture. Trailers which are equipped with conspicuity material which meets the requirements of § 393.11(b) are not required to be equipped with the reflex reflectors listed in Table 1 if—(i) The conspicuity material is placed at the locations where reflex reflectors are required by Table 1. (ii) The conspicuity material when installed on the motor vehicle meets the visibility requirements for the reflex reflector. (b) ***Conspicuity Systems***. Each trailer of 2,032 mm (80 inches) or more overall width, and with a GVWR over 4,536 kg (10,000 pounds), manufactured on or after December 1, 1993, except pole trailers and trailers designed exclusively for living or office use, shall be equipped with either retroreflective sheeting that meets the requirements of FMVSS No. 108 (S5.7.1), reflex reflectors that meet the requirements FMVSS No. 108 (S5.7.2), or a combination of retroreflective sheeting and reflex reflectors that meet the requirements of FMVSS No. 108 (S5.7.3). The conspicuity system shall be installed and located as specified in FMVSS No. 108 [S5.7.1.4 (for retroreflective sheeting), S5.7.2.2 (for reflex reflectors), S5.7.3 (for a combination of sheeting and reflectors)] and have certification and markings as required by S5.7.1.5 (for retroreflective tape) and S5.7.2.3 (for reflex reflectors). (c) ***Prohibition on the use of amber stop lamps and tail lamps***. No commercial motor vehicle may be equipped with an amber stop lamp, a tail lamp, or other lamp which is optically combined with an amber stop lamp or tail lamp.

Violation	Description
393-47	Brake Actuators, Slack Adjusters, Linings/Pads, and Drums/Rotors. (a) ***General requirements***. Brake components must be constructed, installed and maintained to prevent excessive fading and grabbing. The means of attachment and physical characteristics must provide for safe and reliable stopping of the commercial motor vehicle. (b) ***Brake chambers***. The service brake chambers and spring brake chambers on each end of an axle must be the same size. (c) ***Slack adjusters***. The effective length of the slack adjuster on each end of an axle must be the same. (d) ***Linings and pads***. The thickness of the brake linings or pads shall meet the applicable requirements of this paragraph—(1) ***Steering axle brakes***. The brake lining/pad thickness on the steering axle of a truck, truck-tractor or bus shall not be less than 4.8 mm (3⁄16 inch) at the shoe center for a shoe with a continuous strip of lining; less than 6.4 mm (1⁄4 inch) at the shoe center for a shoe with two pads; or worn to the wear indicator if the lining is so marked, for air drum brakes. The steering axle brake lining/pad thickness shall not be less than 3.2 mm (1⁄8 inch) for air disc brakes, or 1.6 mm (1⁄16 inch) or less for hydraulic disc, drum and electric brakes. (2) ***Non-steering axle brakes***. An air braked commercial motor vehicle shall not be operated with brake lining/pad thickness less than 6.4 mm (1⁄4 inch) or to the wear indicator if the lining is so marked (measured at the shoe center for drum brakes); or less than 3.2 mm (1⁄8 inch) for disc brakes. Hydraulic or electric braked commercial motor vehicles shall not be operated with a lining/pad thickness less than 1.6 mm (1⁄16 inch) (measured at the shoe center) for disc or drum brakes. (e) ***Clamp, Bendix DD-3, bolt-type, and rotochamber brake actuator readjustment limits***. (1) The pushrod stroke must not be greater than the values specified in the tables shown in CFR 393.47.
393-55	Antilock Brake Systems. (a) ***Hydraulic brake systems***. Each truck and bus manufactured on or after March 1, 1999 (except trucks and buses engaged in driveaway-towaway operations), and equipped with a hydraulic brake system, shall be equipped with an antilock brake system that meets the requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 105 (49 CFR 571.105, S5.5). (b) ***ABS malfunction indicators for hydraulic braked vehicles***. Each hydraulic braked vehicle subject to the requirements of paragraph (a) of this section shall be equipped with an ABS malfunction indicator system that meets the requirements of FMVSS No. 105 (49 CFR 571.105, S5.3). (c) ***Air brake systems***. (1) Each truck tractor manufactured on or after March 1, 1997 (except truck tractors engaged in driveaway-towaway operations), shall be equipped with an antilock brake system that meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.1(b)). (2) Each air braked commercial motor vehicle other than a truck tractor, manufactured on or after March 1, 1998 (except commercial motor vehicles engaged in driveaway-towaway operations), shall be equipped with an antilock brake system that meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.1(a) for trucks and buses, S5.2.3 for semitrailers, converter dollies and full trailers). (d) ***ABS malfunction circuits and signals for air braked vehicles***. (1) Each truck tractor manufactured on or after March 1, 1997, and each single-unit air braked vehicle manufactured on or after March 1, 1998, subject to the requirements of paragraph (c) of this section, shall be equipped with an electrical circuit that is capable of signaling a malfunction that affects the generation or transmission of response or control signals to the vehicle's

Violation	Description
	antilock brake system (49 CFR 571.121, S5.1.6.2(a)). (2) Each truck tractor manufactured on or after March 1, 2001, and each single-unit vehicle that is equipped to tow another air-braked vehicle, subject to the requirements of paragraph (c) of this section, shall be equipped with an electrical circuit that is capable of transmitting a malfunction signal from the antilock brake system(s) on the towed vehicle(s) to the trailer ABS malfunction lamp in the cab of the towing vehicle, and shall have the means for connection of the electrical circuit to the towed vehicle. The ABS malfunction circuit and signal shall meet the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.2(b)). (3) Each semitrailer, trailer converter dolly, and full trailer manufactured on or after March 1, 2001, and subject to the requirements of paragraph (c)(2) of this section, shall be equipped with an electrical circuit that is capable of signaling a malfunction in the trailer's antilock brake system, and shall have the means for connection of this ABS malfunction circuit to the towing vehicle. In addition, each trailer manufactured on or after March 1, 2001, subject to the requirements of paragraph (c)(2) of this section, that is designed to tow another air-brake equipped trailer shall be capable of transmitting a malfunction signal from the antilock brake system(s) of the trailer(s) it tows to the vehicle in front of the trailer. The ABS malfunction circuit and signal shall meet the requirements of FMVSS No. 121 (49 CFR 571.121, S5.2.3.2). (e) ***Exterior ABS malfunction indicator lamps for trailers***. Each trailer (including a trailer converter dolly) manufactured on or after March 1, 1998, and subject to the requirements of paragraph (c)(2) of this section, shall be equipped with an ABS malfunction indicator lamp which meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.2.3.3).
393-75	Tires. (a) No motor vehicle shall be operated on any tire that: (1) Has body ply or belt material exposed through the tread or sidewall. (2) Has any tread or sidewall separation. (3) Is flat or has an audible leak. (4) Has a cut to the extent that the ply or belt material is exposed. (b) Any tire on the front wheels of a bus, truck, or truck tractor shall have a tread groove pattern depth of at least 4⁄32 of an inch when measured at any point on a major tread groove. The measurements shall not be made where tie bars, humps, or fillets are located. (c) Except as provided in paragraph (b) of this section, tires shall have a tread groove pattern depth of at least 2⁄32 of an inch when measured in a major tread groove. The measurement shall not be made where tie bars, humps or fillets are located. (d) No bus shall be operated with regrooved, recapped or retreaded tires on the front wheels. (e) A regrooved tire with a load-carrying capacity equal to or greater than 2,232 kg (4,920 pounds) shall not be used on the front wheels of any truck or truck tractor. (f) No motor vehicle may be operated with speed-restricted tires labeled with a maximum speed of 55 mph or less in accordance with S6.5(e) of FMVSS No. 119 at speeds that exceed the rated limit of the tire. (g) Tire loading restrictions (except on manufactured homes). No motor vehicle (except manufactured homes, which are governed by paragraph (h) of this section) shall be operated with tires that carry a weight greater than that marked on the sidewall of the tire or, in the absence of such a marking, a weight greater than that specified for the tires in any of the publications of any of the organizations listed in Federal Motor Vehicle Safety Standard No. 119 (49 CFR 571.119, S5.1(b)) unless: (1) The vehicle is being operated under the terms of a special permit issued by the

