Puget Sound **Gateway Program**

INFRA Application

February 25, 2020

Attachment 2 | Appendix A: Benefit-Cost Analysis

All Application Materials Available at www.wsdot.wa.gov/projects/gateway

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Executive Summary

A benefit-cost analysis (BCA) was conducted for the Puget Sound Gateway Program (Gateway Program) for submission to the U.S. Department of Transportation (USDOT) as a requirement of a discretionary grant application for the FY 2020 INFRA Grant program. The analysis was conducted in accordance with the methodology, values, and assumptions specified by USDOT in the "Benefit-Cost Analysis Guidance for Discretionary Grant Programs" document published in January 2020.[1] The benefit-cost analysis considered an overall analysis period corresponding to 32 years, which comprises a program development and construction period from state fiscal year (FY) 2016 through FY 2028 plus an operational period of 20 years for full benefits overlapping with the final year of construction from FY 2029 through FY 2048. An operational period of 30 years of full benefits from FY 2029 through FY 2058 was also evaluated as a sensitivity test. In both cases, minimal partial benefits from the first stage of improvements were also included during the second stage of construction from mid FY 2026 through FY 2028.

The Gateway Program is an integrated highway improvement project that would complete "missing links" in the State Route (SR) 509 and SR 167 corridors within the Puget Sound region, introducing a sustainable approach to relieving traffic congestion and improving freight mobility along the region's economic and mobility backbone, Interstate 5 (I-5). The 12 total miles of new highway infrastructure constructed by the project would connect I-5 with the Ports of Tacoma and Seattle, historically the fourth-largest gateway for containerized cargo in the US, and Seattle-Tacoma International Airport (Sea-Tac Airport), the ninth-busiest U.S. airport by passenger volume. These new highway segments provide "last mile" access, removing trucks from local arterial roads to provide improved reliability for motor freight exports originating from Northern Tier and Midwest states as well as for key supply chain trade flows between the ports and distribution centers in the Kent, Sumner, and Puyallup valleys, the second-largest such distribution center complex on the West Coast and the fourth-largest in the country.

Finally, the Gateway Program includes new segments of regional trail projects. The SR 167 Project will connect walking/biking trails, including the regional Interurban Trail, in the Fife/Milton area and extend non-motorized facilities over the new 70th Avenue East bridge to the Port of Tacoma. The SR 509 Project is funding the final segment of the Lake to Sound Trail, a 16-mile non-motorized trail extending from Lake Washington to the Puget Sound shoreline in coordination with the City of SeaTac and King County.

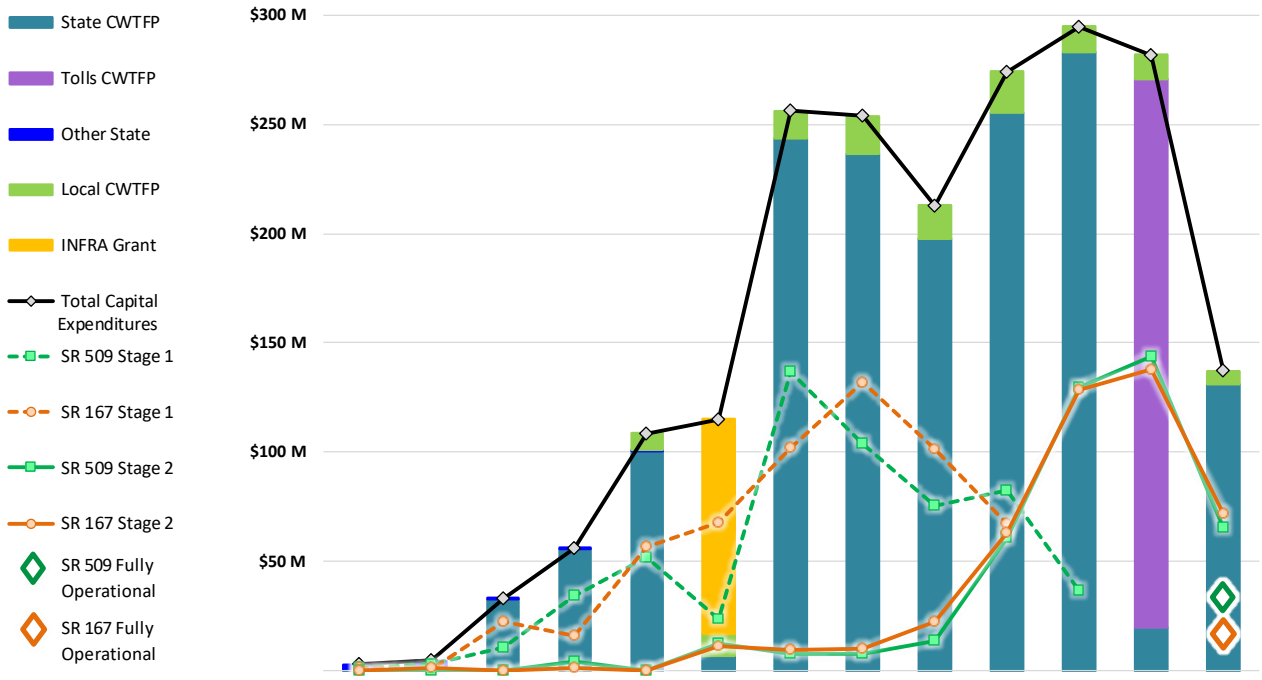
ES.1. Costs

The capital cost for the Gateway Program over the period from FY 2016 through FY 2028 is expected to be $2.031 billion in year of expenditure dollars, which is $1.764 billion in constant, undiscounted 2018 dollars (2018$). At a 7 percent real discount rate, these costs have a present value of $1.198 billion (2018$). Toll collection and facility operations and maintenance (O&M) costs are projected to average $17.36 million per year (2018$) once the project is fully constructed and operational. Over the entire 32-year analysis period — including first stage O&M costs during the initial operating years while the second stage of the Program is still under construction — these costs accumulate to $365 million in undiscounted 2018$, or a present value of nearly $100 million when discounted at 7 percent. Finally, periodic rehabilitation and replacement (R&R) costs are expected to total $77 million (2018$) over this same period, or $18.3 million when discounted at 7 percent.

[1] U.S. Department of Transportation. Benefit-Cost Analysis Guidance for Discretionary Grant Programs. 2020.

The Gateway Program is expected to be financed by state and local funding, toll-generated funds, and locally administered federal funds of $16 million in addition to the requested INFRA grant of $98.4 million. Table ES-1 illustrates the Program's projected annual sources and uses of funds in year of expenditure dollars, assuming an accelerated delivery afforded by the receipt of the requested INFRA grant.

FIGURE ES-1. PUGET SOUND GATEWAY PROGRAM PROJECTED SOURCES AND USES OF FUNDS (MILLIONS OF YEAR OF EXPENDITURE DOLLARS)



	% SHARE	TOTALS	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
SOURCES OF FUNDS															
State CWTFP*	77.1%	$1,565.5 M	0.2	2.1	32.7	55.7	100.5	6.7	243.6	236.8	197.8	255.2	283.0	20.0	131.1
Tolls CWTFP*	12.4%	$251.0 M	-	-	-	-	-	-	-	-	-	-	-	251.0	-
Other State*	0.3%	$6.2 M	2.6	2.5	0.4	0.2	0.5	-	-	-	-	-	-	-	-
Local CWTFP [1]	5.4%	$110.0 M	-	-	-	-	7.7	10.1	12.4	17.0	15.0	19.0	11.9	10.9	6.0
*Non-Federal**	*4.6%*	*$94.0 M*	*-*	*-*	*-*	*-*	*7.7*	*9.1*	*10.9*	*14.0*	*13.0*	*12.5*	*10.9*	*9.9*	*6.0*
Other Federal [2]	*0.8%*	*$16.0 M*	*-*	*-*	*-*	*-*	*-*	*1.0*	*1.5*	*3.0*	*2.0*	*6.5*	*1.0*	*1.0*	*-*
INFRA Grant	4.8%	$98.4 M	-	-	-	-	-	98.4	-	-	-	-	-	-	-
TOTAL SOURCES	**100.0%**	**$2,031.1 M**	**2.8**	**4.7**	**33.1**	**55.9**	**108.7**	**115.2**	**256.0**	**253.8**	**212.8**	**274.2**	**294.9**	**281.9**	**137.1**
USES OF FUNDS															
Prelim. Engineering	6.4%	$129.5 M	2.7	4.5	11.6	15.1	24.3	21.0	18.1	18.1	14.1	-	-	-	-
SR 509 Stage 1	*1.6%*	*$31.9 M*	*1.2*	*2.9*	*5.6*	*7.0*	*12.2*	*3.0*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
SR 509 Stage 2	*1.4%*	*$27.9 M*	*-*	*-*	*-*	*-*	*-*	*6.0*	*7.8*	*7.8*	*6.2*	*-*	*-*	*-*	*-*
SR 167 Stage 1	*2.1%*	*$41.8 M*	*1.2*	*0.5*	*6.0*	*8.0*	*12.0*	*11.9*	*2.3*	*-*	*-*	*-*	*-*	*-*	*-*
SR 167 Stage 2	*1.4%*	*$27.9 M*	*0.2*	*1.2*	*0.0*	*-*	*0.2*	*0.1*	*8.0*	*10.3*	*7.9*	*-*	*-*	*-*	*-*
Right-of-Way	7.0%	$141.5 M	0.1	0.1	19.2	39.7	51.5	29.4	1.4	-	-	-	-	-	-
SR 509 Stage 1	*2.9%*	*$58.4 M*	*0.1*	*0.1*	*2.9*	*26.1*	*29.2*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
SR 509 Stage 2	*0.5%*	*$10.7 M*	*-*	*-*	*-*	*4.4*	*-*	*6.2*	*0.0*	*-*	*-*	*-*	*-*	*-*	*-*
SR 167 Stage 1	*2.9%*	*$58.7 M*	*-*	*-*	*16.4*	*7.9*	*22.3*	*12.1*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
SR 167 Stage 2	*0.7%*	*$13.7 M*	*-*	*-*	*-*	*1.3*	*-*	*11.1*	*1.4*	*-*	*-*	*-*	*-*	*-*	*-*
Construction	86.7%	$1,760.1 M	0.0	0.1	2.2	1.2	32.9	64.7	236.5	235.7	198.7	274.2	294.9	281.9	137.1
SR 509 Stage 1	*23.1%*	*$469.7 M*	*0.0*	*0.1*	*2.2*	*1.2*	*10.7*	*20.6*	*136.8*	*103.5*	*75.2*	*82.7*	*36.8*	*-*	*-*
SR 509 Stage 2	*20.1%*	*$407.4 M*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*7.7*	*60.8*	*129.8*	*144.0*	*65.2*
SR 167 Stage 1	*23.0%*	*$467.2 M*	*-*	*-*	*0.0*	*0.0*	*22.3*	*44.1*	*99.7*	*132.3*	*101.4*	*67.5*	*-*	*-*	*-*
SR 167 Stage 2	*20.5%*	*$415.8 M*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*14.4*	*63.2*	*128.3*	*137.9*	*71.9*
TOTAL USES	**100.0%**	**$2,031.1 M**	**2.8**	**4.7**	**33.1**	**55.9**	**108.7**	**115.2**	**256.0**	**253.8**	**212.8**	**274.2**	**294.9**	**281.9**	**137.1**

* Non-Federal funding [1] $110 M in local funding is net of $20 M assumed within the INFRA grant request [2] $8 M secured out of $16 M planned PSRC MPO grants (federal source)

Source: WSDOT

ES.2. Benefits

In 2018 dollars, the Gateway Program is expected to generate benefits with a present-value of approximately $3.67 billion, at a 7 percent discount rate. These benefits would consist largely of user travel time savings for auto users and trucks, which account for 87 percent of the expected benefits; the remaining benefits would result from safety benefits associated with reduced vehicle miles traveled (VMT) primarily on arterial roads, reduced vehicle O&M costs for autos and trucks, reduced fuel consumption by autos and trucks, reduced tailpipe emissions from autos and trucks, decreased pavement damage and noise costs, and the Program's residual asset value at the end of the evaluation period.

