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PORT OF PORTLAND
CITY OF TROUTDALE
OREGON DEPARTMENT OF TRANSPORTATION

ACCESS OREGON:
ROAD IMPROVEMENTS FOR PHASE II AND PHASE III OF THE TROUTDALE REYNOLDS INDUSTRIAL PARK (TRIP)

ECONOMIC ANALYSIS SUPPLEMENTARY DOCUMENTATION
OCTOBER 28, 2011

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1. Introduction

This document provides detailed technical information on the economic analyses conducted in support of the Grant Application for Phase II and Phase III of the Troutdale Reynolds Industrial Park (TRIP) project. The document is organized as follows:

- Section 1 provides a structural overview of the Benefit-Cost Analysis (BCA).
- Section 2, Methodological Framework, introduces the conceptual framework used in the Benefit-Cost Analysis (BCA).
- Section 3, Project Overview, provides an overview of the project, including a brief description of existing conditions and proposed alternatives; a summary of cost estimates and schedule; and a description of the types of effects that the TRIP Project is expected to generate.
- Section 4, General Assumptions, discusses the general assumptions used in the estimation of project costs and benefits.
- Section 5, Demand Projections provides estimates of travel demand and traffic growth.
- Section 6 provides specific data elements and assumptions pertaining to the long-term outcome selection criteria along with associated benefit estimates.
- Estimates of the project's Net Present Value (NPV), its Benefit/Cost Ratio (BCR) and other project evaluation metrics are introduced in Section 7, Summary of Findings and BCA Outcomes.

Section 0,

- BCA Sensitivity Analysis, provides the outcomes of the sensitivity analysis.
- Detailed economic impact estimates can be found in Section 9, Economic Impact Analysis, along with descriptions of the data sources and modeling tools used in the analysis.

Additional data tables are provided in Section 0,

- Supplementary Data Tables, including annual estimates of benefits and costs, as well as intermediate values to assist the U.S. Department of Transportation (USDOT) in its review of the application.[1]

2. Methodological Framework

Benefit-Cost Analysis (BCA) is a conceptual framework that quantifies in monetary terms as many of the costs and benefits of a project as possible. Benefits from an economic perspective are broadly defined: they represent the extent to which people impacted by the project are made better-off, as measured by their own willingness-to-pay. In other words, central to any benefit-cost analysis is the idea that people are best able to judge what is "good" for them, what improves their well-being or welfare.

Benefit-Cost Analysis also adopts the view that a net increase in welfare (as measured by the summation of individual welfare changes) is a good thing, even if some groups within society are made worse-off. A project or proposal would be rated positively if the benefits to some are large enough to compensate the losses of others.

Finally, Benefit-Cost Analysis is typically a forward-looking exercise, seeking to anticipate the welfare impacts of a project or proposal over its entire life-cycle. Future welfare changes are weighted against today's changes through discounting, which is meant to reflect society's general preference for achieving quantifiable, real results in the present, as well as broader inter-generational concerns.

The specific methodology developed for this application was developed using the above BCA principles and is consistent with the TIGER guidelines published by the USDOT. In particular, the methodology used in this application involves:

- Establishing existing and future conditions under the build and no-build scenarios;
- Assessing benefits with respect to each of the five long-term outcomes identified in the USDOT's Notice of Funding Availability (NOFA)[2];
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Using USDOT guidance for the valuation of travel time savings, safety benefits and reductions in air emissions, while relying on industry best practice for the valuation of other effects;
- Discounting future benefits and costs with the real discount rates recommended by the USDOT (7 percent, as well as 3 percent for sensitivity analysis); and,
- Conducting a sensitivity analysis to assess the impacts of changes in key estimating assumptions.

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[1] While the models and software themselves do not accompany this appendix, greater detail can be provided, including spreadsheets presenting additional interim calculations and discussions on model mechanics and coding, if requested.

[2] U.S. Federal Register, Federal Register / Vol. 76, No. 156 / Friday, August 12, 2011 / Notices, Notice of Funding Availability for the Department of Transportation's National Infrastructure Investments under the Full-Year Continuing Appropriations, 2011; and Request for Comments.

3. Project Overview

The Port/ODOT/Troutdale TIGER III grant will seek funds to provide the required transportation infrastructure needed to open up Phase II and Phase III of the Troutdale Reynolds Industrial Park (TRIP) and the 3,000 new jobs it will bring. The TRIP is the only site within the Portland urbanized area that is large, suitable for industrial development, and ready for development at this time. However, in order for further industrial expansion to occur at the TRIP, roadway infrastructure that accesses the TRIP must be improved and expanded in capacity to mitigate traffic congestion, air emissions, and safety deficits of the existing infrastructure. Practical traffic capacity limits of the existing roadways would be exceeded by further development of the TRIP. Expansion and improvement of the infrastructure will also avoid negative community livability, economic justice, and environmental impacts that would occur if the TRIP development continued regardless.

The cost of this infrastructure will not be fully borne by prospective users of the site, who can instead choose other sites that do not present similar development-cost thresholds. However, these alternative sites lie at a significant distance to the Portland urban area. Trucking and employee commuting costs to and from these distant sites will not be so severe that it will create an economic trigger for industrial-site users to pay for TRIP infrastructure improvements, but it will create a significant externalized cost to the public of traffic congestion, air emissions, highway maintenance, and greater dependence upon fossil fuels. Thus, this TIGER application seeks to quantify the externalized public costs that are expected to occur if the roadway infrastructure necessary to develop the TRIP is not constructed.

The TRIP is the only practical site that avoids these externalized public costs due to unusual characteristics of the Portland urban area. The urban area is highly constrained for development by geography and land ownership. Most of the urban area borders mountain ranges or Columbia River wetlands that are not economically or environmentally practicable for development. Land use patterns and land ownership vested in National Forests, Scenic Areas, watershed collection areas further restrict outward expansion. Within the Portland urban area, historic land uses have subdivided land parcels to the extent that aggregation for industrial use is costly and disruptive to communities. State and local land use policies have emphasized preservation of existing agricultural land and rural communities, in order to improve community livability, quality of life, and economic justice. Under these policies industrial development is only allowed within an established Urban Growth Boundary (UGB) and the industrial land supply within the UGB is constrained.

As a result, industrial development cannot readily occur within the Portland urban area. Instead, development is occurring at significant distances removed from the Portland urban area, such as in farmland at 15 to 20 mile distances across the Columbia River in Washington State, such as near Woodland, Wash., and at 30-50 mile distances on farmland in the Willamette Valley south of Portland, beyond urban land use restrictions. The low cost of this farmland for development provides a satisfactory economic equation for users of industrial parks: trucking to the Portland core does not increase industrial user costs to a sufficient degree to reach the threshold for investing in public infrastructure to support TRIP development.

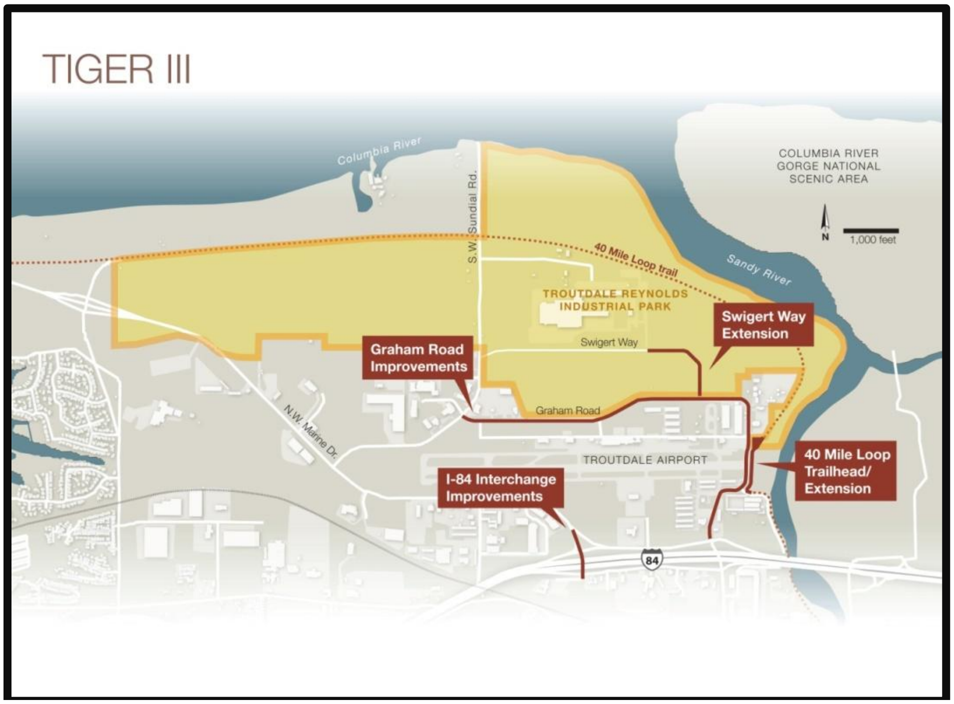
Project Details

The project will improve the roadway infrastructure that serves the TRIP as follows:

1. It will repave 1.5 miles of Graham Road to make it suitable for the heavy truck traffic that will occur with TRIP (see Figure 1 below), and install sidewalks and a storm water drainage system. For the Graham Road project the Port will partner with the City of Troutdale.
2. It will extend Swigert Way from its current terminus to Graham Road.
3. A segment of the 40 Mile Loop Trail from its existing terminus to Harlow Road will be constructed, as well as trailhead parking, in order to improve community livability and meet local community multimodal commuting needs.
4. The Port will partner with the Oregon Department of Transportation to improve the Troutdale Interchange Marine Drive Undercrossing, converting it from one-way to two-way to reduce traffic circuity, congestion and emissions, and improve safety.

The Graham Road, Swigert Way and Troutdale Interchange improvements will not only allow for development of the remainder of TRIP, but will reduce travel times and distances for vehicles destined to and from the industrial park.

Figure 1: TRIP Project Map



3.1 Base Case and Alternatives

The base case or no-build scenario is status quo in that suggested roadway improvements are not made. In this case, undeveloped lands at TRIP are not developed due to lack of appropriate infrastructure and potential tenants seek alternative sites located at a significant distance to the Portland urban area. As a result, highway maintenance, congestion, safety, and emissions costs all increase. Private costs for greater transportation use also increase, as well as employee commute costs. The alternative case or build scenario is the TRIP project is made available for development following the construction of the roadway and trail improvements described above. Externalized public costs for highway congestion, maintenance, safety, and emissions, do not occur (as travel distances for employees and freight moving to and from the location of industrial development are decreased), and private costs for increased trucking and employee commute costs are also reduced.

3.2 Project Cost and Schedule[3]

The total capital costs for the project are $36.7 Million (M) which reflect costs from 2012 through 2015, the expected construction period, and are discounted to 2011 using a 7 percent real discount rate. Undiscounted costs by time period are provided in Table 1.

These costs include construction, design, permitting and close out costs.

Table 1: Summary of Project Costs, Undiscounted, 2011 $

Period	Expenditure
2012	$5.76
2013	$7.05
2014	$21.42
2015	$2.45
Total	**$36.68**

3.3 Effects on Long-Term Outcomes

The main benefit categories associated with the project are mapped into the five long-term outcome criteria set forth by the USDOT in the table below.

Table 2: Expected Effects on Long Term Outcomes and Benefit Categories

Long-Term Outcomes	Benefit Categories	Description	Monetized
State of Good Repair	Reduced Pavement Cost in TRIP due to shorter access/egress for existing traffic	Short vehicle travel distances reduces the cost of highway pavement re-surfacing and maintenance	√

[3] All cost estimates in this section are in millions of dollars of 2011, discounted to 2011 using a 7 percent real discount rate.

Long-Term Outcomes	Benefit Categories	Description	Monetized
	Reduced Regional Pavement Cost due to shorter distance to/from Port of Portland and urban core relative to alternative sites	Shorter access/egress to/from the Port of Portland or the urban core reduces road pavement and maintenance cost	√
Economic Competitiveness	Travel Time Savings in TRIP due to shorter access/egress for existing traffic	The road improvements reduce access/egress distance for existing traffic from the TRIP resulting in travel time savings	√
	Reduced Vehicle Operating Costs in TRIP due to shorter access/egress for existing traffic	The road improvements reduce travel distances leading to less vehicle operating cost., e.g., less fuel and oil consumption	√
	Regional Travel Time Savings due to shorter Travel Distance from Port of Portland and urban core relative to alternative sites	TRIP is geographically closer to the Port of Portland and urban core; trucks to/from TRIP save travel time compared with other industrial sites	√
	Reduced Regional Vehicle Operating Costs due to shorter Distance to/from the Port of Portland and urban core relative to alternative sites	Shorter access/egress from the Port and urban core results in less vehicle operating costs	√
Livability	Health Improvement due to Bicycle Trail Extension	40 Mile Loop Trail extension encourages residents' levels of cycling leading to savings in healthcare cost	√
	Mobility Benefit due to Bicycle Trail Extension	Commuters are willing to spend more time cycling on improved bicycle facilities resulting in mobility benefit	√
	Recreation Benefit due to Bicycle Trail Extension	Improved bicycle facilities generates outdoor recreational benefits	√
	Reduced Auto Use Benefits due to Bicycle Trail Extension	Increased bicycle commuters reduce the use of automobiles leads to less congestion, pollution, and user costs.	√
Environmental Sustainability	Environmental Savings in TRIP due to shorter access/egress for existing traffic	The shorter access/egress from the TRIP reduces travel time and mitigates vehicle emissions	√
	Regional Environmental Savings due to shorter Distance to/from Port of Portland and urban core relative to alternative sites	Shorter access/egress from the Port and urban core help mitigate vehicle emissions	√
Safety	Reduced Accident Costs in TRIP due to less Vehicle Miles Travelled for existing traffic	Reduced vehicle miles traveled reduces the number of vehicle accidents	√
	Reduced Regional Accident Costs due to less Vehicle Miles Traveled to/from Port of Portland and urban core relative to alternative sites	Shorter access/egress routes reduce the overall vehicle accidents	√

4. General Assumptions

The BCA measures benefits against costs throughout a period of analysis beginning at the start of construction in 2012 through 2015 Q1 and including 20 years of operations.

The monetized benefits and costs are estimated in 2011 dollars with future dollars discounted in compliance with TIGER requirements using a 7 percent real rate, and sensitivity testing at 3 percent.

The methodology makes several important assumptions and seeks to avoid overestimation of benefits and underestimation of costs. Specifically:

- Input prices are inflated to 2011 dollars;
- The period of analysis begins in 2012 and ends in 2034. It includes project development and construction years (2012 - 2015) and 20 years of operations (2015 - 2034);
- A constant 7 percent real discount rate is assumed throughout the period of analysis. A 3 percent real discount rate is used for sensitivity analysis;
- Opening year demand is an input to the BCA and is assumed to be fully realized in Year 1 (no ramp-up); and
- Unless specified otherwise, the results shown in this document correspond to the effects of the Full Build alternative.

5. Demand Projections

The demand projections are based on actual traffic counts and no growth is assumed other than traffic generation due to the Industrial Park Development.

Table 3: Assumptions used in the Estimation of Demand

Variable Name	Unit	Value	Source
Existing Inbound Traffic at west end of interchange of TRIP	vehicles/day	2,432	Port of Portland Traffic Counts
Existing Outbound Trucks at west end of interchange of TRIP	vehicles/day	851	Primarily FedEx Trucks (source: Port of Portland Traffic Counts)
Existing Inbound Trucks at east end of interchange of TRIP	vehicles/day	586	Only FedEx trucks are currently prohibited from using Graham (Port of Portland Traffic Counts)
Existing Outbound Trucks at east end of interchange of TRIP	vehicles/day	586	
Percentage of Automobiles of Total Traffic	%	65%	Port of Portland
Percentage of Trucks of Total Traffic	%	35%	Port of Portland
Traffic Generation due to the Industrial Park Development	vehicle trips per day per square foot of building	0.00132	Truck generation rate in the Industrial Park excluding FedEx building development. Source: DKS Associates (2010) TRIP -

Variable Name	Unit	Value	Source
			Phase II Analysis, and Port of Portland
Annual Building Footage Development in the Industrial Park	square ft per year	603,976	Port of Portland; Assuming full development within five years (excluding FedEx)

5.3 Demand Estimates and Projections

The resulting projections for traffic demand are presented in the table below.