Violation	Description
	State. (2) The vehicle is being operated at a reduced speed to compensate for the tire loading in excess of the manufacturer's rated capacity for the tire. In no case shall the speed exceed 80 km/hr (50 mph). (h)(1) Tire loading restrictions for manufactured homes built before January 1, 2002. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) before January 1, 2002, must not be transported on tires that are loaded more than 18 percent over the load rating marked on the sidewall of the tire or, in the absence of such a marking, more than 18 percent over the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). Manufactured homes labeled before January 1, 2002, transported on tires overloaded by 9 percent or more must not be operated at speeds exceeding 80 km/hr (50 mph). (h)(2) Tire loading restrictions for manufactured homes built on or after January 1, 2002. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) on or after January 1, 2002, must not be transported on tires loaded beyond the load rating marked on the sidewall of the tire or, in the absence of such a marking, the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). (i) Tire inflation pressure. (1) No motor vehicle shall be operated on a tire which has a cold inflation pressure less than that specified for the load being carried. (2) If the inflation pressure of the tire has been increased by heat because of the recent operation of the vehicle, the cold inflation pressure shall be estimated by subtracting the inflation buildup factor shown in Table 1 from the measured inflation pressure.
393-9(a)	Lamps Operable, Prohibition of Obstructions of Lamps and Reflectors. (a) All lamps required by this subpart shall be capable of being operated at all times. This paragraph shall not be construed to require that any auxiliary or additional lamp be capable of operating at all times.
396-3(a)(1)	Inspection, Repair, and Maintenance. (a) ***General***. Every motor carrier and intermodal equipment provider must systematically inspect, repair, and maintain, or cause to be systematically inspected, repaired, and maintained, all motor vehicles and intermodal equipment subject to its control. (1) Parts and accessories shall be in safe and proper operating condition at all times. These include those specified in part 393 of this subchapter and any additional parts and accessories which may affect safety of operation, including but not limited to, frame and frame assemblies, suspension systems, axles and attaching parts, wheels and rims, and steering systems.

Table C.2: Vehicle-Related Violation Descriptions at Woodburn POE

Violation	Description
392-2	Applicable Operating Rules. Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
393-45	Brake Tubing and Hoses; Hose Assemblies and End Fittings. (a) ***General construction requirements for tubing and hoses, assemblies, and end fittings***. All brake tubing and hoses, brake hose assemblies, and brake hose end fittings must meet the applicable requirements of FMVSS No. 106 (49 CFR 571.106). (b) ***Brake tubing and hose installation***. Brake tubing and hose must: (1) Be long and flexible enough to accommodate without damage all normal motions of the parts to which it is attached. (2) Be secured against chaffing, kinking, or other mechanical damage. (3) Be installed in a manner that prevents it from contacting the vehicle's exhaust system or any other source of high temperatures. (c) ***Nonmetallic brake tubing***. Coiled nonmetallic brake tubing may be used for connections between towed and towing motor vehicles or between the frame of a towed vehicle and the unsprung subframe of an adjustable axle of the motor vehicle if: (1) The coiled tubing has a straight segment (pigtail) at each end that is at least 51 mm (2 inches) in length and is encased in a spring guard or similar device which prevents the tubing from kinking at the fitting at which it is attached to the vehicle. (2) The spring guard or similar device has at least 51 mm (2 inches) of closed coils or similar surface at its interface with the fitting and extends at least 38 mm (1 1⁄2 inches) into the coiled segment of the tubing from its straight segment. (d) ***Brake tubing and hose connections***. All connections for air, vacuum, or hydraulic braking systems shall be installed so as to ensure an attachment free of leaks, constrictions or other conditions which would adversely affect the performance of the brake system.
393-47	Brake Actuators, Slack Adjusters, Linings/Pads, and Drums/Rotors. (a) ***General requirements***. Brake components must be constructed, installed and maintained to prevent excessive fading and grabbing. The means of attachment and physical characteristics must provide for safe and reliable stopping of the commercial motor vehicle. (b) ***Brake chambers***. The service brake chambers and spring brake chambers on each end of an axle must be the same size. (c) ***Slack adjusters***. The effective length of the slack adjuster on each end of an axle must be the same. (d) ***Linings and pads***. The thickness of the brake linings or pads shall meet the applicable requirements of this paragraph—(1) ***Steering axle brakes***. The brake lining/pad thickness on the steering axle of a truck, truck-tractor or bus shall not be less than 4.8 mm (3⁄16 inch) at the shoe center for a shoe with a continuous strip of lining; less than 6.4 mm (1⁄4 inch) at the shoe center for a shoe with two pads; or worn to the wear indicator if the lining is so marked, for air drum brakes. The steering axle brake lining/pad thickness shall not be less than 3.2 mm (1⁄8 inch) for air disc brakes, or 1.6 mm (1⁄16 inch) or less for hydraulic disc, drum and electric brakes. (2) ***Non-steering axle brakes***. An air braked commercial motor vehicle shall not be operated with brake lining/pad thickness less than 6.4 mm (1⁄4 inch) or to the wear indicator if the

Violation	Description
	lining is so marked (measured at the shoe center for drum brakes); or less than 3.2 mm (1⁄8 inch) for disc brakes. Hydraulic or electric braked commercial motor vehicles shall not be operated with a lining/pad thickness less than 1.6 mm (1⁄16 inch) (measured at the shoe center) for disc or drum brakes. (e) ***Clamp, Bendix DD-3, bolt-type, and rotochamber brake actuator readjustment limits***. (1) The pushrod stroke must not be greater than the values specified in the tables shown in CFR 393.47.
393-53(b)	Automatic Brake Adjusters and Brake Adjustment Indicators. (b) ***Automatic brake adjusters (air brake systems)***. Each commercial motor vehicle manufactured on or after October 20, 1994, and equipped with an air brake system must meet the automatic brake adjustment system requirements of Federal Motor Vehicle Safety Standard No. 121 (49 CFR 571.121, S5.1.8 or S5.2.2) applicable to the vehicle at the time it was manufactured.
393-55	Antilock Brake Systems. (a) ***Hydraulic brake systems***. Each truck and bus manufactured on or after March 1, 1999 (except trucks and buses engaged in driveaway-towaway operations), and equipped with a hydraulic brake system, shall be equipped with an antilock brake system that meets the requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 105 (49 CFR 571.105, S5.5). (b) ***ABS malfunction indicators for hydraulic braked vehicles***. Each hydraulic braked vehicle subject to the requirements of paragraph (a) of this section shall be equipped with an ABS malfunction indicator system that meets the requirements of FMVSS No. 105 (49 CFR 571.105, S5.3). (c) ***Air brake systems***. (1) Each truck tractor manufactured on or after March 1, 1997 (except truck tractors engaged in driveaway-towaway operations), shall be equipped with an antilock brake system that meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.1(b)). (2) Each air braked commercial motor vehicle other than a truck tractor, manufactured on or after March 1, 1998 (except commercial motor vehicles engaged in driveaway-towaway operations), shall be equipped with an antilock brake system that meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.1(a) for trucks and buses, S5.2.3 for semitrailers, converter dollies and full trailers). (d) ***ABS malfunction circuits and signals for air braked vehicles***. (1) Each truck tractor manufactured on or after March 1, 1997, and each single-unit air braked vehicle manufactured on or after March 1, 1998, subject to the requirements of paragraph (c) of this section, shall be equipped with an electrical circuit that is capable of signaling a malfunction that affects the generation or transmission of response or control signals to the vehicle's antilock brake system (49 CFR 571.121, S5.1.6.2(a)). (2) Each truck tractor manufactured on or after March 1, 2001, and each single-unit vehicle that is equipped to tow another air-braked vehicle, subject to the requirements of paragraph (c) of this section, shall be equipped with an electrical circuit that is capable of transmitting a malfunction signal from the antilock brake system(s) on the towed vehicle(s) to the trailer ABS malfunction lamp in the cab of the towing vehicle, and shall have the means for connection of the electrical circuit to the towed vehicle. The ABS malfunction circuit and signal shall meet the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.2(b)). (3) Each semitrailer, trailer converter dolly, and full trailer manufactured on or after March 1, 2001, and subject to the requirements of paragraph (c)(2) of this section, shall be equipped with an electrical circuit that is