ES.3. Results

The benefits and costs for the Gateway Program under a 20-year post-completion evaluation period produce an overall project net present value (NPV) of approximately $2.48 billion and a benefit cost ratio (BCR) of 3.07, using a 7 percent real discount rate. Table ES-1 below summarizes the BCA results for both 20- and 30-year post-completion evaluation periods for the Program as a whole, and each of the two corridor completion projects.

TABLE ES-1. BENEFIT-COST ANALYSIS RESULTS (7% REAL DISCOUNT RATE, 20- AND 30-YEAR EVALUATION PERIODS)

Case	20 Years (FYs 2029 48)		30 Years (FYs 2029 58)	
	Net Present Value (2018$)	Benefit Cost Ratio	Net Present Value (2018$)	Benefit Cost Ratio
SR 509 Completion Project	$1.56 B	3.64	$2.12 B	4.60
SR 167 Completion Project	$0.92 B	2.51	$1.31 B	3.15
Program Total	**$2.48 B**	**3.07**	**$3.43 B**	**3.86**

Source: WSP Analysis; corridor NPV values may not sum to program totals due to differences in interpolation for the program analysis.

Table ES-2 on the following page summarizes the specific beneficial impacts of the Gateway Program relative to the no-build or base case without the program.

TABLE ES-2. PROJECT IMPACTS AND BENEFITS SUMMARY, MONETARY VALUES IN PRESENT-VALUE DISCOUNTED 2018 DOLLARS

Current Status/Baseline & Problem to be Addressed	Change to Baseline/ Alternatives	Type of Impact	Population Affected by Impact	Economic Benefit	Summary of Results 7% discount rate (20 years)	Page Reference in BCA
Freight trucking schedule reliability	The Gateway Program would construct new highway facilities that better connect freight traffic from the Ports of Seattle and Tacoma, as well as Sea-Tac Airport, to I-5, and points beyond, reducing congestion, delays, and VMT for trucks and autos throughout the region.	User travel time savings	Truck users	27,204,380 net truck operator hours saved	$199.2 M	p. 12, p. 20
Roadway congestion		User travel time savings	Auto users	689,672,787 net auto operator hours saved	$3,049.3 M	p. 12, p. 20
Roadway congestion		Reduced tailpipe emissions	Domestic public in general	CO2 Emissions: 710,775 tons NOX Emissions: 191 tons PM10 Emissions: 3 tons SOX Emissions: 5 tons VOC Emissions: 130 tons	$1.40 M	p. 24
Inefficient routing and vehicle distribution		Reduced vehicle operating costs (including fuel)	Shippers, auto users	Reduction of 2,018,380,798 VMT	$255.0 M	p. 21-22
Inefficient routing and vehicle distribution		Reduced crashes (due to reduced VMT)	Public in general	Reduction of 2,018,380,798 VMT	$214.0 M	p. 22-23
Excess pavement damage		Reduced VMT	Public in general	Reduction of 2,018,380,798 VMT	$3.06 M	p. 23-24

Source: WSP, 2020

The overall projected impacts, their units, and the direction of change resulting from the Gateway Program are shown in Table ES-3, summed over the 32-year analysis period. Although full Program benefits do not occur until construction is completed in FY 2028, the table values also include partial benefits which are expected to begin by mid FY 2026.

TABLE ES-3. PROJECT IMPACTS FOR THE GATEWAY PROGRAM, CUMULATIVE, FYS 2025-2048

Category	Unit	Cumulative Change	Direction
Vehicle-Miles Traveled	VMT	2,090,000,762	▼
Passenger-Hours Traveled	PHT	745,019,321	▼
CO_2 Emissions (Domestic)	tons	735,996	▼
NO_X Emissions (Domestic)	tons	197	▼
PM^{10} (Domestic)	tons	3	▼
SO_X (Domestic)	tons	5	▼
VOC (Domestic)	tons	135	▼
Fatalities	#	34	▼
Injury Accidents	#	4,450	▼
Property Damage Only	#	8,448	▼

Source: WSP, 2020

1 Introduction

A benefit-cost analysis (BCA) was conducted for the Puget Sound Gateway Program (Gateway Program) for submission to the U.S. Department of Transportation (USDOT) as a requirement of a discretionary grant application for the federal fiscal year (FFY) 2020 INFRA grant program. The following section describes the BCA framework, evaluation metrics, and report contents.

1.1 BCA Framework

A BCA is an evaluation framework to assess the economic advantages (benefits) and disadvantages (costs) of an investment alternative. Benefits and costs are broadly defined and are quantified in monetary terms to the extent possible. The overall goal of a BCA is to assess whether the expected benefits of a project justify the costs from a national perspective. A BCA framework attempts to capture the net welfare change created by a project, including cost savings and increases in welfare (benefits), as well as disbenefits where costs can be identified (e.g., project capital costs, operations and maintenance costs), and welfare reductions where some groups are expected to experience negative impacts as a result of the proposed project.

The BCA framework involves defining a Base Case or "No Build" Case, which is compared to the "Build" Case, where the grant request is awarded, and the project is built as proposed. The BCA assesses the incremental difference between the Base Case and the Build Case, which represents the net change in welfare. BCAs are forward-looking exercises which seek to assess the incremental change in welfare over a project life-cycle. The importance of future welfare changes is determined through discounting, which is meant to reflect both the opportunity cost of capital as well as the societal preference for the present.

The analysis was conducted in accordance with the benefit-cost methodology as recommended by USDOT in the January 2020 Benefit-Cost Analysis Guidance for Discretionary Grant Programs.[2] This methodology includes the following analytical assumptions:

- Assessing benefits with respect to each of the five long-term outcomes defined by USDOT;
- Defining existing and future conditions under a no build base case as well as under the build case;
- Estimating benefits and costs during project construction and operation, including at least 20 years of operations beyond the project completion when benefits accrue;
- Using USDOT recommended monetized values for reduced fatalities, injuries, property damage, travel time savings, and emissions, while relying on best practices for monetization of other benefits;
- Providing dollar values for outcomes over time in present values, discounting future amounts back to 2018 after first adjusting all cost estimates or benefit unit prices to constant 2018 dollars (including inflating any values from prior years to 2018 using the Inflation Adjustment Factors noted in the USDOT BCA guidance); and
- Applying a real discount rate of 7 percent for all present value discounting of future benefits and costs, consistent with USDOT guidance.

1.2 Report Contents

- Section 2 of this Appendix contains a description of the Gateway Program project elements, along with a summary of the anticipated costs and economic benefits the project would generate.
- Section 3 describes the benefit-cost analysis inputs and methodology.
- Section 4 reports the results of the benefit-cost analysis.

[2] U.S. Department of Transportation. Benefit-Cost Analysis Guidance for Discretionary Grant Programs. 2020.

2 Project Overview

2.1 Description

The Gateway Program is composed of two complementary projects in the Puget Sound region: State Route 167 (SR 167) Completion Project and State Route 509 (SR 509) Completion Project. The Washington State Legislature paired the projects as the Gateway Program to provide funding for an integrated, sustainable approach to relieving traffic congestion and improving freight mobility. Together, these corridor extensions to the region's economic and mobility backbone, Interstate 5 (I-5), will provide direct access to the Ports of Tacoma and Seattle, historically the fourth-largest gateway for containerized cargo in the US, and Seattle-Tacoma International Airport (Sea-Tac Airport), the ninth-busiest U.S. airport by passenger volume, to key supply chains in Washington (see Figure 1) and support interstate trade with exports arriving by truck via I-5 and I-90.

Overall, the Gateway Program seeks to remedy the mobility, safety, community, environmental, and economic challenges that are currently posed by the incomplete segments of SR 167 and SR 509 that lack direct access to I-5, Sea-Tac Airport, and the Ports of Seattle and Tacoma.

Figure 1 on the following page provides a location map for the Gateway Program improvements.

2.1.1 SR 167 Completion Project

The SR 167 Completion Project in Pierce County will build the remaining four miles of SR 167 between its current terminus at SR 161 (Meridian Avenue) and I-5, completing a long-planned connection. Planning for a complete SR 167 began as early as the 1950s. Active planning and construction on numerous sections of SR 167 continued through the 1980s, at which point SR 167 became a four-lane limited access facility from I-405 in Renton to Puyallup, the current southern terminus. Valley Avenue and River Road are the main arterials to continue west from Puyallup to connect with I-5 and the Port of Tacoma. In 1990, the Legislature provided funds to further analyze the potential corridor and start the Environmental Impact Statement (EIS). The Federal Highway Administration (FHWA) approved the Tier I EIS in 1999, which selected a preferred route for SR 167 and allowed ROW acquisition to begin. Further environmental review continued for the project's Tier II EIS, which FHWA approved in October 2007. A NEPA Re-Evaluation Report for the current Project was completed in December 2018.

