Ballard Interbay Regional Transportation System (BIRT) Study

Appendix H: Economic and Social Impacts Analysis

November 2020

Seattle Department of Transportation

Ballard-Interbay Regional Transportation System Project

Economic and Social Impacts Analysis

FINAL DRAFT

August 25, 2020

Prepared by:

cai community attributes inc

Prepared for:

SDOT
Seattle Department of Transportation

Community Attributes Inc. tells data-rich stories about communities that are important to decision makers.

President and CEO:
Chris Mefford

Project Manager:
Madalina Calen

Analysts:
Bryan Lobel
Michaela Jellicoe
Spencer Cohen
Zack Tarhouni

Community Attributes Inc.
500 Union Street, Suite 200
Seattle, Washington 98101

www.communityattributes.com

Contents

This page was intentionally left blank

EXECUTIVE SUMMARY

The Economic and Social Impacts Analysis for the Ballard-Interbay Regional Transportation System (BIRT) presents a summary of the economic and social impacts of the selected alternatives for replacing the bridges.

The alternatives for the Ballard Bridge are:

- **Alternative 1**: Low-level bridge rehabilitation
- **Alternative 2**: Mid-level movable bridge

The alternatives for the Magnolia Bridge are:

- **Alternative 1**: Armory Way
- **Alternative 2**: In-Kind Replacement

Potential impacts of each bridge alternative considered include travel time, vehicle operating costs, safety, accessibility, market desirability, and costs. The study did not evaluate impacts from construction of bridge alternatives. All impacts are for the operational period of the bridges. This analysis does not make a recommendation on which bridge alternative SDOT should implement, rather it aims to provide an objective evaluation to support an informed decision.

Travel Time
The two Ballard Bridge alternatives considered are forecasted to have minimal impact on travel times[1].

- The Mid-level Bridge is expected to improve travel time by **0.6 minutes** per vehicle, resulting in total travel time savings of **$3.9 million** in 2042 (in 2018 dollars).
- The Low-level alternative is expected to improve travel time by **0.2 minutes** per vehicle, resulting in total travel time savings of **$1.4 million** in 2042 (in 2018 dollars).

For the Magnolia Bridge alternatives, the Armory Way Bridge will have the highest impact on travel time. The In-Kind Replacement Bridge, due to a similar design to the existing bridge, will not impact travel time significantly.

- The Armory Way Bridge is forecasted to increase travel times by **12.7 minutes** per vehicle, resulting in total travel time costs of **$23.1 million** in 2042 (in 2018 dollars).

[1] Travel times used for the estimation of travel time savings are average daily ravel times per vehicle, for all travel purposes including commuting, freight, and other (HOV, SOV).

- The In-Kind Replacement is forecasted to increase travel times by **0.7 minutes** per commuting and general purpose vehicle and by **1.3 minutes** per freight vehicle, resulting in total travel time costs of **$1.5 million** in 2042 (in 2018 dollars).

Operating Costs
Vehicle operating cost savings are realized when transportation improvements lead to a decrease in vehicle miles traveled (VMT). Data available at the time of analysis does not provide sufficient evidence to suggest any significant changes in VMT due to any of the bridge alternatives.

Safety[2]
The shared use path included in both alternatives for the Ballard Bridge has the potential to save **$2.65 million per fatal crash and $62,650 per injury crash** by reducing the risk of collision involving cyclists and pedestrians. According to data from the Federal Highway Administration, a shared use path can reduce current fatal and non-fatal crashes by 25%.

For the Magnolia Bridge alternatives, **minimal safety benefits** are expected for non-motorized access due to low levels of historic collisions involving bicyclists or pedestrians on the Magnolia Bridge and relatively small projected increase in pedestrian and cyclist volumes with both alternatives.

Accessibility
The Ballard Low-Level and Mid-Level alternatives and the Magnolia Bridge In-Kind Replacement are projected to have minimal impacts on travel times. There will likely be no impact to access to housing affordable to workers in the study area from these bridge replacement options. The Armory Way Bridge would increase the commute time on average per vehicle, per day, for housing located near the western terminus of the Magnolia Bridge. Most lower priced housing is located well north of the Magnolia Bridge western terminus.

Market Desirability
The Ballard Low-Level and Mid-Level alternatives and the Magnolia Bridge In-Kind alternative are expected to have minimal impact on travel time, with less than one minute change on average per day for all travel purposes. No change in market desirability is foreseen for these bridge replacement options due to continued market demand for the study area.

The Armory Way Bridge is forecasted to add 13 minutes on average per vehicle, per day for all travel purposes on routes that must pass through the

[2] This study does not project future crashes and therefore a full quantification of safety benefits was not possible.

current bridge termini. The travel time impact is measured from the west of the current Magnolia Bridge terminus at Thorndyke Avenue W and W Galer Street to the east at Elliot Avenue W and W Galer Street Flyover. Only a portion of the 20,000 vehicles that are forecasted to cross the bridge traveling from the southern portion of the Magnolia neighborhood will experience this level of change in travel time. The highly desirable attributes of residences affected are expected to sustain market desirability of all affected areas.

Costs

Cost estimates were sourced from existing bridge planning studies. Planning level cost estimates for the **Ballard Low-level Bridge** are **$471 million** for construction, maintenance and operations, and right-of-way, compared to **$971 million** for the **Mid-level alternative**[3].

The total cost for the Magnolia Bridge In-Kind Replacement is estimated at nearly **$398 million** including construction, soft costs, right-of-way, and contingency costs. The cost for the Armory Way alternative is estimated at **$266 million**.

[3] Ballard Bridge Planning Study Alternatives Comparison Report DRAFT, SDOT, March 9, 2020.

INTRODUCTION

Background and Purpose

Originally a salt marsh, the Interbay neighborhood hosts a diverse mix of businesses and industries representing the broad sweep of Seattle's history. North of Interbay, Ballard is one of Seattle's fastest growing neighborhoods and will be the terminus of Sound Transit's Ballard and West Seattle Link Extensions. The 2019 Washington State legislature allocated funds for the City of Seattle to develop a plan to improve mobility for people and freight in the Ballard-Interbay area.