Violation	Description
	capable of signaling a malfunction in the trailer's antilock brake system, and shall have the means for connection of this ABS malfunction circuit to the towing vehicle. In addition, each trailer manufactured on or after March 1, 2001, subject to the requirements of paragraph (c)(2) of this section, that is designed to tow another air-brake equipped trailer shall be capable of transmitting a malfunction signal from the antilock brake system(s) of the trailer(s) it tows to the vehicle in front of the trailer. The ABS malfunction circuit and signal shall meet the requirements of FMVSS No. 121 (49 CFR 571.121, S5.2.3.2). (e) ***Exterior ABS malfunction indicator lamps for trailers***. Each trailer (including a trailer converter dolly) manufactured on or after March 1, 1998, and subject to the requirements of paragraph (c)(2) of this section, shall be equipped with an ABS malfunction indicator lamp which meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.2.3.3).
393-75	Tires. (a) No motor vehicle shall be operated on any tire that: (1) Has body ply or belt material exposed through the tread or sidewall. (2) Has any tread or sidewall separation. (3) Is flat or has an audible leak. (4) Has a cut to the extent that the ply or belt material is exposed. (b) Any tire on the front wheels of a bus, truck, or truck tractor shall have a tread groove pattern depth of at least 4⁄32 of an inch when measured at any point on a major tread groove. The measurements shall not be made where tie bars, humps, or fillets are located. (c) Except as provided in paragraph (b) of this section, tires shall have a tread groove pattern depth of at least 2⁄32 of an inch when measured in a major tread groove. The measurement shall not be made where tie bars, humps or fillets are located. (d) No bus shall be operated with regrooved, recapped or retreaded tires on the front wheels. (e) A regrooved tire with a load-carrying capacity equal to or greater than 2,232 kg (4,920 pounds) shall not be used on the front wheels of any truck or truck tractor. (f) No motor vehicle may be operated with speed-restricted tires labeled with a maximum speed of 55 mph or less in accordance with S6.5(e) of FMVSS No. 119 at speeds that exceed the rated limit of the tire. (g) Tire loading restrictions (except on manufactured homes). No motor vehicle (except manufactured homes, which are governed by paragraph (h) of this section) shall be operated with tires that carry a weight greater than that marked on the sidewall of the tire or, in the absence of such a marking, a weight greater than that specified for the tires in any of the publications of any of the organizations listed in Federal Motor Vehicle Safety Standard No. 119 (49 CFR 571.119, S5.1(b)) unless: (1) The vehicle is being operated under the terms of a special permit issued by the State. (2) The vehicle is being operated at a reduced speed to compensate for the tire loading in excess of the manufacturer's rated capacity for the tire. In no case shall the speed exceed 80 km/hr (50 mph). (h)(1) Tire loading restrictions for manufactured homes built before January 1, 2002. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) before January 1, 2002, must not be transported on tires that are loaded more than 18 percent over the load rating marked on the sidewall of the tire or, in the absence of such a marking, more than 18 percent over the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). Manufactured homes labeled before January 1, 2002, transported on tires overloaded by 9 percent or more must not be operated at speeds exceeding 80 km/hr (50 mph). (h)(2) Tire loading restrictions for manufactured

Violation	Description
	homes built on or after January 1, 2002. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) on or after January 1, 2002, must not be transported on tires loaded beyond the load rating marked on the sidewall of the tire or, in the absence of such a marking, the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). (i) Tire inflation pressure. (1) No motor vehicle shall be operated on a tire which has a cold inflation pressure less than that specified for the load being carried. (2) If the inflation pressure of the tire has been increased by heat because of the recent operation of the vehicle, the cold inflation pressure shall be estimated by subtracting the inflation buildup factor shown in Table 1 from the measured inflation pressure.
393-9(a)	Lamps Operable, Prohibition of Obstructions of Lamps and Reflectors. (a) All lamps required by this subpart shall be capable of being operated at all times. This paragraph shall not be construed to require that any auxiliary or additional lamp be capable of operating at all times.
396-3(a)(1)	Inspection, Repair, and Maintenance. (a) ***General***. Every motor carrier and intermodal equipment provider must systematically inspect, repair, and maintain, or cause to be systematically inspected, repaired, and maintained, all motor vehicles and intermodal equipment subject to its control. (1) Parts and accessories shall be in safe and proper operating condition at all times. These include those specified in part 393 of this subchapter and any additional parts and accessories which may affect safety of operation, including but not limited to, frame and frame assemblies, suspension systems, axles and attaching parts, wheels and rims, and steering systems.

Table C.3: Vehicle-Related Violation Descriptions at Farewell Bend POE

Violation	Description
392-2	Applicable Operating Rules. Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
393-205	Wheels. (a) Wheels and rims shall not be cracked or broken. (b) Stud or bolt holes on the wheels shall not be elongated (out of round). (c) Nuts or bolts shall not be missing or loose.
393-207	Suspension Systems. (a) ***Axles***. No axle positioning part shall be cracked, broken, loose or missing. All axles must be in proper alignment. (b) ***Adjustable axles***. Adjustable axle assemblies shall not have locking pins missing or disengaged. (c) ***Leaf springs***. No leaf spring shall be cracked, broken, or missing nor shifted out of position. (d) ***Coil springs***. No coil spring shall be cracked or broken. (e) ***Torsion bar***. No torsion bar or torsion bar suspension shall be cracked or broken. (f) ***Air suspensions***. The air pressure regulator valve shall not allow air into the suspension system until at least 55 psi is in the braking system. The vehicle shall be level (not tilting to the left or right). Air leakage shall not be greater than 3 psi in a 5-minute time period when the vehicle's air pressure gauge shows normal operating pressure. (g) Air suspension exhaust controls. The air suspension exhaust controls must not have the capability to exhaust air from the suspension system of one axle of a two-axle air suspension trailer unless the controls are either located on the trailer, or the power unit and trailer combination are not capable of traveling at a speed greater than 10 miles per hour while the air is exhausted from the suspension system. This paragraph shall not be construed to prohibit: (1) Devices that could exhaust air from both axle systems simultaneously. (2) Lift axles on multi-axle units.
393-47	Brake Actuators, Slack Adjusters, Linings/Pads, and Drums/Rotors. (a) ***General requirements***. Brake components must be constructed, installed and maintained to prevent excessive fading and grabbing. The means of attachment and physical characteristics must provide for safe and reliable stopping of the commercial motor vehicle. (b) ***Brake chambers***. The service brake chambers and spring brake chambers on each end of an axle must be the same size. (c) ***Slack adjusters***. The effective length of the slack adjuster on each end of an axle must be the same. (d) ***Linings and pads***. The thickness of the brake linings or pads shall meet the applicable requirements of this paragraph—(1) ***Steering axle brakes***. The brake lining/pad thickness on the steering axle of a truck, truck-tractor or bus shall not be less than 4.8 mm (3⁄16 inch) at the shoe center for a shoe with a continuous strip of lining; less than 6.4 mm (1⁄4 inch) at the shoe center for a shoe with two pads; or worn to the wear indicator if the lining is so marked, for air drum brakes. The steering axle brake lining/pad thickness shall not be less than 3.2 mm (1⁄8 inch) for air disc brakes, or 1.6 mm (1⁄16 inch) or less for hydraulic disc, drum and electric brakes. (2) ***Non-steering axle brakes***. An air braked commercial motor vehicle shall not be operated with brake lining/pad thickness less than 6.4 mm (1⁄4 inch) or to the wear indicator if the lining is so marked (measured at the shoe center for drum brakes); or less than 3.2