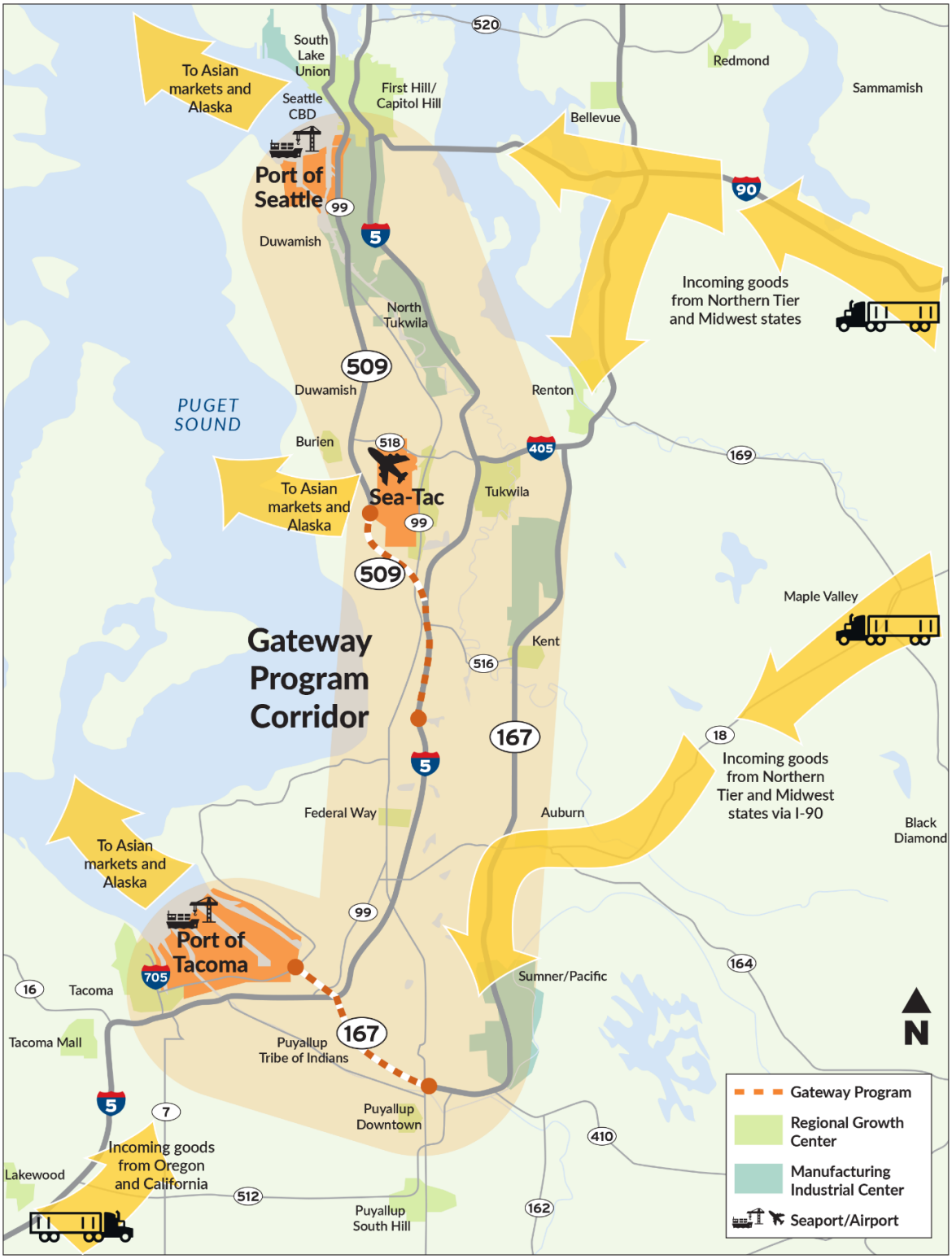
The SR 167 Completion Project also includes a new two-mile access road from I-5 to the Port of Tacoma (south of the SR 509 Completion Project, described in Section 2.1.2), as well as interchanges located at 54th Avenue, I-5, Valley Avenue, and SR 161.

2.1.2 SR 509 Completion Project

The SR 509 Completion Project, located to the north of the SR 167 Completion Project in King County, is needed to create system linkages to I-5 that accommodates travel demand, provides an alternate route south in and out of Seattle, and improves intermodal connections. The SR 509 corridor was adopted by the Washington State Transportation Commission in 1957 and authorized by the legislature in 1959 to accommodate a limited-access highway between Seattle and Tacoma. Because of rising costs and a lack of construction funds, Washington State Department of Transportation (WSDOT) abandoned plans to continue construction of the route, and in 1979, the State completed the freeway segment from S 160th Street to S 188th Street. A Draft EIS evaluating environmental impacts at a corridor level for the completion of SR 509 was issued in 1995. In March 2003, the Record of Decision (ROD) was signed and published. A NEPA Re-

Evaluation Report for the current Project was completed in January 2018. The SR 509 Completion Project will extend SR 509 south approximately 2 miles, providing two new lanes in each direction from S 188th Street to I-5, a new interchange at 24th Avenue South, a new interchange for south access to Sea-Tac Airport, and four miles of improvements on I-5.

FIGURE 1. LOCATION MAP OF PUGET SOUND GATEWAY PROGRAM



2.1.3 Regional Economic Impacts

The Ports of Tacoma and Seattle, now combined and operating as the Northwest Seaport Alliance(NWSA), generate business revenue to local and national firms providing vessel and cargo handling services at the marine terminals, which, in turn, provide employment and income to individuals, and pay taxes to state and local governments. This business revenue impact is bolstered by surface transportation investments like the Gateway Program that make the movement of goods into and out of the Ports by trucks less time-intensive and more cost-effective for commercial vehicle operators and suppliers.

The State of Washington is one of the most trade-dependent states in the nation, with 40% of all jobs tied to trade, including hundreds of thousands in both rural and urban areas who work for importers and exporters that use NWSA and Sea-Tac Airport cargo facilities.[3] The Seattle-Tacoma-Bellevue metropolitan area alone is now the 4th largest goods exporter among U.S. metro areas shipping out $59.7 B in goods in 2018, a 69% increase since 2010.[4] Table 1 shows the economic impact of the NWSA and Sea-Tac Airport cargo facilities, which support over 178,000 direct and indirect jobs and generate $35 billion in business revenue.

As Table 1 provides, NWSA and Sea-Tac Airport exported nearly 11 million metric tons of cargo valued at over $24 billion in 2019. These facilities represent critical infrastructure for the nation's agricultural industry and the rural communities. In fact, according to the U.S. Department of Agriculture, the NWSA is the second largest port in the country as measured by agricultural trade tonnage, and the nation's leading export gateway for refrigerated agriculture products, representing nearly 20% of national volumes.[5]

Exports moving through the NWSA and Sea-Tac are constrained by congested freight highway infrastructure. Given the relatively low margins for agricultural goods, small increases in cost have serious implications for the future of farmers in every corner of the country. NWSA's main competitors are the nearby Canadian ports of Vancouver and Prince Rupert, which in recent years have aggressively targeted U.S.-bound cargo with substantial financial and policy support from the government of Canada. In the past two years the government of Canada awarded $US 384 million to the ports of Vancouver and Prince Rupert alone for projects that support goods movement through those ports. Canadian federal investment in their trade gateways and highway corridors that connect the ports to population centers in the Canadian and U.S. heartland now offer an efficient and lower-cost alternative to shipping through NWSA, which has lost 15% of its market share to the British Columbia ports since 2007. Meanwhile, the Port of Tacoma is left behind as the only significant port on the west coast, including Canada, which does not have access via an expressway.

In order to maximize the competitiveness of the U.S. and the Puget Sound air and marine facilities, reliable freight highway corridors are needed to access the Sea-Tac Airport and NWSA marine ports.

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[3] U.S. Senate Committee on Commerce, Science and Transportation Subcommittee on Transportation and Safety, "Building Infrastructure in America: Overview of the Build America Bureau and the U.S. Department of Transportation Rural Initiatives", Testimony of The Honorable John McCarthy, Port of Tacoma Commission President and Co-Chair of The Northwest Seaport Alliance, January 28, 2020, p. 1.

[4] U.S. Department of Commerce, International Trade Administration, Office of Trade and Economic Analysis, Industry and Analysis, Seattle-Tacoma-Bellevue, WA Merchandise Exports, October 2019.

[5] U.S. Senate Committee on Commerce, Science and Transportation Subcommittee on Transportation and Safety, "Building Infrastructure in America: Overview of the Build America Bureau and the U.S. Department of Transportation Rural Initiatives", Testimony of The Honorable John McCarthy, Port of Tacoma Commission President and Co-Chair of The Northwest Seaport Alliance, January 28, 2020, p. 2.

TABLE 1. ECONOMIC IMPACT OF SEA-TAC AIRPORT AND THE NORTHWEST SEAPORT ALLIANCE (2017)

	NWSA	Sea Tac Airport Cargo	TOTAL
Jobs Supported (2017)	58,400 jobs, including 20,100 direct jobs (2017)	119,700 jobs (2019)	178,100 jobs
Business Revenue (2017)	$12.4 B (2017)	$22.7 B (2019)	$35.1 B
State Taxes Generated (2017)	$135.9 M (2017)	$521 M (2019)	$656.9 M
Labor Income (2017)	$4.0 B (2017)	$5.5 B (2019)	$9.5 B
National Ranking (2018)	4th largest container gateway in North America	19th largest U.S. air cargo gateway by tonnage	--
Export Cargo Handled (2019)	Over 10.5 million metric tons of containerized cargo valued at $12.4 B	74,633 metric tons of air cargo valued at $11.8 B	Nearly 10.6 million metric tons of cargo valued at $24.2 B
Top Export Commodities	Agricultural products (e.g. oil seeds, grain, seed, fruits, plants), industrial machinery, and computers	Computers, aircraft engines & parts, medical/surgical apparatus, immunological products, cherries & seafood	--

Sources: NWSA Economic Impact, PSRC Freight Work Program, and Sea-Tac Airport 2019 Year-End Air Cargo Fact Sheet (dated 2/5/2020).

2.2 General Assumptions

2.2.1 Discount Rates and Base Year

Costs for the Gateway Program were readily available in constant 2018 dollars as estimated by WSDOT, as well as in inflated, year of expenditure dollars for financial planning purposes.[6] For instances in which benefit valuations were expressed in dollar values reflecting prices in some other year, those values were adjusted to 2018 dollars using the Inflation Adjustment Factors provided in the Benefit-Cost Analysis Guidance for Discretionary Grant Programs document provided by USDOT.

The real discount rate used for this analysis was 7.0 percent.

2.2.2 Analysis Evaluation Period

The BCA analysis evaluation period totals 32 years, which comprises a 12-year program development and construction period from state fiscal year (FY) 2016 through FY 2028 plus an operational evaluation period of 20 years for full benefits overlapping with the final year of construction from FY 2029 through FY 2048.

The evaluation period includes the following project periods, some of which overlap:

- The program development and construction period commenced in FY 2016, during which capital costs will be expended, with Stage 1 to be completed in FY 2026 and Stage 2 construction to be concluded in FY 2029.
- While partial (first stage) benefits will accrue starting in mid FY 2026, a complete year of full program benefits will not be realized until FY 2029.

[6] Individual escalation factors were used provided for Preliminary Engineering, Right-of-Way Acquisition, Construction, O&M costs, and R&R costs.

- The 20-year operational period for full benefits period starts with FY 2029 and runs through FY 2048:
  - FY 2028 is the final year in which construction expenditures occur and FY2029 the first year in which the complete benefits of the program will be realized (full Stage 2 operations begin halfway through FY 2028).
  - While results for a 20-year post-completion operational period were analyzed for this report, a 30-year post-completion operational period was analyzed as a sensitivity analysis for long-lived assets such as these two new roadway segments that complete each corridor.