The Ballard-Interbay Regional Transportation System (BIRT) plan is developed by an interagency team led by SDOT and including the City of Seattle, Port of Seattle, Sound Transit, King County, Washington State Department of Transportation, and the Washington State Military. According to the Washington State legislature:

"The plan must examine replacement of the Ballard bridge and the Magnolia bridge, which was damaged in the 2001 Nisqually earthquake. The city must provide a report on the plan that includes recommendations to the Seattle City Council, King County Council, and the transportation committees of the legislature by November 1, 2020. The report must include recommendations on how to maintain the current and future capacities of the Magnolia and Ballard bridges, an overview and analysis of all plans between 2010 and 2020 that examine how to replace the Magnolia bridge, and recommendations on a timeline for constructing new Magnolia and Ballard bridges."

In analyzing future transportation demand for the Ballard-Interbay area, the project will take into consideration future residential growth in nearby neighborhoods and additional employment at sites such as the Armory, Expedia, and the Port of Seattle's Terminal 91. It will also adjust to reflect the recommendations of the Mayor's current Maritime and Industrial Lands Strategy.

This report represents a summary of the analysis of economic and social impacts of alternatives for replacing the Magnolia and Ballard bridge. Potential impacts considered include travel time, vehicle operating costs, safety, accessibility, and market desirability. The analysis builds on the findings from the Community and Economic Assessment which was also conducted as part of the BIRT study. The report does not make a recommendation on which bridge alternative SDOT should implement. It aims to provide an objective evaluation to support an informed decision.

Methods

The analysis of economic and social impacts of the two bridges assesses the potential benefits and limitations of bridge replacement alternatives. The analysis includes a well-defined baseline to measure against the incremental benefits and limitations of the proposed alternatives. All bridge alternatives are assessed against the following criteria: travel time, operating costs, safety, accessibility, market desirability and costs.

This report draws on multiple data and information sources, including previous bridge plans and studies, traffic analysis conducted as part of this study, state and federal sources such as the Washington State Employment Security Department, Office of Financial Management, and U.S. Bureau of Labor Statistics.

Organization of Report

The remainder of this report is organized as follows:

- **Alternatives Overview**. A brief description of the Magnolia and Ballard bridge alternatives analyzed in this study.
- **Analysis Framework and Assumptions**. A discussion of criteria and assumptions included in the analysis of economic and social impacts.
- **Economic and Social Impacts**. A discussion of the economic and social impacts analysis of the bridge alternatives.
- **Impact Assessment Summary**. A matrix summarizing the findings from the economic and impact analysis to compare alternatives.

ALTERNATIVES OVERVIEW

This study assesses two alternatives each for the replacement of Ballard and Magnolia bridges. A brief description of each alternative is provided below.

Ballard Bridge

The Ballard Bridge Planning Study (2020) is currently underway and the final report will be released in 2020. The Planning Study is considering three options for the replacement of the Ballard bridge. Of those, two options that have the most support are analyzed in this report:

- **Alternative 1 – Low-level bridge rehabilitation** includes rehabilitation and strengthening of the existing Ballard bridge structures and creates a 14-foot wide Shared Use Path (SUP). The SUP would extend from Ballard Way at the north end to a new Modified Single Point Urban Interchange at the south end.

- **Alternative 2 – Mid-level movable bridge** replaces the existing bridge with a higher profile mid-level movable bridge that improves the vertical clearance by approximately 20-ft. Other components include construction of new bascule bridge and approach structures for 15th Ave W-NW, ramp structures to NW Leary Way, a Modified Single Point Urban Interchange (MSPUI) at Emerson-Nickerson. This alternative requires a temporary detour bridge to facilitate construction.

Magnolia Bridge

The Magnolia Bridge Planning Study (2019) analyzed and compared four bridge replacement options. Of those options, the following are being considered for this study:

- **Alternative 1 – Armory Way** constructs a new bridge over the railroad tracks connecting 15th Avenue W & W Armory Way to Thorndyke Avenue W just south of W Raye Street. The new Armory Way bridge would include a Western Perimeter Road to Smith Cove Park/Elliot Bay Marina. Thorndyke Avenue W and 20th Ave W would be improved to allow access to the marina and port properties. Additional bridge components, such as a new ramp down to Alaskan Way W on the north side of the bridge, are designed to provide alternative access to Terminal 91, Port of Seattle property, and Expedia campus. Under this alternative, the existing Magnolia Bridge would be decommissioned.
- **Alternative 4 – In-kind replacement** constructs a new bridge immediately south of the existing Magnolia bridge, following a similar alignment and functionality as the current bridge. The new bridge would feature a 10-foot wide shared use path on the south side, though it would not connect to the Elliott Bay Trail.

Analysis Framework and Assumptions

The Magnolia and Ballard bridge replacement alternatives were assessed against the following criteria:

- **Travel time**. How will the bridge replacement alternatives impact travel time for commuters and freight that use the bridges?
- **Operating costs**. How will the alternative impact vehicle operating costs for transport users?
- **Safety.** How will each bridge alternative impact safety for various modes of transportation?
- **Accessibility.** How will each bridge alternative impact access to housing for workers in the study area?
- **Market desirability.** How will each bridge alternative impact market demand for affected areas?

- **Costs.** What are cost estimates of each bridge replacement alternative?

The analysis follows a conservative estimation of the impacts and assesses some of the impacts qualitatively. Where possible, the potential impacts expected to result from each bridge replacement alternative were monetized.

The analysis leveraged the U.S. Department of Transportation Benefit-Cost Analysis Guidance for Discretionary Grant Programs. Generally, standard factors and values accepted by federal agencies are used for the benefits calculation except in cases where more project specific values or prices are available. In all such cases, modifications are noted, and references are provided for data sources. The impacts are expressed in constant 2018 dollars, the year in which standard values are provided in the guidance, to avoid forecasting future inflation, unless otherwise stated.