Table 4: Demand Estimates and Projections

	In Project Opening Year (2015)	2019	2024	2029	2034
Existing TRIP ADT benefit from Road Improvements - Automobiles	1,581	1,581	1,581	1,581	1,581
Existing TRIP ADT benefit from Road Improvements - Trucks	2,874	2,874	2,874	2,874	2,874
Total Number of Trucks to/from Port of Portland and urban core due to TRIP development	797	3,986	3,986	3,986	3,986

6. Benefits Measurement, Data and Assumptions

This section describes the measurement approach used for each benefit category identified in Table 2 (Expected Effects on Long Term Outcomes and Benefit Categories) and provides an overview of the associated methodology, assumptions, and estimates.

6.1 State of Good Repair

To quantify the benefits associated with maintaining the existing transportation network in a state of good repair these benefits include reduced pavement costs through shorter access/egress through Troutdale and the Port of Portland and the Portland urban core.

6.1.1 Methodology

Structure and logic models are provided to illustrate how reduced pavement costs are developed as a function of the difference in vehicle miles travelled (e.g., Alt. – base) and a unit cost per vehicle miles travelled.

Figure 2: Reduced Pavement Cost in TRIP due to shorter access/egress from Troutdale

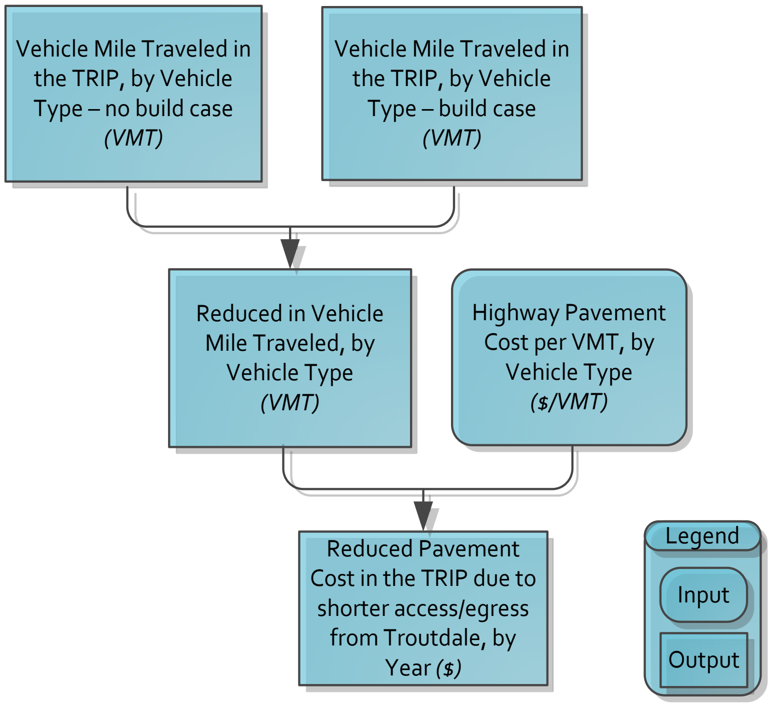
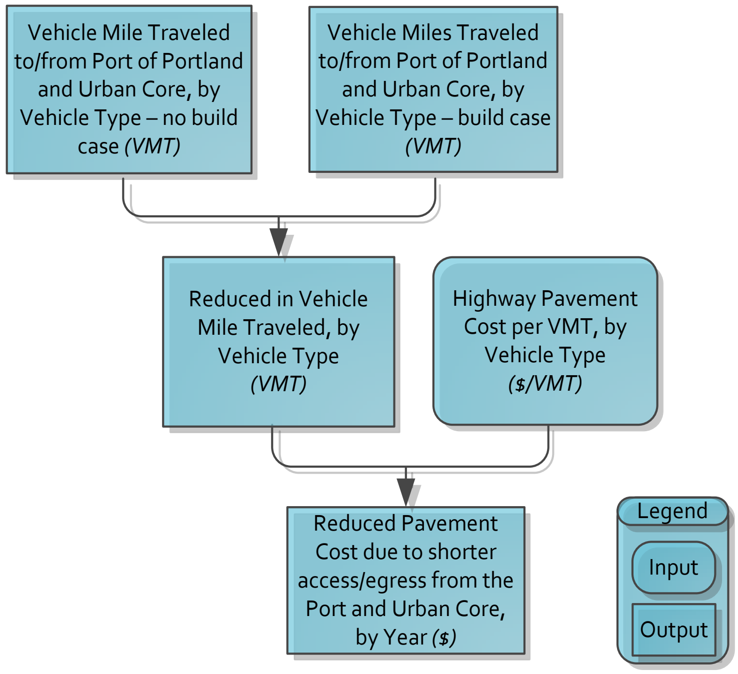


Figure 3: Reduced Pavement Cost in TRIP due to shorter access/egress from Port of Portland and Portland Urban Core



6.1.2 Assumptions

The assumptions used in the estimation of State-of-Good-Repair benefits are summarized in the table below.

Table 5: Assumptions used in the Estimation of State-of-Good-Repair Benefits

Variable Name	Unit	Value	Source
Number of equivalent days per year of TRIP Operations	days	286	HDR calculation based on average trip rates from the 7th Edition ITE Trip Generation Manual for Manufacturing and Distribution and Warehousing (25% traffic volume for Sat and Sun, 100% for Mon - Fri)
Average Trip Length of Inbound Traffic at west end of interchange before Road Improvements	miles	2.88	Source: Port of Portland
Average Trip Length of Inbound Traffic at west end of interchange after Road Improvements	miles	1.96	
Average Trip Length of Outbound Trucks at west end of interchange before Road Improvements	miles	2.2	FedEx trucks could save travel distance by using Swigert extension and Graham Rd after the improvements (Source: Port of Portland)
Average Trip Length of Outbound Trucks at west end of interchange after Road Improvements	miles	1.6	
Average Trip Length of Inbound Trucks at east end of interchange before road	miles	2.3	Source: Port of Portland

Variable Name	Unit	Value	Source
improvements			
Average Trip Length of Inbound Trucks at east end of interchange after road improvements	miles	1.8	
Average Trip Length of Outbound Trucks at east end of interchange before road improvements	miles	2.2	FedEx trucks could save travel distance by using Swigert extension and Graham Rd after the improvements (Source: Port of Portland)
Average Trip Length of Outbound trucks at east end of interchange after road improvements	miles	1.6	
Percentage of Automobiles of Total Traffic	%	0.65	Port of Portland
Percentage of Trucks of Total Traffic	%	0.35	Port of Portland
Percentage of Trucks traveling between Industrial Park and Portland International Airport (PDX)	%	0.15	Port of Portland
Percentage of Trucks traveling between Industrial Park and T6	%	0.85	
Road Distance between TRIP and PDX	mile	10.7	Port of Portland and HDR calculation
Road Distance between TRIP and Port of Portland Terminal 6	mile	19.1	
Road Distance between Woodland and PDX	mile	28.3	
Road Distance between Woodland and T6	mile	26.4	
Highway Pavement Cost per mile of Automobile Travel	2011$/vmt	$0.001	Addendum to the 1997 Federal Highway Cost Allocation Study, U.S. DOT, FHWA May 2000. (http://www.fhwa.dot.gov/policy/hcas/addendum.htm)
Highway Pavement Cost per mile of Truck Travel	2011$/vmt	$0.14	

6.1.3 Benefit Estimates

The reduced pavement costs are $10.7 M over the project lifecycle.

Table 6: Estimates of State-of-Good-Repair Benefits, in Millions of 2011 Dollars

	In Project Opening Year	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Reduced Pavement Cost in TRIP due to shorter access/egress	$0.08	$1.54	$0.66
Reduced Regional Pavement Cost due to shorter Distance to/from Port of Portland and PDX	$0.28	$24.98	$10.02

6.2 Economic Competitiveness

The proposed project would contribute to enhancing the economic competitiveness of the Nation through improvements in the mobility of people and goods within and across the study area. In this analysis, two measures of mobility are presented: travel-time savings and out-of-pocket transportation cost savings.

Economic competitiveness is enhanced by TRIP through travel time savings and out-of-pocket travel cost savings that would be generated by the project; and estimated and monetized in the BCA.

6.2.1 Methodology

Structure and logic models are provided to illustrate the derivation of travel time savings and vehicle operating cost savings.

Figure 4: Travel Time Savings due to shorter access/egress from Troutdale

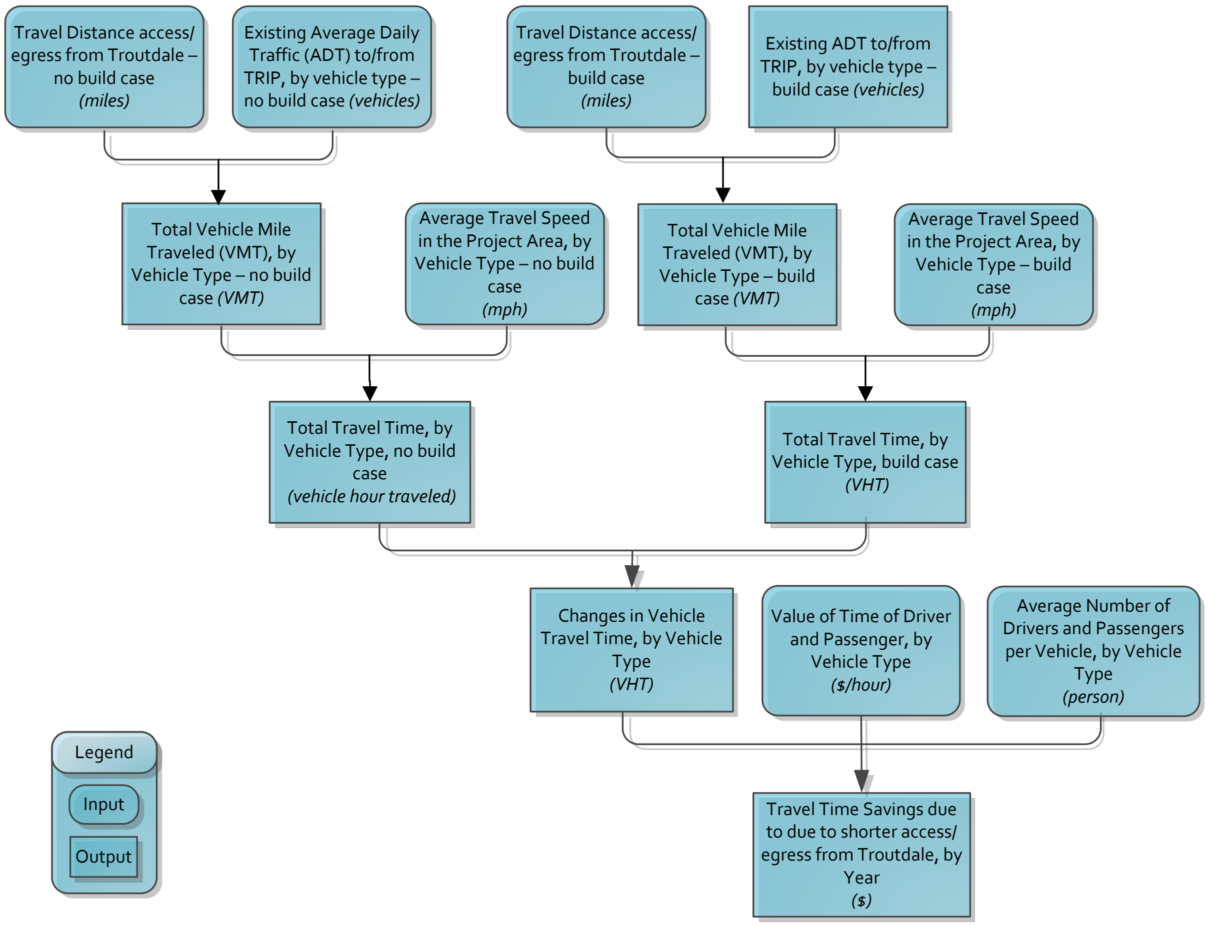


Figure 5: Reduced Vehicle Operating Costs due to shorter access/egress from Troutdale

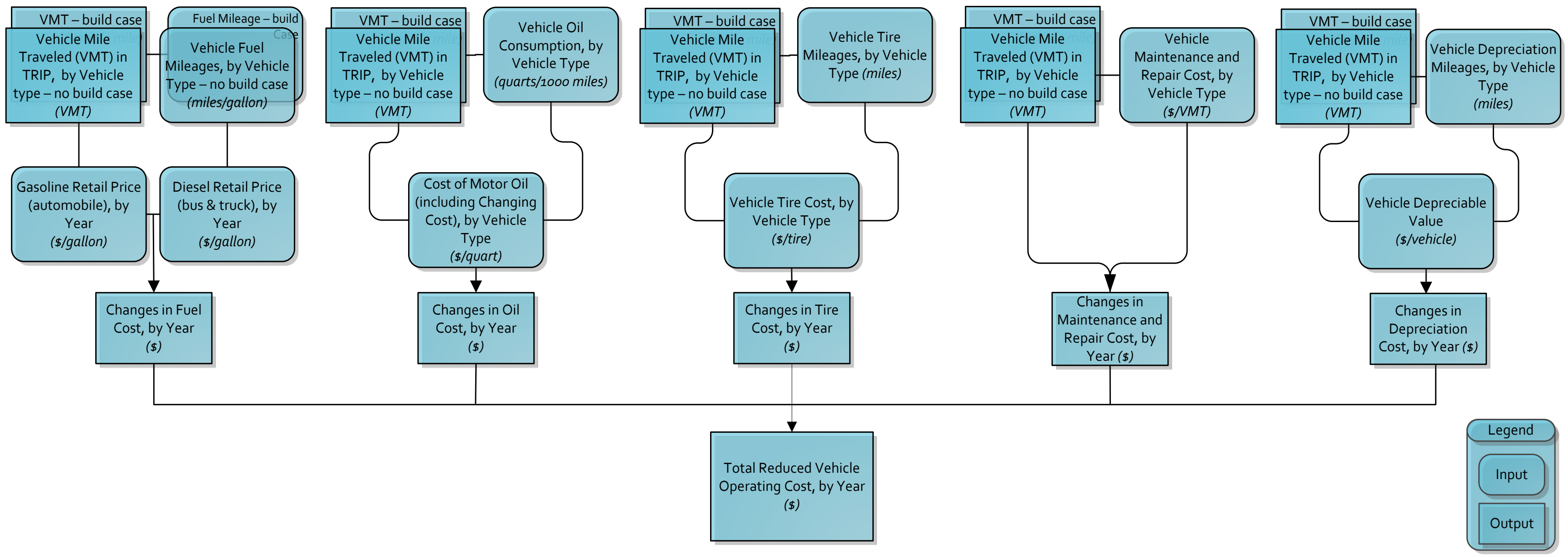


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Figure 6: Travel Time Savings due to shorter distance from TRIP than Alternative Industrial Sites