2.3 Base Case and Build Case

The base case for this analysis assumes that none of the contemplated infrastructure projects would be completed, and that the regional roadway network would remain essentially unchanged except for consideration of other funded regional improvements already under development.

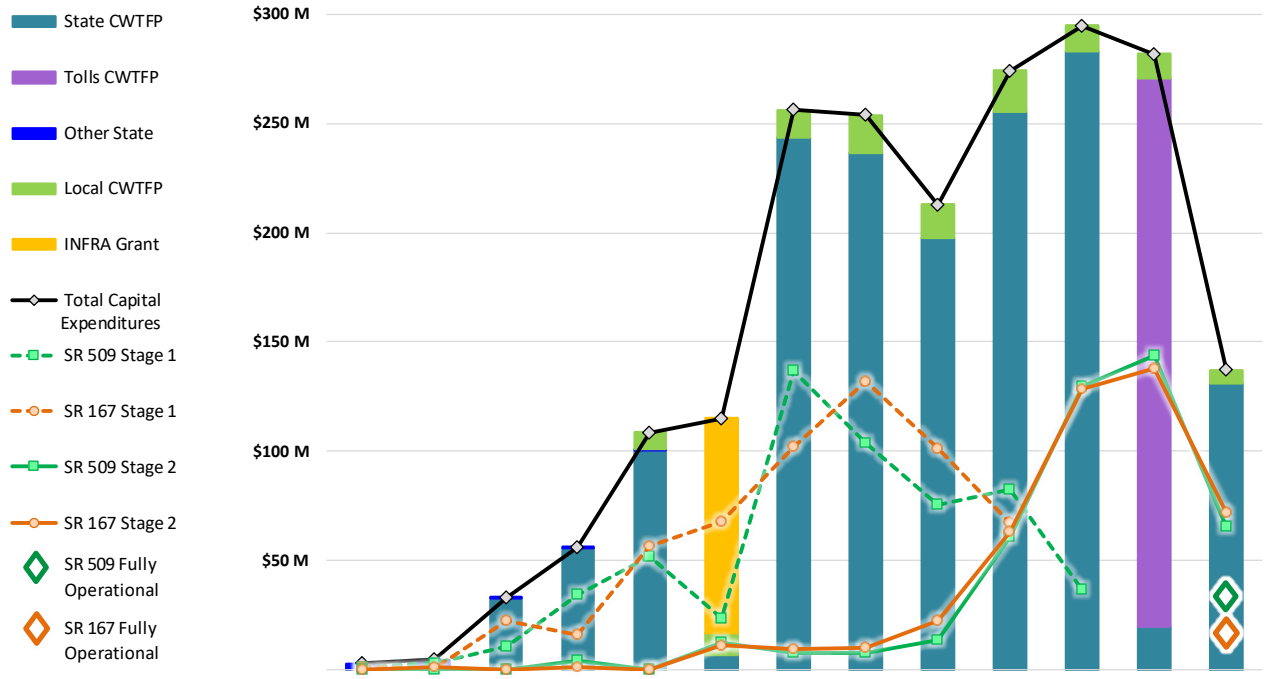
The build case for this analysis assumes that the Gateway Program would be completed in the sequence described earlier, and therefore consists of the proposed project.

2.4 Project Costs

2.4.1 Capital Costs

The projected sources and uses for the Gateway Program are detailed in Section 4 of the application narrative. Figure 2 on the following page shows the projected schedule of Program expenditures in year of expenditure dollars (YOE$), totaling $2.031 billion. In constant 2018 dollars (2018$) for this BCA, total capital costs are estimated at $1.764 billion. This figure includes $1.506 billion in construction costs, $136 million for right-of-way acquisition, and $122 million for professional services (see Table 2 and Figure 2).

FIGURE 2. PUGET SOUND GATEWAY PROGRAM PROJECTED SOURCES AND USES OF FUNDS (MILLIONS OF YEAR OF EXPENDITURE DOLLARS)



	% SHARE	TOTALS	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028
SOURCES OF FUNDS															
State CWTFP*	77.1%	$1,565.5 M	0.2	2.1	32.7	55.7	100.5	6.7	243.6	236.8	197.8	255.2	283.0	20.0	131.1
Tolls CWTFP*	12.4%	$251.0 M	-	-	-	-	-	-	-	-	-	-	-	251.0	-
Other State*	0.3%	$6.2 M	2.6	2.5	0.4	0.2	0.5	-	-	-	-	-	-	-	-
Local CWTFP [1]	5.4%	$110.0 M	-	-	-	-	7.7	10.1	12.4	17.0	15.0	19.0	11.9	10.9	6.0
*Non-Federal**	*4.6%*	*$94.0 M*	*-*	*-*	*-*	*-*	*7.7*	*9.1*	*10.9*	*14.0*	*13.0*	*12.5*	*10.9*	*9.9*	*6.0*
Other Federal [2]	*0.8%*	*$16.0 M*	*-*	*-*	*-*	*-*	*-*	*1.0*	*1.5*	*3.0*	*2.0*	*6.5*	*1.0*	*1.0*	*-*
INFRA Grant	4.8%	$98.4 M	-	-	-	-	-	98.4	-	-	-	-	-	-	-
TOTAL SOURCES	**100.0%**	**$2,031.1 M**	**2.8**	**4.7**	**33.1**	**55.9**	**108.7**	**115.2**	**256.0**	**253.8**	**212.8**	**274.2**	**294.9**	**281.9**	**137.1**
USES OF FUNDS															
Prelim. Engineering	6.4%	$129.5 M	2.7	4.5	11.6	15.1	24.3	21.0	18.1	18.1	14.1	-	-	-	-
SR 509 Stage 1	*1.6%*	*$31.9 M*	*1.2*	*2.9*	*5.6*	*7.0*	*12.2*	*3.0*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
SR 509 Stage 2	*1.4%*	*$27.9 M*	*-*	*-*	*-*	*-*	*-*	*6.0*	*7.8*	*7.8*	*6.2*	*-*	*-*	*-*	*-*
SR 167 Stage 1	*2.1%*	*$41.8 M*	*1.2*	*0.5*	*6.0*	*8.0*	*12.0*	*11.9*	*2.3*	*-*	*-*	*-*	*-*	*-*	*-*
SR 167 Stage 2	*1.4%*	*$27.9 M*	*0.2*	*1.2*	*0.0*	*-*	*0.2*	*0.1*	*8.0*	*10.3*	*7.9*	*-*	*-*	*-*	*-*
Right-of-Way	7.0%	$141.5 M	0.1	0.1	19.2	39.7	51.5	29.4	1.4	-	-	-	-	-	-
SR 509 Stage 1	*2.9%*	*$58.4 M*	*0.1*	*0.1*	*2.9*	*26.1*	*29.2*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
SR 509 Stage 2	*0.5%*	*$10.7 M*	*-*	*-*	*-*	*4.4*	*-*	*6.2*	*0.0*	*-*	*-*	*-*	*-*	*-*	*-*
SR 167 Stage 1	*2.9%*	*$58.7 M*	*-*	*-*	*16.4*	*7.9*	*22.3*	*12.1*	*-*	*-*	*-*	*-*	*-*	*-*	*-*
SR 167 Stage 2	*0.7%*	*$13.7 M*	*-*	*-*	*-*	*1.3*	*-*	*11.1*	*1.4*	*-*	*-*	*-*	*-*	*-*	*-*
Construction	86.7%	$1,760.1 M	0.0	0.1	2.2	1.2	32.9	64.7	236.5	235.7	198.7	274.2	294.9	281.9	137.1
SR 509 Stage 1	*23.1%*	*$469.7 M*	*0.0*	*0.1*	*2.2*	*1.2*	*10.7*	*20.6*	*136.8*	*103.5*	*75.2*	*82.7*	*36.8*	*-*	*-*
SR 509 Stage 2	*20.1%*	*$407.4 M*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*7.7*	*60.8*	*129.8*	*144.0*	*65.2*
SR 167 Stage 1	*23.0%*	*$467.2 M*	*-*	*-*	*0.0*	*0.0*	*22.3*	*44.1*	*99.7*	*132.3*	*101.4*	*67.5*	*-*	*-*	*-*
SR 167 Stage 2	*20.5%*	*$415.8 M*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*14.4*	*63.2*	*128.3*	*137.9*	*71.9*
TOTAL USES	**100.0%**	**$2,031.1 M**	**2.8**	**4.7**	**33.1**	**55.9**	**108.7**	**115.2**	**256.0**	**253.8**	**212.8**	**274.2**	**294.9**	**281.9**	**137.1**

* Non-Federal funding [1] $110 M in local funding is net of $20 M assumed within the INFRA grant request [2] $8 M secured out of $16 M planned PSRC MPO grants (federal source)

Source: WSDOT

TABLE 2. SCHEDULE AND COSTS FOR GATEWAY PROGRAM, SR 509 CORRIDOR COMPLETION AND SR 167 CORRIDOR COMPLETION

Variable	Unit	Gateway Program Total	SR 509 Corridor Completion	SR 167 Corridor Completion
Program Delivery Start Date	Fiscal Year	FY 2016	FY 2016	FY 2016
Program Construction Completed	Fiscal Year	FY 2028	FY 2028	FY 2028
Construction Duration	years	12	12	12
Stage 1 Open	Fiscal Year	start FY 2026	start FY 2026	mid FY 2026
Stage 2 Open	Fiscal Year	mid FY 2028	mid FY 2028	mid FY 2028
Capital Cost – Professional Services	Millions of 2018 $s	121.8	56.4	65.4
Capital Cost – Right-of-Way Acquisition	Millions of 2018 $s	136.4	66.7	69.7
Capital Cost – Construction	Millions of 2018 $s	1,505.5	749.1	756.4

2.4.2 Operations and Maintenance (O&M) and Repair and Rehabilitation (R&R) Costs

Because it is assumed that none of the proposed infrastructure would be constructed in the no build scenario, all reported operations and maintenance (O&M) and repair and rehabilitation (R&R) costs represent incremental figures over and above the no build.

WSDOT has prepared for future operations and maintenance of the Gateway Program's O&M costs — as well as for the costs of periodic R&R of capital — with an asset management plan that relies on dedicated toll revenue rather than federal funding or state gas taxes. Per toll authorization passed by the 2019 Legislature, toll revenues would not only pay debt service on the toll bonds but will also cover all routine facility and toll collection O&M costs as well as the periodic roadway and toll collection R&R costs. State statutes require that tolls generated by the Gateway Program "must be used only to construct, improve, preserve, maintain, manage, or operate… [the program] in which the revenue is collected."7 Through FY 2048 (20 years of post-completion operations), roadway and toll collection O&M and R&R costs to be paid by tolls are projected to total over $900 M in inflated YOE dollars.