Violation	Description
	mm (1⁄8 inch) for disc brakes. Hydraulic or electric braked commercial motor vehicles shall not be operated with a lining/pad thickness less than 1.6 mm (1⁄16 inch) (measured at the shoe center) for disc or drum brakes. (e) ***Clamp, Bendix DD-3, bolt-type, and rotochamber brake actuator readjustment limits***. (1) The pushrod stroke must not be greater than the values specified in the tables shown in CFR 393.47.
393-75	Tires. (a) No motor vehicle shall be operated on any tire that: (1) Has body ply or belt material exposed through the tread or sidewall. (2) Has any tread or sidewall separation. (3) Is flat or has an audible leak. (4) Has a cut to the extent that the ply or belt material is exposed. (b) Any tire on the front wheels of a bus, truck, or truck tractor shall have a tread groove pattern depth of at least 4⁄32 of an inch when measured at any point on a major tread groove. The measurements shall not be made where tie bars, humps, or fillets are located. (c) Except as provided in paragraph (b) of this section, tires shall have a tread groove pattern depth of at least 2⁄32 of an inch when measured in a major tread groove. The measurement shall not be made where tie bars, humps or fillets are located. (d) No bus shall be operated with regrooved, recapped or retreaded tires on the front wheels. (e) A regrooved tire with a load-carrying capacity equal to or greater than 2,232 kg (4,920 pounds) shall not be used on the front wheels of any truck or truck tractor. (f) No motor vehicle may be operated with speed-restricted tires labeled with a maximum speed of 55 mph or less in accordance with S6.5(e) of FMVSS No. 119 at speeds that exceed the rated limit of the tire. (g) ***Tire loading restrictions (except on manufactured homes)***. No motor vehicle (except manufactured homes, which are governed by paragraph (h) of this section) shall be operated with tires that carry a weight greater than that marked on the sidewall of the tire or, in the absence of such a marking, a weight greater than that specified for the tires in any of the publications of any of the organizations listed in Federal Motor Vehicle Safety Standard No. 119 (49 CFR 571.119, S5.1(b)) unless: (1) The vehicle is being operated under the terms of a special permit issued by the State. (2) The vehicle is being operated at a reduced speed to compensate for the tire loading in excess of the manufacturer's rated capacity for the tire. In no case shall the speed exceed 80 km/hr (50 mph). (h)(1) ***Tire loading restrictions for manufactured homes built before January 1, 2002***. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) before January 1, 2002, must not be transported on tires that are loaded more than 18 percent over the load rating marked on the sidewall of the tire or, in the absence of such a marking, more than 18 percent over the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). Manufactured homes labeled before January 1, 2002, transported on tires overloaded by 9 percent or more must not be operated at speeds exceeding 80 km/hr (50 mph). (h)(2) ***Tire loading restrictions for manufactured homes built on or after January 1, 2002***. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) on or after January 1, 2002, must not be transported on tires loaded beyond the load rating marked on the sidewall of the tire or, in the absence of such a marking, the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). (i) ***Tire inflation pressure***. (1) No motor vehicle shall be operated on a tire which has a cold inflation pressure less than that specified for the load being carried.

Violation	Description
	(2) If the inflation pressure of the tire has been increased by heat because of the recent operation of the vehicle, the cold inflation pressure shall be estimated by subtracting the inflation buildup factor shown in Table 1 from the measured inflation pressure.
393-9(a)	Lamps Operable, Prohibition of Obstructions of Lamps and Reflectors. (a) All lamps required by this subpart shall be capable of being operated at all times. This paragraph shall not be construed to require that any auxiliary or additional lamp be capable of operating at all times.
396-3(a)(1)	Inspection, Repair, and Maintenance. (a) ***General***. Every motor carrier and intermodal equipment provider must systematically inspect, repair, and maintain, or cause to be systematically inspected, repaired, and maintained, all motor vehicles and intermodal equipment subject to its control. (1) Parts and accessories shall be in safe and proper operating condition at all times. These include those specified in part 393 of this subchapter and any additional parts and accessories which may affect safety of operation, including but not limited to, frame and frame assemblies, suspension systems, axles and attaching parts, wheels and rims, and steering systems.

Table C.4: Vehicle-Related Violation Descriptions at Cascade Locks POE

Violation	Description
392-2	Applicable Operating Rules. Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
393-100	Which types of commercial motor vehicles are subject to the cargo securement standards of this subpart, and what general requirements apply? (a) ***Applicability***. The rules in this subpart are applicable to trucks, truck tractors, semitrailers, full trailers, and pole trailers. (b) ***Prevention against loss of load***. Each commercial motor vehicle must, when transporting cargo on public roads, be loaded and equipped, and the cargo secured, in accordance with this subpart to prevent the cargo from leaking, spilling, blowing or falling from the motor vehicle. (c) ***Prevention against shifting of load***. Cargo must be contained, immobilized or secured in accordance with this subpart to prevent shifting upon or within the vehicle to such an extent that the vehicle's stability or maneuverability is adversely affected.
393-45	Brake Tubing and Hoses; Hose Assemblies and End Fittings. (a) ***General construction requirements for tubing and hoses, assemblies, and end fittings***. All brake tubing and hoses, brake hose assemblies, and brake hose end fittings must meet the applicable requirements of FMVSS No. 106 (49 CFR 571.106). (b) ***Brake tubing and hose installation***. Brake tubing and hose must: (1) Be long and flexible enough to accommodate without damage all normal motions of the parts to which it is attached. (2) Be secured against chaffing, kinking, or other mechanical damage. (3) Be installed in a manner that prevents it from contacting the vehicle's exhaust system or any other source of high temperatures. (c) ***Nonmetallic brake tubing***. Coiled nonmetallic brake tubing may be used for connections between towed and towing motor vehicles or between the frame of a towed vehicle and the unsprung subframe of an adjustable axle of the motor vehicle if: (1) The coiled tubing has a straight segment (pigtail) at each end that is at least 51 mm (2 inches) in length and is encased in a spring guard or similar device which prevents the tubing from kinking at the fitting at which it is attached to the vehicle. (2) The spring guard or similar device has at least 51 mm (2 inches) of closed coils or similar surface at its interface with the fitting and extends at least 38 mm (11⁄2 inches) into the coiled segment of the tubing from its straight segment. (d) ***Brake tubing and hose connections***. All connections for air, vacuum, or hydraulic braking systems shall be installed so as to ensure an attachment free of leaks, constrictions or other conditions which would adversely affect the performance of the brake system.
393-47	Brake Actuators, Slack Adjusters, Linings/Pads, and Drums/Rotors. (a) ***General requirements***. Brake components must be constructed, installed and maintained to prevent excessive fading and grabbing. The means of attachment and physical characteristics must provide for safe and reliable stopping of the commercial motor vehicle. (b) ***Brake chambers***. The service brake chambers and spring brake chambers on each end of an axle must be the same size. (c) ***Slack adjusters***. The effective length of the slack adjuster on each end of an axle must be the same. (d) ***Linings and***

Violation	Description
	pads. The thickness of the brake linings or pads shall meet the applicable requirements of this paragraph—(1) ***Steering axle brakes***. The brake lining/pad thickness on the steering axle of a truck, truck-tractor or bus shall not be less than 4.8 mm (3⁄16 inch) at the shoe center for a shoe with a continuous strip of lining; less than 6.4 mm (1⁄4 inch) at the shoe center for a shoe with two pads; or worn to the wear indicator if the lining is so marked, for air drum brakes. The steering axle brake lining/pad thickness shall not be less than 3.2 mm (1⁄8 inch) for air disc brakes, or 1.6 mm (1⁄16 inch) or less for hydraulic disc, drum and electric brakes. (2) ***Non-steering axle brakes***. An air braked commercial motor vehicle shall not be operated with brake lining/pad thickness less than 6.4 mm (1⁄4 inch) or to the wear indicator if the lining is so marked (measured at the shoe center for drum brakes); or less than 3.2 mm (1⁄8 inch) for disc brakes. Hydraulic or electric braked commercial motor vehicles shall not be operated with a lining/pad thickness less than 1.6 mm (1⁄16 inch) (measured at the shoe center) for disc or drum brakes. (e) ***Clamp, Bendix DD-3, bolt-type, and rotochamber brake actuator readjustment limits***. (1) The pushrod stroke must not be greater than the values specified in the tables shown in CFR 393.47.
393-53(b)	Automatic Brake Adjusters and Brake Adjustment Indicators. (b) ***Automatic brake adjusters (air brake systems)***. Each commercial motor vehicle manufactured on or after October 20, 1994, and equipped with an air brake system must meet the automatic brake adjustment system requirements of Federal Motor Vehicle Safety Standard No. 121 (49 CFR 571.121, S5.1.8 or S5.2.2) applicable to the vehicle at the time it was manufactured.
393-75	Tires. (a) No motor vehicle shall be operated on any tire that: (1) Has body ply or belt material exposed through the tread or sidewall. (2) Has any tread or sidewall separation. (3) Is flat or has an audible leak. (4) Has a cut to the extent that the ply or belt material is exposed. (b) Any tire on the front wheels of a bus, truck, or truck tractor shall have a tread groove pattern depth of at least 4⁄32 of an inch when measured at any point on a major tread groove. The measurements shall not be made where tie bars, humps, or fillets are located. (c) Except as provided in paragraph (b) of this section, tires shall have a tread groove pattern depth of at least 2⁄32 of an inch when measured in a major tread groove. The measurement shall not be made where tie bars, humps or fillets are located. (d) No bus shall be operated with regrooved, recapped or retreaded tires on the front wheels. (e) A regrooved tire with a load-carrying capacity equal to or greater than 2,232 kg (4,920 pounds) shall not be used on the front wheels of any truck or truck tractor. (f) No motor vehicle may be operated with speed-restricted tires labeled with a maximum speed of 55 mph or less in accordance with S6.5(e) of FMVSS No. 119 at speeds that exceed the rated limit of the tire. (g) ***Tire loading restrictions (except on manufactured homes)***. No motor vehicle (except manufactured homes, which are governed by paragraph (h) of this section) shall be operated with tires that carry a weight greater than that marked on the sidewall of the tire or, in the absence of such a marking, a weight greater than that specified for the tires in any of the publications of any of the organizations listed in Federal Motor Vehicle Safety Standard No. 119 (49 CFR 571.119, S5.1(b)) unless: (1) The vehicle is being operated under the terms of a special permit issued by the State. (2) The vehicle is being operated at a reduced speed to compensate for the tire