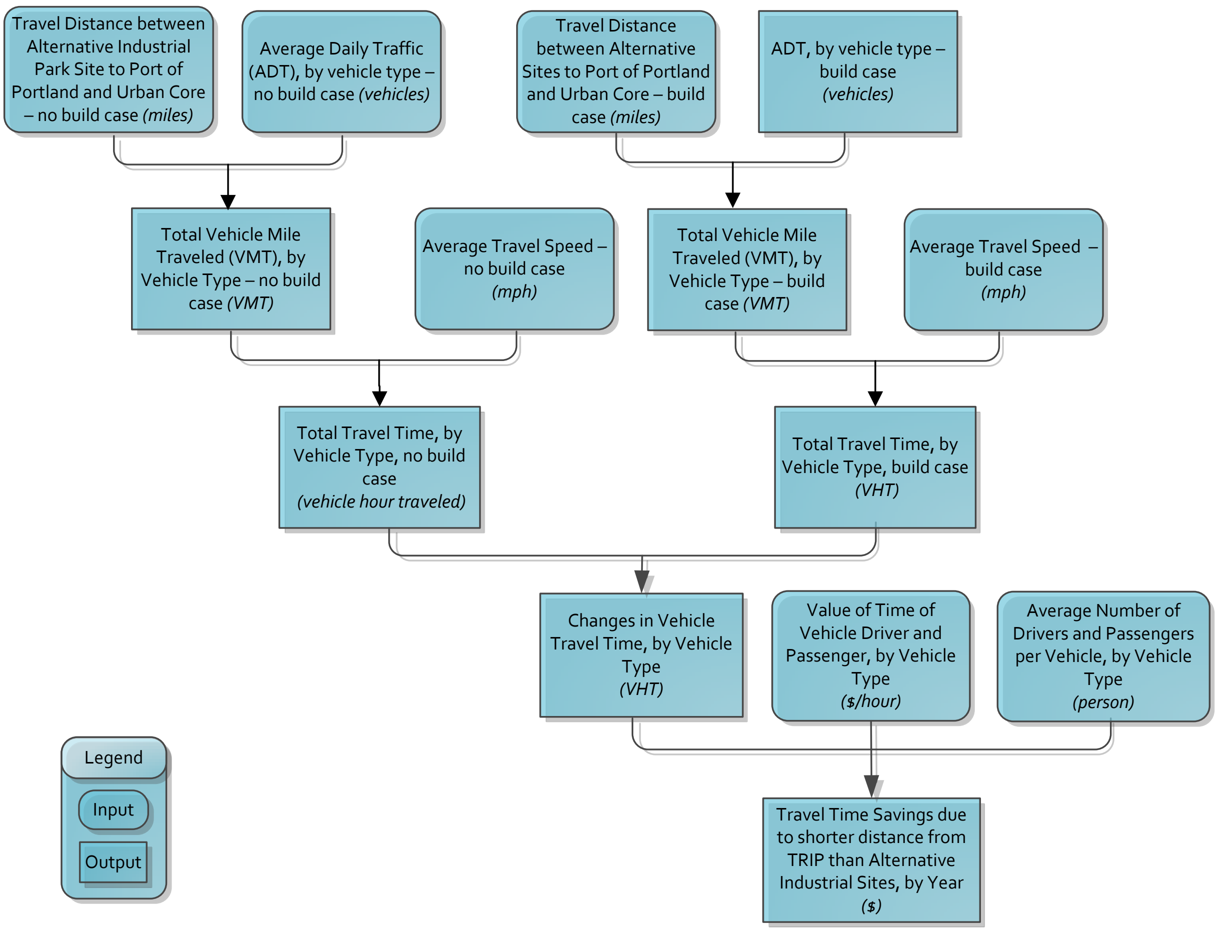
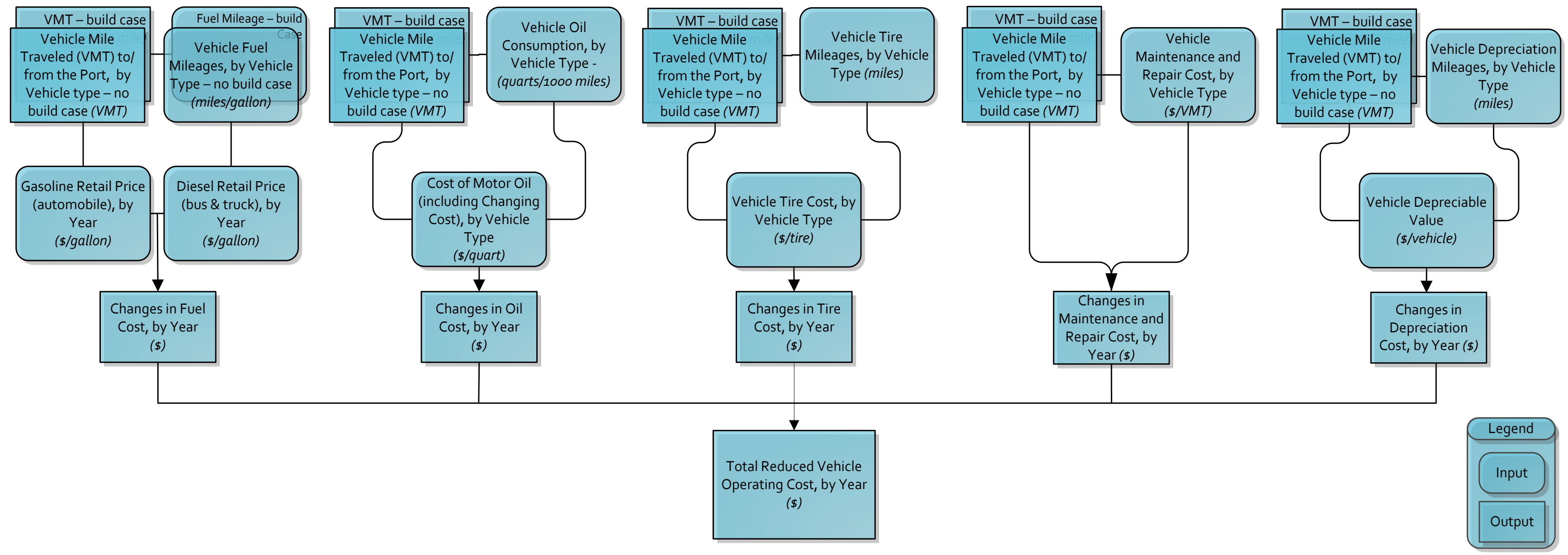


Figure 7: Reduced Vehicle Operating Costs due to shorter access/egress from Port of Portland and Urban Core



6.2.2 Assumptions

The assumptions used in the estimation of travel time savings and vehicle operating cost savings are summarized in the tables below.

Table 7: Assumptions used in the Estimation of TRIP and Regional Travel Time Savings

Variable Name	Unit	Value	Source
Average Travel Speed in TRIP - no build case	mph	35	Port of Portland
Average Travel Speed in TRIP - build case	mph	35	Port of Portland
Average Number of Persons per Automobile	persons	1.60	Average 1.60 drivers and passengers per vehicle sourced from National Highway Traffic Safety Administration, "Corporate Average Fuel Economy for FY 2011 Passenger Cars and Light Trucks", 2006 page VIII-59
Value of Time for Automobile Driver and Passenger	2011$/hour	$12.77	USDOT (2011) Revised Departmental Guidance: Valuation of Travel Time in Economic Analysis. Inflated 2009$ to 2011$.
Value of Time for Truck Driver	2011$/hour	$24.75	
Value of Time Growth Rate per Year	%	1.6%	USDOT (2011) Revised Departmental Guidance: Valuation of Travel Time in Economic Analysis.
Average Travel Speed from TRIP to PDX and T6 - build case	mph	55	Port of Portland
Average Travel Speed from the Alternative Park Location to PDX and T6- no build case	mph	55	

Table 8: Assumptions used in the Estimation of TRIP and Regional Reduced Vehicle Operating Costs

Variable Name	Unit	Value	Source
Automobile Fuel Mileage - no build case	miles/gallon	33.3	CAFÉ standards of 2013 model passenger cars. USDOT NHTSA (2011)
Truck Fuel Mileage - no build case	miles/gallon	6.5	Mobile 6.2 assumes a current tractor-trailer combination loaded to the legal 80,000-lb.-GVW limit and getting 6.5 mpg. No empty backhaul is assumed.
Annual Automobile Fuel Efficiency Improvement	%	5%	Calculated efficiency improvements from CAFÉ standards between 2013-2016; Assumes no improvements for fuel efficiency of trucks
Automobile Oil Consumption	quarts/1000 miles	0.04	FHWA (Federal Highway Administration) HERS-ST Technical Report August 2005
Truck Oil Consumption	quarts/1000 miles	0.53	
Automobile Tires Mileage	miles	62,203	FHWA HERS-ST Technical Report 2002
Truck Tires Mileage	miles	32,404	
Automobile Tire Cost	2011$/tire	$74	HDR sourced tire cost from FHWA (2002) HERS Technical Report and inflated to 2011$ by Tire Price Index (source: BLS CUUR0000SETC01)
Truck Tire Cost	2011$/tire	$601	

Variable Name	Unit	Value	Source
Automobile Maintenance and Repair Cost	2011$/1000 miles	$158	HDR sourced vehicle maintenance and repair cost from FHWA (2002) HERS Technical Report and inflated to 2011$ by motor vehicle maintenance and repair price index (BLS CUUR0000SETD)
Truck Maintenance and Repair Cost	2011$/1000 miles	$550	
Automobile Depreciation Mileage	miles	153,860	FHWA HERS-ST Technical Report August 2005
Truck Depreciation Mileage	miles	1,043,793	
Automobile Depreciable Value	2011$/vehicle	$17,656	HDR sourced new vehicle cost from FHWA (2002) HERS Technical Report and inflated to 2011$ by new vehicle price index (BLS CUUR0000SS45021, CUUS0000SS45011)
Truck Depreciable Value	2011$/vehicle	$83,136	
Gasoline Retail Price - 2015	2011$/gallon	$3.27	Gasoline sales weighted-average price for all grades. Includes Federal, State, and local taxes. (Source: US EIA Annual Energy Outlook 2011. Converted to 2011$)
Gasoline Retail Price - 2016	2011$/gallon	$3.31	
Gasoline Retail Price - 2017	2011$/gallon	$3.39	
Gasoline Retail Price - 2018	2011$/gallon	$3.44	
Gasoline Retail Price - 2019	2011$/gallon	$3.48	
Gasoline Retail Price - 2020	2011$/gallon	$3.52	
Gasoline Retail Price - 2021	2011$/gallon	$3.53	
Gasoline Retail Price - 2022	2011$/gallon	$3.60	
Gasoline Retail Price - 2023	2011$/gallon	$3.61	
Gasoline Retail Price - 2024	2011$/gallon	$3.67	
Gasoline Retail Price - 2025	2011$/gallon	$3.69	
Gasoline Retail Price - 2026	2011$/gallon	$3.71	
Gasoline Retail Price - 2027	2011$/gallon	$3.77	
Gasoline Retail Price - 2028	2011$/gallon	$3.78	
Gasoline Retail Price - 2029	2011$/gallon	$3.83	
Gasoline Retail Price - 2030	2011$/gallon	$3.79	
Gasoline Retail Price - 2031	2011$/gallon	$3.80	
Gasoline Retail Price - 2032	2011$/gallon	$3.81	
Gasoline Retail Price - 2033	2011$/gallon	$3.82	
Gasoline Retail Price - 2034	2011$/gallon	$3.84	
Diesel Retail Price - 2015	2011$/gallon	$3.21	Diesel fuel for on-road use. Includes Federal and State taxes while excluding county and local taxes. (Source: US EIA Annual Energy Outlook 2011. Converted to 2011$)
Diesel Retail Price - 2016	2011$/gallon	$3.33	
Diesel Retail Price - 2017	2011$/gallon	$3.43	
Diesel Retail Price - 2018	2011$/gallon	$3.52	
Diesel Retail Price - 2019	2011$/gallon	$3.61	
Diesel Retail Price - 2020	2011$/gallon	$3.67	
Diesel Retail Price - 2021	2011$/gallon	$3.69	
Diesel Retail Price - 2022	2011$/gallon	$3.76	
Diesel Retail Price - 2023	2011$/gallon	$3.78	
Diesel Retail Price - 2024	2011$/gallon	$3.86	
Diesel Retail Price - 2025	2011$/gallon	$3.88	
Diesel Retail Price - 2026	2011$/gallon	$3.91	

Variable Name	Unit	Value	Source
Diesel Retail Price - 2027	2011$/gallon	$3.96	
Diesel Retail Price - 2028	2011$/gallon	$3.98	
Diesel Retail Price - 2029	2011$/gallon	$4.03	
Diesel Retail Price - 2030	2011$/gallon	$4.00	
Diesel Retail Price - 2031	2011$/gallon	$4.00	
Diesel Retail Price - 2032	2011$/gallon	$4.01	
Diesel Retail Price - 2033	2011$/gallon	$4.01	
Diesel Retail Price - 2034	2011$/gallon	$4.04	
Cost of Motor Oil - Automobile	2011$/quart	$8.65	HDR calculated by inflating motor oil price of FHWA (2002) HERS Technical Report to 2011$ by Motor Oil CPI (BLS CUUR0000SS47021)
Cost of Motor Oil - Truck	2011$/quart	$3.46	

6.2.3 Benefit Estimates

The TRIP Project results in significant benefits in terms of economic competitiveness in excess of $147 Million over the project lifecycle. The largest benefit relates to reduced vehicle operating costs which is the TRIP project's largest individual benefit.

Table 9: Estimates of Travel Time and Out-of-Pocket Cost Savings, in Millions of 2011 Dollars

	In Project Opening Year	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Travel Time Savings in TRIP due to shorter access/egress	$0.68	$15.80	$6.60
Reduced Vehicle Operating Costs in TRIP due to shorter access/egress	$0.82	$17.16	$7.37
Regional Travel Time Savings due to shorter Travel Distance from Port of Portland, Portland urban core, and PDX	$0.97	$103.10	$40.14
Reduced Regional Vehicle Operating Costs due to shorter Distance to/from Port of Portland, Portland urban core, and PDX	$2.42	$235.20	$93.55

6.3 Livability

The proposed project would contribute to enhancing livability and quality of life in the study area through the extension of the bicycle trail. Health, mobility, recreational and reduced auto use benefits are monetized in the study

6.3.1 Methodology

Structure and logic models are provided for each benefit to illustrate how the monetized values of these four effects are derived.