O&M costs consist of two components: toll collection O&M and facility O&M. In FY 2029, the first year for complete toll operations of both corridors, toll collection O&M costs are expected to total $13.07 million in 2018 dollars, and comprise roadway toll collection systems (TCS), customer service center (CSC) operations, state operations costs, and credit card fees.

Planning-level estimates for facility O&M costs, as well as R&R costs, were developed based on historic expenditures by WSDOT's regional maintenance divisions. The project team consulted with the maintenance divisions in their respective regions to incorporate historic maintenance costs based on the preliminary project information available. These estimates are detailed in Table 3, Table 4, and Table 5 for the Gateway Program, SR 509 Corridor Completion project, and the SR 167 Corridor Completion project respectively. Per USDOT guidance, O&M and R&R costs have been included in the numerator of the BCR.

[7] Engrossed Senate Substitute Bill (ESSB) 5825 as codified in RCW 47.56.895 and RCW 47.56.820

TABLE 3. SCHEDULE OF O&M AND R&R COSTS FOR GATEWAY PROGRAM, UNDISCOUNTED (2018$)

Fiscal Year	Build	
	O&M	R&R
2026	$3,157,274	$369,120
2027	$5,010,957	-
2028	$9,270,406	$1,410,515
2029	$13,071,084	$4,674,898
2030	$14,822,673	$504,587
2031	$15,749,270	-
2032	$15,924,371	$252,294
2033	$16,736,416	$237,702
2034	$16,817,946	$1,706,776
2035	$16,960,728	$3,953,687
2036	$17,064,313	$2,867,084
2037	$17,348,768	$5,245,469
2038	$17,305,625	$7,749,719
2039	$17,691,607	$7,313,993
2040	$17,896,023	$894,831
2041	$18,088,021	$5,124,729
2042	$18,386,664	$3,091,448
2043	$18,537,401	$87,228
2044	$18,800,520	$10,417,295
2045	$19,082,642	$3,953,687
2046	$18,962,474	$2,867,084
2047	$19,123,917	$5,245,469
2048	$18,870,065	$7,893,846

TABLE 4. SCHEDULE OF O&M AND R&R COSTS FOR SR 509 CORRIDOR COMPLETION, UNDISCOUNTED (2018$)

Fiscal Year	Build	
	O&M	R&R
2026	$2,492,189	$227,576
2027	$2,989,407	-
2028	$4,424,827	$724,765
2029	$5,664,173	$2,104,733
2030	$6,293,000	$252,294
2031	$6,652,888	-
2032	$6,773,906	-
2033	$7,175,775	$103,710
2034	$7,262,590	$822,911
2035	$7,377,372	$3,102,218
2036	$7,391,747	$2,745,934
2037	$7,645,335	$195,122
2038	$7,798,800	$1,267,108
2039	$7,907,424	$3,394,976
2040	$8,056,768	$447,416
2041	$8,203,840	$4,905,449
2042	$8,400,109	$251,098
2043	$8,531,082	-
2044	$8,715,878	$4,283,120
2045	$8,915,485	$3,102,218
2046	$8,803,597	$2,745,934
2047	$8,966,095	$195,122
2048	$8,988,453	$1,424,052

TABLE 5. SCHEDULE OF O&M AND R&R COSTS FOR SR 167 CORRIDOR COMPLETION, UNDISCOUNTED (2018$)

Fiscal Year	Build	
	O&M	R&R
2026	$665,086	$141,544
2027	$2,021,550	-
2028	$4,845,579	$685,750
2029	$7,406,912	$2,570,165
2030	$8,529,672	$252,294
2031	$9,096,382	-
2032	$9,150,465	$252,294
2033	$9,560,642	$133,991
2034	$9,555,356	$883,864
2035	$9,583,356	$851,468
2036	$9,672,566	$121,150
2037	$9,703,433	$5,050,347
2038	$9,506,825	$6,482,611
2039	$9,784,183	$3,919,017
2040	$9,839,255	$447,416
2041	$9,884,181	$219,280
2042	$9,986,555	$2,840,350
2043	$10,006,319	$87,228
2044	$10,084,641	$6,134,175
2045	$10,167,157	$851,468
2046	$10,158,876	$121,150
2047	$10,157,822	$5,050,347
2048	$9,881,612	$6,469,794

2.5 Project Benefits

The major improvements that would be facilitated by the Gateway Program are intended to relieve traffic congestion and improve freight mobility. By providing more efficient highway links that are suitable for the mix of vehicular traffic on the roadways surrounding the ports of Seattle and Tacoma, the Gateway Program will result in travel time savings for auto and truck users and reduce overall vehicle miles traveled on the regional road network. The VMT reductions will, in turn, increase safety benefits, reduce fuel consumption, limit harmful tailpipe emissions, decrease roadway O&M costs, and improve safety outcomes on existing roadway facilities near the ports.

2.5.1 Travel Time Savings

The Gateway Program would help to improve schedule reliability, which is one of the trucking industry's primary obstacles to efficient operations. Traffic using I-5 is often delayed by congestion, accidents, or major incidents that can make truck deliveries unreliable. In addition, Sea-Tac Airport generates significant truck traffic, which contributes further to the inefficiencies of other modes. Delay in the peak travel period on Puget Sound freeways can cause a loss of up to 60 percent in productivity for truckers.

Without the Gateway Program, schedules for truckers will become increasingly unreliable as truck volumes on SR 509, I-5, and SR 167 are expected to increase at a growth rate of approximately 2 percent per year to 46,600 trucks per day in 2020 due to population and employment growth and economic development in the local area. At this rate, truck traffic is increasing at a faster rate than passenger-vehicle traffic.

WSDOT's 2007 economic analysis of the SR 167 Completion Project found that direct impacts of the project to users of the transportation system include reductions in congestion and travel times. Travel times with and without the project were compared and the net improvement projected over 30 years totaled $940 million for a full build of the extension. The analysis also found that a primary indirect impact of the SR 167 Completion Project is the support it lends to the containerized cargo industry in the region and future growth of Port of Tacoma operations, which is responsible for generating the majority of direct jobs and business revenue at the Port of Tacoma. Without the SR 167 Completion Project, the Ports of Tacoma and Seattle will find it difficult to compete with Canadian ports for the movement of containers.

Similarly, WSDOT's 2003 Final EIS for the SR 509 Completion Project found that the new roadway would improve the reliability of the movement of goods and people from I-5 to Sea-Tac Airport and other locations along the SR 509 corridor. Extending the SR 509 freeway would also improve schedule reliability for goods movement, providing a second route that truckers could use to bypass congestion on I-5. Although parallel routes exist south of I-405 (e.g. SR 167), accessing those routes from the Port of Seattle or Sea-Tac Airport would require a truck to pass through the I-5/I-405 interchange at Tukwila, the primary bottleneck in the area. The SR 509 Completion Project would allow trucks to bypass this interchange altogether and improve the reliability of the entire system.

In addition, because the completed SR 509 would reduce traffic volumes on I-5, travel time savings would be realized by motorists who remain on I-5.

2.5.2 VMT Savings

The SR 509 Completion Project will also reduce the travel distance between the Ports of Seattle and Tacoma by 1.2 miles compared to using only I-5, and by 1.7 miles compared to using SR 599 and I-5. Drivers traveling between Tacoma and Sea-Tac Airport would realize the largest reduction in mileage. The extension of SR 509 would save approximately 2.5 miles of travel distance compared to the existing route along I-5 and

S 188th Street. In this way, the SR 509 Completion Project will reduce truck travel times in the Puget Sound area freight highway network. The shorter distances would provide travel time savings over I-5 in the peak direction.

In addition to creating improved access for freight via these new highway segments, this program also creates much-needed redundancy and resiliency for commuters, residents, visitors, and commercial vehicle operators seeking alternatives to I-5, the lifeline of West Coast goods and passenger movement. The Gateway Program will improve speeds and throughput on I-5 by allowing freight trips to continue on the SR 509 and SR 167 corridors without circuitous routing of trips on I-5 or local roads. Additional capacity to I-5 via auxiliary lanes and improved interchanges will benefit I-5 operations, significantly reducing highway congestion and bottlenecks.

The SR 167 project will draw many trips off the heavily-congested I-5 and local arterial roads and onto the freeway network. The project will also reduce truck volumes and congestion at interchanges on I-5 by allowing traffic to directly travel from the Port of Tacoma to the existing SR 167 corridor and warehousing districts. Additionally, current arterials and highways in Pierce County, specifically, River Road in Puyallup and SR 99 in Fife were not designed to carry current and projected vehicle volumes and loads. Current tractor trailer traffic to and from the Port of Tacoma causes significant pavement wear and necessitates more investment in road maintenance and preservation. Construction of the SR 167 Completion Project would accommodate forecasted traffic and could produce long-term cost savings by reducing rehabilitation costs on existing arterials.

2.5.3 Safety Improvements

The SR 167 and SR 509 Completion Projects will allow trucks to arrive and leave the Ports of Tacoma and Seattle through limited access routes. This will improve safety through better flow of traffic, improved visibility, and less interaction of trucks and pedestrians.

Crashes on local roads, I-5, and existing segments of SR 167 and SR 509 would increase without the SR 167 and SR 509 Completion Projects. Both the SR 167 and SR 509 Completion Projects are projected to decrease the number of crashes on local roads and highways, as well as on the completed SR 167 and SR 509 corridors, by drivers using them as alternatives to I-5 and local roads. The quantitative calculations for the reduction in crashes is presented in Section 3.3.

2.5.4 Residual Value

The projected useful life for the infrastructure that would be constructed with the Gateway Program is 75 years. Because the assets' useful life extends beyond the 20-year post-construction evaluation period (or even the full 32-year analysis period), the BCA includes a residual value in the final analysis year, FY 2048, that includes the remaining, undepreciated construction costs and the value of the ROW.

The residual value was calculated by disaggregating the project capital costs into three categories: construction costs, right-of-way acquisition, and professional services. For construction costs, the proportion of expenditures related to structures was assumed to be 43 percent, based on preliminary cost information; that portion of the construction costs was depreciated over the analysis period using the straight-line method. In accordance with generally-accepted accounting principles, right-of-way costs were not depreciated because they are not fixed assets. Professional services were not included in the residual value calculation.

For BCA purposes, the residual value is considered a "negative cost" incurred during the final year of the analysis period, acting like a benefit for purposes of the NPV. Per USDOT guidance the residual value has

been factored into the numerator of the BCR. Table 6 outlines the capital cost components included in the residual value calculation.

TABLE 6. RESIDUAL VALUE COMPONENTS, UNDISCOUNTED (2018$)

Cost Category	Capital Costs	Depreciable Costs	Residual Value
Preliminary Engineering	$121,848,263	$121,848,263	$0
Right-of-Way	$136,406,728	$0	$136,406,728
Construction	$1,505,503,116	$647,366,340	$491,998,418
Total	$1,763,758,107	$738,780,792	$628,405,146

2.5.5 Quantifying and Monetizing Benefits

The benefits evaluated in this analysis and outlined in Table 7 are all readily quantifiable using a travel-demand model calibrated for the regional network; using standard values provided by USDOT and other industry-standard sources, these quantified benefits are also readily monetized for comparison to the capital, O&M, and R&R costs described earlier.

