Ballard Interbay Regional Transportation System (BIRT) Study

Appendix F: Corridor Management Strategies

November 2020

Seattle Department of Transportation

Ballard-Interbay Regional Transportation System

Summary of Corridor Management Strategies - FINAL

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1. Introduction and Overview

The Multi-Modal Needs Assessment report documented the traffic operations analysis previously conducted for the Existing, Future 2042 Baseline, and base conditions of two Future Bridge Scenarios for the Ballard-Interbay Regional Transportation (BIRT) system project. A list of additional network improvement projects was developed with the goal of enhancing transportation system operations, person throughput, goods and freight movements, and overall system reliability beyond the base conditions of the bridge projects. The purpose of the corridor management strategies (CMS) analysis is to evaluate the traffic operational benefits of these additional network improvements.

2. Study Area and Corridor Descriptions

The transportation analysis study area is bound by NW Market Street to the north, 14th Avenue W to the east, W Mercer Place to the south, and Thorndyke Avenue W to the west. A primary concern about transportation is the throughput along the major study area corridors. For this reason, proposed projects were packaged into corridor management strategies for each of six major corridors listed below.

- 15th Avenue NW/W: Market St. to Mercer Pl. (Corridor 1)
- NW Leary Way: 17th Ave. NW to 14th Ave. NW (Corridor 2)
- W Emerson Street/W Nickerson St.: Gilman Drive to 13th Avenue NW (Corridor 3)
- W Dravus Street – 20th Ave. NW to 14th Ave. NW (Corridor 4)
- Armory Way Bridge – Thorndyke Ave. to 15th Avenue W via Armory Bridge (Corridor 5)
- Magnolia Bridge – 23rd Ave. NW to Terminal 91 (Corridor 6)

The project list developed by the BIRT consultant team for the multi-modal needs assessment included projects specifically targeting improvements for pedestrians, bicyclists, general purpose traffic, freight, and transit. The primary purpose of the corridor management strategies is to identify the impacts and benefits of projects on vehicular operations with the stated objective of improving person throughput and the movement of goods and freight. It should be noted that conflicts between these vehicular-focused projects and other modes of travel are expected to be evaluated in other studies. Figure 1 provides a map of the study corridors and Table 1 provides a summary of the traffic, freight, and transit characteristics of each of the corridors.

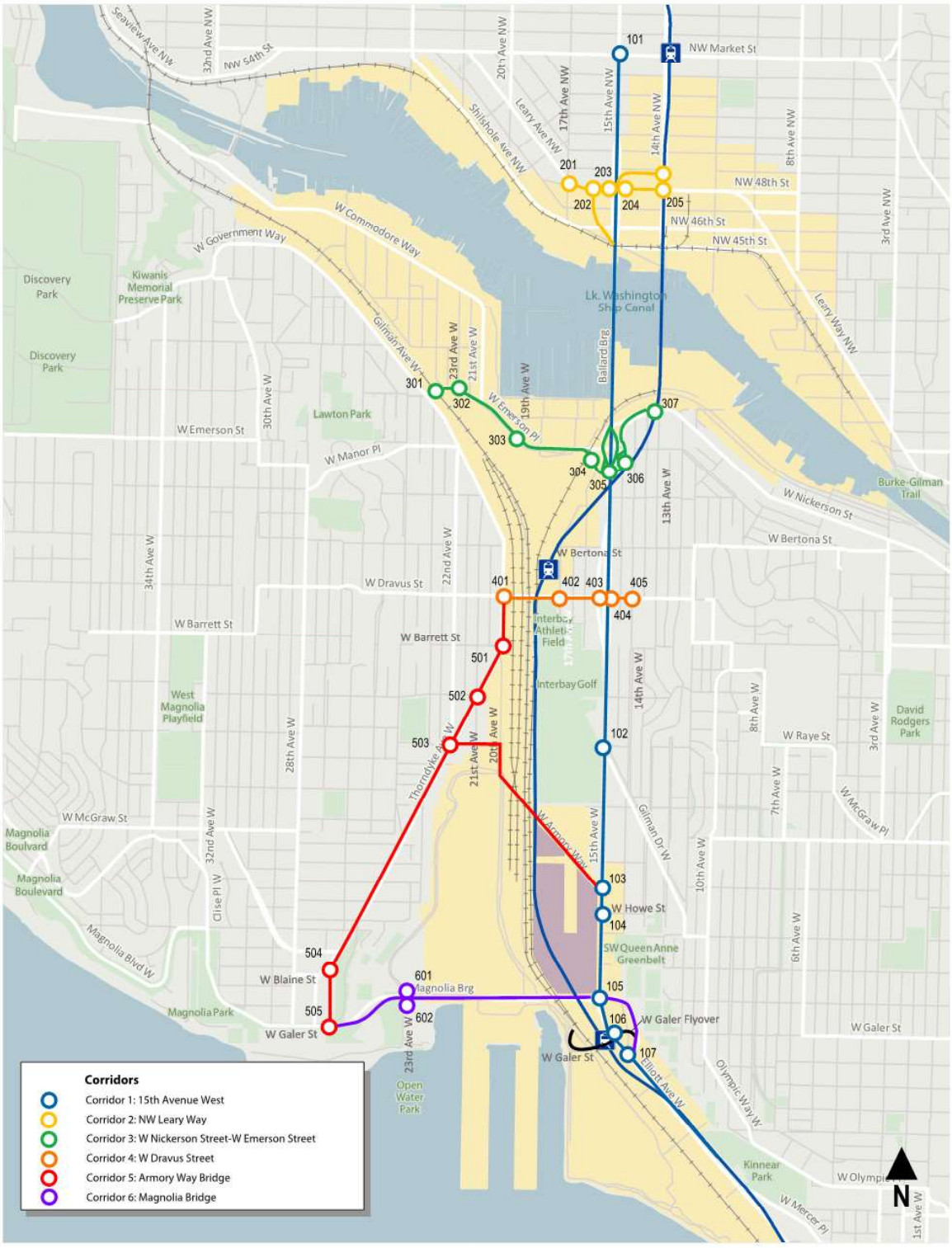

Figure 1. Study Corridors and Intersections

Table 1. Traffic, Freight, and Transit Characteristics of Corridors

Corridor	Extents	Classification	Posted Speed	ADT	AM/PM Peak Traffic	AM/PM HV%	Transit Routes
15th Ave. W (Corridor 1)	NW Market St. / W Mercer Pl.	Principal Arterial	35	59,000	3,600 / 3,700	5 / 3	15, 17, 18, 19, 24, 29, 32, 33, D Line
NW Leary Way (Corridor 2)	17th Ave. NW / 14th Ave. NW	Principal Arterial	35	21,200	1,200 / 1,600	6 / 2	17,18,40
W Emerson St./ W Nickerson St. (Corridor 3)	Gilman Ave. W / 13th Ave. W	Principal Arterial	25/35	18,700	1,200 / 1,400	4 / 3	29, 31, 32
W Dravus St. (Corridor 4)	20th Ave. W / 14th Ave. W	Principal Arterial	35	16,200*	1,000 / 1,300	2 / 2	994 (school route)
Armory / Thorndyke (Corridor 5)	W Galer St. & Thorndyke Ave. W / W Galer St. Flyover & Elliot Ave. W	Minor Arterial	35	5,000*	300 / 500	5 / 2	31, 33
Magnolia Bridge (Corridor 6)	W Galer St. & Thorndyke Ave. W / W Galer St. Flyover & Elliot Ave. W	Minor Arterial	30	20,000*	1,100 / 1,200	5 / 4	19, 24, 33

Notes:
-*Daily volumes estimated from peak hour counts

3. Corridor Opportunities and Needs

3.1 Analysis Methodologies

The multi-modal needs assessment report documented the existing and future 2042 baseline conditions for the BIRT study area. The analysis was conducted using Synchro Highway Capacity Manual (HCM) 2000 Level-of-Service and Delay reporting for the AM and PM peak hours. Forecast year 2042 peak hour traffic projections for two bridge replacement scenarios were developed as part of the traffic analysis effort. The two scenarios included; *Scenario 1: Mid-Height Ballard Bridge and Magnolia Bridge 1-1 replacement and Scenario 2: Low-Height Ballard Bridge with Armory Way Bridge alternative*. The future year projections were based on an EMME model from the West Seattle Ballard Link Extension study, originally derived from PSRC land use models.