Figure 8: Health Improvement due to the Bicycle Trail Extension

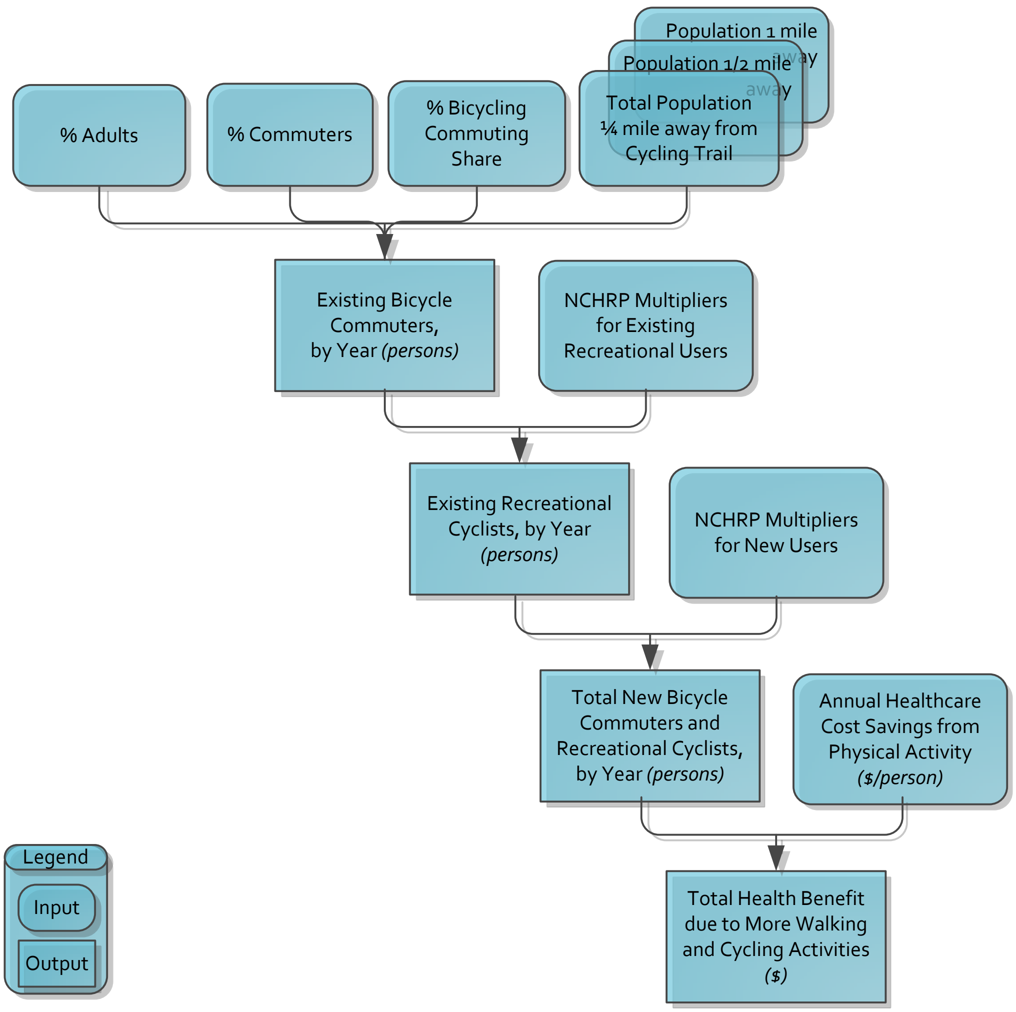


Figure 9: Mobility Benefit due to the Bicycle Trail Extension

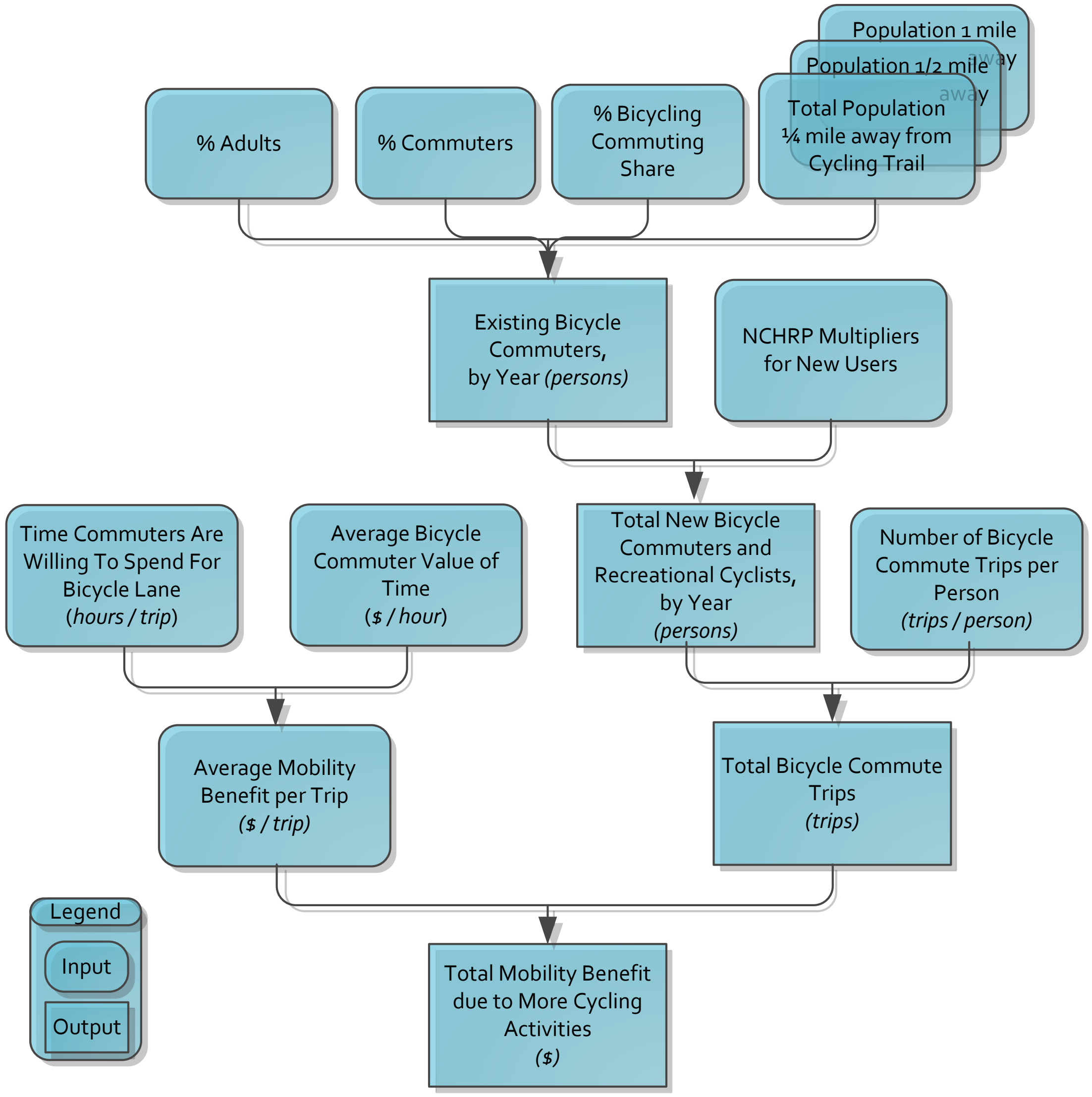


Figure 10: Recreation Benefit due to the Bicycle Trail Extension

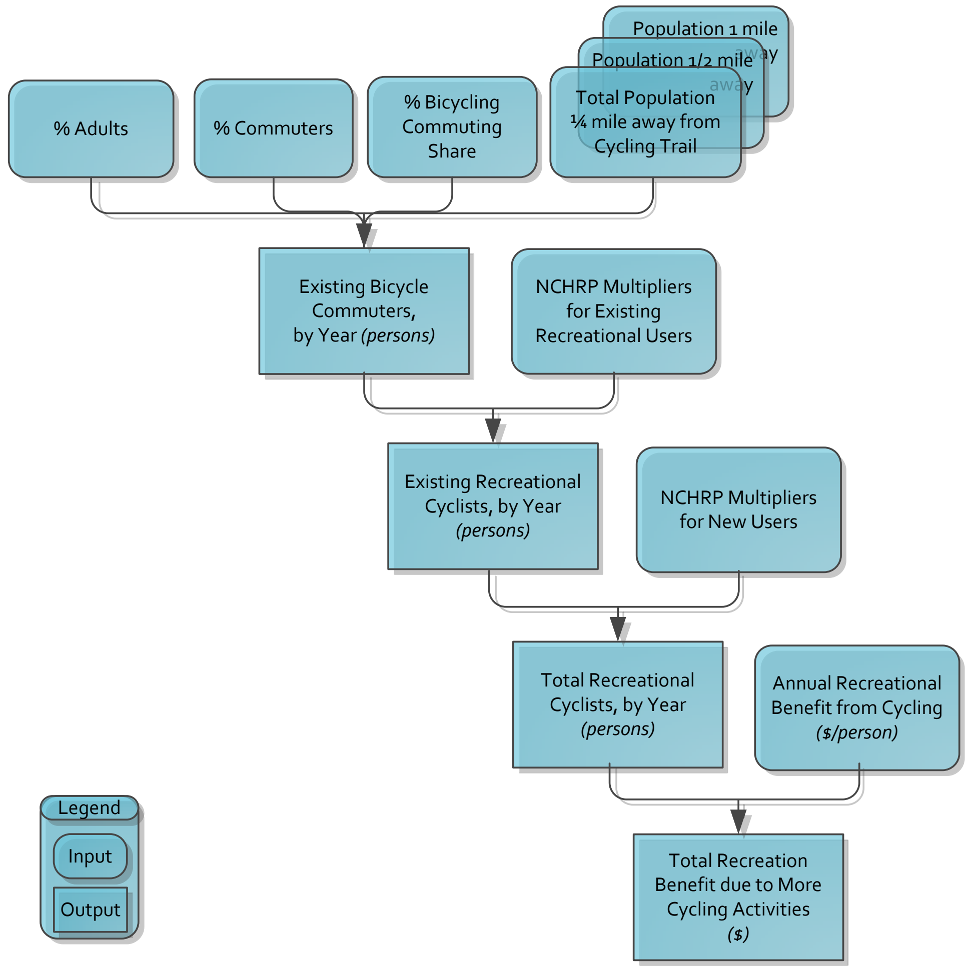
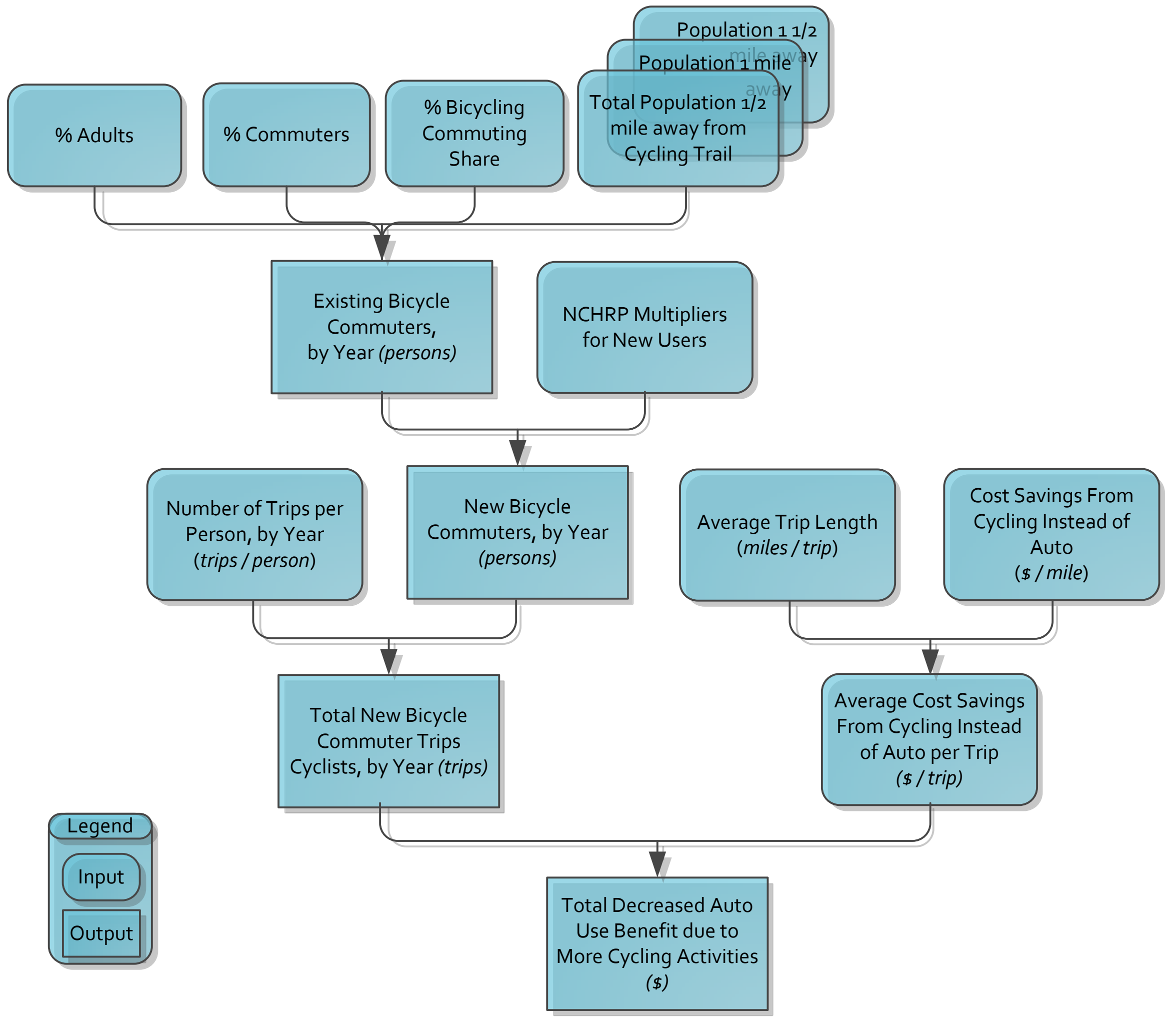


Figure 11: Reduced Auto Use Benefits due to the Bicycle Trail Extension



6.3.2 Assumptions

The assumptions used in the estimation of livability benefits are summarized in the tables below.

Table 10: Assumptions used in the Estimation of Health Improvement due to Improved Bicycle Facilities

Variable Name	Unit	Value	Source
Length of the New Bike Trail on Graham Road	feet	1,000	Port of Portland
Length of the New Bike Trail on Marine Drive Underpass	feet	400	
Total Length of the New Bicycle Facility	mile	0.27	HDR calculation
Bicycle Facility Type	type	Type (2)	(1) On-Street Bicycle Lane with Parking; (2) On-Street Bicycle Lane without Parking;

Variable Name	Unit	Value	Source
			(3) Off-Street Bicycle Trail
Percentage of Adult Residents in Study Area	%	78.8%	Percentage of residents 18 years and older in Multnomah County, OR. (US census bureau 2009)
Percentage of Commuters	%	50%	TRB-NCHRP (National Cooperative Highway Research Program) Guidelines (2006)
Percentage of Bicycle Commute Share	%	0.8%	the 2000 Census indicates a bicycle commute share of 0.76% for Portland--Salem, OR--WA
Percentage of Children who ride a bike on a given day	%	5.0%	2001 National Household Travel Survey (NHTS)
NCHRP Biking Likelihood Multiplier of Population live within 1/2 mile of a Bike Trail	unit	2.11	TRB-NCHRP (National Cooperative Highway Research Program) Guidelines (2006)
NCHRP Biking Likelihood Multiplier of Population live from 1/2 - 1 mile away of a Bike Trail	unit	1.39	
NCHRP Biking Likelihood Multiplier of Population from 1 - 1 1/2 miles away of a Bike Trail	unit	0.15	
Annual Healthcare Cost Savings from Physical Activity	2011$/person	$141.97	NCHRP Guidelines (2006) - the median value of 10 studies

Table 11: Assumptions used in the Estimation of Mobility Benefit due to Improved Bicycle Facilities

Variable Name	Unit	Value	Source
Time Bicycle Commuters are willing to spend for a bicycle lane	minutes	18	NCHRP Guidelines (2006) for Type (2) bike lane
Value of Time for Cyclist	2011$/hour	$12.77	Assume to be same as a automobile driver
Cyclist Commuting Trips Per Day	trips	2	NCHRP Guidelines (2006)
Number of Working Days per Year	days/year	250	HDR Calculation: 5 days per week multiplied by 50 working weeks per year

Table 12: Assumptions used in the Estimation of Recreation Benefit due to more Cycling Activities

Variable Name	Unit	Value	Source
Value of Recreation per day including 1 hour of Bicycling Activity	2011$/day	$10.00	NCHRP Guidelines (2006) sourced from a variety of studies of outdoor recreational activities.

Table 13: Assumptions used in the Estimation of Benefits due to Decreased Auto Use

Variable Name	Unit	Value	Source
Reduced Auto Use Savings per Mile from Cycling	2011$/mile	$0.08	NCHRP Guidelines (2006) for suburban areas

Variable Name	Unit	Value	Source
Daily Round Trip Length of Bicycle Commuters	mile	0.53	HDR calculated as twice the length of the bike trail

6.3.3 Benefit Estimates

The overall livability effect of the project is valued at $8.8 million over the project lifecycle of the TRIP project. The largest effect relates to the recreational use of the bicycle trail extensions valued at $7.1 million.