Construction Impacts

There is insufficient data and information on detour routes, traffic volumes diverted or the impact on travel times to quantify the effects from construction of bridge alternatives. A review of information on construction impacts from current bridge studies was completed and summarized in this section.

The Ballard Bridge Planning Study (2020) did not evaluate traffic conditions during construction[4].

- The Ballard Bridge Low-Level alternative would require single lane shutdowns as needed across the bridge during construction, with no need for a detour. Further analysis would be required to determine how the Modified Single-Point Urban Interchange (that replaces existing interchange at the W Nickerson St/W Emerson St/15th Ave W intersection) could be constructed while retaining through traffic on 15th Ave W as well as all connections to W Nickerson St and W Emerson St. The Low-level Bridge has the shortest construction duration of the three alternatives considered in the Ballard Bridge Planning Study.
- The Ballard Bridge Mid-Level alternative would require complete closure of the existing Ballard Bridge during construction, and a temporary bridge and detour route. Fremont and Aurora Bridge do not have enough capacity to accommodate diverted traffic. Further traffic and design analysis are required to determine configuration and location of a temporary crossing.

Existing planning studies for the Magnolia Bridge provide some information on change in traffic patterns for the No Build scenario. The Magnolia Bridge

[4] SDOT Ballard Bridge Planning Study Transportation Discipline Report, Appendix A, March 10, 2010.

Traffic Maintenance During Bridge Closure (2017) study evaluated the impact to traffic during a potential closure of the existing bridge, either because of a catastrophic event or because of the need to detour traffic during construction of a permanent facility. The analysis performed assumes that traffic would divert to either W Dravus St or W Emerson St based on existing travel patterns and these alternate routes are expected to become congested. The congestion hot spots identified include: W Dravus St / 15th Ave W ramp intersections; W Dravus St / 20th Ave W; W Emerson St / Gilman Ave W; and W Emerson St / W Nickerson St. Transit would have to be rerouted using the currently designated snow route or other alternative route.

The Magnolia Bridge Planning Study (2019) estimates that the Magnolia Bridge alternatives will have a similar construction duration. The Armory Way Bridge will take 29 months to complete, compared to 31 months for the In-Kind Replacement. However, the construction impacts for the In-Kind Replacement in terms of significant impact to traffic are expected to last almost twice as long (27 months) as for the Armory Way alternative (14 months).

ECONOMIC AND SOCIAL IMPACTS

This chapter provides a summary of the analysis of each alternative against the economic and social criteria.

Travel Time

The analysis of travel time impacts measures the value of changes to travel time with the implementation of the proposed Magnolia and Ballard Bridge replacement alternatives. Travel time impacts are estimated using data on projected traffic volumes and travel time changes for the different corridors provided by Fehr & Peers and Concord Engineering. The forecasts are produced for the 2042 future year for the AM and PM peak periods for two network scenarios:

- **Network Scenario 1.** Mid-level Ballard Bridge and Armory Bridge Alternative 1; land uses and transportation network consistent with the West Seattle Ballard Link Extension (WSBLE) model and inclusion of interim Armory Development land use.
- **Network Scenario 2.** Low-level Ballard Bridge and In-kind replacement Alternative 4 for Magnolia Bridge, as well as new intersections at 20th Avenue W and Thorndyke Avenue, and new flyover ramp access at Galer Street for access across BSNF rail to Pier 91 and adjacent facilities; land uses and transportation network consistent with the West Seattle and Ballard Link Extensions (WSBLE) model.

The existing and projected travel times and traffic volumes from this study differ from previous Ballard and Magnolia Bridge studies because of distinct horizon year, analytical methods, and project extents.

The forecasted travel time impacts of the bridge replacement alternatives are compared to the No Build option in 2042. The No Build option for the Magnolia and Ballard bridge assumes no changes to the existing transportation network. **Exhibit 1** and **Exhibit 2** show the change in travel time by corridor and scenario for general purpose traffic and freight for the AM, PM peak hour, and average daily.

Exhibit 1. Travel Time Savings, General Purpose Traffic, 2042

Corridor	Scenario	AM - Average TT*	AM - Peak TT**	PM - Average TT	PM - Peak TT	Average Daily TT***
Ballard Bridge	Scenario 1 (Mid Level)	0.8	1	0.1	0.2	0.3
	Scenario 2 (Low Level)	0.5	0.7	0.3	0.5	0.2
Magnolia Bridge	Scenario 1 (In-Kind)	-2.1	-3.1	-0.2	-0.3	-0.7
	Scenario 2 (Armory Way)	-18.2	-25.2	-21.8	-30.2	-12.7
NW Leary Way	Scenario 1	0.2	0.2	-0.4	-0.6	-0.1
	Scenario 2	0	-0.1	0	-0.1	0.0
W Emerson Street/ W Nickerson Street	Scenario 1	-1.8	-2.5	-0.8	-0.9	-0.7
	Scenario 2	-1.8	-2.5	-0.8	-0.9	-0.7
W Dravus Street	Scenario 1	0	0	0	0	0.0
	Scenario 2	-0.5	-0.7	-1.8	-2.4	-0.6

Source: Concord Engineering, 2020; Community Attributes, 2020.

Note: For further details on the origin and destination points for the corridors in this table please refer to Appendix A.

Exhibit 2. Travel Time Savings, Freight, 2042

Corridor	Scenario	AM - Average TT*	AM - Peak TT**	PM - Average TT	PM - Peak TT	Average Daily TT***
Ballard Bridge	Scenario 1 (Mid Level)	0.7	1.1	0.0	0.0	0.2
	Scenario 2 (Low Level)	0.5	0.8	0.2	0.3	0.2
Magnolia Bridge	Scenario 1 (In-Kind)	-3.7	-1.2	-0.9	-1.4	-1.3
	Scenario 2 (Armory Way)	-18.3	-27.5	-20.7	-31.1	-12.6
NW Leary Way	Scenario 1	-0.5	-0.8	-1.1	-1.7	-0.5
	Scenario 2	0.0	0.0	0.0	0.0	0.0
W Emerson Street/ W Nickerson Street	Scenario 1	-2.7	-4.1	-1.6	-2.4	-1.2
	Scenario 2	-2.7	-4.1	-1.6	-2.4	-1.2
W Dravus Street	Scenario 1	-0.2	-0.3	-0.2	-0.3	-0.1
	Scenario 2	-0.7	-1.1	-2.0	-3.0	-0.8

Source: Concord Engineering, 2020; Community Attributes, 2020.