For the corridor management strategies analysis, the models were updated to incorporate individual intersection improvements packaged together by corridor for the purposes of improving the mobility of people and goods. For each of the corridors, additional improvement strategies to relieve traffic, transit, and freight related congestion were identified above and beyond the projects already identified in the bridge replacement scenarios developed as part of the BIRT study.

3.2 Summary of Corridor Performance and Needs

Congestion impeding the movement of people and goods was the primary need identified for all six of the study corridors under the two bridge improvement scenarios. To quantify the congestion peak hour movement delay was calculated at key intersections along the corridors for freight and transit vehicles. Table 2 provides the average delay and Level-of-Service (LOS) for the worst performing traffic movement for freight and transit vehicles at each intersection along the study corridors by peak hour under the two bridge replacement scenarios. Table 3 shows the average travel time under normal conditions for freight and transit along the six study corridors under the 2042 base bridge replacement scenarios.

Table 2. Freight and Transit Intersection Movement Level-of-Service; 2042 Base Alternatives

ID	Corridor/ Intersection	Control	Freight LOS				Transit LOS			
			AM Peak		PM Peak		AM Peak		PM Peak	
			2042 Scen. 1	2042 Scen. 2	2042 Scen. 1	2042 Scen. 2	2042 Scen. 1	2042 Scen. 2	2042 Scen. 1	2042 Scen. 2
Corridor 1: 15th Avenue W										
101	NW Market St	Signal	F (SBT)	F (SBT)	F (NBT)	F (NBT)	C (SBT)	C (SBT)	C (NBT)	C (NBT)
102	Gilman Dr W	Signal	F (SBT)	E (SBT)	F (NBT)	F (NBT)	A (SBT)	A (SBT)	B (NBT)	B (NBT)
103	W Armory Way	Signal	F (SBT)	F (SBT)	D (NBT)	F (NBT)	A (SBT)	D (SBT)	A (NBT)	A (NBT)
104	W Howe St	Signal	F (SBT)	F (SBT)	F (NBT)	F (NBT)	B (SBT)	A (SBT)	E (NBT)	E (NBT)
105	W Garfield St	Signal	E (SBT)	F (SBT)	F (NBT)	F (NBT)	A (SBT)	A (SBT)	A (NBT)	A (NBT)
106	W Galer St	Signal	B (SBT)	A (SBT)	D (NBT)	F (NBT)	A (SBT)	A (SBT)	B (NBT)	B (NBT)
107	Galer Flyover	Signal	F (NBT)	A (SBT)	F (NBT)	F (NBT)	F (NBT)	A (NBT)	B (NBT)	A (NBT)
Corridor 2: NW Leary Way										
201	17th Ave NW	TWSC	C (WBT)	A (WBT)	C (WBT)	A (WBT)	C (WBT)	A (WBT)	C (WBT)	A (WBT)
202	15th Ramps (new)	Signal	C (EBT)	A (EBT)	C (EBT)	A (EBT)	C (EBT)	A (EBT)	C (EBT)	A (EBT)

Table 2. Freight and Transit Intersection Movement Level-of-Service; 2042 Base Alternatives

ID	Corridor/ Intersection	Control	Freight LOS				Transit LOS			
			AM Peak		PM Peak		AM Peak		PM Peak	
			2042 Scen. 1	2042 Scen. 2	2042 Scen. 1	2042 Scen. 2	2042 Scen. 1	2042 Scen. 2	2042 Scen. 1	2042 Scen. 2
203	15th SB Ramps	Signal	C (EBT)	E (EBT)	C (WBT)	D (EBT)	C (EBT)	E (EBT)	C (WBT)	D (EBT)
204	15th NB Ramps	Signal	C (WBT)	B (WBT)	B (WBT)	D (WBT)	C (WBT)	B (WBT)	B (WBT)	D (WBT)
205	14th Ave NW	Signal	B (WBT)	A (WBT)	D (WBT)	B (WBT)	B (WBT)	A (WBT)	D (WBT)	B (WBT)
Corridor 3: W Emerson Place / W Nickerson Street										
301	Gilman Ave W	AWSC	F (SEL)	F (SEL)	F (WBR)	F (WBR)	F (SEL)	F (SEL)	F (WBR)	F (WBR)
302	23rd Ave W	TWSC	A (EBT)	A (EBT)	A (WBT)	A (WBT)	A (EBT)	A (EBT)	A (WBT)	A (WBT)
303	19th Ave W	Signal	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)
304	SB 15th Off Ramp	Signal	B (EBR)	B (EBR)	C (NBL)	C (NBL)	B (EBR)	B (EBR)	C (NBL)	C (NBL)
305	15th Ramps	Signal	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)
306	NB 15th Ramps	Signal	B (NBR)	B (NBR)	B (WBL)	B (WBL)	B (NBR)	B (NBR)	B (WBL)	B (WBL)
307	13th Ave W	Signal	B (EBT)	B (EBT)	A (EBT)	A (EBT)	B (EBT)	B (EBT)	A (EBT)	A (EBT)
Corridor 4: W Dravus Street										
401	20th Ave W	Signal	D (EBT)	E (EBT)	F (WBT)	F (WBT)	D (EBT)	E (EBT)	F (WBT)	F (WBT)
402	17th Ave W	Signal	A (EBT)	A (EBT)	B (WBT)	B (WBT)	A (EBT)	A (EBT)	B (WBT)	B (WBT)
403	SB 15th Ramps	Signal	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)
404	NB 15th Ramps	Signal	D (WBT)	D (WBT)	F (WBT)	F (WBT)	D (WBT)	D (WBT)	F (WBT)	F (WBT)
405	14th Ave W	TWSC	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)
Corridor 5: Thorndyke Avenue W & W Armory Way										
501	20th Ave W	TWSC	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)

Table 2. Freight and Transit Intersection Movement Level-of-Service; 2042 Base Alternatives

ID	Corridor/ Intersection	Control	Freight LOS				Transit LOS			
			AM Peak		PM Peak		AM Peak		PM Peak	
			2042 Scen. 1	2042 Scen. 2	2042 Scen. 1	2042 Scen. 2	2042 Scen. 1	2042 Scen. 2	2042 Scen. 1	2042 Scen. 2
502	21st Ave W	TWSC	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)
503	W Armory Way	Signal	NA	F (WBL)	NA	C (WBL)	NA	F (WBL)	NA	C (WBL)
504	W Blaine St	TWSC	B (EBL)	F(EBL)	B (EBL)	F (EBL)	B (EBL)	F (EBL)	B (EBL)	F (EBL)
505	W Galer St	TWSC	F (SBL)	F (SBR)	C (SBR)	C (SBR)	F (SBL)	F (SBR)	C (SBR)	C (SBR)
Corridor 6: Magnolia Bridge										
601	23rd Ave NW	TWSC	A (EBLR)	A (EBLR)	A (EBLR)	A (EBLR)	A (EBLR)	A (EBLR)	A (EBLR)	A (EBLR)
602	Terminal 91 Gate	TWSC	A(NBR)	A(NBR)	A(NBR)	A(NBR)	A (NBR)	A (EBLR)	A (NBR)	A (EBLR)