Section 3 of this report describes the assumptions and methods used to quantify these benefits, as well as details the results used in the BCA.

TABLE 7. PROJECT BENEFITS BY LONG-TERM OUTCOME CATEGORY

Long Term Outcome	Benefit Category	Description	Monetized	Quantified	Qualitative
Economic Competitiveness	Travel Time Savings	Delta in typical travel time between build and no build for trucks and autos on different facility types.	√	√	
	Reductions in Vehicle Operating and Maintenance (O&M) Costs	Delta in total vehicle miles traveled (VMT) between build and no build with VMT savings resulting in lower vehicle O&M costs.	√	√	
Safety	Reduced Incidents	Delta in total vehicle miles traveled (VMT) between build and no build with VMT savings resulting in fewer incidents and fatalities.	√	√	
State of Good Repair	Reduced Road Damage	Delta in total vehicle miles traveled (VMT) between build and no build with VMT savings resulting in lower road damage.	√	√	
Environmental Sustainability	Reduced Emissions	Delta in total vehicle miles traveled (VMT) between build and no build with VMT savings resulting in lower emissions.	√	√	

3 Benefit-Cost Analysis Data and Assumptions

3.1 Demand Projections

3.1.1 PSRC and Gateway Program DTA Travel Demand Models

By improving connectivity around the ports of Seattle and Tacoma, the Gateway Program would alter traffic patterns of demand levels for roadway facilities throughout the regional network. Understanding the nature and magnitude of these changes in future vehicular demand is essential to performing a benefit-cost analysis for the Gateway Program.

Forecasts of the likely changes in vehicle-miles traveled (VMT) and vehicle-hours traveled (VHT) for several types of highway users were developed using an updated version of the Puget Sound Regional Council (PSRC) regional travel demand forecasting model specifically refined for the Puget Sound Gateway Program. No-build (i.e., the future without the Gateway Program) and build model runs were performed for three horizon years and two stages of construction: Stage 1 uses FY 2025 and FY 2030 forecasts, and Stage 2 uses FY 2030 and FY 2045 forecasts. The travel demand forecasts were prepared by WSDOT's traffic and revenue consultant (Stantec) in 2018 and reflect tolls on both the SR 509 and SR 167 completion segments. The forecasts also reflect anticipated changes in land use (population and employment) based on Stantec's recent land use forecasts, which have been refined from PSRC's base forecasts through consultation with local jurisdictions.

The PSRC model is a regional multi-modal travel demand model that has been calibrated and validated for use in a variety of regional and corridor-level transportation planning projects in the Puget Sound four-county region. A refined version of the PSRC regional travel demand model was used to produce traffic projections without and with the tolled project improvements.

As the effects of the Program cover a large geographic area and are realized over all 24 hours of the day. The model was used to develop network VMT and VHT change estimates associated with the Program for auto and truck users on two types of facility: limited-access highways and arterial surface roads. The model projects study area changes in VMT and VHT during peak, midday, and overnight periods.

The results of the travel demand modeling indicate that net decreases in VMT and VHD are expected to result from the project due to the addition of a new facilities and capacity within the existing roadway network, and the more direct routing of some vehicle trips.

3.1.2 Travel Demand Modeling Results

The travel demand model was used to generate estimates for incremental daily VMT and VHT, relative to the no build scenario, for three future years and two construction stages — FY 2025, FY 2030 and FY 2045 — and six vehicle-facility type combinations—autos on arterial streets, autos on limited-access facilities, medium trucks on arterial streets, medium trucks on limited-access facilities, large (tractor-trailer) trucks on arterial streets, and large trucks on limited-access facilities. These estimates are detailed on the following pages in Table 9, Table 10, and Table 11 for the Gateway Program, SR 509 Completion Project, and the SR 167 Completion Project respectively.

The changes in weekday daily VMT and VHT values were annualized using a factor of 321 to account for diminished vehicular volumes on weekend days. This factor implies that project benefits on weekend days are approximately 60 percent of those on weekdays. According to recent traffic counts collected by WSDOT, weekend traffic volumes along I-5 and SR 167 in the vicinity of the proposed projects range from 66 to 92

percent of weekday volumes; therefore, the conservative annualization factor used for the BCA is likely to understate the magnitude of expected benefits. Table 8 details the weekday traffic to blended annualized expansion factor calculations used in the BCA model.

The travel demand models forecast an overall reduction in VMT and VHT on the regional road network as a result of the Gateway Program. However, because of the specific nature of the infrastructure improvements that would be introduced by the project, not all of the vehicle-facility types are forecasted to experience a reduction in VMT. For example, while auto VMT on arterial roadways would decrease, there would be a nearly commensurate increase in auto VMT on limited access facilities following completion of the Program, as these vehicles are attracted to the new highways.

To account for the Program's partial (Stage 1) opening in mid FY 2025 for SR 509 and mid FY 2026 for SR 167 (see Section 2.2.2), the annual reduction in vehicle-facility type VMT and VHT for the opening years were reduced by 50 percent. To interpolate partial-benefit annual rates of change for years between FY 2025 and FY 2030, the compound annual growth rate (CAGR) between the two model years was calculated and applied to generate values for each intermediate year. Similarly, to interpolate full-benefit annual rates of change for years between FY 2030 and FY 2045, the CAGR between the two model years was calculated and applied to generate values for each intermediate year. Because travel demand modeling does not produce forecasts for a horizon year beyond FY 2045 — and in light of national-level trends in travel growth — the annual rates of change in travel demand model outputs for years beyond FY 2046 were assumed to be 50 percent of the interpolated rates of change between FY 2030 and FY 2045.

The demand modeling for the build case assumes that both of the Program's integrated corridor completion projects are constructed, and the base case (no-build) assumes that neither are constructed. Because the State Legislature has linked the non-federal funding (shown in **Error! Reference source not found.**) to the completion of both projects, and has enacted toll authorization legislation that links the toll revenues to one Program account, the projects were not modeled individually. Therefore, a post-model link evaluation analysis was performed to estimate the changes in VHT and VMT attributed to SR 509 separate from those attributed to SR 167.

TABLE 8: WEEKDAY TO ANNUAL EXPANSION FACTOR

Annualization Factor Calculation	Number of days	Share of weekday traffic
# Weekdays (non-holiday)	255	100%
# Weekend days and major holidays	110	60%
Annualization Factor	**321**	

TABLE 9. CHANGE IN AVERAGE WEEKDAY VMT & VHT RELATIVE TO NO BUILD, GATEWAY PROGRAM

	FY 2025 Daily (Stage 1[1])	FY 2030 Daily (Stage 1[1])	FY 2030 Daily (Full Benefits[1])	FY 2045 Daily (Full Benefits[1])
Vehicle-Miles of Travel (VMT):				
Limited Access Facilities				
SOVs	45,732	36,645	319,914	240,144
2+HOVs	247	(170,673)	(134,140)	54,957
Medium Trucks	(2,131)	(1,001)	5,543	1,204
Heavy Trucks	(800)	(1,223)	2,230	781
Arterials				
SOVs	(60,562)	(82,525)	(344,303)	(470,303)
2+HOVs	(11,337)	(107,584)	(153,164)	(106,931)
Medium Trucks	1,866	516	(5,802)	(11,270)
Heavy Trucks	770	44	(3,859)	(8,010)
Total - All Combined	**(26,215)**	**(325,801)**	**(313,581)**	**(299,427)**
Vehicle-Hours of Travel (VHT):				
SOVs	(7,208)	(14,759)	(29,933)	(95,256)
2+HOVs	(1,097)	(13,617)	(16,409)	(15,841)
Medium Trucks	(225)	(459)	(951)	(2,848)
Heavy Trucks	(329)	(615)	(1,190)	(3,539)
Total - All Combined	**(8,857)**	**(29,450)**	**(48,483)**	**(117,484)**

[1] The full benefits period will not begin until FY 2029, as described in Section 2.2.2; values for full-benefit years were calculated using the interpolated growth rates between FY 2030 and FY 2045, while values for partial-benefit years were calculated using the interpolated growth rates between FY 2025 and FY 2030.

TABLE 10. CHANGE IN AVERAGE WEEKDAY VMT & VHT RELATIVE TO NO BUILD, SR 509 CORRIDOR COMPLETION

	FY 2025 Daily (Stage 1[1])	FY 2030 Daily (Stage 1[1])	FY 2030 Daily (Full Benefits[1])	FY 2045 Daily (Full Benefits[1])
Vehicle-Miles of Travel (VMT):				
Limited Access Facilities				
SOVs	37,589	42,525	177,097	132,543
2+HOVs	(1,750)	(110,692)	(99,211)	19,775
Medium Trucks	(316)	613	4,625	6,194
Heavy Trucks	1,412	711	2,064	4,288
Arterials				
SOVs	(42,574)	(49,668)	(167,873)	(220,765)
2+HOVs	(9,503)	(73,410)	(91,389)	(59,326)
Medium Trucks	1,018	263	(2,576)	(7,139)
Heavy Trucks	515	(350)	(2,182)	(5,518)
Total - All Combined	**(13,609)**	**(190,009)**	**(179,447)**	**(129,948)**
Vehicle-Hours of Travel (VHT):				
SOVs	(3,598)	(8,059)	(15,612)	(53,904)
2+HOVs	(670)	(9,415)	(10,631)	(10,547)
Medium Trucks	(68)	(213)	(495)	(1,613)
Heavy Trucks	(57)	(247)	(597)	(1,964)
Total - All Combined	**(4,393)**	**(17,934)**	**(27,335)**	**(68,028)**

[1] The full benefits period will not begin until FY 2029, as described in Section 2.2.2; values for full-benefit years were calculated using the interpolated growth rates between FY 2030 and FY 2045, while values for partial-benefit years were calculated using the interpolated growth rates between FY 2025 and FY 2030.