Table 14: Estimates of Livability Benefits, in Millions of 2011 Dollars

	In Project Opening Year	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Health Improvement due to Bicycle Trail Extension	$0.03	$0.77	$0.32
Mobility Benefit due to Bicycle Trail Extension	$0.14	$3.27	$1.37
Recreation Benefit due to Bicycle Trail Extension	$0.73	$16.87	$7.06
Reduced Auto Use Benefits due to Bicycle Trail Extension	$0.0004	$0.008	$0.003

6.4 Environmental Sustainability

The proposed project would contribute to environmental sustainability through reduced pollutant emissions due to less vehicle miles traveled.

6.4.1 Methodology

Structure and logic models are provided for each benefit to illustrate how the monetized values of these sustainability effects are derived.

Figure 12: Environmental Savings due to shorter access/egress from Troutdale

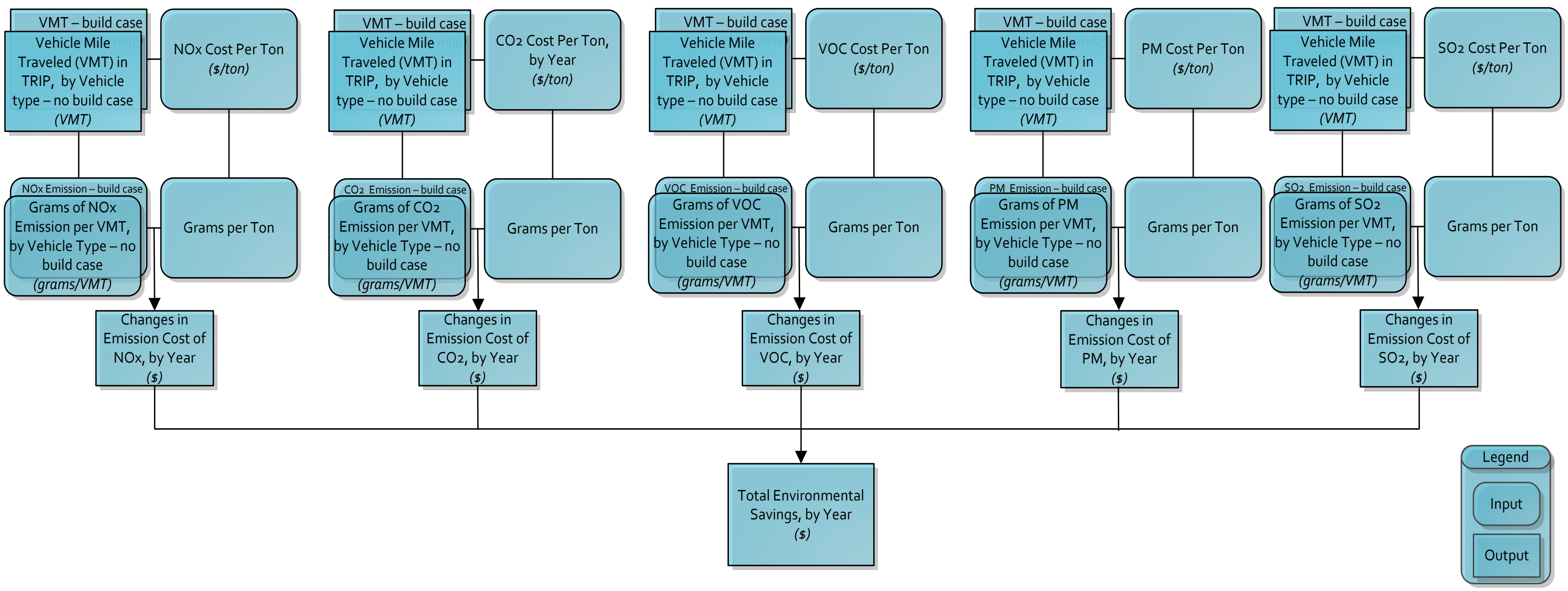
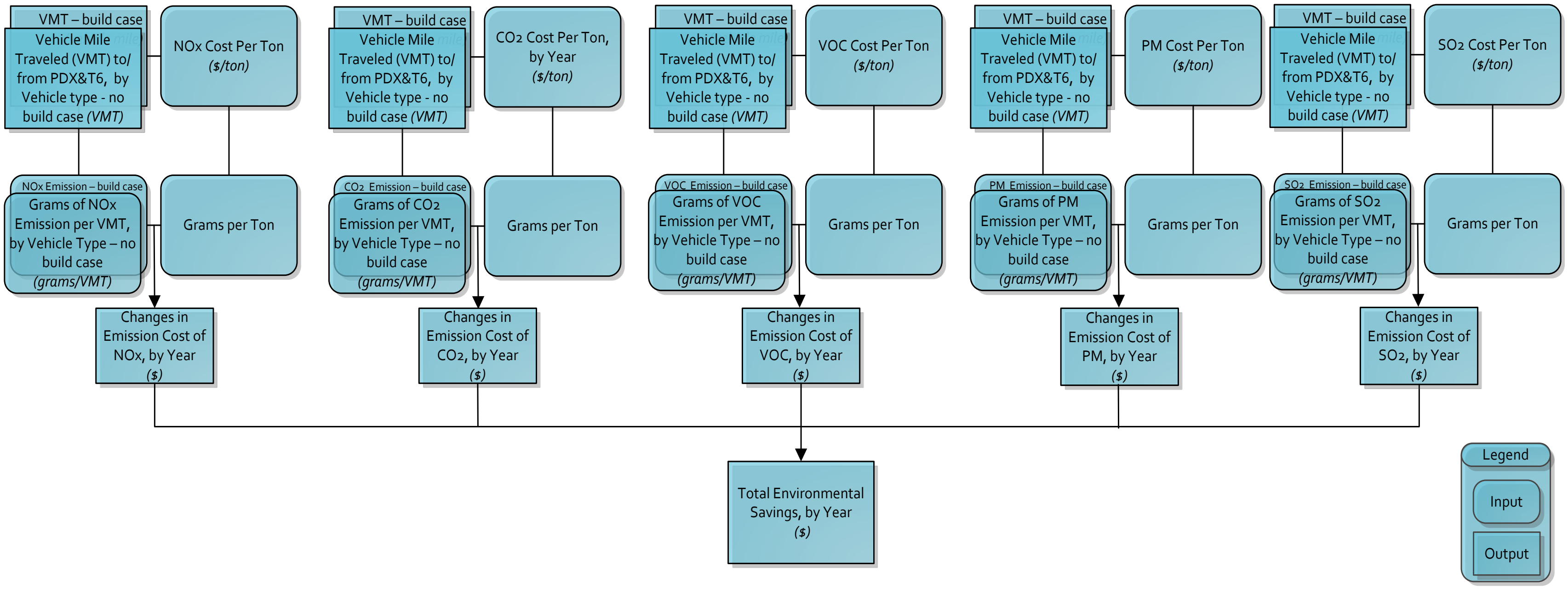


Figure 13: Environmental Savings due to shorter access/egress from Port of Portland and PDX



6.4.2 Assumptions

The assumptions used in the estimation of sustainability benefits are summarized in the table below.

Table 15: Assumptions used in the Estimation of TRIP and Regional Environmental Savings

Variable Name	Unit	Value	Source
CO2 Emission per Auto Mile Traveled at 35 mph -2015	grams/vmt	320	Emission rates used for Local Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
CO2 Emission per Auto Mile Traveled at 35 mph -2016	grams/vmt	314	
CO2 Emission per Auto Mile Traveled at 35 mph -2017	grams/vmt	307	
CO2 Emission per Auto Mile Traveled at 35 mph -2018	grams/vmt	301	
CO2 Emission per Auto Mile Traveled at 35 mph -2019	grams/vmt	296	
CO2 Emission per Auto Mile Traveled at 35 mph -2020	grams/vmt	292	
CO2 Emission per Auto Mile Traveled at 35 mph -2021	grams/vmt	287	
CO2 Emission per Auto Mile Traveled at 35 mph -2022	grams/vmt	284	
CO2 Emission per Auto Mile Traveled at 35 mph -2023	grams/vmt	280	
CO2 Emission per Auto Mile Traveled at 35 mph -2024	grams/vmt	277	
CO2 Emission per Auto Mile Traveled at 35 mph -2025	grams/vmt	275	
CO2 Emission per Auto Mile Traveled at 35 mph -2026	grams/vmt	272	
CO2 Emission per Auto Mile Traveled at 35 mph -2027	grams/vmt	270	
CO2 Emission per Auto Mile Traveled at 35 mph -2028	grams/vmt	269	
CO2 Emission per Auto Mile Traveled at 35 mph -2029	grams/vmt	268	
CO2 Emission per Auto Mile Traveled at 35 mph -2030	grams/vmt	267	
CO2 Emission per Auto Mile Traveled at 35 mph -2031	grams/vmt	266	
CO2 Emission per Auto Mile Traveled at 35 mph -2032	grams/vmt	266	
CO2 Emission per Auto Mile Traveled at 35 mph -2033	grams/vmt	265	
CO2 Emission per Auto Mile Traveled at 35 mph -2034	grams/vmt	265	
CO2 Emission per Truck Mile Traveled at 35 mph - 2015	grams/vmt	2,066	Emission rates used for Local Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
CO2 Emission per Truck Mile Traveled at 35 mph - 2016	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2017	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2018	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2019	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2020	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2021	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2022	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2023	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2024	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2025	grams/vmt	2,066	

Variable Name	Unit	Value	Source
CO2 Emission per Truck Mile Traveled at 35 mph - 2026	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2027	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2028	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2029	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2030	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2031	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2032	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2033	grams/vmt	2,066	
CO2 Emission per Truck Mile Traveled at 35 mph - 2034	grams/vmt	2,066	
NOx Emission per Auto Mile Traveled at 35 mph-2015	grams/vmt	0.188	Emission rates used for Local Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
NOx Emission per Auto Mile Traveled at 35 mph-2016	grams/vmt	0.158	
NOx Emission per Auto Mile Traveled at 35 mph-2017	grams/vmt	0.133	
NOx Emission per Auto Mile Traveled at 35 mph-2018	grams/vmt	0.112	
NOx Emission per Auto Mile Traveled at 35 mph-2019	grams/vmt	0.099	
NOx Emission per Auto Mile Traveled at 35 mph-2020	grams/vmt	0.088	
NOx Emission per Auto Mile Traveled at 35 mph-2021	grams/vmt	0.078	
NOx Emission per Auto Mile Traveled at 35 mph-2022	grams/vmt	0.073	
NOx Emission per Auto Mile Traveled at 35 mph-2023	grams/vmt	0.069	
NOx Emission per Auto Mile Traveled at 35 mph-2024	grams/vmt	0.065	
NOx Emission per Auto Mile Traveled at 35 mph-2025	grams/vmt	0.064	
NOx Emission per Auto Mile Traveled at 35 mph-2026	grams/vmt	0.062	
NOx Emission per Auto Mile Traveled at 35 mph-2027	grams/vmt	0.061	
NOx Emission per Auto Mile Traveled at 35 mph-2028	grams/vmt	0.061	
NOx Emission per Auto Mile Traveled at 35 mph-2029	grams/vmt	0.060	
NOx Emission per Auto Mile Traveled at 35 mph-2030	grams/vmt	0.060	
NOx Emission per Auto Mile Traveled at 35 mph-2031	grams/vmt	0.060	
NOx Emission per Auto Mile Traveled at 35 mph-2032	grams/vmt	0.060	
NOx Emission per Auto Mile Traveled at 35 mph-2033	grams/vmt	0.059	
NOx Emission per Auto Mile Traveled at 35 mph-2034	grams/vmt	0.059	
NOx Emission per Truck Mile Traveled at 35 mph-2015	grams/vmt	7.72	Emission rates used for Local Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon Emission rates used for Local Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model
NOx Emission per Truck Mile Traveled at 35 mph-2016	grams/vmt	6.84	
NOx Emission per Truck Mile Traveled at 35 mph-2017	grams/vmt	6.06	
NOx Emission per Truck Mile Traveled at 35 mph-2018	grams/vmt	5.37	
NOx Emission per Truck Mile Traveled at 35 mph-2019	grams/vmt	4.77	
NOx Emission per Truck Mile Traveled at 35 mph-2020	grams/vmt	4.24	
NOx Emission per Truck Mile Traveled at 35 mph-2021	grams/vmt	3.76	
NOx Emission per Truck Mile Traveled at 35 mph-2022	grams/vmt	3.40	
NOx Emission per Truck Mile Traveled at 35 mph-2023	grams/vmt	3.07	
NOx Emission per Truck Mile Traveled at 35 mph-2024	grams/vmt	2.77	

Variable Name	Unit	Value	Source
NOx Emission per Truck Mile Traveled at 35 mph-2025	grams/vmt	2.55	outputs for Multnomah County, Oregon
NOx Emission per Truck Mile Traveled at 35 mph-2026	grams/vmt	2.34	
NOx Emission per Truck Mile Traveled at 35 mph-2027	grams/vmt	2.15	
NOx Emission per Truck Mile Traveled at 35 mph-2028	grams/vmt	2.03	
NOx Emission per Truck Mile Traveled at 35 mph-2029	grams/vmt	1.92	
NOx Emission per Truck Mile Traveled at 35 mph-2030	grams/vmt	1.81	
NOx Emission per Truck Mile Traveled at 35 mph-2031	grams/vmt	1.75	
NOx Emission per Truck Mile Traveled at 35 mph-2032	grams/vmt	1.69	
NOx Emission per Truck Mile Traveled at 35 mph-2033	grams/vmt	1.64	
NOx Emission per Truck Mile Traveled at 35 mph-2034	grams/vmt	1.62	
VOC Emission per Auto Mile Traveled at 35 mph-2015	grams/vmt	0.03	
VOC Emission per Auto Mile Traveled at 35 mph-2016	grams/vmt	0.02	
VOC Emission per Auto Mile Traveled at 35 mph-2017	grams/vmt	0.02	
VOC Emission per Auto Mile Traveled at 35 mph-2018	grams/vmt	0.02	
VOC Emission per Auto Mile Traveled at 35 mph-2019	grams/vmt	0.02	
VOC Emission per Auto Mile Traveled at 35 mph-2020	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2021	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2022	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2023	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2024	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2025	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2026	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2027	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2028	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2029	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2030	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2031	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2032	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2033	grams/vmt	0.01	
VOC Emission per Auto Mile Traveled at 35 mph-2034	grams/vmt	0.01	
VOC Emission per Truck Mile Traveled at 35 mph-2015	grams/vmt	0.34	Emission rates used for Local Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
VOC Emission per Truck Mile Traveled at 35 mph-2016	grams/vmt	0.30	
VOC Emission per Truck Mile Traveled at 35 mph-2017	grams/vmt	0.26	
VOC Emission per Truck Mile Traveled at 35 mph-2018	grams/vmt	0.23	
VOC Emission per Truck Mile Traveled at 35 mph-2019	grams/vmt	0.20	
VOC Emission per Truck Mile Traveled at 35 mph-2020	grams/vmt	0.17	
VOC Emission per Truck Mile Traveled at 35 mph-2021	grams/vmt	0.15	
VOC Emission per Truck Mile Traveled at 35 mph-2022	grams/vmt	0.13	
VOC Emission per Truck Mile Traveled at 35 mph-2023	grams/vmt	0.11	