Notes:
- Red Shading – LOS F (average vehicular delay >80 seconds for signalized intersections, >55 seconds for unsignalized intersections)
- Yellow Shading – LOS E (average vehicular delay 55-79 seconds for signalized intersections, 35-55 seconds for unsignalized intersections)
- Level-of-Service (LOS) based on Highway Capacity Manual (HCM) 2000 methodology
- Worst-performing traffic movement for each scenario/peak hour shown as follows: (XXY) XX is approach direction (NB – Northbound, SB – Southbound, EB – Eastbound, WB – Westbound) and Y is the movement (L – Left, T – Thru, R – Right)
- Scenario 1: Mid-Height Ballard Bridge and Magnolia Bridge 1-1 replacement
- Scenario 2: Low-Height Ballard Bridge with Armory Way Bridge alternative

Table 3. Freight and Transit Travel Times by Corridor, Base Bridge Replacement Scenarios

Corridor/ Segment	Direction	Free^ Flow (mins)	Freight Travel Time (minutes)				Transit Travel Time (minutes)			
			AM Peak		PM Peak		AM Peak		PM Peak	
			Scen. 1	Scen. 2	Scen. 1	Scen. 2	Scen. 1	Scen. 2	Scen. 1	Scen. 2
Corridor 1: 15th Ave W	SB	5.2	14.8	21.9	7.4	7.7	10.6	12.0	10.7	12.1
	NB	5.2	8.2	8.4	21.0	24.6	12.6	12.9	13.3	17.3
Corridor 2: NW Leary Way	EB	0.5	1.7	1.9	1.9	1.5	2.2	2.4	2.4	2.0
	WB	0.5	1.7	1.0	2.2	1.5	2.2	1.5	2.7	2.0
Corridor 3: W Emerson Pl / W Nickerson St	EB	2.0	5.3	5.3	4.1	4.1	4.8	4.8	3.6	3.7
	WB	2.0	4.7	4.7	10.8	10.8	4.3	4.3	10.4	10.4
Corridor 4: W Dravus St.	EB	0.6	4.6	5.0	3.2	3.6	4.5	4.9	3.1	3.5
	WB	0.6	2.2	2.3	4.8	6.2	2.1	2.2	4.7	6.1

Table 3. Freight and Transit Travel Times by Corridor, Base Bridge Replacement Scenarios

Corridor/ Segment	Direction	Free^ Flow (mins)	Freight Travel Time (minutes)				Transit Travel Time (minutes)			
			AM Peak		PM Peak		AM Peak		PM Peak	
			Scen. 1	Scen. 2	Scen. 1	Scen. 2	Scen. 1	Scen. 2	Scen. 1	Scen. 2
Corridor 5: Thorndyke Ave W / W Armory Way	EB	3.5	NA	7.3	NA	18.4	NA	8.5	NA	11.3
	WB	3.5	NA	16.0	NA	7.9	NA	11.8	NA	8.8
Corridor 6: Magnolia Bridge	EB	2.0	4.9	NA	2.7	NA	4.4	NA	2.2	NA
	WB	1.9	3.8	NA	3.8	NA	3.3	NA	3.3	NA

Notes:
- ^ Freeflow travel time represents the travel time a general purpose vehicle would experience when no traffic congestion is present
- Expected travel times are calculated by the vehicle running time plus average intersection delay, with dwell time added to transit movements and reduced turning speeds for turns and grade for freight vehicles. Travel times during congestion expected to be up to 50% greater than the values listed.
- Scenario 1: Mid-Height Ballard Bridge and Magnolia Bridge 1-1 replacement
- Scenario 2: Low-Height Ballard Bridge with Armory Way Bridge alternative

The following bulleted lists summarize the existing needs relative to improving the movement of people and goods by evaluating freight and transit travel times and bottleneck locations with excessive delay.

15th Avenue W (Corridor 1)

Primary Needs:

- Southbound congestion in AM and
- Northbound congestion in PM

Scenario 1 Bottlenecks:

- Southbound through in AM at all intersections but W Galer St., with cumulative delay for freight over 5 minutes
- Northbound through in PM at Galer Flyover, Gilman Dr W, NW Market St. with all intersections cumulatively delaying freight by over 11 minutes and transit by over 3 minutes

Scenario 2 Bottlenecks:

- Southbound through in AM at NW Market St., W Armory Way, and W Howe St. with all intersections cumulatively delaying freight by over 12 minutes and transit by 2 minutes
- Northbound through in PM at all intersections except W Armory Way with all intersections cumulatively delaying freight by over 15 minutes and transit by nearly 7 minutes

NW Leary Way (Corridor 2)

Primary Needs:

- Increase mobility of people and goods through closely spaced signalized, high-access locations

Scenario 1 Bottlenecks:

- No locations with through movement worse than LOS D, but southbound left turn from 17th Avenue W is LOS F. Little impact on through movement travel time of freight and transit.

Scenario 2 Bottlenecks:

- Eastbound through in AM at 15th Avenue W southbound ramps is LOS E, however not a significant cause of delay to freight and transit along the short corridor.
- Southbound left turn from 17th Avenue W is LOS F.

W Emerson Place / W Nickerson Street (Corridor 3)

Primary Needs:

- Maintain mobility of people and goods while balancing serving access points.

Scenario 1 Bottlenecks:

- W Emerson Pl & Gilman Ave W as an all-way stop controlled intersection has excessive delay on multiple approaches, 19th Avenue W and at northbound off ramp approaches are LOS E. Little delay for through movements of freight and transit except at Gilman Ave W.

Scenario 2 Bottlenecks:

- Same as Scenario 1

W Dravus Street (Corridor 4)

Primary Needs:

- Trucks unable to make turning maneuvers in lane at intersections with 15th Avenue W ramps

Scenario 1 Bottlenecks:

- 20th Avenue W intersection in both peak hours, eastbound through movement at 15th Avenue West southbound ramps in AM peak, westbound through movement at 15th Avenue W northbound ramps in PM peak. Eastbound and westbound freight and transit delayed by 1-2 minutes due to congestion in both peaks.

Scenario 2 Bottlenecks:

- Same as Scenario 1, except with 10-50 percent more delay due to higher vehicular demand to use W Dravus Street with the Armory Way bridge alternative. Eastbound and westbound freight and transit delayed by 2-4 minutes due to congestion in both peaks.

Thorndyke Avenue W / W Armory Way (Corridor 5)

Primary Needs:

- Maintain mobility of people and goods while balancing serving access points.

Scenario 1 Bottlenecks:

- Not Applicable

Scenario 2 Bottlenecks:

- Eastbound W Blaine Street in both peak hours, Southbound W Galer Street left turn in AM peak, westbound W Armory Way left turn in AM peak, similar bottlenecks along 15th Avenue W from W Armory Way intersection along shared corridor segment connecting to the W Galer Street Flyover intersection as in Corridor 1, Scenario 2.

Magnolia Bridge (Corridor 6)

Primary Needs:

- Maintain mobility of people and goods

Scenario 1 Bottlenecks:

- Westbound left turn on W Galer Flyover at 15th Avenue W.

Scenario 2 Bottlenecks:

- Not Applicable

4. Corridor Management Strategies

4.1 Strategy Categories and Sources

A set of corridor management strategies were drawn from a variety of previous studies including the Magnolia Bridge Planning Study (MBPS), Ballard Bridge Planning Study (BBPS), SDOT Freight Master Plan (FMP), SDOT programmed improvements (SDOT), the Expedia Campus Transportation Technical Report (EXP), Move Ballard (MB), and new concepts developed by the Ballard-Interbay Regional Transportation Study consultant team (BIRT). The corridor management strategies were grouped and organized in the following categories:

- Signal Operations
- ITS Strategies
- Traffic Control
- Channelization/Striping
- Access Management
- Capital Improvements

The corridor management strategies were analyzed individually at the intersection level and as a package at the corridor level in order to determine independent value as well as to determine overall benefits for freight or transit travel along the six study corridors. The overall congestion

relief attributed to some of the strategies is not able be quantified due to limitations in traffic modeling tools but were still included if they were believed to qualitatively provide congestion relief to freight or transit travel.