*Note: *Average TT represents the average travel time a vehicle is expected to experience aggregated over the peak hour. Running time plus intersection delay.*

***Peak TT represents the typical highest travel time a vehicle may experience on days with high levels of congestion. This value is based on peak factors created from 95th percentile peak travel times collected along 15th Avenue in October, 2019 from SDOT's Acyclica ITS system.*

****Data was not available from the travel demand model for average daily travel time. This was calculated as the weighted average of the AM peak, PM peak and free flow travel times. Average Daily TT = ((2hrs*AM Average TT+1hr*AM Peak TT)+10hrs*(Average(Free Flow TT, AM Average TT, PM Average TT)+(2hrs*PM Average TT+1hr*PM Peak TT)+8hrs*Free Flow TT)/24hrs).*

Ballard Bridge

Based on traffic volume data from Fehr & Peers, just over 5,600 vehicles are forecasted to cross the Ballard Bridge under both alternatives during the PM peak hour in 2042. This represents an average annual increase of 0.9% from existing volumes. Roughly 23% of future traffic volumes are commuters, 17% is freight and the remaining 60% are High Occupancy Vehicles (HOV) and Single Occupancy Vehicles (SOV) travelling for other purposes, such as business or personal.

Both Ballard Bridge alternatives are forecasted to have minimal impact on travel time for private vehicles and freight crossing the bridge. The Mid-level alternative may improve travel time by 0.6 minutes on average per vehicle, for all travel purposes. This includes the time savings associated with reduced bridge openings of roughly 22 seconds per vehicle[5]. Multiplying the annual hours lost by average vehicle occupancy (1.3) and value of time by travel purpose, yields total travel time savings of $3.9 million in 2042 (in 2018 dollars). (**Exhibit 3**)

Exhibit 3. Value of Travel Time Savings, All Travel Purposes, Ballard Bridge, 2042 (Mils $2018)

Corridor	Scenario	Commuting	Freight	Other	Total
Ballard Bridge	Scenario 1 (Mid Level)	$0.8	$0.8	$2.3	$3.9
	Scenario 2 (Low Level)	$0.3	$0.3	$0.9	$1.4

Source: Concord Engineering, 2020; Fehr & Peers, 2020; U.S. Department of Transportation Benefit-Cost Analysis Guidance for Discretionary Grant Programs; Community Attributes, 2020.

The Low-level alternative is expected to decrease travel time by 0.2 minutes on average per vehicle crossing the bridge, for all travel purposes. The total

[5] According to the Ballard Bridge Planning Study (2020) the Mid-Level Bridge will eliminate about 70% of the bridge openings. The average delay per vehicle would decrease from about 31 seconds per vehicle to 9 seconds per vehicle.

estimated value of travel time benefits is $1.4 million in 2042 (in 2018 dollars).

Magnolia Bridge

Total traffic volume for the Magnolia Bridge alternatives is forecasted at approximately 1,500 in the PM peak hour in 2042. This implies an average annual growth of 0.2% from existing traffic volumes. The projected mode split differs slightly between the Armory Way bridge and In-Kind Replacement alternatives. While commuting volumes represent roughly 18% under both alternatives, freight volumes are estimated at 23% for the In-Kind Replacement and 17% for the Armory Way bridge. High Occupancy Vehicles (HOV) and Single Occupancy Vehicles (SOV) travelling for other purposes make up 60% of total traffic volumes for the In-Kind Replacement alternative and 65% for the Armory Way Bridge alternative.

The In-Kind Replacement alternative of the Magnolia Bridge will have minimal impact on travel times for private vehicles and freight crossing the bridge due to its similar design to the existing bridge. It is estimated that the In-Kind Replacement bridge will increase travel time by 0.7 minutes on average for commuters and general purpose traffic and 1.3 minutes on average for freight. This results in total annual travel time costs of $1.5 million in 2042 (in 2018 dollars). (**Exhibit 4**)

Exhibit 4. Value of Travel Time Savings, All Travel Purposes, Magnolia Bridge, 2042 (Mils $2018)

Corridor	Scenario	Commuting	Freight	Other	Total
Magnolia Bridge	Scenario 1 (In-Kind)	-$0.2	-$0.6	-$0.7	-$1.5
	Scenario 2 (Armory Way)	-$3.8	-$4.4	-$14.9	-$23.1

Source: Concord Engineering, 2020; Fehr & Peers, 2020; U.S. Department of Transportation Benefit-Cost Analysis Guidance for Discretionary Grant Programs; Community Attributes, 2020.

The proposed Armory Way bridge is forecasted to increase travel times by roughly 13 minutes on average per vehicle for all travel purposes, with higher increases of up to 30 minutes in the PM peak hour. Economic impacts from travel time delays are estimated at $23.1 million in 2042 (in 2018 dollars) for the Armory Way bridge. This assumes that all 18,000 vehicles that are forecasted to cross the Armory Way bridge in 2042 will experience the full 13 minutes delay. The 13 minutes change in travel time is measured between the existing west Magnolia Bridge terminus at Thorndyke Ave W and W Galer Street and the east terminus at Elliot Avenue W and W Galer Street Flyover, via the new Armory Way Bridge.