Variable Name	Unit	Value	Source
VOC Emission per Truck Mile Traveled at 35 mph-2024	grams/vmt	0.10	
VOC Emission per Truck Mile Traveled at 35 mph-2025	grams/vmt	0.09	
VOC Emission per Truck Mile Traveled at 35 mph-2026	grams/vmt	0.08	
VOC Emission per Truck Mile Traveled at 35 mph-2027	grams/vmt	0.07	
VOC Emission per Truck Mile Traveled at 35 mph-2028	grams/vmt	0.06	
VOC Emission per Truck Mile Traveled at 35 mph-2029	grams/vmt	0.06	
VOC Emission per Truck Mile Traveled at 35 mph-2030	grams/vmt	0.05	
VOC Emission per Truck Mile Traveled at 35 mph-2031	grams/vmt	0.05	
VOC Emission per Truck Mile Traveled at 35 mph-2032	grams/vmt	0.05	
VOC Emission per Truck Mile Traveled at 35 mph-2033	grams/vmt	0.04	
VOC Emission per Truck Mile Traveled at 35 mph-2034	grams/vmt	0.04	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2015	grams/vmt	0.006	Emission rates used for Local Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
PM2.5 Emission per Auto Mile Traveled at 35 mph-2016	grams/vmt	0.006	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2017	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2018	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2019	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2020	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2021	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2022	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2023	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2024	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2025	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2026	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2027	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2028	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2029	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2030	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2031	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2032	grams/vmt	0.005	
PM2.5 Emission per Auto Mile Traveled at 35 mph-2033	grams/vmt	0.005	

Variable Name	Unit	Value	Source
PM2.5 Emission per Auto Mile Traveled at 35 mph-2034	grams/vmt	0.005	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2015	grams/vmt	0.363	Emission rates used for Local Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
PM2.5 Emission per Truck Mile Traveled at 35 mph-2016	grams/vmt	0.315	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2017	grams/vmt	0.274	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2018	grams/vmt	0.238	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2019	grams/vmt	0.206	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2020	grams/vmt	0.178	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2021	grams/vmt	0.154	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2022	grams/vmt	0.133	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2023	grams/vmt	0.116	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2024	grams/vmt	0.101	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2025	grams/vmt	0.088	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2026	grams/vmt	0.077	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2027	grams/vmt	0.068	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2028	grams/vmt	0.061	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2029	grams/vmt	0.055	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2030	grams/vmt	0.049	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2031	grams/vmt	0.046	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2032	grams/vmt	0.043	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2033	grams/vmt	0.040	
PM2.5 Emission per Truck Mile Traveled at 35 mph-2034	grams/vmt	0.039	
SO2 Emission per Auto Mile Traveled at 35 mph-2015	grams/vmt	0.006	Emission rates used for Local Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
SO2 Emission per Auto Mile Traveled at 35 mph-2016	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2017	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2018	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2019	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2020	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2021	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2022	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2023	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2024	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2025	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2026	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2027	grams/vmt	0.005	

Variable Name	Unit	Value	Source
SO2 Emission per Auto Mile Traveled at 35 mph-2028	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2029	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2030	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2031	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2032	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2033	grams/vmt	0.005	
SO2 Emission per Auto Mile Traveled at 35 mph-2034	grams/vmt	0.005	
SO2 Emission per Truck Mile Traveled at 35 mph-2015	grams/vmt	0.014	Emission rates used for Local Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
SO2 Emission per Truck Mile Traveled at 35 mph-2016	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2017	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2018	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2019	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2020	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2021	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2022	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2023	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2024	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2025	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2026	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2027	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2028	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2029	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2030	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2031	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2032	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2033	grams/vmt	0.014	
SO2 Emission per Truck Mile Traveled at 35 mph-2034	grams/vmt	0.014	
CO2 cost per ton - 2015	2011$/ton	$25.60	HDR calculation based on Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (February 2010), pp. 39, Table A-1 "Annual SCC Values 2010-2050 (in 2007 dollars)" www.epa.gov/oms/climate/regulations/scc-tsd.pdf; adjusted to 2011$ per short ton.
CO2 cost per ton - 2016	2011$/ton	$26.14	
CO2 cost per ton - 2017	2011$/ton	$26.69	
CO2 cost per ton - 2018	2011$/ton	$27.25	
CO2 cost per ton - 2019	2011$/ton	$27.82	
CO2 cost per ton - 2020	2011$/ton	$28.41	
CO2 cost per ton - 2021	2011$/ton	$29.03	
CO2 cost per ton - 2022	2011$/ton	$29.67	
CO2 cost per ton - 2023	2011$/ton	$30.33	
CO2 cost per ton - 2024	2011$/ton	$30.99	
CO2 cost per ton - 2025	2011$/ton	$31.67	
CO2 cost per ton - 2026	2011$/ton	$32.37	
CO2 cost per ton - 2027	2011$/ton	$33.08	
CO2 cost per ton - 2028	2011$/ton	$33.81	
CO2 cost per ton - 2029	2011$/ton	$34.55	
CO2 cost per ton - 2030	2011$/ton	$35.32	

Variable Name	Unit	Value	Source
CO2 cost per ton - 2031	2011$/ton	$35.95	
CO2 cost per ton - 2032	2011$/ton	$36.60	
CO2 cost per ton - 2033	2011$/ton	$37.26	
CO2 cost per ton - 2034	2011$/ton	$37.93	
NOx cost per ton	2011$/ton	$5,720	Final Regulatory Impact Analysis Corporate Average Fuel Economy for MY 2012-MY 2016 Passenger Cars and Light Trucks, March 2010,Table VIII-8 Economic Values Used for Benefits Computations (2007 Dollars); adjusted to 2011$
VOC cost per ton	2011$/ton	$1,400	
PM cost per ton	2011$/ton	$312,740	
SOx Cost per ton	2011$/ton	$33,430	
CO2 Emission per Truck Mile Traveled at 55 mph - 2015	grams/vmt	1824.88	Emission rates used for Regional Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
CO2 Emission per Truck Mile Traveled at 55 mph - 2016	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2017	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2018	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2019	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2020	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2021	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2022	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2023	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2024	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2025	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2026	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2027	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2028	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2029	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2030	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2031	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2032	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2033	grams/vmt	1824.88	
CO2 Emission per Truck Mile Traveled at 55 mph - 2034	grams/vmt	1824.88	
NOx Emission per Truck Mile Traveled at 55 mph-2015	grams/vmt	6.90	Emission rates used

Variable Name	Unit	Value	Source
NOx Emission per Truck Mile Traveled at 55 mph-2016	grams/vmt	6.09	for Regional Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
NOx Emission per Truck Mile Traveled at 55 mph-2017	grams/vmt	5.38	
NOx Emission per Truck Mile Traveled at 55 mph-2018	grams/vmt	4.76	
NOx Emission per Truck Mile Traveled at 55 mph-2019	grams/vmt	4.21	
NOx Emission per Truck Mile Traveled at 55 mph-2020	grams/vmt	3.73	
NOx Emission per Truck Mile Traveled at 55 mph-2021	grams/vmt	3.30	
NOx Emission per Truck Mile Traveled at 55 mph-2022	grams/vmt	2.97	
NOx Emission per Truck Mile Traveled at 55 mph-2023	grams/vmt	2.67	
NOx Emission per Truck Mile Traveled at 55 mph-2024	grams/vmt	2.40	
NOx Emission per Truck Mile Traveled at 55 mph-2025	grams/vmt	2.20	
NOx Emission per Truck Mile Traveled at 55 mph-2026	grams/vmt	2.02	
NOx Emission per Truck Mile Traveled at 55 mph-2027	grams/vmt	1.85	
NOx Emission per Truck Mile Traveled at 55 mph-2028	grams/vmt	1.74	
NOx Emission per Truck Mile Traveled at 55 mph-2029	grams/vmt	1.63	
NOx Emission per Truck Mile Traveled at 55 mph-2030	grams/vmt	1.53	
NOx Emission per Truck Mile Traveled at 55 mph-2031	grams/vmt	1.48	
NOx Emission per Truck Mile Traveled at 55 mph-2032	grams/vmt	1.43	
NOx Emission per Truck Mile Traveled at 55 mph-2033	grams/vmt	1.38	
NOx Emission per Truck Mile Traveled at 55 mph-2034	grams/vmt	1.37	
VOC Emission per Truck Mile Traveled at 55 mph-2015	grams/vmt	0.26	Emission rates used for Regional Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
VOC Emission per Truck Mile Traveled at 55 mph-2016	grams/vmt	0.23	
VOC Emission per Truck Mile Traveled at 55 mph-2017	grams/vmt	0.20	
VOC Emission per Truck Mile Traveled at 55 mph-2018	grams/vmt	0.17	
VOC Emission per Truck Mile Traveled at 55 mph-2019	grams/vmt	0.15	
VOC Emission per Truck Mile Traveled at 55 mph-2020	grams/vmt	0.13	
VOC Emission per Truck Mile Traveled at 55 mph-2021	grams/vmt	0.11	
VOC Emission per Truck Mile Traveled at 55 mph-2022	grams/vmt	0.10	
VOC Emission per Truck Mile Traveled at 55 mph-2023	grams/vmt	0.08	
VOC Emission per Truck Mile Traveled at 55 mph-2024	grams/vmt	0.07	
VOC Emission per Truck Mile Traveled at 55 mph-2025	grams/vmt	0.06	
VOC Emission per Truck Mile Traveled at 55 mph-2026	grams/vmt	0.06	
VOC Emission per Truck Mile Traveled at 55 mph-2027	grams/vmt	0.05	
VOC Emission per Truck Mile Traveled at 55 mph-2028	grams/vmt	0.05	
VOC Emission per Truck Mile Traveled at 55 mph-2029	grams/vmt	0.04	
VOC Emission per Truck Mile Traveled at 55 mph-2030	grams/vmt	0.04	
VOC Emission per Truck Mile Traveled at 55 mph-2031	grams/vmt	0.03	

Variable Name	Unit	Value	Source
VOC Emission per Truck Mile Traveled at 55 mph-2032	grams/vmt	0.03	
VOC Emission per Truck Mile Traveled at 55 mph-2033	grams/vmt	0.03	
VOC Emission per Truck Mile Traveled at 55 mph-2034	grams/vmt	0.03	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2015	grams/vmt	0.2	Emission rates used for Regional Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon
PM2.5 Emission per Truck Mile Traveled at 55 mph-2016	grams/vmt	0.2	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2017	grams/vmt	0.2	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2018	grams/vmt	0.2	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2019	grams/vmt	0.1	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2020	grams/vmt	0.1	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2021	grams/vmt	0.1	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2022	grams/vmt	0.1	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2023	grams/vmt	0.1	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2024	grams/vmt	0.1	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2025	grams/vmt	0.1	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2026	grams/vmt	0.1	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2027	grams/vmt	0.0	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2028	grams/vmt	0.0	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2029	grams/vmt	0.0	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2030	grams/vmt	0.0	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2031	grams/vmt	0.0	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2032	grams/vmt	0.0	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2033	grams/vmt	0.0	
PM2.5 Emission per Truck Mile Traveled at 55 mph-2034	grams/vmt	0.0	
SO2 Emission per Truck Mile Traveled at 55 mph-2015	grams/vmt	$0.01	Emission rates used for Regional Benefits. Source: U.S. EPA (Environmental Protection Agency) MOVES2010 model outputs for Multnomah County, Oregon.
SO2 Emission per Truck Mile Traveled at 55 mph-2016	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2017	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2018	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2019	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2020	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2021	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2022	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2023	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2024	grams/vmt	$0.01	

Variable Name	Unit	Value	Source
SO2 Emission per Truck Mile Traveled at 55 mph-2025	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2026	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2027	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2028	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2029	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2030	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2031	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2032	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2033	grams/vmt	$0.01	
SO2 Emission per Truck Mile Traveled at 55 mph-2034	grams/vmt	$0.01	

6.4.3 Benefit Estimates

The TRIP project provides environmental sustainability benefits of $12.4 million over the project lifecycle.

Table 16: Estimates of Environmental Sustainability Benefits, in Millions of 2011 Dollars

	In Project Opening Year	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Environmental Savings in TRIP due to shorter access/egress	$0.13	$1.65	$1.00
Regional Environmental Savings due to shorter Distance to/from Port of Portland and Urban Core	$0.36	$19.50	$11.40

6.5 Safety

The proposed project would contribute to promoting USDOT's safety long-term outcome through reduced accidents and property damage.

6.5.1 Methodology

Structure and logic models are provided for each benefit to illustrate how the monetized values of these safety effects are derived.

Figure 14: Reduced Accident Costs due to less Vehicle Miles Travelled

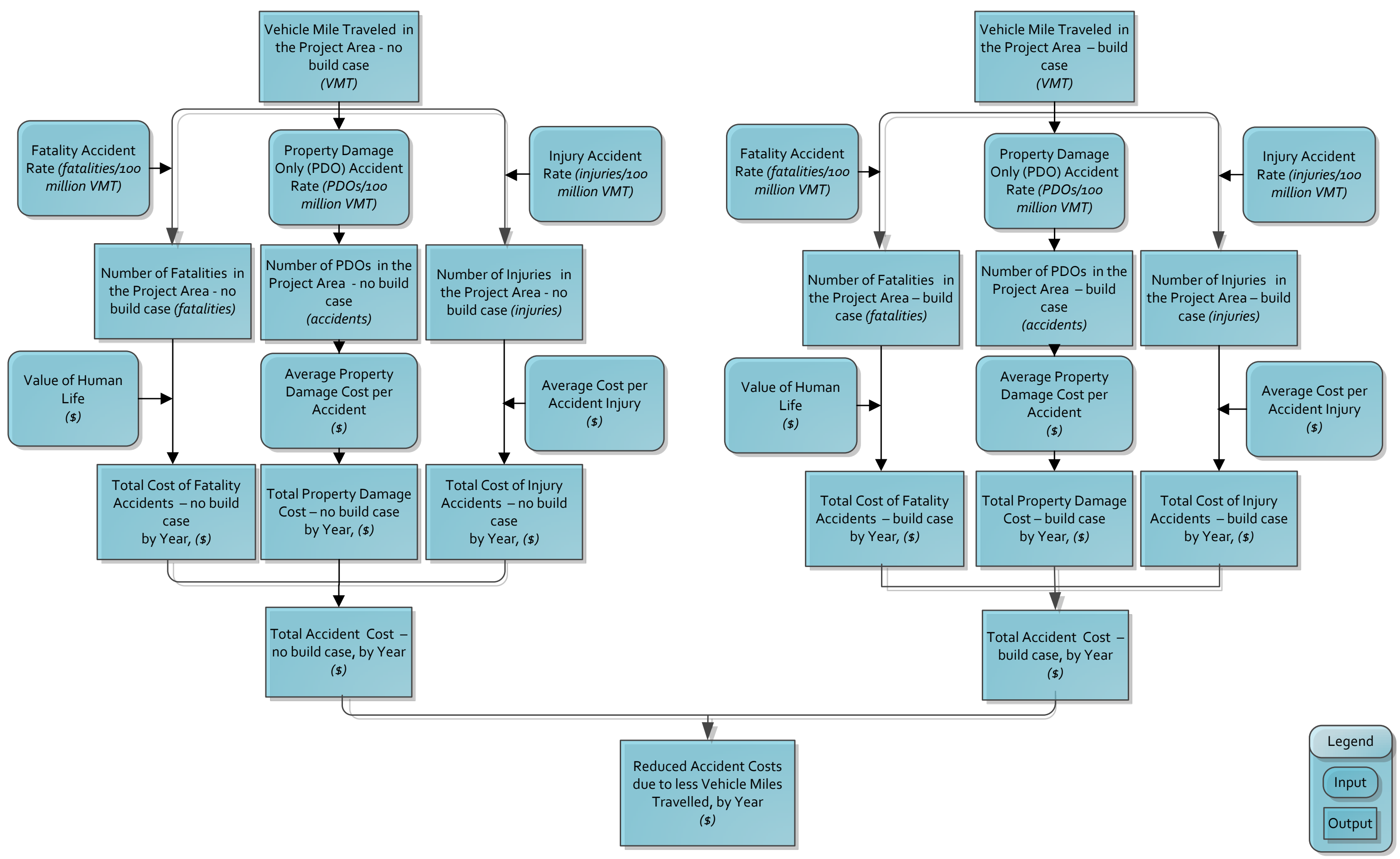
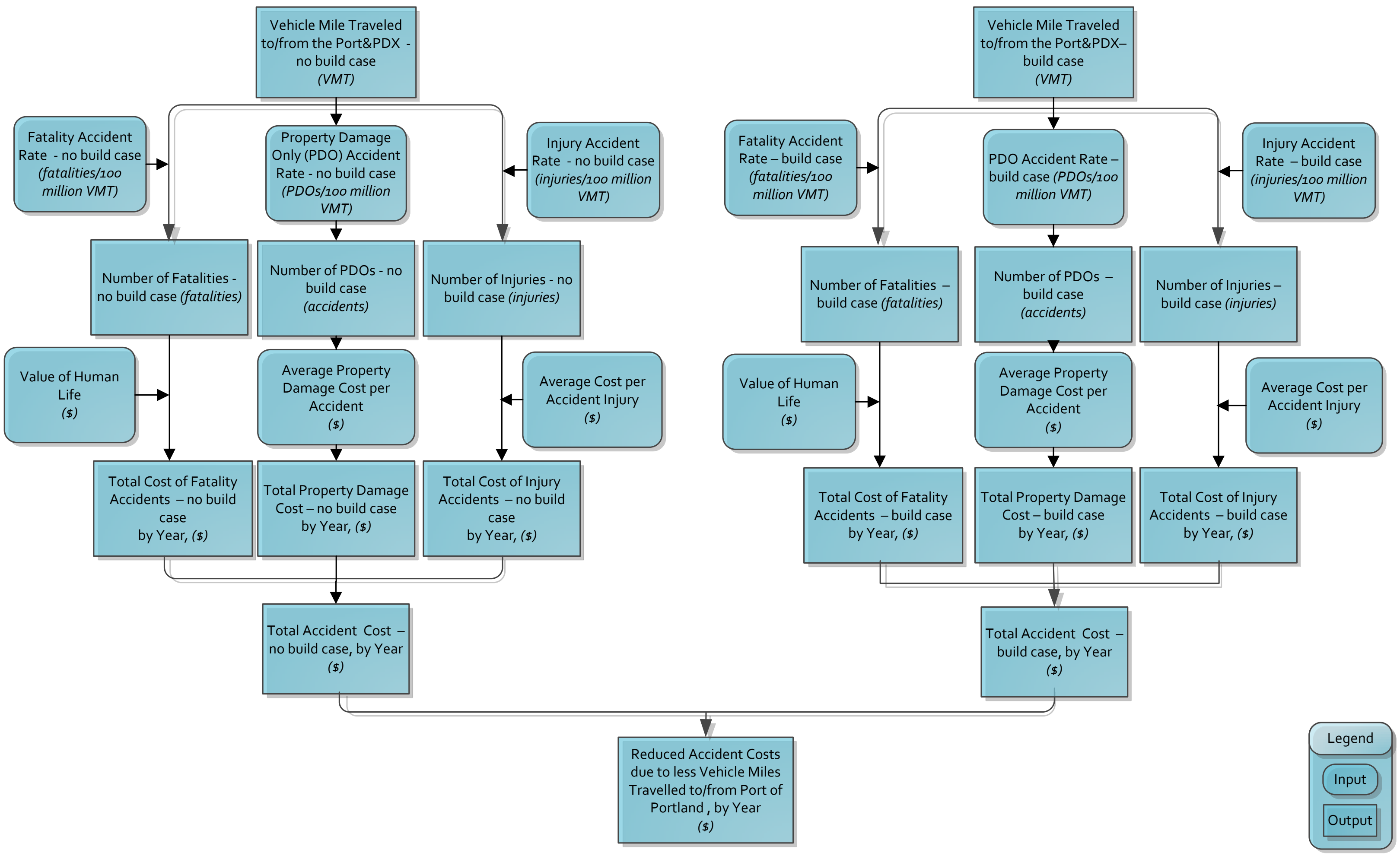