4.2 Summary of Corridor Management Strategies

Several corridor management strategies were compiled and analyzed to determine potential performance improvements for each key corridor. Table 4 provides a summary of the corridor management strategy types along each corridor. A full list of all corridor management strategies is included in Attachment A of the memo.

Table 4. Summary of Corridor Management Strategies by Type and Corridor

Corridor	Strategy Type					
	Signal Operations (SO)	ITS Strategies (ITS)	Traffic Control (TC)	Channelization/ Striping (CHAN)	Access Management (AM)	Capital Improvements (CI)
15th Ave. W (Corridor 1)	1	1	1	7	3	
NW Leary Way (Corridor 2)	4	1		2	2	1
W Emerson St. / W Nickerson St. (Corridor 3)	4	3	1			
W Dravus St. (Corridor 4)	2	3		3	1	
Thorndyke Ave. W / Armory Bridge (Corridor 5)		1	1	4		3
Magnolia Bridge (Corridor 6)				2		1
Total	11	9	3	18	6	5

Tables 5 - 7 provide a detailed description each of the corridor management strategies, including demonstrated needs, strategy details and expected performance improvement after implementation. The tables are broken out by strategies that can be applied independently from the bridge scenarios 1 and 2 (independent utility strategies), strategies that must be implemented with bridge scenario 1 and strategies that must be implemented with bridge scenario 2. Figure 2 shows a graphic summary of the strategies for each corridor.

Table 5. Corridor Management Strategies with Independent Utility

Corridor	Location/ Strategy ID	Description of Need	Strategy	Type	Primary Modal Benefit	Vehicle Delay Savings
15th Ave. W (Corridor 1)	100	AM congestion SB and PM congestion NB	Install adaptive signal system & suite of ITS strategies	SO/ITS	GP	<30 sec
	101	Freight LOS F SB in AM & NB in PM	Convert BOLs to FAT lanes	CHAN	F	>2 min
	102	Freight LOS F SB in AM & NB in PM; Transit LOS F SB in AM	Convert BOLs to FAT lanes	CHAN	F	>2 min
	103a	Freight LOS F SB in AM	Convert BOLs to FAT lanes	CHAN	F	>2 min
	104a	Freight LOS F SB in AM & NB in PM, Transit LOS E NB in PM	Convert BOLs to FAT lanes	CHAN	F	>2 min
	105a	Freight & Transit LOS F NB in PM	Convert BOLs to FAT lanes	CHAN	F	30 sec – 2 min
	106	Continuity and signal coordination	Convert BOLs to FAT lanes	CHAN	F	<30 sec
	107	Freight and Transit LOS F NB in AM	Convert BOLs to FAT lanes	CHAN	F	>2 min
Corridor 2: NW Leary Way	200	Congestion impedes freight and transit	Install adaptive signal system & suite of ITS strategies	SO/ITS	GP	<30 sec
	201	Minor street approaches LOS E	Optimize adjacent signals to add gaps	SO	GP	<30 sec
	203b	Freight & Transit LOS E EB in AM	Implement FAT lanes	CHAN	F, T	<30 sec
	204b	Moderate congestion (LOS D) westbound in PM	Implement FAT lanes	CHAN	F, T	<30 sec
	205	Minor street approaches LOS D	Optimize signal operations	SO	GP	<30 sec
	300	Congestion impedes freight and transit	Suite of ITS strategies	ITS	GP	<30 sec

Table 5. Corridor Management Strategies with Independent Utility

Corridor	Location/ Strategy ID	Description of Need	Strategy	Type	Primary Modal Benefit	Vehicle Delay Savings
Corridor 3: W Emerson Pl / W Nickerson St	301	Freight and Transit LOS E EB in AM & LOS F WB in PM	Install traffic signal	TC	GP	30 sec – 2 min
	302	Minor street approach LOS E	Optimize signal operations	SO	GP	<30 sec
	303	Minor street approach LOS F	Optimize signal operations	SO	GP	<30 sec
	304	Moderate congestion (LOS D) in both peak hours	Optimize signal operations	SO	GP	<30 sec
	305	Eastbound and Westbound through movements high LOS D in both peak hours	Optimize signal operations	SO	GP	<30 sec
	306	15th Ave. off ramp queuing and delay	Add queue detectors	ITS	GP	<30 sec
	307	Conflicts with trains, trail traffic on north leg	Upgrade vehicle, ped/bike, and queue detectors	ITS	GP	<30 sec
Corridor 4: W Dravus St	400	Multi-modal conflicts with freight/transit	Update channelization/striping	CHAN	F, T	<30 sec
	401a	Freight & Transit LOS F WB in PM, GP LOS F NB & SB	Optimize signal operations	SO	GP	<30 sec
	401b	Driveway access conflicts	Modify driveway access	AM	GP	<30 sec
	402	Maintain freight and transit mobility	Optimize signal operations	SO	GP	<30 sec
	403	Geometric constraints for large vehicles	Channelization and detection upgrades	CHAN, ITS	F, T	<30 sec
	404	Geometric constraints for large vehicles	Channelization and detection upgrades	CHAN, ITS	F, T	<30 sec
	405	Congestion impedes freight and transit	Suite of ITS strategies	ITS	F, T	<30 sec

Table 5. Corridor Management Strategies with Independent Utility

Corridor	Location/ Strategy ID	Description of Need	Strategy	Type	Primary Modal Benefit	Vehicle Delay Savings
Corridor 5: Thorndyke Ave W / W Armory Way	500a	Congestion impedes freight and transit	Suite of ITS strategies	ITS	GP	<30 sec
	501	Geometric constraints for large vehicles	Update channelization/striping	CHAN	GP	<30 sec
	502	Multi-modal conflicts	Update channelization/striping	CHAN	GP	<30 sec
	505	Freight & Transit SB right turn LOS F in AM	Install traffic signal	TC	GP	<30 sec

Notes:

Orientation Key:
NB – Northbound, SB – Southbound, EB – Eastbound, WB - Westbound
Strategy Key:
BOL – Bus Only Lane FAT – Freight and Transit Lane, SO – Signal Operations, ITS – Intelligent Transportation Systems, TC – Traffic Control, CHAN – Channelization & Striping, AM – Access Management, CI – Capital Improvements
Primary Modal Benefit Key:
GP – General Purpose Traffic, F – Freight, T – Transit
Benefit: Listed value is either the quantifiable delay savings at the location from Synchro model analysis or a qualitative benefit from strategies that could not be adequately modeled in this study

Table 6. Corridor Management Strategies: Implementable in Scenario 1

Corridor	Location/ Strategy ID	Description of Need	Strategy	Type	Mode Target	Vehicle Delay Savings
Corridor 2: NW Leary Way	202	Ballard Bridge Replacement	Construct new southbound 15th Ave on ramp with Mid-Height Ballard Bridge scenario	CI	GP	30 sec – 2 min
	601	Unclear intersection control	Update channelization/striping	CHAN	GP	<30 sec

Table 6. Corridor Management Strategies: Implementable in Scenario 1

Corridor	Location/ Strategy ID	Description of Need	Strategy	Type	Mode Target	Vehicle Delay Savings
Corridor 6: Magnolia Bridge	602	Unclear intersection control	Update channelization/striping	CHAN	GP	<30 sec