Other Corridors

The analysis of travel time impacts also considered potential impacts to other corridors in the BIRT study area from changes to the network produced by the proposed Ballard and Magnolia bridge alternatives. According to travel time results provided by Concord Engineering, travel time impacts for general purpose and freight traffic are projected to be minimal on NW Leary Way between 17th Ave NW and 14th Ave NW, W Emerson Street / W Nickerson Street between Gilman Avenue W and 13th Avenue W and W Dravus Street corridors. (**Exhibit 1** and **Exhibit 2**)

There was no information provided on travel time impacts for corridors that include the Ballard Bridge segment and provide access to industrial businesses along the Ship Canal. The Ballard Bridge Planning Study (2020) reports some potential changes to vehicular and truck access and connectivity to industrial businesses along the Ship Canal and/or traffic served by NW Leary Way. The Low-Level Bridge retains ramp configuration at the north end of the bridge but would improve access at the south end due to the reconfiguration of the W Emerson St/W Nickerson St/15th Ave W interchange. The Mid-Level Bridge would improve traffic operations on both ends of the bridge, with the same reconfiguration of the interchange at the south end and longer one-way ramps connecting to the grid further away from 15th Ave NW on the north end.

Operating Costs

The analysis of economic impacts considers potential improvements to travel efficiencies on the proposed Ballard and Magnolia Bridge replacement alternatives that would reduce vehicle operating costs. Vehicle operating cost savings are realized when transportation improvements lead to less vehicle miles travelled (VMT).

Data provided by Fehr & Peers from the travel demand model shows a change in VMT by bridge crossing for commute and freight trips for both scenarios (**Exhibit 5**). However, the changes are attributed to model assumptions such as land use changes, rather than bridge alternative specific improvements. Fehr & Peers applied a version of the PSRC model that is currently being used for the WSBLE project. Post-processing of traffic volumes incorporated future pipeline projects such as T-91 development, Expedia Campus, and Armory Development for the baseline scenario.

Exhibit 5. Vehicle Miles Travelled (VMT) Savings, 2042

Corridor	Scenario	Commuting	Freight
Ballard Bridge	Scenario 1 (Mid Level)	607	-1943
	Scenario 2 (Low Level)	893	-1721
Magnolia Bridge	Scenario 1 (In-Kind)	809	-272
	Scenario 2 (Armory Way)	709	-463

Source: Fehr & Peers, 2020.

Note: VMT changes show the difference between the existing VMT and the future 2042 scenarios. VMT was calculated by multiplying the number of trips from origin to destination that cross each bridge by the distance between the origin and destination. Freight is defined as commercial vehicles, medium trucks, and heavy trucks and commuting are Home-Based Work trips.

There is insufficient evidence to suggest that the Ballard Bridge and Magnolia Bridge alternatives evaluated as part of this study will lead to a significant change in VMT.

Safety

The safety analysis considers whether the proposed Ballard and Magnolia Bridge alternatives reduce the likelihood of fatalities, injuries, and property damage and improve safety outcomes for residents and workers in the BIRT study area. Traffic collisions can impose various types of costs such as property damage, emergency services, traffic delays, medical and rehabilitation care, lost productivity and disability compensation costs, and non-market costs, including pain, grief, and reduced quality of life. Transportation projects that improve road safety can enhance economic performance by improving labor productivity and reducing economic losses that result from injuries and disabilities.

The expected effectiveness of the Ballard and Magnolia Bridge alternatives in reducing the frequency or severity of collisions is required to estimate the safety benefits. This study does not project future crashes and therefore a full quantification of benefits was not possible. The analysis considered alternative methods to tie the specific type of improvement being implemented with each bridge alternative to safety outcomes and sourced information available from previous bridge studies.

Ballard Bridge

Both Ballard Bridge alternatives considered as part of this study will provide improved facilities for bicycle and pedestrians that are likely to provide safer conditions for travel by these modes.

- The Low-level bridge alternative will create a 14-foot wide Shared Use Path (SUP) on the west side of the existing bridge, which will move cyclists using the traffic lanes today to the SUP. The SUP is expected to improve bicycle and pedestrian safety and accessibility. The east sidewalk on the approach structures would also be widened to 6-feet to match the existing bascule bridge.
- The Mid-level bridge alternative will also create a 14-foot wide SUP on the west side of the bridge but will not provide any bicycle or pedestrian facilities on the east side of the bridge.

The Ballard Bridge Planning Study looked at collisions data for the Ballard Bridge and the ramp junctions north and south of the bridge. Five years of collision data show no pedestrian or cyclist collisions on the main segment of the Ballard Bridge between the ramp junctions, and only one pedestrian/cyclist collision at each interchange on 15th Ave North and south of the bridge. (**Exhibit 6**) None of these collisions resulted in serious injuries or fatalities. However, this trend might not continue as the number of bicyclists and pedestrians crossing the Ballard Bridge could increase due to installing the Shared Use PAth and the opening of the light rail stations in Ballard.

Exhibit 6. Ballard Bridge Collision Summary
(June 1, 2014 through June 1, 2019)

Location	Vehicle	Ped/ Cycle	Other	Total	Average /Year
15th Ave NW/NW Leary Way Interchange	36	1	17	54	10.8
15th Ave W / W Emerson St / W Nickerson St Interchange	34	1	11	46	9.2
Ballard Bridge (ramp to ramp roadway segment)	40	0	18	58	11.6

Source: SDOT Ballard Bridge Planning Study Transportation Discipline Report – Appendix A, 2020.
Note: Other collision types included insufficient information, driver inattention, parked car, and improper movement.

Data available through extensive research by USDOT and other organizations from the online Crash Modification Factor (CMF) Clearinghouse was used to estimate the potential change in the number of collisions from implementing a SUP. A Crash Modification Factor (CMF) is a multiplicative factor that indicates the proportion of crashes that would be expected after implementing a countermeasure. Installing a shared path may reduce current fatal and non-fatal crashes involving bicyclists by 25%[6]. The benefit of preventing a fatal crash is valued at $10.6 million in 2018 dollars, while the monetized value of an injury crash is $250,600 in 2018 dollars[7].

[6] Statewide Analysis of Bicycle Crashes, Alluri et al., 2017.
[7] Monetization values for injury crashes and fatal crashes are based on an estimate of approximately 1.44 injuries per injury crash and 1.09 fatalities per fatal crash,

Both Ballard Bridge alternatives will implement a Shared Use Path that has the potential to save $2.65 million in 2018 dollars per fatal crash and $62,650 in 2018 dollars per injury crash by reducing the risk of collisions involving bicyclists.