Violation	Description
	loading in excess of the manufacturer's rated capacity for the tire. In no case shall the speed exceed 80 km/hr (50 mph). (h)(1) ***Tire loading restrictions for manufactured homes built before January 1, 2002***. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) before January 1, 2002, must not be transported on tires that are loaded more than 18 percent over the load rating marked on the sidewall of the tire or, in the absence of such a marking, more than 18 percent over the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). Manufactured homes labeled before January 1, 2002, transported on tires overloaded by 9 percent or more must not be operated at speeds exceeding 80 km/hr (50 mph). (h)(2) ***Tire loading restrictions for manufactured homes built on or after January 1, 2002***. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) on or after January 1, 2002, must not be transported on tires loaded beyond the load rating marked on the sidewall of the tire or, in the absence of such a marking, the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). (i) ***Tire inflation pressure***. (1) No motor vehicle shall be operated on a tire which has a cold inflation pressure less than that specified for the load being carried. (2) If the inflation pressure of the tire has been increased by heat because of the recent operation of the vehicle, the cold inflation pressure shall be estimated by subtracting the inflation buildup factor shown in Table 1 from the measured inflation pressure.
393-9(a)	Lamps Operable, Prohibition of Obstructions of Lamps and Reflectors. (a) All lamps required by this subpart shall be capable of being operated at all times. This paragraph shall not be construed to require that any auxiliary or additional lamp be capable of operating at all times.
396-3(a)(1)	Inspection, Repair, and Maintenance. (a) ***General***. Every motor carrier and intermodal equipment provider must systematically inspect, repair, and maintain, or cause to be systematically inspected, repaired, and maintained, all motor vehicles and intermodal equipment subject to its control. (1) Parts and accessories shall be in safe and proper operating condition at all times. These include those specified in part 393 of this subchapter and any additional parts and accessories which may affect safety of operation, including but not limited to, frame and frame assemblies, suspension systems, axles and attaching parts, wheels and rims, and steering systems.

Table C.5: Vehicle-Related Violation Descriptions at Wyeth

Violation	Description
392-2	Applicable Operating Rules. Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
393-205	Wheels. (a) Wheels and rims shall not be cracked or broken. (b) Stud or bolt holes on the wheels shall not be elongated (out of round). (c) Nuts or bolts shall not be missing or loose.
393-207	Suspension Systems. (a) ***Axles***. No axle positioning part shall be cracked, broken, loose or missing. All axles must be in proper alignment. (b) ***Adjustable axles***. Adjustable axle assemblies shall not have locking pins missing or disengaged. (c) ***Leaf springs***. No leaf spring shall be cracked, broken, or missing nor shifted out of position. (d) ***Coil springs***. No coil spring shall be cracked or broken. (e) ***Torsion bar***. No torsion bar or torsion bar suspension shall be cracked or broken. (f) ***Air suspensions***. The air pressure regulator valve shall not allow air into the suspension system until at least 55 psi is in the braking system. The vehicle shall be level (not tilting to the left or right). Air leakage shall not be greater than 3 psi in a 5-minute time period when the vehicle's air pressure gauge shows normal operating pressure. (g) Air suspension exhaust controls. The air suspension exhaust controls must not have the capability to exhaust air from the suspension system of one axle of a two-axle air suspension trailer unless the controls are either located on the trailer, or the power unit and trailer combination are not capable of traveling at a speed greater than 10 miles per hour while the air is exhausted from the suspension system. This paragraph shall not be construed to prohibit: (1) Devices that could exhaust air from both axle systems simultaneously. (2) Lift axles on multi-axle units.
393-75	Tires. (a) No motor vehicle shall be operated on any tire that: (1) Has body ply or belt material exposed through the tread or sidewall. (2) Has any tread or sidewall separation. (3) Is flat or has an audible leak. (4) Has a cut to the extent that the ply or belt material is exposed. (b) Any tire on the front wheels of a bus, truck, or truck tractor shall have a tread groove pattern depth of at least 4⁄32 of an inch when measured at any point on a major tread groove. The measurements shall not be made where tie bars, humps, or fillets are located. (c) Except as provided in paragraph (b) of this section, tires shall have a tread groove pattern depth of at least 2⁄32 of an inch when measured in a major tread groove. The measurement shall not be made where tie bars, humps or fillets are located. (d) No bus shall be operated with regrooved, recapped or retreaded tires on the front wheels. (e) A regrooved tire with a load-carrying capacity equal to or greater than 2,232 kg (4,920 pounds) shall not be used on the front wheels of any truck or truck tractor. (f) No motor vehicle may be operated with speed-restricted tires labeled with a maximum speed of 55 mph or less in accordance with S6.5(e) of FMVSS No. 119 at speeds that exceed the rated limit of the tire. (g) ***Tire loading restrictions (except on manufactured homes)***. No motor vehicle (except manufactured homes, which are governed by paragraph (h) of this section) shall be operated with tires that carry a weight greater than that marked on

Violation	Description
	the sidewall of the tire or, in the absence of such a marking, a weight greater than that specified for the tires in any of the publications of any of the organizations listed in Federal Motor Vehicle Safety Standard No. 119 (49 CFR 571.119, S5.1(b)) unless: (1) The vehicle is being operated under the terms of a special permit issued by the State. (2) The vehicle is being operated at a reduced speed to compensate for the tire loading in excess of the manufacturer's rated capacity for the tire. In no case shall the speed exceed 80 km/hr (50 mph). (h)(1) ***Tire loading restrictions for manufactured homes built before January 1, 2002***. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) before January 1, 2002, must not be transported on tires that are loaded more than 18 percent over the load rating marked on the sidewall of the tire or, in the absence of such a marking, more than 18 percent over the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). Manufactured homes labeled before January 1, 2002, transported on tires overloaded by 9 percent or more must not be operated at speeds exceeding 80 km/hr (50 mph). (h)(2) ***Tire loading restrictions for manufactured homes built on or after January 1, 2002***. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) on or after January 1, 2002, must not be transported on tires loaded beyond the load rating marked on the sidewall of the tire or, in the absence of such a marking, the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). (i) ***Tire inflation pressure***. (1) No motor vehicle shall be operated on a tire which has a cold inflation pressure less than that specified for the load being carried. (2) If the inflation pressure of the tire has been increased by heat because of the recent operation of the vehicle, the cold inflation pressure shall be estimated by subtracting the inflation buildup factor shown in Table 1 from the measured inflation pressure.
393-9(a)	Lamps Operable, Prohibition of Obstructions of Lamps and Reflectors. (a) All lamps required by this subpart shall be capable of being operated at all times. This paragraph shall not be construed to require that any auxiliary or additional lamp be capable of operating at all times.
393-95(a)	Emergency Equipment on all Power Units. (a) ***Fire extinguishers***: (1) Minimum ratings. (i) A power unit that is used to transport hazardous materials in a quantity that requires placarding (See § 177.823 of this title) must be equipped with a fire extinguisher having an Underwriters' Laboratories rating of 10 B:C or more. (ii) A power unit that is not used to transport hazardous materials must be equipped with either: (A) A fire extinguisher having an Underwriters' Laboratories rating of 5 B:C or more. (B) Two fire extinguishers, each of which has an Underwriters' Laboratories rating of 4 B:C or more. (2) ***Labeling and marking***. Each fire extinguisher required by this section must be labeled or marked by the manufacturer with its Underwriters' Laboratories rating. (3) ***Visual Indicators***. The fire extinguisher must be designed, constructed, and maintained to permit visual determination of whether it is fully charged. (4) ***Condition, location, and mounting***. The fire extinguisher(s) must be filled and located so that it is readily accessible for use. The extinguisher(s) must be securely mounted to prevent sliding, rolling, or vertical movement relative to the motor vehicle. (5) ***Extinguishing agents***. The fire extinguisher must use an extinguishing agent that does not need protection from freezing. Extinguishing agents