Notes:

Orientation Key:
NB – Northbound, SB – Southbound, EB – Eastbound, WB - Westbound
Strategy Key:
BOL – Bus Only Lane FAT – Freight and Transit Lane, SO – Signal Operations, ITS – Intelligent Transportation Systems, TC – Traffic Control, CHAN – Channelization & Striping, AM – Access Management, CI – Capital Improvements
Primary Modal Benefit Key:
GP – General Purpose Traffic, F – Freight, T – Transit
Benefit: Listed value is either the quantifiable delay savings at the location from Synchro model analysis or a qualitative benefit from strategies that could not be adequately modeled in this study

Table 7. Corridor Management Strategies: Implementable in Scenario 2

Corridor	Location/ Strategy ID	Description of Need	Strategy	Type	Mode Target	Vehicle Delay Savings
Corridor 1: 15th Ave. W	105b	Freight LOS F SB in AM, Freight & Transit LOS F NB in PM	Remove traffic signal, prohibit left turns	TC/AM	GP	>2 min
Corridor 2: NW Leary Way	203a	Freight & Transit LOS E EB in AM	Prohibit WB left, force through movement then right turn loop via 17th/49th	AM	GP	<30 sec
	204a	Moderate congestion (LOS D) westbound in PM peak	Prohibit EB left, force through movement then right turn loop via 14th/Ballard Way	AM	GP	No Benefit
Corridor 5: Thorndyke Ave W / W Armory Way	500b	Congestion impedes freight and transit	Implement FAT lanes (may require widening in some locations)	CI/CHAN	GP	30 sec – 2 min
	503	Freight and Transit WB left LOS F in AM and PM	Add northbound right turn lane	CI	GP	<30 sec
	504	Eastbound approach LOS F in both peaks	Implement FAT lanes (requires widening)	CI/CHAN	GP	30 sec – 2 min

Notes:

Orientation Key:
NB – Northbound, SB – Southbound, EB – Eastbound, WB - Westbound
Strategy Key:
BOL – Bus Only Lane FAT – Freight and Transit Lane, SO – Signal Operations, ITS – Intelligent Transportation Systems, TC – Traffic Control, CHAN – Channelization & Striping, AM – Access Management, CI – Capital Improvements
Primary Modal Benefit Key:
GP – General Purpose Traffic, F – Freight, T – Transit
Benefit: Listed value is either the quantifiable delay savings at the location from Synchro model analysis or a qualitative benefit from strategies that could not be adequately modeled in this study

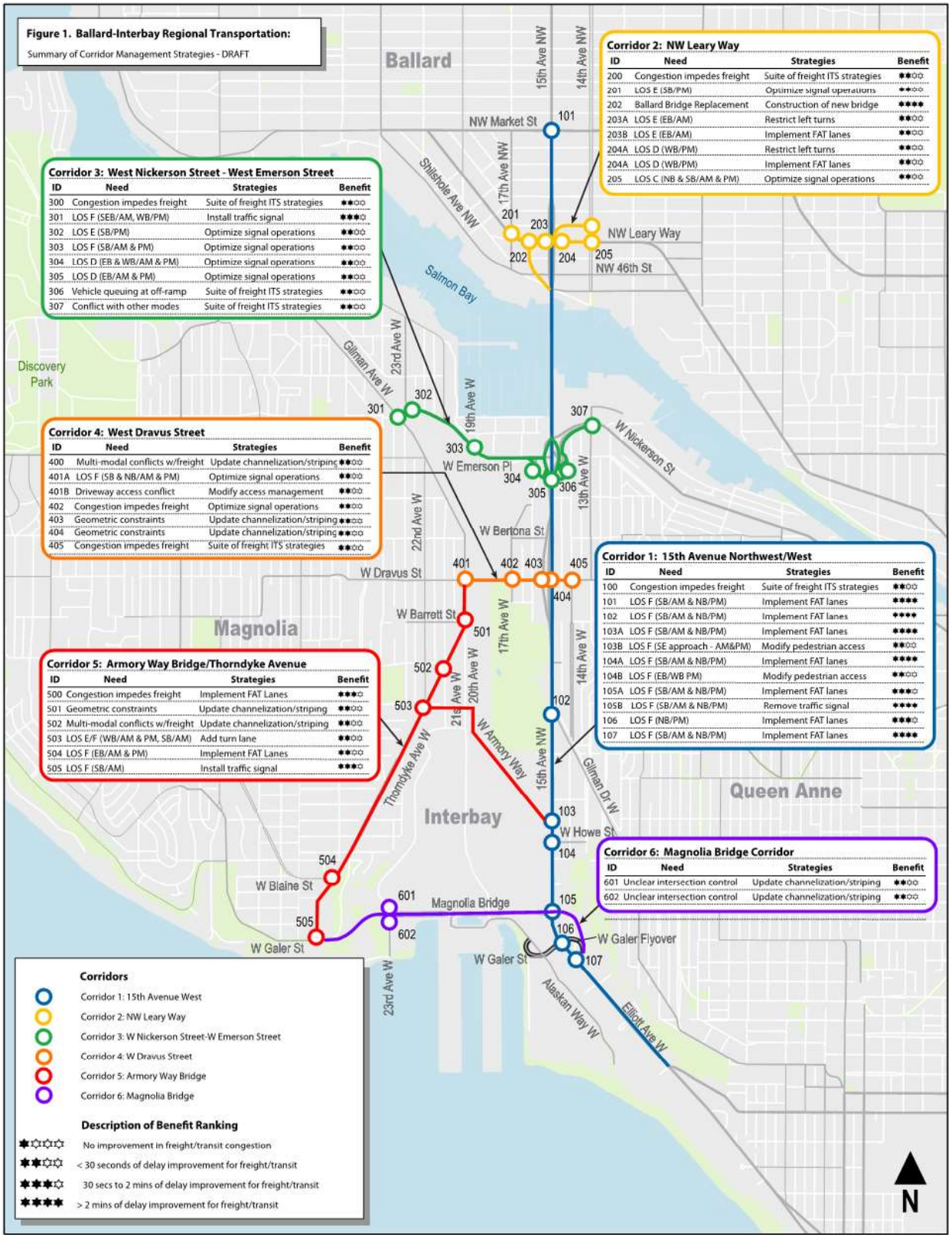

Figure 2. Summary of Corridor management Strategies

4.3 Corridor Management Strategies: Performance Summary

Study Intersection Performance

Intersection performance was evaluated using the worst LOS movement for freight and transit at each study location as shown in Tables 8 and 9 and Figures 3-6.

Freight LOS is measurably improved with the implementation of the following Corridor Management Strategies: 103-105 (Scenarios 1 and 2), 503 (Scenario 2), and 505 (Scenarios 1 and 2). Freight is most benefited by strategies including Freight and Transit lanes. At all other locations, LOS for freight remains the same or improves in one of the peak hours.

Although a LOS F designation is defined by 80 seconds or more of delay for signalized locations, many of the strategies provide significant delay savings despite the movement remaining at LOS F. Freight LOS degrades for strategy 204 under Scenario 2 in the PM peak, but there are no other freight movements that degrade in LOS with the implementation of any of the strategies.

Transit LOS is measurably improved with the implementation of the following corridor management strategies: 103 (Scenario 2), 104 (Scenario 2), 203 (Scenario 2), 503 (Scenario 2), and 505 (Scenarios 1 & 2). Transit delay increases with the implementation of the corridor management strategy at 204 under Scenario 2 in the PM peak. All other Transit movements remain at the same LOS as the base conditions.

Corridor Performance

Corridor performance was evaluated using the overall corridor travel time for freight and transit at each of the six study area corridors as shown in Tables 10 and 11.