Magnolia Bridge

The In-Kind Replacement and the Armory Way alternative will feature a non-motorized, multi-use path on the south side. For the In-Kind Replacement alternative there are no planned connections to the Elliot Bay Trail, as opposed to the Armory Way bridge which would provide improved connections to the Elliot Bay Trail via 20th Ave W.

Although both alternatives would improve non-motorized facilities, previous transportation analysis conducted for the Magnolia Bridge Long Term Replacement Study suggests that people will likely continue using existing travel routes regardless of the alternative chosen because of the steep grades under both bridge replacement options. A relatively small increase in bicycle and pedestrian traffic is expected with both alternatives[8].

Like the Ballard Bridge, there have been no pedestrian or bicycle fatalities reported for the Magnolia Bridge over the past 5 years. SDOT collisions data reports no bicycle and pedestrian collisions on the Magnolia Bridge between 2014 and 2019. The low level of historic collisions combined with the relatively small increase in bicycle and pedestrian volumes would suggest safety benefits for non-motorized access are expected to be minimal for both alternatives.

Accessibility

The accessibility analysis assessed how the proposed bridge alternatives would impact access to housing for workers in the BIRT study area. The housing market within the residential boundary of the BIRT study area served by the Ballard and Magnolia Bridges is composed of approximately 44,000 housing units, of which just 5% are vacant. Nearly 55% of housing units throughout the area are owner-occupied. The median value of owner-occupied units across the area is nearly $660,000 and the median gross rent is nearly $1,600. While analysis of households within the area found that the median gross rent as a percentage of household income is below the cost burden threshold, just 9% of residents are also employed in the study area.

based on an average of the last five years of data in NHTSA's National Crash Statistics. The fatal crash value is further adjusted for the average number of injuries per fatal crash.

[8]

An estimated 42% of study area workers earn less than $50,000 and 21% earn less than $35,000 (**Exhibit 7**). An estimated 15% of study area employment can afford up to $1,500 in monthly housing costs without experiencing housing cost burden. An additional 18% can afford monthly rents between $1,500 and $2,000[9]. Overall, an estimated 46% of study area employment can afford monthly housing costs up to $2,500 without experiencing cost burden. (**Exhibit 8**)

Exhibit 7. Wage Percentiles, Commercial Study Area, 2018

	Study Area Employment	Share of Employment
Less than $35,000	7,030	21%
$35,000-$50,000	7,020	21%
$50,000-$85,000	9,520	29%
$85,000-$125,000	5,010	15%
More than $125,000	4,170	13%
Total	**32,750**	**100%**

Sources: Puget Sound Regional Council, 2020; Washington State Employment Security Department, 2020; Bureau of Labor Statistics, 2020; Community Attributes Inc., 2020.
Note: Wage figures are for Seattle-Tacoma-Bellevue MSA.

Exhibit 8. Study Area Employment by Monthly Housing Cost, 2018

	Study Area Employment	Share of Employment
Less than $1,500	5,010	15%
$1,500-$2,000	6,030	18%
$2,000-$2,500	4,130	13%
$2,500-$3,500	6,170	19%
More than $3,500	11,410	35%
Total	**32,750**	**100%**

Sources: Puget Sound Regional Council, 2020; Washington State Employment Security Department, 2020; Bureau of Labor Statistics, 2020; U.S. Census Bureau American Community Survey, 2020; Community Attributes Inc., 2020.

Housing data indicates that housing affordable to area workers – especially rental housing - does exist in the study area but is difficult to find due to very low vacancy rates for both rental and for-sale units. In the residential study area, there were almost 19,000 units of renter-occupied housing, but only 588 units of vacant-for-rent housing[10]. This rate of vacancy – around 3.0% - falls

[9] Annual wages are converted to an estimated household wage based on 2018 American Community Survey data on Family Income by Number of Workers. Monthly housing cost is 30% of estimated annual household income, to account for housing cost burden, divided by 12.
[10] For the period 2014-2018, according to the U.S. Census American Community Survey.

well below what is generally considered to be a healthy market rental vacancy rate of 5%. However, again in the study area as whole, 51% of renter-occupied units and 57% or about 335 vacant-for-rent units were affordable to workers who can pay $1,500 a month in housing costs[11] (**Exhibit 9**). Another 31% of renter-occupied units were rented at between $1,500 and $2,000 a month. These more affordable renter-occupied units in the study area (those costing up to $2,000 per month in rent) were concentrated in Ballard and other northern neighborhoods of the study area.

Exhibit 9. Number of Renter-Occupied Housing Units by Neighborhood by Monthly Housing Cost, 2014-2018

	Number of Renter-Occupied Units with Cash Rent				
Housing Cost Levels Affordable to Study Area Workers	Magnolia	Ballard	Interbay	Other Neighbor-hoods	Study Area
Less than $1,500	1,300	4,495	986	2,761	9,542
$1,500-$2,000	730	2,892	599	1,619	5,840
$2,000-$2,500	238	761	114	633	1,746
$2,500-$3,500	250	342	234	527	1,353
More than $3,500	32	84	15	108	239
	2,550	**8,574**	**1,948**	**5,648**	**18,720**

Sources: U.S. Census Bureau American Community Survey, 2014-2018; Community Attributes Inc., 2020.

Exhibit 10. Number of Owner-Occupied Housing Units by Neighborhood by Monthly Housing Cost, 2014-2018

	Number of Owner-Occupied Units with Mortgage				
Housing Cost Levels Affordable to Study Area Workers	Magnolia	Ballard	Interbay	Other Neighbor-hoods	Study Area
Less than $1,500	568	398	152	676	1,794
$1,500-$2,000	479	861	170	1,028	2,538
$2,000-$2,500	820	1,359	89	1,511	3,779
$2,500-$3,500	1,137	1,951	220	2,232	5,540
More than $3,500	1,169	658	63	1,434	3,324
	4,173	**5,227**	**694**	**6,881**	**16,975**

Sources: U.S. Census Bureau American Community Survey, 2014-2018; Community Attributes Inc., 2020.