Violation	Description
	must comply with the toxicity provisions of the Environmental Protection Agency's Significant New Alternatives Policy (SNAP) regulations under 40 CFR Part 82, Subpart G. (6) ***Exception***. This paragraph (a) does not apply to the driven unit in a driveaway-towaway operation.

Table C.6: Vehicle-Related Violation Descriptions at Umatilla POE

Violation	Description
392-2	Applicable Operating Rules. Every commercial motor vehicle must be operated in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated. However, if a regulation of the Federal Motor Carrier Safety Administration imposes a higher standard of care than that law, ordinance or regulation, the Federal Motor Carrier Safety Administration regulation must be complied with.
393-130	What are the rules for securing heavy vehicles, equipment and machinery? (a) ***Applicability***. The rules in this section apply to the transportation of heavy vehicles, equipment and machinery which operate on wheels or tracks, such as front end loaders, bulldozers, tractors, and power shovels and which individually weigh 4,536 kg (10,000 lb.) or more. Vehicles, equipment and machinery which is lighter than 4,536 kg (10,000 lb.) may also be secured in accordance with the provisions of this section, with § 393.128, or in accordance with the provisions of §§ 393.100 through 393.114. (b) ***Preparation of equipment being transported***. (1) Accessory equipment, such as hydraulic shovels, must be completely lowered and secured to the vehicle. (2) Articulated vehicles shall be restrained in a manner that prevents articulation while in transit. (c) ***Securement of heavy vehicles, equipment or machinery with crawler tracks or wheels***. (1) In addition to the requirements of paragraph (b) of this section, heavy equipment or machinery with crawler tracks or wheels must be restrained against movement in the lateral, forward, rearward, and vertical direction using a minimum of four tiedowns. (2) Each of the tiedowns must be affixed as close as practicable to the front and rear of the vehicle, or mounting points on the vehicle that have been specifically designed for that purpose.
393-47	Brake Actuators, Slack Adjusters, Linings/Pads, and Drums/Rotors. (a) ***General requirements***. Brake components must be constructed, installed and maintained to prevent excessive fading and grabbing. The means of attachment and physical characteristics must provide for safe and reliable stopping of the commercial motor vehicle. (b) ***Brake chambers***. The service brake chambers and spring brake chambers on each end of an axle must be the same size. (c) ***Slack adjusters***. The effective length of the slack adjuster on each end of an axle must be the same. (d) ***Linings and pads***. The thickness of the brake linings or pads shall meet the applicable requirements of this paragraph—(1) ***Steering axle brakes***. The brake lining/pad thickness on the steering axle of a truck, truck-tractor or bus shall not be less than 4.8 mm (3⁄16 inch) at the shoe center for a shoe with a continuous strip of lining; less than 6.4 mm (1⁄4 inch) at the shoe center for a shoe with two pads; or worn to the wear indicator if the lining is so marked, for air drum brakes. The steering axle brake lining/pad thickness shall not be less than 3.2 mm (1⁄8 inch) for air disc brakes, or 1.6 mm (1⁄16 inch) or less for hydraulic disc, drum and electric brakes. (2) ***Non-steering axle brakes***. An air braked commercial motor vehicle shall not be operated with brake lining/pad thickness less than 6.4 mm (1⁄4 inch) or to the wear indicator if the lining is so marked (measured at the shoe center for drum brakes); or less than 3.2 mm (1⁄8 inch) for disc brakes. Hydraulic or electric braked commercial motor vehicles shall not be operated with a lining/pad thickness less than 1.6 mm (1⁄16 inch) (measured at the shoe center) for disc or drum brakes. (e) ***Clamp, Bendix DD-3, bolt-***

Violation	Description
	type, and rotochamber brake actuator readjustment limits. (1) The pushrod stroke must not be greater than the values specified in the tables shown in CFR 393.47.
393-53(b)	Automatic Brake Adjusters and Brake Adjustment Indicators. (b) ***Automatic brake adjusters (air brake systems)***. Each commercial motor vehicle manufactured on or after October 20, 1994, and equipped with an air brake system must meet the automatic brake adjustment system requirements of Federal Motor Vehicle Safety Standard No. 121 (49 CFR 571.121, S5.1.8 or S5.2.2) applicable to the vehicle at the time it was manufactured.
393-55	Antilock Brake Systems. (a) ***Hydraulic brake systems***. Each truck and bus manufactured on or after March 1, 1999 (except trucks and buses engaged in driveaway-towaway operations), and equipped with a hydraulic brake system, shall be equipped with an antilock brake system that meets the requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 105 (49 CFR 571.105, S5.5). (b) ***ABS malfunction indicators for hydraulic braked vehicles***. Each hydraulic braked vehicle subject to the requirements of paragraph (a) of this section shall be equipped with an ABS malfunction indicator system that meets the requirements of FMVSS No. 105 (49 CFR 571.105, S5.3). (c) ***Air brake systems***. (1) Each truck tractor manufactured on or after March 1, 1997 (except truck tractors engaged in driveaway-towaway operations), shall be equipped with an antilock brake system that meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.1(b)). (2) Each air braked commercial motor vehicle other than a truck tractor, manufactured on or after March 1, 1998 (except commercial motor vehicles engaged in driveaway-towaway operations), shall be equipped with an antilock brake system that meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.1(a) for trucks and buses, S5.2.3 for semitrailers, converter dollies and full trailers). (d) ***ABS malfunction circuits and signals for air braked vehicles***. (1) Each truck tractor manufactured on or after March 1, 1997, and each single-unit air braked vehicle manufactured on or after March 1, 1998, subject to the requirements of paragraph (c) of this section, shall be equipped with an electrical circuit that is capable of signaling a malfunction that affects the generation or transmission of response or control signals to the vehicle's antilock brake system (49 CFR 571.121, S5.1.6.2(a)). (2) Each truck tractor manufactured on or after March 1, 2001, and each single-unit vehicle that is equipped to tow another air-braked vehicle, subject to the requirements of paragraph (c) of this section, shall be equipped with an electrical circuit that is capable of transmitting a malfunction signal from the antilock brake system(s) on the towed vehicle(s) to the trailer ABS malfunction lamp in the cab of the towing vehicle, and shall have the means for connection of the electrical circuit to the towed vehicle. The ABS malfunction circuit and signal shall meet the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.2(b)). (3) Each semitrailer, trailer converter dolly, and full trailer manufactured on or after March 1, 2001, and subject to the requirements of paragraph (c)(2) of this section, shall be equipped with an electrical circuit that is capable of signaling a malfunction in the trailer's antilock brake system, and shall have the means for connection of this ABS malfunction circuit to the towing vehicle. In addition, each trailer manufactured on or after March 1, 2001, subject to the requirements of paragraph (c)(2) of this section, that is designed to tow another air-