Freight performance on Corridor 1 is greatly improved under both Scenarios, and transit performance improves under all conditions with one exception - southbound transit in the AM peak under Scenario 1 which increases by 1.2 minutes. Benefits for freight range from 0.4 minutes to 17.3 minutes of reduced travel time. Corridor 2 shows mixed results for both modes of travel; however, the travel times do not change by more than 0.7 minutes under any of the evaluated conditions. Freight and transit performance for Corridor 3 also shows mixed results, with the majority of added delay at W Emerson Pl. & Gilman Ave. W due to a change of traffic control, which does provide better overall operations. Corridor 4 shows slight benefits to both modes under Scenario 2 and little change under Scenario 1. Under Scenario 2, the corridor management strategies considerably improve freight and transit travel time. Freight and transit performance on Corridor 6 (Magnolia Bridge) is expected to degrade due to converting uncontrolled eastbound/westbound approaches on W Galer St. at Thorndyke Ave. W to signal control, and the modifications to timing at W Galer St. Flyover and W Elliot Ave. Travel time may increase by 0.1 to 1.7 minutes under Scenario 1.

Permitting freight to use existing bus only lanes by converting them to freight and transit Lanes does not appear to have negative impacts to transit travel time. Other spot improvements recommended generally show minor improvements to freight and transit.

Table 8. Freight and Transit: Intersection Movements Level-of-Service; 2042 Alternatives Comparison – AM Peak

ID	Corridor/Intersection	Control	Freight LOS				Transit LOS			
			2042 Scenario 1: *Mid-Height Ballard Bridge with Magnolia 1-1 Bridge Replacement*		**2042 Scenario 2:** *Low-Height Ballard Bridge with Armory Way Bridge*		**2042 Scenario 1:** *Mid-Height Ballard Bridge with Magnolia 1-1 Bridge Replacement*		**2042 Scenario 2:** *Low-Height Ballard Bridge with Armory Way Bridge*	
			Base	w/CMS	Base	w/CMS	Base	w/CMS	Base	w/CMS
	Corridor 1: 15th Avenue W									
101	NW Market St	Signal	F (SBT)	C (SBT)	F (SBT)	C (SBT)	C (SBT)	C (SBT)	C (SBT)	C (SBT)
102	Gilman Dr W	Signal	F (SBT)	A (SBT)	E (SBT)	A (SBT)	A (SBT)	A (SBT)	A (SBT)	A (SBT)
103	W Armory Way	Signal	F (SBT)	A (SBT)	F (SBT)	C (SBT)	A (SBT)	A (SBT)	D (SBT)	C (SBT)
104	W Howe St	Signal	F (SBT)	B (SBT)	F (SBT)	A (SBT)	B (SBT)	B (SBT)	A (SBT)	A (SBT)
105	W Garfield St	Signal	E (SBT)	A (SBT)	F (SBT)	A (SBT)	A (SBT)	A (SBT)	A (SBT)	A (SBT)
106	W Galer St	Signal	B (SBT)	A (SBT)	A (SBT)	A (SBT)	A (SBT)	A (SBT)	A (SBT)	A (SBT)
107	Galer Flyover	Signal	F (NBT)	F (NBR)	A (SBT)	A (SBT)	F (NBT)	F (NBT)	A (NBT)	A (NBT)
	Corridor 2: NW Leary Way									
201	17th Ave NW	TWSC	A (WBT)	A (WBT)	A (WBT)	A (WBT)	A (WBT)	A (WBT)	A (WBT)	A (WBT)
202	New 15th Ave W SB Ramp	Signal	C (EBT)	C (EBT)	Not Applicable		C (EBT)	C (EBT)	Not Applicable	
203	15th Ave W SB Ramps	Signal	C (EBT)	C (EBT)	E (EBT)	D (EBT)	C (EBT)	C (EBT)	E (EBT)	D (EBT)
204	15th Ave W NB Ramps	Signal	C (WBT)	C (WBT)	B (WBT)	C (WBT)	C (WBT)	B (WBT)	B (WBT)	C (WBT)
205	14th Ave NW	Signal	B (WBT)	B (WBT)	A (WBT)	A (WBT)	B (WBT)	B (WBT)	A (WBT)	A (WBT)
	Corridor 3: W Emerson Pl/W Nickerson St									
301	Gilman Ave W	AWSC	F (SEL)	F (SEL)	F (SEL)	F (SEL)	F (SEL)	F (SEL)	F (SEL)	F (SEL)
302	23rd Ave W	TWSC	A (EBT)	(EBT)	A (WBT)	A (WBT)	A (EBT)	A (EBT)	A (WBT)	A (WBT)
303	19th Ave W	Signal	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)
304	SB 15th Ave W Off Ramp	Signal	B (EBR)	B (EBR)	B (EBR)	B (EBR)	B (EBR)	B (EBR)	B (EBR)	B (EBR)
305	North 15th Ave W Ramps	Signal	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)
306	NB 15th Ave W Ramp	Signal	B (NBR)	B (NBR)	B (NBR)	B (NBR)	B (NBR)	B (NBR)	B (NBR)	B (NBR)

Table 8. Freight and Transit: Intersection Movements Level-of-Service; 2042 Alternatives Comparison – AM Peak

ID	Corridor/Intersection	Control	Freight LOS				Transit LOS			
			2042 Scenario 1: *Mid-Height Ballard Bridge with Magnolia 1-1 Bridge Replacement*		**2042 Scenario 2:** *Low-Height Ballard Bridge with Armory Way Bridge*		**2042 Scenario 1:** *Mid-Height Ballard Bridge with Magnolia 1-1 Bridge Replacement*		**2042 Scenario 2:** *Low-Height Ballard Bridge with Armory Way Bridge*	
			Base	w/CMS	Base	w/CMS	Base	w/CMS	Base	w/CMS
307	13th Ave W	Signal	B (EBT)	B (EBT)	B (EBT)	B (EBT)	B (EBT)	B (EBT)	B (EBT)	B (EBT)
	Corridor 4: W Dravus St									
401	20th Ave W	Signal	D (EBT)	D (EBT)	E (EBT)	E (EBT)	D (EBT)	D (EBT)	E (EBT)	E (EBT)
402	17th Ave W	Signal	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)
403	SB 15th Ave W Ramps	Signal	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)
404	NB 15th Ave W Ramps	Signal	D (WBT)	D (WBT)	D (WBT)	D (WBT)	D (WBT)	D (WBT)	D (WBT)	D (WBT)
405	14th Ave W	TWSC	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)
	Corridor 5: Thorndyke Ave W / W Armory Way									
501	20th Ave W	TWSC	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)
502	21st Ave W	TWSC	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)
503	W Armory Way	TWSC	Not Applicable		F (WBL)	C (WBL)	Not Applicable		F (WBL)	C (WBL)
504	W Blaine St	TWSC	B (EBL)	B (EBL)	F (EBL)	F (EBL)	B (EBL)	B (EBL)	F (EBL)	F (EBL)
505	W Galer St	Signal	F (SBL)	B (SBL)	F (SBR)	A (SBR)	F (SBL)	B (SBL)	F (SBR)	A (SBR)
	Corridor 6: Magnolia Bridge									
601	23rd Ave NW	TWSC	A (EBLR)	A (EBLR)	Not Applicable		A (EBLR)	A (EBLR)	Not Applicable	
602	Terminal 91 Gate	TWSC	A(NBR)	A(NBR)	Not Applicable		A (NBR)	A (NBR)	Not Applicable	

Notes:

- CMS – Corridor Management Strategy
- Scenario 1 Strategies include: 100-102, 103a&b, 104a&b, 105a, 106, 107, 200-202, 203b, 204b, 205, 300-307, 400, 401a&b, 403-405, 500a, 501, 502, 505, 601-602
- Scenario 2 Strategies include: 100-102, 103a&b, 104a&b, 105b, 106, 107, 200, 201, 203a, 204a, 205, 300-307, 400, 401a&b, 403-405, 500a&b, 501-505
- Level-of-Service (LOS) based on Highway Capacity Manual (HCM) 2000 methodology
- Worst-performing traffic movement for each scenario/peak hour shown as follows: (XXY) XX is approach direction (NB – Northbound, SB – Southbound, EB – Eastbound, WB – Westbound) and Y is the movement (L – Left, T – Thru, R – Right)
- Red Shading – LOS F (average vehicular delay >80 seconds for signalized intersections, >55 seconds for unsignalized intersections)
- Yellow Shading – LOS E (average vehicular delay 55-79 seconds for signalized intersections, 35-55 seconds for unsignalized intersections)

Table 9. Freight and Transit: Intersection Movements Level-of-Service; 2042 Alternatives Comparison – PM Peak

ID	Corridor/Intersection	Control	Freight LOS				Transit LOS			
			2042 Scenario 1: *Mid-Height Ballard Bridge with Magnolia 1-1 Bridge Replacement*		**2042 Scenario 2:** *Low-Height Ballard Bridge with Armory Way Bridge*		**2042 Scenario 1:** *Mid-Height Ballard Bridge with Magnolia 1-1 Bridge Replacement*		**2042 Scenario 2:** *Low-Height Ballard Bridge with Armory Way Bridge*	
			Base	w/CMS	Base	w/CMS	Base	w/CMS	Base	w/CMS
	Corridor 1: W 15th Ave									
101	NW Market St	Signal	F (NBT)	C (NBT)	F (NBT)	C (NBT)	C (NBT)	C (NBT)	C (NBT)	C (NBT)
102	Gilman Dr W	Signal	F (NBT)	B (NBT)	F (NBT)	B (NBT)	B (NBT)	B (NBT)	B (NBT)	B (NBT)
103	W Armory Way	Signal	D (NBT)	A (NBT)	F (NBT)	A (NBT)	A (NBT)	A (NBT)	A (NBT)	A (NBT)
104	W Howe St	Signal	F (NBT)	A (NBT)	F (NBT)	A (NBT)	E (NBT)	A (NBT)	E (NBT)	A (NBT)
105	W Garfield St	Signal	F (NBT)	A (NBT)	F (NBT)	A (NBT)	A (NBT)	A (NBT)	A (NBT)	A (NBT)
106	W Galer St	Signal	D (SBT)	B (SBT)	F (NBT)	B (NBT)	B (NBT)	B (NBT)	B (NBT)	B (NBT)
107	Galer Flyover	Signal	F (NBT)	B (NBT)	F (NBT)	A (NBT)	B (NBT)	B (NBT)	A (NBT)	A (NBT)
	Corridor 2: NW Leary Way									
201	17th Ave NW	TWSC	A (WBT)	A (WBT)	A (WBT)	A (WBT)	A (WBT)	A (WBT)	A (WBT)	A (WBT)
202	New 15th Ave W SB Ramp	Signal	C (EBT)	C (EBT)	Not Applicable		C (EBT)	C (EBT)	Not Applicable	
203	15th Ave W SB Ramps	Signal	C (WBT)	A (WBT)	D (EBT)	D (EBT)	C (WBT)	A (WBT)	D (EBT)	D (EBT)
204	15th Ave W NB Ramps	Signal	B (WBT)	B (WBT)	D (WBT)	E (WBT)	B (WBT)	B (WBT)	D (WBT)	E (WBT)
205	14th Ave NW	Signal	D (WBT)	D (WBT)	B (WBT)	B (WBT)	D (WBT)	D (WBT)	B (WBT)	B (WBT)
	Corridor 3: W Emerson Pl/W Nickerson St									
301	Gilman Ave W	AWSC	F (WBR)	F (WBR)	F (WBR)	F (WBR)	F (WBR)	F (WBR)	F (WBR)	F (WBR)
302	23rd Ave W	TWSC	A (EBT)	A (EBT)	A (WBT)	A (WBT)	A (EBT)	A (EBT)	A (WBT)	A (WBT)
303	19th Ave W	Signal	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)
304	SB 15th Ave W Off Ramp	Signal	C (NBL)	C (NBL)	C (NBL)	C (NBL)	C (NBL)	C (NBL)	C (NBL)	C (NBL)
305	North 15th Ave W Ramps	Signal	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)	D (EBT)
306	NB 15th Ave W Ramp	Signal	B (WBL)	B (WBL)	B (WBL)	B (WBL)	B (WBL)	B (WBL)	B (WBL)	B (WBL)
307	13th Ave W	Signal	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)

Table 9. Freight and Transit: Intersection Movements Level-of-Service; 2042 Alternatives Comparison – PM Peak

ID	Corridor/Intersection	Control	Freight LOS				Transit LOS			
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			Base	w/CMS	Base	w/CMS	Base	w/CMS	Base	w/CMS
Corridor 4: W Dravus St										
401	20th Ave W	Signal	F (WBT)	F (WBT)	F (WBT)	F (WBT)	F (WBT)	F (WBT)	F (WBT)	F (WBT)
402	17th Ave W	Signal	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)	B (WBT)
403	SB 15th Ave W Ramps	Signal	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)	F (EBT)
404	NB 15th Ave W Ramps	Signal	F (WBT)	F (WBT)	F (WBT)	F (WBT)	F (WBT)	F (WBT)	F (WBT)	F (WBT)
405	14th Ave W	TWSC	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)	A (EBT)
Corridor 5: Thorndyke Ave W/W Armory Way										
501	20th Ave W	TWSC	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)
502	21st Ave W	TWSC	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)	A (NBTR)
503	W Armory Way	TWSC	Not Applicable		E (WBL)	D (WBL)	Not Applicable		E (WBL)	D (WBL)
504	W Blaine St	TWSC	B (EBL)	B (EBL)	F (EBL)	F (EBL)	B (EBL)	B (EBL)	F (EBL)	F (EBL)
505	W Galer St	Signal	C (SBR)	A (SBL)	C (SBR)	A (SBL)	C (SBR)	A (SBL)	C (SBR)	A (SBL)
Corridor 6: Magnolia Bridge										
601	23rd Ave NW	TWSC	A (EBLR)	A (EBLR)	Not Applicable		A (EBLR)	A (EBLR)	Not Applicable	
602	Terminal 91 Gate	TWSC	A (NBR)	A (NBR)	Not Applicable		A(NBR)	A(NBR)	Not Applicable	

Notes:

- CMS – Corridor Management Strategy
- Scenario 1 Strategies include: 100-102, 103a&b, 104a&b, 105a, 106, 107, 200-202, 203b, 204b, 205, 300-307, 400, 401a&b, 403-405, 500a, 501, 502, 505, 601-602
- Scenario 2 Strategies include: 100-102, 103a&b, 104a&b, 105b, 106, 107, 200, 201, 203a, 204a, 205, 300-307, 400, 401a&b, 403-405, 500a&b, 501-505
- Level-of-Service (LOS) based on Highway Capacity Manual (HCM) 2000 methodology
- Worst-performing traffic movement for each scenario/peak hour shown as follows: (XXY) XX is approach direction (NB – Northbound, SB – Southbound, EB – Eastbound, WB – Westbound) and Y is the movement (L – Left, T – Thru, R – Right)
- Red Shading – LOS F (average vehicular delay >80 seconds for signalized intersections, >55 seconds for unsignalized intersections)
- Yellow Shading – LOS E (average vehicular delay 55-79 seconds for signalized intersections, 35-55 seconds for unsignalized intersections)