The story is different with owner-occupied and vacant-for-sale housing – such units (usually single-family detached housing) were less accessible to area workers who could only afford up to $2,000 per month in housing costs. Of

[11] Gross rent is the contract rent plus the estimated average monthly cost of utilities (electricity, gas, and water and sewer) and fuels (oil, coal, kerosene, wood, etc.) if these are paid by the renter (or paid for the renter by someone else).

the nearly 17,000 owner-occupied housing units in the study area for which a mortgage existed, only 10.6% cost $1,500 or less a month[12], and another 15% cost from $1,500 to $2,000 per month (**Exhibit 10**). The greatest number of owner-occupied units – just under a third – cost between $2,500 and $3,500 per month, with another 20% costing more than $3,500 per month. The total number of vacant-for-sale units was only 350 for the entire study area – an extremely low vacancy rate of 1.5% for owner occupied / vacant-for-sale housing units.

Given the minimal change in travel time for the Ballard Bridge alternatives and the Magnolia Bridge In-Kind Replacement, there will likely be no impact to access to housing. The Armory Way alternative could increase commute time for some workers in the Magnolia area that are already facing very low to extremely low vacancy rates for housing units that are more affordable to them. Besides vacant units, this includes just over 2,000 renter-occupied units costing up to $2,000 per month located in Magnolia. Most of these units are located to the north of the Magnolia Bridge. The further north of the bridge, the less of an increase of travel time would be experienced.

Market Desirability

Many residents in the study area have concerns about the impact of the bridge alternatives on home real estate values and marketability of all real estate. The assessment of market desirability effects describes the impact of the proposed Magnolia and Ballard Bridge replacement alternatives within the BIRT study area.

There are many factors that impact regional demand for real estate, real estate prices and availability. Demographics such as age, income, migration patterns, and population growth can have a large impact on how real estate is priced and what type of properties are in demand. Seattle and the region are growing faster that they have in decades. Over the past decade, Seattle added more than 143,000 people, of which roughly 15,000 were in the BIRT study area. The growth of ICT and other related companies has attracted more people to the area. Strong economic performance coupled with declining inventories and falling interest rates have led to an expensive real estate market in Seattle.

The Ballard Bridge alternatives and the Magnolia Bridge In-Kind alternative are expected to have minimal impact on travel time, with less than one minute change on average per day for all travel purposes. No change in

[12] Mortgage and select owner costs include the sum of payments for mortgages, deeds of trust, contracts to purchase, or similar debts on the property; real estate taxes; fire, hazard, and flood insurance on the property; utilities (electricity, gas, and water and sewer); and fuels (oil, coal, kerosene, wood, etc.). It also includes, where appropriate, the monthly condominium fee for condominiums and mobile home costs.

market desirability is foreseen for these bridge replacement options due to continued market demand for the study area.

The Magnolia Bridge Armory Way alternative is expected to increase travel time by 13 minutes on average, with longer delays during the AM and PM peak, for all travel purposes on routes that must pass through the current bridge termini. The travel time change is measured for the corridor that starts to the west of the current Magnolia Bridge terminus at Thorndyke Avenue W and W Galer Street and ends to the east at Elliot Avenue W and W Galer Street Flyover. Only a portion of current Magnolia Bridge users will experience the full 13 minutes delay. Trip origins and destinations north of the bridge on the eastern side of Magnolia will experience lower increases in travel time. Trips beginning or ending on the western side will find alternative routes as well, pending additional analysis of route alternatives.

The highly desirable attributes of residences affected are expected to sustain market desirability of all affected areas. Continued growth and demand for housing in the area will more than offset considerations of travel time with the Armory Way bridge. Traffic patterns shifts may cause micro-level market variances within Magnolia, but the overall demand for living in Magnolia will sustain the interests of prospective buyers and renters.

Costs

The Ballard Bridge Planning Study includes planning-level cost estimates of construction, maintenance and operations, and right-of-way. Design and construction costs are estimated at $390 million in 2019 dollars for the Low-level alternative, compared to $857 million for the Mid-level alternative. Right-of-way cost is estimated at $81 million in 2019 dollars for the Low-level alternative, compared to $114 million for the Mid-level alternative[13].

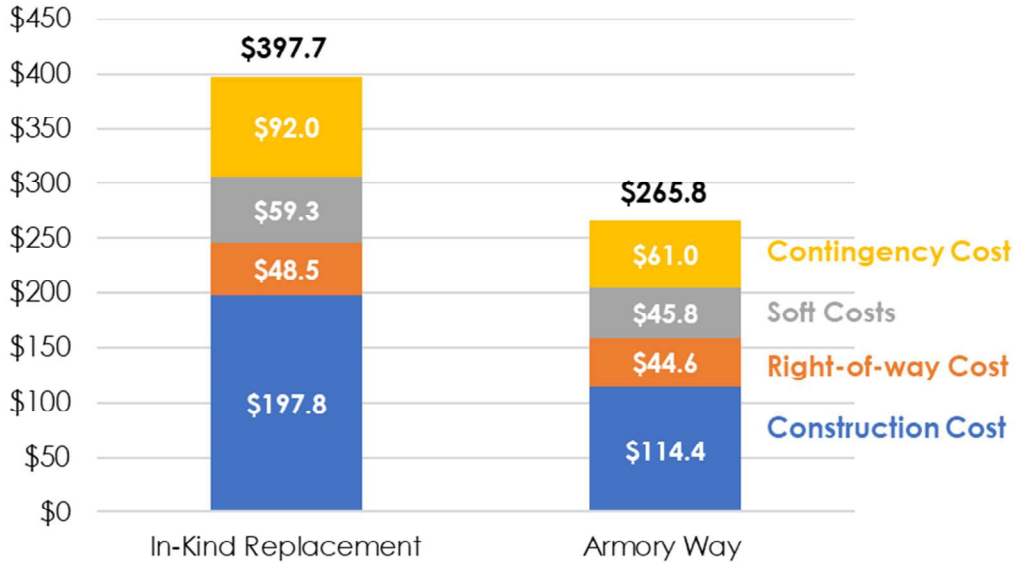
The Low-level bridge will maintain the same structure as the existing Ballard Bridge with a rehabilitated bascule section. Given the older structure, it will require more ongoing maintenance than the Mid-level alternative. The Mid-level bridge is also expected to require less ongoing operations staff and movable bridge maintenance than the rehabilitated structure because the number of bridge openings will be reduced.