Figure 15: Reduced Accident Costs due to less Vehicle Miles Travelled to/from Port of Portland and PDX



6.5.2 Assumptions

The assumptions used in the estimation of safety benefits are summarized in the table below.

Table 17: Assumptions used in the Estimation of Safety Benefits

Variable Name	Unit	Value	Source
Value of a Statistical Life	2011$	$6,200,000	Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses - 2011 Revision (2011) http://ostpxweb.dog.gov/policy
Average Cost per Accident Injury	2011$	$1,257,360	Average Cost of AIS 1 to AIS 5 Accidents. Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses - 2011 Revision (2011) http://ostpxweb.dog.gov/policy
Cost of a Property Damage Only (PDO) Accident	2011$	$3,368	NHTSA (2000) The Economic Impact of Motor Vehicle Crashes 2000; http://www.nhtsa.gov/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/EconomicImpact2000.pdf; adjusted to 2011$
Growth of the Cost of Accidents	%	0.88%	Adjusted for growth in real income (source: US DOT)
Fatality Accident Rate per 100 million VMT	fatalities/100 mil. VMT	0.0	HDR calculation based on the Technical Memorandum #2 - Existing Transportation Conditions (Port of Portland, July 2010)
Injury Accident Rate per 100 million VMT	injuries/100 mil. VMT	113.5	
PDO (Property Damage Only) Accident Rate per 100 million VMT	crashes/100 mil. VMT	155.3	
Fatality Accident Rate per 100 million Truck VMT in Oregon	fatalities/100 mil. VMT	2.3	HDR calculation based on the Oregon DOT 2007-2010 All Truck Crashes report (http://www.oregon.gov/ODOT/TD/TDATA/car/docs/MotorCarrierCrashRateUpdate2007-2010.pdf)
Injury Accident Rate per 100 million Truck VMT in Oregon	injuries/100 mil. VMT	25.9	
PDO Accident Rate per 100 million Truck VMT in Oregon	crashes/100 mil. VMT	80.0	

6.5.3 Benefit Estimates

The safety related benefits of the project are approximately $51.7 million and offset the total project expenditures on their own merits.

Table 18: Estimates of Safety Benefits, in Millions of 2011 Dollars

	In Project Opening Year	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
Reduced Accident Costs in TRIP due to less Vehicle Miles Travelled	$1.44	$31.32	$13.29
Reduced Regional Accident Costs due to less Vehicle Miles Travelled to/from Port of Portland and Urban Core	$0.99	$97.24	$38.36

7. Summary of Findings and BCA Outcomes

The tables below summarize the BCA findings. Annual costs and benefits are computed over the lifecycle of the project (23 years). As stated earlier, construction is expected to be completed by 2015 Q1. Benefits accrue during the full operation of the project.

Table 19: Overall Results of the Benefit Cost Analysis in Millions of 2011 Dollars unless Specified Otherwise

Project Evaluation Metric	7% Discount Rate	3% Discount Rate
Total Discounted Benefits	$231.14	$375.11
Total Discounted Costs	$31.57	$34.37
Net Present Value	$199.56	$340.74
Benefit / Cost Ratio	7.32	10.91
Internal Rate of Return (%)	41.5%	
Payback Period (years)	2.7	

Considering all monetized benefits and costs, the estimated internal rate of return of the project is 41.5 percent. With a 7 percent real discount rate, the $36.7 million investment would result in $231.1 million in total benefits and a Benefit/Cost ratio of approximately 7.3.

With a 3 percent real discount rate, the Net Present Value of the project would increase to $375.1 million, for a Benefit/Cost ratio of 10.9.

Table 20: Benefit Estimates by Long-Term Outcome for the Full Alignment

Long-Term Outcomes	Benefit Categories	7% Discount Rate	3% Discount Rate
State of Good Repair	Reduced Pavement Cost in TRIP due to shorter access/egress	$0.66	$1.05
	Reduced Regional Pavement Cost due to shorter Distance to/from Port of Portland, urban core, and PDX	$10.02	$16.50
Economic Competitiveness	Travel Time Savings in TRIP due to shorter access/egress	$6.60	$10.59
	Reduced Vehicle Operating Costs in TRIP due to shorter access/egress	$7.37	$11.65
	Regional Travel Time Savings due to shorter Travel Distance from Port of Portland, urban core, and PDX	$40.14	$67.21
	Reduced Regional Vehicle Operating Costs due to shorter Distance to/from Port of Portland, urban core, and PDX	$93.55	$154.81
Livability	Health Improvement due to Bicycle Trail Extension	$0.32	$0.51
	Mobility Benefit due to Bicycle Trail Extension	$1.37	$2.19

	Recreation Benefit due to Bicycle Trail Extension	$7.06	$11.32
	Reduced Auto Use Benefits due to Bicycle Trail Extension	$0.003	$0.005
Environmental Sustainability	Environmental Savings in TRIP due to shorter access/egress	$1.00	$1.16
	Regional Environmental Savings due to shorter Distance to/from Port of Portland, urban core, and PDX	$11.40	$13.21
Safety	Reduced Accident Costs in TRIP due to less Vehicle Miles Travelled	$13.29	$21.14
	Reduced Regional Accident Costs due to less Vehicle Miles Travelled to/from Port of Portland, urban core, and PDX	$38.36	$63.76
Total Benefits		**$231.14**	**$375.11**

8. BCA Sensitivity Analysis

The BCA outcomes presented in the previous sections rely on a large number of assumptions and long-term projections; both of which are subject to considerable uncertainty.

The primary purpose of the sensitivity analysis is to help identify the variables and model parameters whose variations have the greatest impact on the BCA outcomes: the “critical variables.”

The sensitivity analysis can also be used to:

- Evaluate the impact of changes in individual critical variables – how much the final results would vary with reasonable departures from the “preferred” or most likely value for the variable; and
- Assess the robustness of the BCA and evaluate, in particular, whether the conclusions reached under the “preferred” set of input values are significantly altered by reasonable departures from those values.

The outcomes of the quantitative analysis for the TRIP project using a 7 percent discount rate are summarized in the table below. The table provides the percentage changes in project NPV associated with variations in variables or parameters (listed in row), as indicated in the column headers.

For example, a 20 percent reduction in existing traffic levels lowers the NPV to $205 million. Similarly a 20 percent reduction in building footage lowers the NPV to $161 million. Even at different / lower levels of demand, the NPV is significantly positive.

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Table 21: Quantitative Assessment of Sensitivity, Summary

Parameters	Change in Parameter Value	New NPV	Change in NPV	New B/C Ratio
Existing TRIP Traffic	20% Increase in Existing Traffic	$205.35	3%	7.50
	20% Reduction in Existing Traffic	$193.78	-3%	7.14
TRIP Building Area Development	20% Increase in Building Footage	$238.26	19%	8.55
	20% Reduction in Building Footage	$160.87	-19%	6.10

9. Economic Impact Analysis

The Minnesota IMPLAN Group's input-output model has been used to estimate the direct, indirect and induced effects of the TRIP project, in terms of employment, labor income and value added.

Employment effects represent full-time and part-time jobs created for a full year (unless noted otherwise). Labor income consists of total employee compensation (wage and salary payments, as well as health and life insurance benefits, retirement payments and any other non-cash compensation) and proprietary income (payments received by self-employed individuals as income). Value added represents total business sales (output) minus the cost of purchasing intermediate products and is roughly equivalent to gross regional/domestic product.

9.1 Short-Term Impacts from Capital Expenditures

Estimated spending on project engineering and construction (capital expenditures) between 2012 and 2015 is used to compute short-term economic impacts.

The project is expected to generate 708 job-years during the project development phase. It is also expected to create $54 million in value added, including $37 million in labor income. A breakdown of short-term impacts by type of effect (direct, indirect and induced) is provided in the table below.

Table 22: Direct, Indirect and Induced Impacts during Project Development Phase

	Spending (Millions of 2011 Dollars)	Direct	Indirect	Induced	Total
Employment*		286.1	154.1	267.8	707.9
Labor Income**	$36.68	$14.76	$9.49	$12.59	$36.83
Value Added**		$16.76	$15.18	$22.35	$54.29

*Note: * Employment impacts from IMPLAN reflect total employment (full time plus part time). On average, the ratio of FTE to total employment is estimated at 90 percent. **Millions of 2011 Dollars.*

Another method to estimate job-years from additional spending uses the Council of Economic Advisors' (CEA) methodology as presented in a 2009 analysis[4]. This method assumes that for every $92,000 of government spending, one job-year is created. The following table shows the difference in job-year estimates using the IMPLAN and CEA methodologies.

Note that the estimated employment impacts are lower when using CEA's approach. Specifically, the simplified computation produces a more conservative estimate of 398.7 job-years.

[4] Executive Office of the President, Council of Economic Advisers, "Estimates of Job Creation from the American Recovery and Reinvestment Act of 2009," Washington, D.C., May 11, 2009.

Table 23: Job Year Estimates with IMPLAN and CEA Methodology

	Spending (Millions of 2011 Dollars)	Direct	Indirect	Induced	Total
IMPLAN *	$36.68	286.1	154.1	267.8	707.9
CEA		255.2		143.5	398.7

*Note: * Employment impacts from IMPLAN should not be interpreted as full-time equivalent (FTE) as they reflect the mix of full and part time jobs that is typical for each sector.*

A breakdown of short-term economic impacts (using IMPLAN estimates) in terms of employment (job-hours), labor income and value added is provided by quarter in the table below.

Table 24: Short-Term Impacts Resulting from Capital Expenditures

Period	Spending (Millions of 2011 Dollars)*	Total Job-Hours**	Direct Job-Hours**	Total Labor Income (Millions of 2011 Dollars)	Total Value Added (Millions of 2011 Dollars)
2012 - Q1	$0.62	5,358	2,165	$0.62	$0.92
2012 - Q2	$0.74	6,388	2,582	$0.74	$1.09
2012 - Q3	$1.93	16,706	6,752	$1.94	$2.86
2012 - Q4	$2.47	21,415	8,655	$2.48	$3.66
2013 - Q1	$2.71	23,441	9,473	$2.72	$4.01
2013 - Q2	$1.21	10,491	4,240	$1.22	$1.79
2013 - Q3	$0.66	5,704	2,305	$0.66	$0.98
2013 - Q4	$2.47	21,398	8,648	$2.48	$3.66
2014 - Q1	$4.79	41,462	16,757	$4.81	$7.09
2014 - Q2	$5.70	49,357	19,947	$5.73	$8.44
2014 - Q3	$5.86	50,759	20,514	$5.89	$8.68
2014 - Q4	$5.07	43,852	17,722	$5.09	$7.50
2015 – Q1	$2.45	21,164	8,553	$2.46	$3.62
Total	**$36.68**	**317,495**	**128,314**	**$36.83**	**$54.29**

Notes: * includes construction ($26.17 million), design ($9.90 million), permitting ($0.48million) and close-out ($0.12million) ** assuming average weekly hours of 34.5 (Bureau of Labor Statistics estimate).

The table below presents the short-term increase in employment and labor income resulting from capital expenditures in key industries employing low-income people. 422 cumulative job-years (or 60 percent of total job-years) are expected to be created in those industries by the end of 2015, bringing in an additional $20 million in labor income. The majority of jobs will be created in the Construction sector.

Table 25: Short-Term Impacts in Key Industries Employing Low-Income People

Sectors	Employment (Job-Years)	Labor Income (Millions of 2011 Dollars)
Agriculture, forestry, fishing and hunting	0.0	$0.22
Construction	289.8	$14.95
Retail trade	44.0	$1.67
Truck transportation	7.3	$0.40
Administrative and support and waste management and remediation services	25.7	$1.04
Nursing and residential care facilities, home health care services	18.3	$0.61
Accommodation and food services	33.0	$0.77
Personal and laundry services	3.7	$0.23
Total	**421.8**	**$19.89**

Note: Low-income sectors are identified in BLS, A Profile of the Working Poor, March 2009; BLS, Characteristics of Minimum Wage Workers, March 2009; and Carsey Institute, Issue Brief No. 2, Summer 2008.