Violation	Description
	brake equipped trailer shall be capable of transmitting a malfunction signal from the antilock brake system(s) of the trailer(s) it tows to the vehicle in front of the trailer. The ABS malfunction circuit and signal shall meet the requirements of FMVSS No. 121 (49 CFR 571.121, S5.2.3.2). (e) ***Exterior ABS malfunction indicator lamps for trailers***. Each trailer (including a trailer converter dolly) manufactured on or after March 1, 1998, and subject to the requirements of paragraph (c)(2) of this section, shall be equipped with an ABS malfunction indicator lamp which meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.2.3.3).
393-75	Tires. (a) No motor vehicle shall be operated on any tire that: (1) Has body ply or belt material exposed through the tread or sidewall. (2) Has any tread or sidewall separation. (3) Is flat or has an audible leak. (4) Has a cut to the extent that the ply or belt material is exposed. (b) Any tire on the front wheels of a bus, truck, or truck tractor shall have a tread groove pattern depth of at least 4⁄32 of an inch when measured at any point on a major tread groove. The measurements shall not be made where tie bars, humps, or fillets are located. (c) Except as provided in paragraph (b) of this section, tires shall have a tread groove pattern depth of at least 2⁄32 of an inch when measured in a major tread groove. The measurement shall not be made where tie bars, humps or fillets are located. (d) No bus shall be operated with regrooved, recapped or retreaded tires on the front wheels. (e) A regrooved tire with a load-carrying capacity equal to or greater than 2,232 kg (4,920 pounds) shall not be used on the front wheels of any truck or truck tractor. (f) No motor vehicle may be operated with speed-restricted tires labeled with a maximum speed of 55 mph or less in accordance with S6.5(e) of FMVSS No. 119 at speeds that exceed the rated limit of the tire. (g) ***Tire loading restrictions (except on manufactured homes)***. No motor vehicle (except manufactured homes, which are governed by paragraph (h) of this section) shall be operated with tires that carry a weight greater than that marked on the sidewall of the tire or, in the absence of such a marking, a weight greater than that specified for the tires in any of the publications of any of the organizations listed in Federal Motor Vehicle Safety Standard No. 119 (49 CFR 571.119, S5.1(b)) unless: (1) The vehicle is being operated under the terms of a special permit issued by the State. (2) The vehicle is being operated at a reduced speed to compensate for the tire loading in excess of the manufacturer's rated capacity for the tire. In no case shall the speed exceed 80 km/hr (50 mph). (h)(1) ***Tire loading restrictions for manufactured homes built before January 1, 2002***. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) before January 1, 2002, must not be transported on tires that are loaded more than 18 percent over the load rating marked on the sidewall of the tire or, in the absence of such a marking, more than 18 percent over the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). Manufactured homes labeled before January 1, 2002, transported on tires overloaded by 9 percent or more must not be operated at speeds exceeding 80 km/hr (50 mph). (h)(2) ***Tire loading restrictions for manufactured homes built on or after January 1, 2002***. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) on or after January 1, 2002, must not be transported on tires loaded beyond the load rating marked on the sidewall of the tire or, in the absence of such a marking, the load rating specified in any of the

Violation	Description
	publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). (i) ***Tire inflation pressure***. (1) No motor vehicle shall be operated on a tire which has a cold inflation pressure less than that specified for the load being carried. (2) If the inflation pressure of the tire has been increased by heat because of the recent operation of the vehicle, the cold inflation pressure shall be estimated by subtracting the inflation buildup factor shown in Table 1 from the measured inflation pressure.
393-9(a)	Lamps Operable, Prohibition of Obstructions of Lamps and Reflectors. (a) All lamps required by this subpart shall be capable of being operated at all times. This paragraph shall not be construed to require that any auxiliary or additional lamp be capable of operating at all times.
396-3(a)(1)	Inspection, Repair, and Maintenance. (a) ***General***. Every motor carrier and intermodal equipment provider must systematically inspect, repair, and maintain, or cause to be systematically inspected, repaired, and maintained, all motor vehicles and intermodal equipment subject to its control. (1) Parts and accessories shall be in safe and proper operating condition at all times. These include those specified in part 393 of this subchapter and any additional parts and accessories which may affect safety of operation, including but not limited to, frame and frame assemblies, suspension systems, axles and attaching parts, wheels and rims, and steering systems.

Table C.7: Vehicle-Related Violation Descriptions at Klamath Falls POE

Violation	Description
393-45	Brake Tubing and Hoses; Hose Assemblies and End Fittings. (a) ***General construction requirements for tubing and hoses, assemblies, and end fittings***. All brake tubing and hoses, brake hose assemblies, and brake hose end fittings must meet the applicable requirements of FMVSS No. 106 (49 CFR 571.106). (b) ***Brake tubing and hose installation***. Brake tubing and hose must: (1) Be long and flexible enough to accommodate without damage all normal motions of the parts to which it is attached. (2) Be secured against chaffing, kinking, or other mechanical damage. (3) Be installed in a manner that prevents it from contacting the vehicle's exhaust system or any other source of high temperatures. (c) ***Nonmetallic brake tubing***. Coiled nonmetallic brake tubing may be used for connections between towed and towing motor vehicles or between the frame of a towed vehicle and the unsprung subframe of an adjustable axle of the motor vehicle if: (1) The coiled tubing has a straight segment (pigtail) at each end that is at least 51 mm (2 inches) in length and is encased in a spring guard or similar device which prevents the tubing from kinking at the fitting at which it is attached to the vehicle. (2) The spring guard or similar device has at least 51 mm (2 inches) of closed coils or similar surface at its interface with the fitting and extends at least 38 mm (1 1⁄2 inches) into the coiled segment of the tubing from its straight segment. (d) ***Brake tubing and hose connections***. All connections for air, vacuum, or hydraulic braking systems shall be installed so as to ensure an attachment free of leaks, constrictions or other conditions which would adversely affect the performance of the brake system.
393-47	Brake Actuators, Slack Adjusters, Linings/Pads, and Drums/Rotors. (a) ***General requirements***. Brake components must be constructed, installed and maintained to prevent excessive fading and grabbing. The means of attachment and physical characteristics must provide for safe and reliable stopping of the commercial motor vehicle. (b) ***Brake chambers***. The service brake chambers and spring brake chambers on each end of an axle must be the same size. (c) ***Slack adjusters***. The effective length of the slack adjuster on each end of an axle must be the same. (d) ***Linings and pads***. The thickness of the brake linings or pads shall meet the applicable requirements of this paragraph—(1) ***Steering axle brakes***. The brake lining/pad thickness on the steering axle of a truck, truck-tractor or bus shall not be less than 4.8 mm (3⁄16 inch) at the shoe center for a shoe with a continuous strip of lining; less than 6.4 mm (1⁄4 inch) at the shoe center for a shoe with two pads; or worn to the wear indicator if the lining is so marked, for air drum brakes. The steering axle brake lining/pad thickness shall not be less than 3.2 mm (1⁄8 inch) for air disc brakes, or 1.6 mm (1⁄16 inch) or less for hydraulic disc, drum and electric brakes. (2) ***Non-steering axle brakes***. An air braked commercial motor vehicle shall not be operated with brake lining/pad thickness less than 6.4 mm (1⁄4 inch) or to the wear indicator if the lining is so marked (measured at the shoe center for drum brakes); or less than 3.2 mm (1⁄8 inch) for disc brakes. Hydraulic or electric braked commercial motor vehicles shall not be operated with a lining/pad thickness less than 1.6 mm (1⁄16 inch) (measured at the shoe center) for disc or drum brakes. (e) ***Clamp, Bendix DD-3, bolt-type, and rotochamber brake actuator readjustment limits***. (1) The pushrod stroke must not be greater than the values specified in the tables shown in CFR 393.47.