TABLE 11. CHANGE IN AVERAGE WEEKDAY VMT & VHT RELATIVE TO NO BUILD, SR 167 CORRIDOR COMPLETION

	FY 2025 Daily (Stage 1[1])	FY 2030 Daily (Stage 1[1])	FY 2030 Daily (Full Benefits[1])	FY 2045 Daily Full Benefits[1]
Vehicle-Miles of Travel (VMT):				
Limited Access Facilities				
SOVs	8,144	(5,880)	142,817	107,602
2+HOVs	1,997	(59,981)	(34,928)	35,182
Medium Trucks	(1,815)	(1,614)	918	(4,990)
Heavy Trucks	(2,212)	(1,933)	166	(3,507)
Arterials				
SOVs	(17,989)	(32,857)	(176,429)	(249,538)
2+HOVs	(1,834)	(34,174)	(61,775)	(47,605)
Medium Trucks	847	253	(3,226)	(4,132)
Heavy Trucks	255	394	(1,678)	(2,491)
Total - All Combined	**(12,607)**	**(135,792)**	**(134,134)**	**(169,479)**
Vehicle-Hours of Travel (VHT):				
SOVs	(3,609)	(6,700)	(14,321)	(41,352)
2+HOVs	(427)	(4,202)	(5,778)	(5,295)
Medium Trucks	(157)	(246)	(456)	(1,234)
Heavy Trucks	(272)	(368)	(593)	(1,574)
Total - All Combined	**(4,465)**	**(11,516)**	**(21,147)**	**(49,456)**

[1] The full benefits period will not begin until FY 2029, as described in Section 2.2.2; values for full-benefit years were calculated using the interpolated growth rates between FY 2030 and FY 2045, while values for partial-benefit years were calculated using the interpolated growth rates between FY 2025 and FY 2030.

3.2 Economic Competitiveness

3.2.1 Summary of Economic Competitiveness Benefits

The Gateway Program would augment the economic competitiveness of the nation by generating improvements in mobility of people and goods in the Puget Sound region. As presented in Table 12 on the following page, two types of societal benefits are measured in the assessment of economic competitiveness: travel time savings and vehicle operating savings. In calculating vehicle operating savings for this BCA, two estimates were generated: one for savings resulting from decreased wear and tear on vehicles, and another from reduced fuel consumption. The latter benefit was calculated to exclude fuel taxes.

Both travel time savings and reduced vehicle operating costs were calculated using the results of the travel demand modeling described in Section 3.1.

TABLE 12. ECONOMIC COMPETITIVENESS ESTIMATION OF BENEFITS, MILLIONS (2018$)

Benefit	Project Full Opening Year (FY 2029)		Project Lifecycle	
	Undiscounted	Discounted (7%)	Undiscounted	Discounted (7%)
Travel Time Savings: Truck Users	$18.9	$9.0	$831.0	$199.2
Travel Time Savings: Auto Users	$395.3	$187.8	$11,903	$3,049
Vehicle Operating Savings: Truck Users	$0.215	$0.102	$65.7	$14.3
Vehicle Operating Savings: Auto Users	$41.4	$19.7	$828.8	$240.7

3.2.2 Travel Time Savings

Travel time savings includes in-vehicle travel time savings for auto drivers and passengers as well as truck drivers. Travel time is considered a cost to users, and its value depends on the disutility that travelers attribute to time spent traveling. A reduction in travel time translates into more time available for work, leisure, or other activities.

In order to monetize the travel time savings benefits that are likely to result from the Gateway Program, the VHT savings described in Section 3.1 must be converted to person-hours traveled (PHT) by applying an occupancy factor to each vehicle type. PHTs are then converted to dollars in order to aggregate benefits for comparison against costs. This is performed by assuming that travel time is valued as a percentage of the average wage rate, with different percentages assigned to different trip purposes. The assumptions used for value of time and occupancy factors are presented in Table 13 and Table 14, respectively.

TABLE 13. TRAVEL TIME SAVINGS ASSUMPTIONS AND SOURCES

Variable	Unit	Value	Source
Auto Users: Value of Time	2018$/hour	$16.60	US DOT BCA Guidance: Personal Value of Time, Local Auto Users
Truck Users: Value of Time	2018$/hour	$29.50	US DOT TIGER and INFRA BCA Resource Guide: Value of Time, Truck Drivers
Real Wage Growth Rate	per year	0.0%	Real wage growth omitted per US DOT feedback
Annualization Factor	Days	321	Travel Demand Modeling

TABLE 14. AVERAGE VEHICLE OCCUPANCY FACTORS

Variable	Unit	Value	Source
Single-Occupancy Auto	Passengers	1.0	Travel Demand Modeling
HOVs	Passengers	2.8	Travel Demand Modeling
Medium-Duty Trucks	Passengers	1.0	Travel Demand Modeling
Heavy-Duty Trucks	Passengers	1.0	Travel Demand Modeling

Source: https://public.tableau.com/profile/lisa.ballard#!/vizhome/HOVPerformance/Congestionandpersonthroughput.

As described above, the travel demand model was used to generate estimates for incremental daily travel time (relative to the no build scenario) for three future years and two construction stage — FY 2025, FY 2030 and FY 2045 — and six vehicle-facility type combinations. To interpolate partial-benefit annual rates of change for years between FY 2025 and FY 2030, the CAGR between the two model years was calculated and applied to generate values for each intermediate year. Similarly, to interpolate full-benefit annual rates of change for years between FY 2030 and FY 2045, the CAGR between the two model years was calculated and applied to generate values for each intermediate year. The annual rates of change in demand model outputs for years between FY 2046 and FY 2059 were assumed to be 50 percent of the interpolated rates of change between FY 2030 and FY 2045.

The forecasted travel time savings and their monetized benefits are summarized in Table 15 and Table 16 respectively.

TABLE 15. FORECASTED TRAVEL TIME SAVINGS, FY 2029, FY 2045, AND CUMULATIVE (THROUGH FY 2048)

User Type	Unit	FY 2029 (First Full Benefits Year)	2045	Cumulative
Auto Users	PHT	23,809,619	44,942,617	716,849,624
Truck Users	PHT	638,989	2,050,015	28,169,697
Total	PHT	24,448,608	46,992,632	745,019,321

TABLE 16. VALUE OF TRAVEL TIME SAVINGS, FY 2029, FY 2045, AND CUMULATIVE (2018$)

User Type	Unit	FY 2029 (First Full Benefits Year)	2045	Cumulative
Auto Users	2018$	$187,823,032	$115,648,704	$3,049,271,001
Truck Users	2018$	$8,955,586	$9,398,827	$199,172,446
Total	2018$	$196,778,618	$125,047,531	$3,248,443,448

3.2.3 Operating Cost Savings

Vehicle operating cost savings includes the cost of fuel, as well as maintenance and repair, replacement of tires, and the depreciation of the vehicle over time. Fuel consumption rates per VMT are combined with per-VMT rates of wear and tear and depreciation to calculate total vehicle operating cost savings. Estimates of VMT described above and in Table 18 and unit costs for each component of vehicle operating cost are applied to the consumption rates to calculate the total vehicle operating cost. The assumptions used in the estimation of vehicle operating costs are presented in Table 17, with results shown in Table 12.

TABLE 17. OPERATING COST SAVINGS ASSUMPTIONS AND SOURCES

Variable	Unit	Value	Source(s)
Auto: Fuel, Maintenance, Repair, Tires, and Depreciation	2018$ per VMT	$0.41	USDOT BCA Guidance 2020 / AAA "Your Driving Costs" 2018
Truck: Fuel, Maintenance, Repair, Tires, and Depreciation	2018$ per VMT	$0.96	USDOT BCA Guidance 2020 / ATRI Update 2018

Results from the travel demand models described in Section 3.1 were used to estimate vehicle operating cost savings on a per-VMT basis. Table 18 below summarizes the forecasted changes in VMT for autos and trucks.

TABLE 18. FORECASTED CHANGE IN VMT, FY 2029, FY 2045, AND CUMULATIVE (THROUGH FY 2048)

User Type	Unit	2029 (Full Year)	2045	Cumulative
Autos	VMT	(101,035,256)	(90,564,376)	(2,021,584,761)
Trucks	VMT	(224,255)	(5,551,619)	(68,416,001)
Total	**VMT**	**(101,259,511)**	**(96,115,996)**	**(2,090,000,762)**

3.3 Safety

As described earlier, the SR 167 and SR 509 Completion Projects will improve highway safety not only within the project area, but also on roadways throughout the region. By allowing trucks to arrive and leave the Ports of Tacoma and Seattle through limited access routes, the Gateway Program will improve safety through better flow of traffic, improved visibility, and less interaction of trucks and pedestrians. In addition, crashes on local roads, I-5, and existing segments of SR 167 and SR 509 would increase without the SR 167 and SR 509 Completion Projects. Both the SR 167 and SR 509 Completion Projects are projected to increase the safety performance of local roads and highways, as well as on the completed SR 167 and SR 509 corridors, by drivers using them as alternatives to I-5 and local roads.

Utilizing 5-year average crash data for King and Pierce counties from WSDOT Engineering Crash Database (2013 to 2017, see Table 19) as well as the associated VMT data from the 2017 Highway Performance Monitoring System (HPMS) submittal, a crash per million VMT factor was developed for each of the KABCO injury scale levels. The VMT reduction arising from the build case was then multiplied with the crash per million VMT factor for each of the KABCO levels to quantify the reduction in the various KABCO incident categories. These reductions were then monetized to the associated safety costs avoided using the conversion and valuation factors provided in the USDOT INFRA guidance document.

TABLE 19. CALCULATED KABCO CRASHES PER MILLION VMT USING 2013-2017 WSDOT CRASH DATA AND VMT DATA FROM A 2017 HPMS SUBMITTAL

	Limited Access	Arterials
O Crashes per million VMT	1.168	2.790
C Crashes per million VMT	0.368	1.067
B Crashes per million VMT	0.068	0.265
A Crashes per million VMT	0.010	0.064
K Crashes per million VMT	0.003	0.011

Table 20 details the safety benefits arising from the expected reduction in fatalities, injuries, and property damage as result of the expected VMT reductions generated by the project.

TABLE 20. EXPECTED REDUCTION IN KABCO INCIDENTS - CUMULATIVE (THROUGH FY 2048)

Safety Benefit Type	Unit	Cumulative Expected Reduction
Killed – K	Number of incidents	34
Incapacitating – A	Number of incidents	220
Non-Incapacitating – B	Number of incidents	872
Possible Injury – C	Number of incidents	3,358
No Injury - O	Number of incidents	8,448

3.4 State of Good Repair

The primary benefit related to state of good repair assessed in this analysis is the decrease in road and pavement damage caused by a reduction in VMT among auto and truck users. In order to calculate the monetized value for decrease in road damage, per-VMT costs for pavement damage from FHWA were applied to estimates of the expected change in auto and truck VMT, as described in Section 3.1.

The assumptions and sources used in this calculation are presented in Table 21. Monetized estimates for pavement damage reduction in the project's opening year and over the project's lifecycle can be seen in Table 22 on the following page.

TABLE 21. STATE OF GOOD REPAIR BENEFITS ASSUMPTIONS AND SOURCES

Variable	Unit	Value (2018$)	Source
Pavement Damage Costs: Autos	per VMT	$0.002	FHWA, 2000 – weighed on project characteristics of 6% rural and 94% urban
Pavement Damage Costs: Trucks	per VMT	$0.141	FHWA, 2000 – weighed on project characteristics of 6% rural and 94% urban

TABLE 22. STATE OF GOOD REPAIR ESTIMATION OF BENEFITS (2018$)

Benefit	Project Full Opening Year (2029)		Project Lifecycle	
	Undiscounted	Discounted (7%)	Undiscounted	Discounted (7%)
Pavement Damage – Autos	$166,759	$79,226	$3,336,628	$969,015
Pavement Damage - Trucks	$31,558	$14,993	$9,627,876	$2,095,269

3.5 Environmental Sustainability

This project will create environmental and sustainability benefits relating to reduction in air pollution associated with decreased automobile and commercial truck travel. Five forms of emissions were identified, measured and monetized, including: carbon dioxide, nitrous oxide, sulfur dioxide, particulate matter, and volatile organic compounds.