10. Supplementary Data Tables

This section breaks down all benefits associated with the five long-term outcome criteria (State of Good Repair, Economic Competiveness, Livability, Sustainability, and Safety) in annual form for the TRIP project. Supplementary data tables are also provided for some specific benefit categories. For example, tables providing estimates of annual emission reductions (in tons) are provided under Environmental Sustainability.

10.1 Annual Estimates of Total Project Benefits and Costs

Calendar Year	Project Year	Total Benefits ($2011)	Total Costs ($2011)	Undiscounted Net Benefits ($2011)	Discounted Net Benefits at 7%	Discounted Net Benefits at 3%
2012	1	$0	$5,760,958	-$5,760,958	-$5,461,405	-$5,629,773
2013	2	$0	$7,051,000	-$7,051,000	-$6,310,481	-$6,721,540
2014	3	$0	$21,422,000	-$21,422,000	-$17,850,525	-$19,802,779
2015 (opening)	4	$9,067,673	$2,445,000	$6,622,673	$4,983,929	$5,837,838
2016	5	$14,172,443	$0	$14,172,443	$10,141,994	$12,225,274
2017	6	$19,339,439	$0	$19,339,439	$12,948,692	$16,196,476
2018	7	$24,572,603	$0	$24,572,603	$15,394,023	$19,979,775
2019	8	$29,878,335	$0	$29,878,335	$17,514,590	$23,586,234
2020	9	$30,043,852	$0	$30,043,852	$16,478,897	$23,026,111
2021	10	$30,162,570	$0	$30,162,570	$15,481,501	$22,443,785
2022	11	$30,397,877	$0	$30,397,877	$14,600,896	$21,960,073
2023	12	$30,550,658	$0	$30,550,658	$13,734,029	$21,427,617
2024	13	$30,813,366	$0	$30,813,366	$12,965,122	$20,982,403
2025	14	$30,989,835	$0	$30,989,835	$12,206,005	$20,487,932
2026	15	$31,186,104	$0	$31,186,104	$11,499,301	$20,017,174
2027	16	$31,434,174	$0	$31,434,174	$10,851,764	$19,588,738
2028	17	$31,637,956	$0	$31,637,956	$10,227,107	$19,141,484
2029	18	$31,903,264	$0	$31,903,264	$9,657,322	$18,739,805
2030	19	$32,027,946	$0	$32,027,946	$9,080,808	$18,265,090
2031	20	$32,231,576	$0	$32,231,576	$8,559,262	$17,845,842
2032	21	$32,440,494	$0	$32,440,494	$8,069,570	$17,438,364
2033	22	$32,647,831	$0	$32,647,831	$7,608,150	$17,038,658
2034	23	$32,894,174	$0	$32,894,174	$7,181,974	$16,667,206
Total		**$568,392,171**	**$36,678,958**	**$531,713,213**	**$199,562,524**	**$340,741,787**

10.2 Annual Demand Projections

Calendar Year	Project Year	Existing TRIP ADT benefit from Road Improvements - Automobiles	Existing TRIP ADT benefit from Road Improvements - Trucks	Total Number of Trucks to/from Port of Portland and PDX due to TRIP development
2015 (opening)	4	1,581	2,874	797
2016	5	1,581	2,874	1,594
2017	6	1,581	2,874	2,392
2018	7	1,581	2,874	3,189
2019	8	1,581	2,874	3,986
2020	9	1,581	2,874	3,986
2021	10	1,581	2,874	3,986
2022	11	1,581	2,874	3,986
2023	12	1,581	2,874	3,986
2024	13	1,581	2,874	3,986
2025	14	1,581	2,874	3,986
2026	15	1,581	2,874	3,986
2027	16	1,581	2,874	3,986
2028	17	1,581	2,874	3,986
2029	18	1,581	2,874	3,986
2030	19	1,581	2,874	3,986
2031	20	1,581	2,874	3,986
2032	21	1,581	2,874	3,986
2033	22	1,581	2,874	3,986
2034	23	1,581	2,874	3,986

10.3 State of Good Repair: Annual Benefit Estimates

Calendar Year	Project Year	Pavement Cost Savings in TRIP - Undiscounted Benefits	Regional Pavement Cost Savings - Undiscounted Benefits	Total Undiscounted Benefits	Total Discounted Benefits at 7%	Total Discounted Benefits at 3%
2015 (opening)	4	$76,841	$277,586	$354,427	$270,391	$314,904
2016	5	$76,841	$555,173	$632,014	$450,617	$545,180
2017	6	$76,841	$832,759	$909,600	$606,105	$761,776
2018	7	$76,841	$1,110,345	$1,187,186	$739,320	$965,291
2019	8	$76,841	$1,387,932	$1,464,773	$852,511	$1,156,305
2020	9	$76,841	$1,387,932	$1,464,773	$796,739	$1,122,626
2021	10	$76,841	$1,387,932	$1,464,773	$744,616	$1,089,928
2022	11	$76,841	$1,387,932	$1,464,773	$695,903	$1,058,183
2023	12	$76,841	$1,387,932	$1,464,773	$650,377	$1,027,362
2024	13	$76,841	$1,387,932	$1,464,773	$607,829	$997,439
2025	14	$76,841	$1,387,932	$1,464,773	$568,064	$968,387
2026	15	$76,841	$1,387,932	$1,464,773	$530,901	$940,182
2027	16	$76,841	$1,387,932	$1,464,773	$496,169	$912,798
2028	17	$76,841	$1,387,932	$1,464,773	$463,709	$886,211
2029	18	$76,841	$1,387,932	$1,464,773	$433,373	$860,400
2030	19	$76,841	$1,387,932	$1,464,773	$405,022	$835,339
2031	20	$76,841	$1,387,932	$1,464,773	$378,525	$811,009
2032	21	$76,841	$1,387,932	$1,464,773	$353,762	$787,387
2033	22	$76,841	$1,387,932	$1,464,773	$330,618	$764,454
2034	23	$76,841	$1,387,932	$1,464,773	$308,989	$742,188
Total		**$1,536,816**	**$24,982,772**	**$26,519,588**	**$10,683,540**	**$17,547,350**

10.4 Economic Competitiveness: Annual Benefit Estimates

Calendar Year	Project Year	Travel Time Savings in TRIP - Undiscounted Benefits	Vehicle Operating Cost Savings in TRIP - Undiscounted Benefits	Regional Travel Time Savings - Undiscounted Benefits	Regional Vehicle Operating Cost Savings- Undiscounted Benefits	Total Undiscounted Benefits	Total Discounted Benefits at 7%	Total Discounted Benefits at 3%
2015 (opening)	4	$676,433	$821,555	$967,157	$2,420,246	$4,885,393	$3,727,043	$4,340,608
2016	5	$687,256	$829,670	$1,965,264	$4,910,989	$8,393,179	$5,984,221	$7,240,030
2017	6	$698,253	$837,259	$2,995,062	$7,461,557	$11,992,130	$7,990,863	$10,043,220
2018	7	$709,425	$843,837	$4,057,311	$10,065,158	$15,675,731	$9,762,057	$12,745,804
2019	8	$720,775	$850,021	$5,152,784	$12,720,500	$19,444,081	$11,316,632	$15,349,337
2020	9	$732,308	$853,394	$5,235,229	$12,807,812	$19,628,743	$10,676,736	$15,043,797
2021	10	$744,025	$853,267	$5,318,993	$12,835,299	$19,751,583	$10,040,703	$14,697,033
2022	11	$755,929	$858,780	$5,404,097	$12,954,949	$19,973,754	$9,489,387	$14,429,465
2023	12	$768,024	$858,993	$5,490,562	$12,985,670	$20,103,249	$8,926,083	$14,100,014
2024	13	$780,312	$864,747	$5,578,411	$13,110,170	$20,333,641	$8,437,738	$13,846,220
2025	14	$792,797	$865,030	$5,667,666	$13,139,274	$20,464,767	$7,936,590	$13,529,622
2026	15	$805,482	$866,039	$5,758,348	$13,179,696	$20,609,565	$7,469,855	$13,228,496
2027	16	$818,370	$869,591	$5,850,482	$13,262,158	$20,800,600	$7,045,883	$12,962,247
2028	17	$831,464	$869,917	$5,944,090	$13,289,645	$20,935,115	$6,627,521	$12,666,089
2029	18	$844,767	$873,432	$6,039,195	$13,370,489	$21,127,883	$6,250,978	$12,410,405
2030	19	$858,283	$868,927	$6,135,822	$13,313,898	$21,176,931	$5,855,598	$12,076,908
2031	20	$872,016	$868,374	$6,233,995	$13,323,599	$21,297,985	$5,503,804	$11,792,178
2032	21	$885,968	$868,002	$6,333,739	$13,334,918	$21,422,627	$5,173,845	$11,515,718
2033	22	$900,144	$867,406	$6,435,079	$13,341,385	$21,544,014	$4,862,768	$11,243,659
2034	23	$914,546	$868,543	$6,538,040	$13,376,957	$21,698,086	$4,577,144	$10,994,241
Total		**$15,796,577**	**$17,156,785**	**$103,101,326**	**$235,204,372**	**$371,259,060**	**$147,655,448**	**$244,255,091**

10.5 Livability: Annual Benefit Estimates

Calendar Year	Project Year	Health Improvement - Undiscounted Benefits	Mobility Benefit - Undiscounted Benefits	Recreation Benefit - Undiscounted Benefits	Reduced Auto Use Benefits - Undiscounted Benefits	Total Undiscounted Benefits	Total Discounted Benefits at 7%	Total Discounted Benefits at 3%
2015 (opening)	4	$33,148	$141,600	$730,353	$354	$905,455	$690,767	$804,485
2016	5	$33,640	$143,705	$741,210	$359	$918,914	$655,173	$792,664
2017	6	$34,140	$145,841	$752,228	$365	$932,574	$621,414	$781,016
2018	7	$34,648	$148,009	$763,410	$370	$946,437	$589,393	$769,540
2019	8	$35,163	$150,209	$774,759	$376	$960,506	$559,023	$758,232
2020	9	$35,686	$152,442	$786,275	$381	$974,784	$530,218	$747,091
2021	10	$36,216	$154,708	$797,964	$387	$989,274	$502,897	$736,113
2022	11	$36,754	$157,008	$809,825	$393	$1,003,980	$476,984	$725,297
2023	12	$37,301	$159,342	$821,864	$399	$1,018,905	$452,406	$714,639
2024	13	$37,855	$161,710	$834,081	$404	$1,034,051	$429,094	$704,138
2025	14	$38,418	$164,114	$846,479	$410	$1,049,422	$406,984	$693,792
2026	15	$38,989	$166,554	$859,062	$417	$1,065,022	$386,013	$683,597
2027	16	$39,569	$169,030	$871,833	$423	$1,080,854	$366,123	$673,552
2028	17	$40,157	$171,542	$884,793	$429	$1,096,921	$347,257	$663,655
2029	18	$40,754	$174,092	$897,945	$435	$1,113,227	$329,364	$653,903
2030	19	$41,360	$176,680	$911,293	$442	$1,129,775	$312,392	$644,295
2031	20	$41,974	$179,307	$924,840	$448	$1,146,569	$296,295	$634,828
2032	21	$42,598	$181,972	$938,588	$455	$1,163,613	$281,028	$625,499
2033	22	$43,232	$184,677	$952,540	$462	$1,180,910	$266,547	$616,308
2034	23	$43,874	$187,422	$966,700	$469	$1,198,465	$252,812	$607,252
Total		**$765,476**	**$3,269,963**	**$16,866,041**	**$8,178**	**$20,909,658**	**$8,752,184**	**$14,029,896**

10.6 Environmental Sustainability: Annual Benefit Estimates

Calendar Year	Project Year	Environmental Savings in TRIP	Regional Environmental Savings	Total Undiscounted Benefits	Total Discounted Benefits at 7%	Total Discounted Benefits at 3%
2015 (opening)	4	$134,377	$363,248	$497,625	$397,213	$442,133
2016	5	$122,783	$665,668	$788,452	$599,393	$680,125
2017	6	$112,756	$919,768	$1,032,524	$750,021	$864,722
2018	7	$104,098	$1,135,966	$1,240,064	$863,691	$1,008,286
2019	8	$96,483	$1,320,654	$1,417,137	$949,914	$1,118,701
2020	9	$89,966	$1,235,947	$1,325,912	$858,240	$1,016,201
2021	10	$84,444	$1,164,549	$1,248,993	$783,304	$929,368
2022	11	$80,103	$1,108,501	$1,188,604	$723,781	$858,673
2023	12	$76,418	$1,061,214	$1,137,631	$674,293	$797,912
2024	13	$73,310	$1,021,636	$1,094,946	$633,034	$745,605
2025	14	$71,054	$993,483	$1,064,537	$600,459	$703,785
2026	15	$69,177	$970,322	$1,039,499	$572,784	$667,215
2027	16	$67,637	$951,622	$1,019,259	$549,180	$635,168
2028	17	$66,907	$943,570	$1,010,476	$531,231	$611,355
2029	18	$66,351	$937,834	$1,004,185	$515,399	$589,853
2030	19	$65,956	$934,241	$1,000,197	$501,376	$570,398
2031	20	$66,011	$936,342	$1,002,352	$489,037	$554,978
2032	21	$66,127	$939,272	$1,005,399	$477,583	$540,452
2033	22	$66,303	$943,000	$1,009,304	$466,918	$526,748
2034	23	$66,858	$951,846	$1,018,704	$457,943	$516,169
Total		**$1,647,119**	**$19,498,683**	**$21,145,802**	**$12,394,796**	**$14,377,848**

10.7 Safety: Annual Benefit Estimates

Calendar Year	Project Year	Reduced Accident Costs in TRIP	Reduced Regional Accident Costs	Total Undiscounted Benefits	Total Discounted Benefits at 7%	Total Discounted Benefits at 3%
2015 (opening)	4	$1,439,563	$985,210	$2,424,773	$1,849,848	$2,154,380
2016	5	$1,452,186	$1,987,699	$3,439,885	$2,452,590	$2,967,275
2017	6	$1,464,919	$3,007,692	$4,472,611	$2,980,290	$3,745,742
2018	7	$1,477,765	$4,045,420	$5,523,185	$3,439,562	$4,490,855
2019	8	$1,490,723	$5,101,116	$6,591,838	$3,836,510	$5,203,658
2020	9	$1,503,794	$5,145,845	$6,649,639	$3,616,963	$5,096,395
2021	10	$1,516,980	$5,190,967	$6,707,947	$3,409,980	$4,991,342
2022	11	$1,530,282	$5,236,484	$6,766,766	$3,214,842	$4,888,456
2023	12	$1,543,700	$5,282,400	$6,826,101	$3,030,870	$4,787,690
2024	13	$1,557,236	$5,328,719	$6,885,956	$2,857,427	$4,689,001
2025	14	$1,570,891	$5,375,445	$6,946,336	$2,693,909	$4,592,346
2026	15	$1,584,666	$5,422,580	$7,007,245	$2,539,748	$4,497,684
2027	16	$1,598,561	$5,470,128	$7,068,689	$2,394,409	$4,404,973
2028	17	$1,612,578	$5,518,093	$7,130,671	$2,257,388	$4,314,173
2029	18	$1,626,718	$5,566,479	$7,193,197	$2,128,207	$4,225,245
2030	19	$1,640,982	$5,615,289	$7,256,271	$2,006,419	$4,138,150
2031	20	$1,655,371	$5,664,527	$7,319,898	$1,891,601	$4,052,850
2032	21	$1,669,886	$5,714,197	$7,384,083	$1,783,353	$3,969,308
2033	22	$1,684,529	$5,764,302	$7,448,830	$1,681,299	$3,887,489
2034	23	$1,699,299	$5,814,846	$7,514,146	$1,585,086	$3,807,356
Total		**$31,320,628**	**$97,237,436**	**$128,558,064**	**$51,650,300**	**$84,904,365**