Violation	Description
393-55	Antilock Brake Systems. (a) ***Hydraulic brake systems***. Each truck and bus manufactured on or after March 1, 1999 (except trucks and buses engaged in driveaway-towaway operations), and equipped with a hydraulic brake system, shall be equipped with an antilock brake system that meets the requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 105 (49 CFR 571.105, S5.5). (b) ***ABS malfunction indicators for hydraulic braked vehicles***. Each hydraulic braked vehicle subject to the requirements of paragraph (a) of this section shall be equipped with an ABS malfunction indicator system that meets the requirements of FMVSS No. 105 (49 CFR 571.105, S5.3). (c) ***Air brake systems***. (1) Each truck tractor manufactured on or after March 1, 1997 (except truck tractors engaged in driveaway-towaway operations), shall be equipped with an antilock brake system that meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.1(b)). (2) Each air braked commercial motor vehicle other than a truck tractor, manufactured on or after March 1, 1998 (except commercial motor vehicles engaged in driveaway-towaway operations), shall be equipped with an antilock brake system that meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.1(a) for trucks and buses, S5.2.3 for semitrailers, converter dollies and full trailers). (d) ***ABS malfunction circuits and signals for air braked vehicles***. (1) Each truck tractor manufactured on or after March 1, 1997, and each single-unit air braked vehicle manufactured on or after March 1, 1998, subject to the requirements of paragraph (c) of this section, shall be equipped with an electrical circuit that is capable of signaling a malfunction that affects the generation or transmission of response or control signals to the vehicle's antilock brake system (49 CFR 571.121, S5.1.6.2(a)). (2) Each truck tractor manufactured on or after March 1, 2001, and each single-unit vehicle that is equipped to tow another air-braked vehicle, subject to the requirements of paragraph (c) of this section, shall be equipped with an electrical circuit that is capable of transmitting a malfunction signal from the antilock brake system(s) on the towed vehicle(s) to the trailer ABS malfunction lamp in the cab of the towing vehicle, and shall have the means for connection of the electrical circuit to the towed vehicle. The ABS malfunction circuit and signal shall meet the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.2(b)). (3) Each semitrailer, trailer converter dolly, and full trailer manufactured on or after March 1, 2001, and subject to the requirements of paragraph (c)(2) of this section, shall be equipped with an electrical circuit that is capable of signaling a malfunction in the trailer's antilock brake system, and shall have the means for connection of this ABS malfunction circuit to the towing vehicle. In addition, each trailer manufactured on or after March 1, 2001, subject to the requirements of paragraph (c)(2) of this section, that is designed to tow another air-brake equipped trailer shall be capable of transmitting a malfunction signal from the antilock brake system(s) of the trailer(s) it tows to the vehicle in front of the trailer. The ABS malfunction circuit and signal shall meet the requirements of FMVSS No. 121 (49 CFR 571.121, S5.2.3.2). (e) ***Exterior ABS malfunction indicator lamps for trailers***. Each trailer (including a trailer converter dolly) manufactured on or after March 1, 1998, and subject to the requirements of paragraph (c)(2) of this section, shall be equipped with an ABS malfunction indicator lamp which meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.2.3.3).

Violation	Description
393-75	Tires. (a) No motor vehicle shall be operated on any tire that: (1) Has body ply or belt material exposed through the tread or sidewall. (2) Has any tread or sidewall separation. (3) Is flat or has an audible leak. (4) Has a cut to the extent that the ply or belt material is exposed. (b) Any tire on the front wheels of a bus, truck, or truck tractor shall have a tread groove pattern depth of at least 4⁄32 of an inch when measured at any point on a major tread groove. The measurements shall not be made where tie bars, humps, or fillets are located. (c) Except as provided in paragraph (b) of this section, tires shall have a tread groove pattern depth of at least 2⁄32 of an inch when measured in a major tread groove. The measurement shall not be made where tie bars, humps or fillets are located. (d) No bus shall be operated with regrooved, recapped or retreaded tires on the front wheels. (e) A regrooved tire with a load-carrying capacity equal to or greater than 2,232 kg (4,920 pounds) shall not be used on the front wheels of any truck or truck tractor. (f) No motor vehicle may be operated with speed-restricted tires labeled with a maximum speed of 55 mph or less in accordance with S6.5(e) of FMVSS No. 119 at speeds that exceed the rated limit of the tire. (g) ***Tire loading restrictions (except on manufactured homes)***. No motor vehicle (except manufactured homes, which are governed by paragraph (h) of this section) shall be operated with tires that carry a weight greater than that marked on the sidewall of the tire or, in the absence of such a marking, a weight greater than that specified for the tires in any of the publications of any of the organizations listed in Federal Motor Vehicle Safety Standard No. 119 (49 CFR 571.119, S5.1(b)) unless: (1) The vehicle is being operated under the terms of a special permit issued by the State. (2) The vehicle is being operated at a reduced speed to compensate for the tire loading in excess of the manufacturer's rated capacity for the tire. In no case shall the speed exceed 80 km/hr (50 mph). (h)(1) ***Tire loading restrictions for manufactured homes built before January 1, 2002***. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) before January 1, 2002, must not be transported on tires that are loaded more than 18 percent over the load rating marked on the sidewall of the tire or, in the absence of such a marking, more than 18 percent over the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). Manufactured homes labeled before January 1, 2002, transported on tires overloaded by 9 percent or more must not be operated at speeds exceeding 80 km/hr (50 mph). (h)(2) ***Tire loading restrictions for manufactured homes built on or after January 1, 2002***. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) on or after January 1, 2002, must not be transported on tires loaded beyond the load rating marked on the sidewall of the tire or, in the absence of such a marking, the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). (i) ***Tire inflation pressure***. (1) No motor vehicle shall be operated on a tire which has a cold inflation pressure less than that specified for the load being carried. (2) If the inflation pressure of the tire has been increased by heat because of the recent operation of the vehicle, the cold inflation pressure shall be estimated by subtracting the inflation buildup factor shown in Table 1 from the measured inflation pressure.
393-9(a)	Lamps Operable, Prohibition of Obstructions of Lamps and Reflectors. (a) All lamps required by this subpart shall be capable of being operated at all times. This paragraph

Violation	Description
	shall not be construed to require that any auxiliary or additional lamp be capable of operating at all times.
393-95(a)	Emergency Equipment on all Power Units. (a) ***Fire extinguishers***: (1) Minimum ratings. (i) A power unit that is used to transport hazardous materials in a quantity that requires placarding (See § 177.823 of this title) must be equipped with a fire extinguisher having an Underwriters' Laboratories rating of 10 B:C or more. (ii) A power unit that is not used to transport hazardous materials must be equipped with either: (A) A fire extinguisher having an Underwriters' Laboratories rating of 5 B:C or more. (B) Two fire extinguishers, each of which has an Underwriters' Laboratories rating of 4 B:C or more. (2) ***Labeling and marking***. Each fire extinguisher required by this section must be labeled or marked by the manufacturer with its Underwriters' Laboratories rating. (3) ***Visual Indicators***. The fire extinguisher must be designed, constructed, and maintained to permit visual determination of whether it is fully charged. (4) ***Condition, location, and mounting***. The fire extinguisher(s) must be filled and located so that it is readily accessible for use. The extinguisher(s) must be securely mounted to prevent sliding, rolling, or vertical movement relative to the motor vehicle. (5) ***Extinguishing agents***. The fire extinguisher must use an extinguishing agent that does not need protection from freezing. Extinguishing agents must comply with the toxicity provisions of the Environmental Protection Agency's Significant New Alternatives Policy (SNAP) regulations under 40 CFR Part 82, Subpart G. (6) ***Exception***. This paragraph (a) does not apply to the driven unit in a driveaway-towaway operation.
396-17(c)	Periodic Inspection. (c) A motor carrier must not use a commercial motor vehicle, and an intermodal equipment provider must not tender equipment to a motor carrier for interchange, unless each component identified in appendix A to this part has passed an inspection in accordance with the terms of this section at least once during the preceding 12 months and documentation of such inspection is on the vehicle. The documentation may be: (1) The inspection report prepared in accordance with § 396.21(a). (2) Other forms of documentation, based on the inspection report (e.g., sticker or decal), which contains the following information: (i) The date of inspection. (ii) Name and address of the motor carrier, intermodal equipment provider, or other entity where the inspection report is maintained. (iii) Information uniquely identifying the vehicle inspected if not clearly marked on the motor vehicle. (iv) A certification that the vehicle has passed an inspection in accordance with § 396.17.
396-3(a)(1)	Inspection, Repair, and Maintenance. (a) ***General***. Every motor carrier and intermodal equipment provider must systematically inspect, repair, and maintain, or cause to be systematically inspected, repaired, and maintained, all motor vehicles and intermodal equipment subject to its control. (1) Parts and accessories shall be in safe and proper operating condition at all times. These include those specified in part 393 of this subchapter and any additional parts and accessories which may affect safety of operation, including but not limited to, frame and frame assemblies, suspension systems, axles and attaching parts, wheels and rims, and steering systems.