The Magnolia Bridge Planning Study provides planning-level cost estimates of construction, right-of-way, engineering, and administration. The total cost for the In-Kind Replacement is estimated at $397.7 million, compared to $265.8 for the Armory Way bridge. A breakdown of the different cost

[13] Ballard Bridge Planning Study Alternatives Comparison Report DRAFT, SDOT, March 9, 2020.

components for the Magnolia Bridge alternatives is illustrated in **Exhibit 11**.

Exhibit 11. Magnolia Bridge Alternatives Cost Estimate, Mils $ 2018



Source: Magnolia Bridge Planning Study, 2019.

Impact Assessment Summary

Exhibit 12 and **Exhibit 13** below provide a summary of the evaluation outcomes for each bridge alternative.

Exhibit 12. Ballard Bridge Alternatives Impact Assessment Results

Criteria	Low-level bridge rehabilitation	Mid-level movable bridge
Travel Time Savings	**0.2 minutes** per vehicle (average daily, all travel purposes) Value of travel time savings, 2042: **$1.4 million ($2018)**	**0.6 minutes** per vehicle (average daily, all travel purposes, including savings from reduction in bridge openings) Value of travel time savings, 2042: **$3.9 million ($2018)**
Operating Costs	Insufficient evidence to suggest impact.	
Safety	Safety benefits from implementing a Shared Use Path: **$2.65 million per fatal crash** and **$62,650 per injury crash** ($2018) This alternative will also widen the east sidewalk to 6-feet with potential additional safety benefits to pedestrians.	Safety benefits from implementing a Shared Use Path: **$2.65 million per fatal crash** and **$62,650 per injury crash** ($2018)
Accessibility	**No impact** to access to housing due to minimal change in travel time.	
Market Desirability	**No change** in market desirability foreseen due to continued market demand for the study area.	
Costs	Design, construction, and right-of-way costs: **$471 million** ($2019) Older structure requires **more ongoing maintenance**.	Design, construction, and right-of-way costs: **$971 million** ($2019) New structure will require **less ongoing maintenance** than rehabilitated structure.

Exhibit 13. Magnolia Bridge Alternatives Impact Assessment Results

Criteria	Armory Way Bridge	In-Kind Replacement
Travel Time Savings	**-12.7 minutes** per vehicle (average daily, all travel purposes) Value of travel time savings, 2042: -**$1.5 million ($2018)**	**-0.7 minutes** per vehicle (average daily, all travel purposes, including savings from reduction in bridge openings) Value of travel time savings, 2042: -**$23.1 million ($2018)**
Operating Costs	Insufficient evidence to suggest impact.	
Safety	**Minimal benefits for non-motorized access** due to low level of historic collisions involving bicyclists or pedestrians on the Magnolia Bridge and relatively small projected increase in pedestrian and cyclist volumes for this alternative.	**Minimal benefits for non-motorized access** due to low level of historic collisions involving bicyclists or pedestrians on the Magnolia Bridge and relatively small projected increase in pedestrian and cyclist volumes for this alternative.
Accessibility	The Armory Way alternative **could increase commute time for some workers** in the Magnolia area that are already facing very low to extremely low vacancy rates for housing units that are more affordable to them.	**No impact** to access housing due to minimal change in travel time.
Market Desirability	Insufficient evidence to suggest that the change in travel time will correlate with an impact on market desirability for the Magnolia neighborhood.	**No change** in market desirability foreseen due to continued market demand for the study area.
Costs	Construction, soft costs, right-of-way, and contingency costs: **$265.8 million** ($2018)	Construction, soft costs, right-of-way, and contingency costs: **$397.7 million** ($2018)

APPENDIX A. ECONOMIC ANALYSIS ASSUMPTIONS

A list of assumptions for the inputs into the economic impact analysis is provided below. The list contains inputs for the calculation of travel time savings and safety benefits.

Input	Value	Source
Dollar year	2018	
Annualization factor	250	Number of working days in a
Share of AWDT that occurs in the PM peak hour	8%	SDOT Ballard Bridge Planning Study Transportation Discipline Report, 2020
Average Vehicle Occupancy – Ballard Bridge	1.3	Fehr & Peers, 2020
Average Vehicle Occupancy – Magnolia Bridge	1.4	Fehr & Peers, 2020
Value of Travel Time - Commuting	$15.2	USDOT BCA Guidance ($2018)
Value of Travel Time - Freight	$27.1	USDOT BCA Guidance ($2018)
Value of Travel Time – All Purposes	$16.6	USDOT BCA Guidance ($2018)
Average vehicle delay (sec/vehicle) from bridge openings - Low-Level (2040)	30.7	SDOT Ballard Bridge Planning Study Transportation Discipline Report, 2020
Average vehicle delay (sec/vehicle) from bridge openings - Mid-Level (2040)	9.2	SDOT Ballard Bridge Planning Study Transportation Discipline Report, 2020

Travel times were estimated for the following study area corridors:

- **Ballard Bridge**: 15th Avenue NW & NW Market Street to 15th Avenue W & Gilman Drive W.
- **Magnolia Bridge**: Thorndyke Avenue W & W Galer Street to W Galer Street Flyover & Elliot Avenue W
- **NW Leary Way**: 17th Avenue NW & NW Leary Way to 14th Avenue NW & NW Leary Way
- **W Emerson Street/W Nickerson St.**: Gilman Avenue W & W Emerson Street to 13th Avenue W & W Nickerson Street
- **W Dravus Street**: 20th Avenue W & W Dravus Street to 14th Avenue W & W Dravus Street