Estimates of emissions reductions were calculated by applying a per-VMT rate of emissions, adjusted for average speed, to expected changes in VMT, as detailed in Section 3.1. This calculation was performed separately for each of the four vehicle-facility types due to different per-VMT emissions rates, expected changes in VMT, and differences in average speed. These monetized emissions reductions for each vehicle type and road type were then summed together to provide a total for each year.

Per-ton monetized estimates for each pollutant type were then applied to the estimates of emissions reductions. USDOT's 2020 Benefit-Cost Analysis Guidance for Discretionary Grant Programs was used to obtain the recommended per-ton monetization values. The final monetized value of emissions reductions can be seen in Table 23 below. The assumptions used are presented in Table 24.

TABLE 23. ENVIRONMENTAL SUSTAINABILITY ESTIMATION OF BENEFITS (2018$)

Domestic Benefit	Project Full Opening Year (FY 2029)		Project Lifecycle	
	Undiscounted	Discounted (7%)	Undiscounted	Discounted (7%)
CO2 Reduction	$30,761	$15,133	$1,194,626	$308,700
NOX Reduction	$35,806	$17,615	$1,806,394	$506,444
SOX Reduction	$11,578	$5,696	$268,360	$77,590
PM^{10} Reduction	$70,669	$34,766	$1,273,990	$394,036
VOC Reduction	$35,349	$17,390	$300,821	$113,170

TABLE 24. ENVIRONMENTAL SUSTAINABILITY BENEFITS ASSUMPTIONS AND SOURCES

Variable	Unit	Value	Source
Emissions Rates by Vehicle Class and Speed	grams per VMT	Varies	California Air Resources Board EMFAC Database, 2017
Domestic Cost of Carbon	2018$/ton	Varies	USDOT 2020 Benefit-Cost Analysis Guidance for Discretionary Grant Programs
Domestic Cost of other Pollutants	2018$/ton	Varies	USDOT 2020 Benefit-Cost Analysis Guidance for Discretionary Grant Programs

4 Summary of Results

4.1 Evaluation Measures

The benefit-cost analysis converts potential gains (benefits) and losses (costs) from each Project into monetary units and compares them. The following common benefit-cost evaluation measures are included in this BCA:

- **Net Present Value (NPV)**: NPV compares the net benefits (benefits minus costs) after being discounted to present values using the real discount rate assumption. The NPV provides a perspective on the overall dollar magnitude of cash flows over time in today's dollar terms.
- **Benefit Cost Ratio (BCR):** The evaluation also estimates the benefit-cost ratio; the present value of incremental benefits is divided by the present value of incremental costs to yield the benefit-cost ratio. The BCR expresses the relation of discounted benefits to discounted costs as a measure of the extent to which a project's benefits either exceed or fall short of the costs.
- **Economic Rate of Return (ERR):** The ERR (sometimes referred to as the Internal Rate of Return or ERR) equates to the discount rate at which the NPV from the Gateway Program equals zero. In other words, it is the discount rate at which the project benefits and costs are equal. Generally, the greater the ERR, the more desirable the project.

4.2 BCA Results

Table 25 presents the evaluation results for the Program. Results are presented in undiscounted form as well as discounted at 7 percent as prescribed by the USDOT.

All benefits and costs were estimated in constant 2018 dollars over an evaluation period extending 32 years from the start of construction in 2016; this period includes 20 years of analysis beginning the commencement of full benefits in FY 2029.

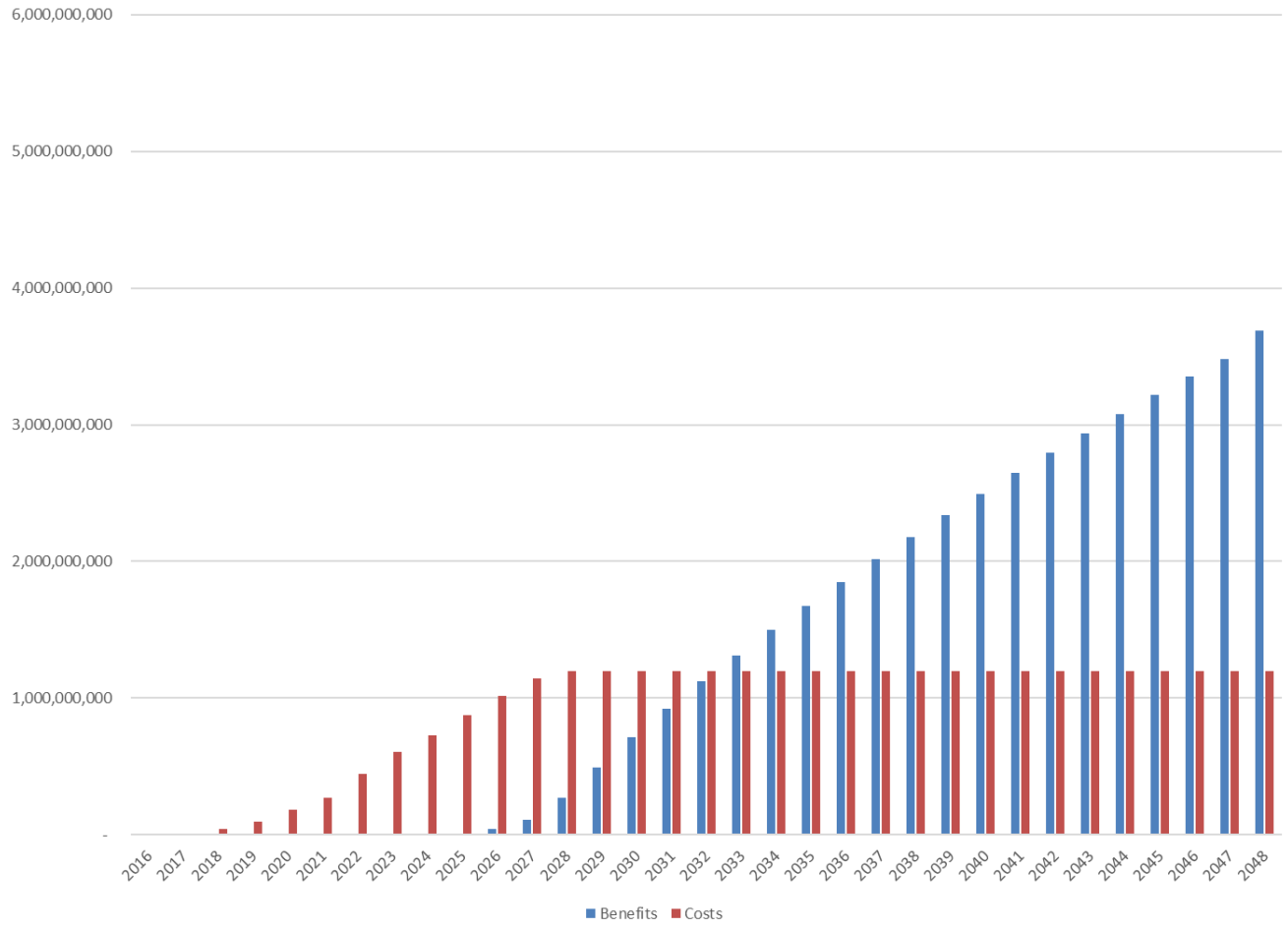
At a discount rate of 7 percent, the Program yields a BCR of 3.07, i.e. the benefits that are likely to result from the Gateway Program clearly exceed its costs.

TABLE 25. BENEFIT COST ANALYSIS RESULTS, 20-YEARS (FYS 2029-48)

BCA Metric	Program Lifecycle	
	Undiscounted 2018$	Discounted 2018$ (7%)
Total Benefits	$14,607,959,664	$3,674,335,924
Total Costs	$1,763,758,107	$1,197,704,678
Net Present Value (NPV)	$12,844,201,557	$2,476,631,246
Benefit Cost Ratio (BCR)	8.28	3.07
Economic Rate of Return (ERR)	17.4%	9.7%

Figure 3 on the following page presents the cumulative benefits and costs in discounted 2018$ for the Gateway Program over 20 years.

FIGURE 3. CUMULATIVE BENEFITS AND COSTS IN DISCOUNTED 2018$, 20-YEARS (FYS 2029-48)



As noted earlier, a 20-year post-construction evaluation period was utilized to present the results of the analysis. However, a 30-year post-construction evaluation period may be most appropriate for long-lived assets such as the Program's new highway segments. Therefore, as a test of the robustness of the BCA results, a 30-year post-construction evaluation period was also analyzed. The overall Program BCA results for both 20- and 30- year post-construction evaluation periods are shown in Table 26 below.

TABLE 26. BENEFIT COST ANALYSIS RESULTS, SENSITIVITY ANALYSIS, MILLIONS (2018$)

BCA Metric	Post Construction / Full Benefits Evaluation Period	
	20 years (FYs 2029 48)	30 years (FYs 2029 58)
Total Benefits	$3,674,335,924	$4,625,654,626
Total Costs	$1,197,704,678	$1,197,704,678
Net Present Value (NPV)	$2,476,631,246	$3,427,949,948
Benefit Cost Ratio (BCR)	3.07	3.43
Economic Rate of Return (ERR)	9.7%	10.2%

Table 27 summarizes the benefit-cost analysis results for the SR 509 and SR167 Completion Projects separately as well as for the overall Program, analyzed for both the 20- and 30- year post-construction benefits evaluation periods.

TABLE 27. BENEFIT COST ANALYSIS RESULTS COMPARISON SUMMARY (2018$)

Case	20 Years (FYs 2029 48)		30 Years (FYs 2029 58)	
	Net Present Value (2018$)	Benefit Cost Ratio	Net Present Value (2018$)	Benefit Cost Ratio
SR 509 Completion Project	$1.56 B	3.64	$2.12 B	4.60
SR 167 Completion Project	$0.92 B	2.51	$1.31 B	3.15
Program Total	**$2.48 B**	**3.07**	**$3.43 B**	**3.86**

Source: WSP Analysis

At a 7% real discount rate, the Gateway Program achieves a benefit-cost ratio (BCR) of 3.07 under a 20-year post-completion evaluation period, with individual corridor BCRs of 3.64 for SR 509 and 2.51 for SR 167. The net benefits under a 30-year post-completion evaluation period are more robust, with higher growth rates in benefits giving SR 509 a higher BCR at 4.60, compared with 3.15 for SR 167.