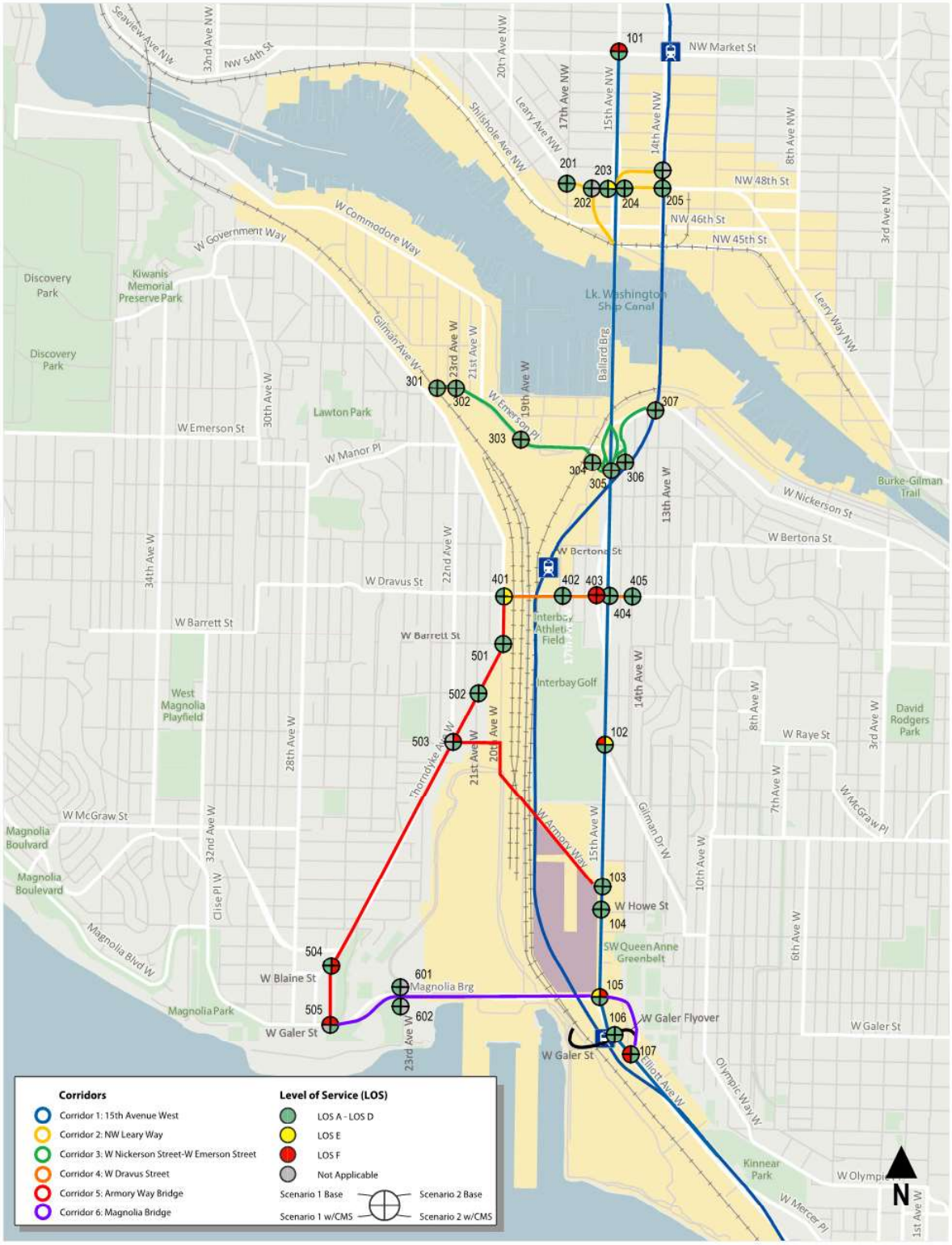

Figure 3. Freight LOS (Scenario 1 and Scenario 2) – AM Peak Hour

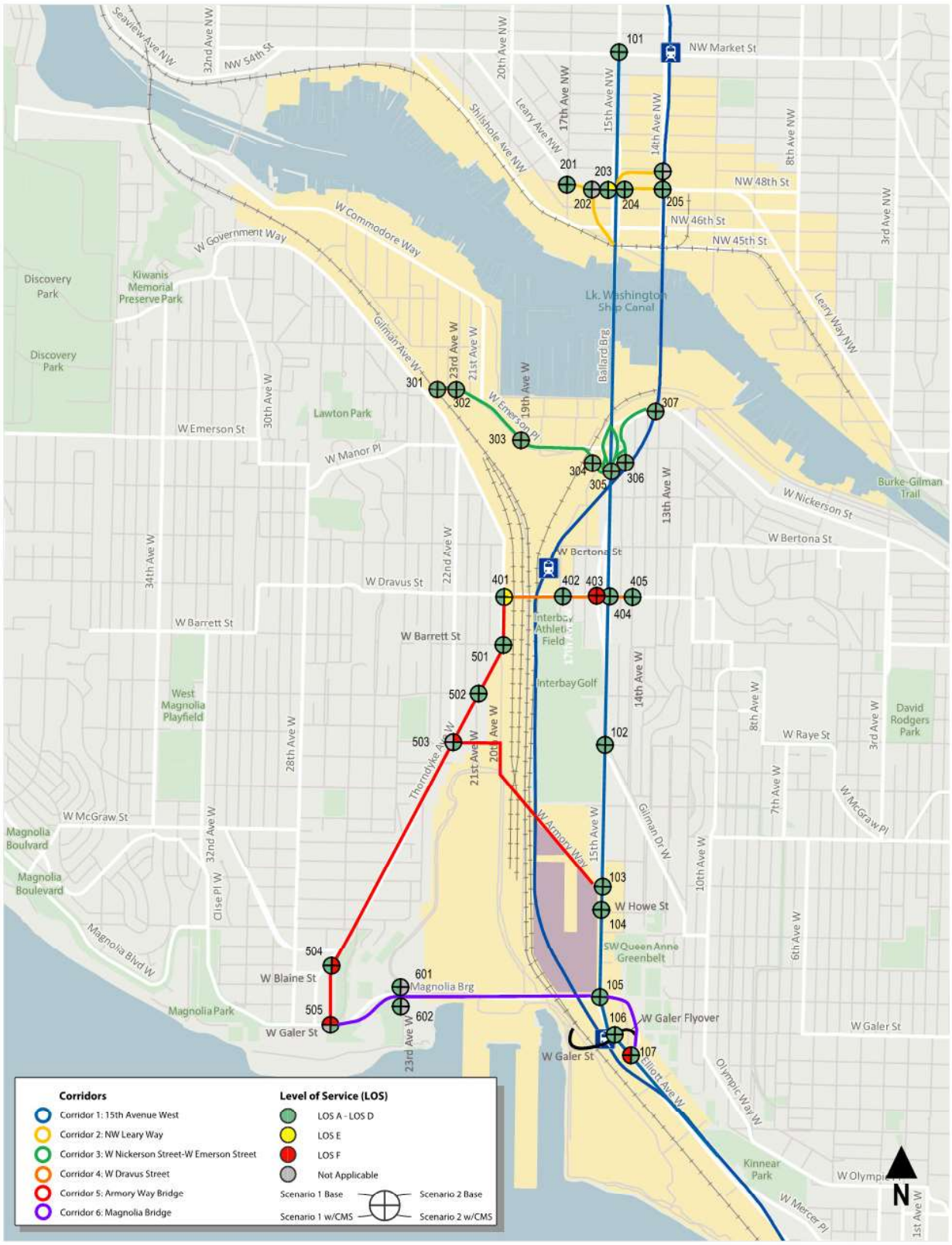

Figure 4 – Transit LOS (Scenario 1 and Scenario 2) – AM Peak Hour

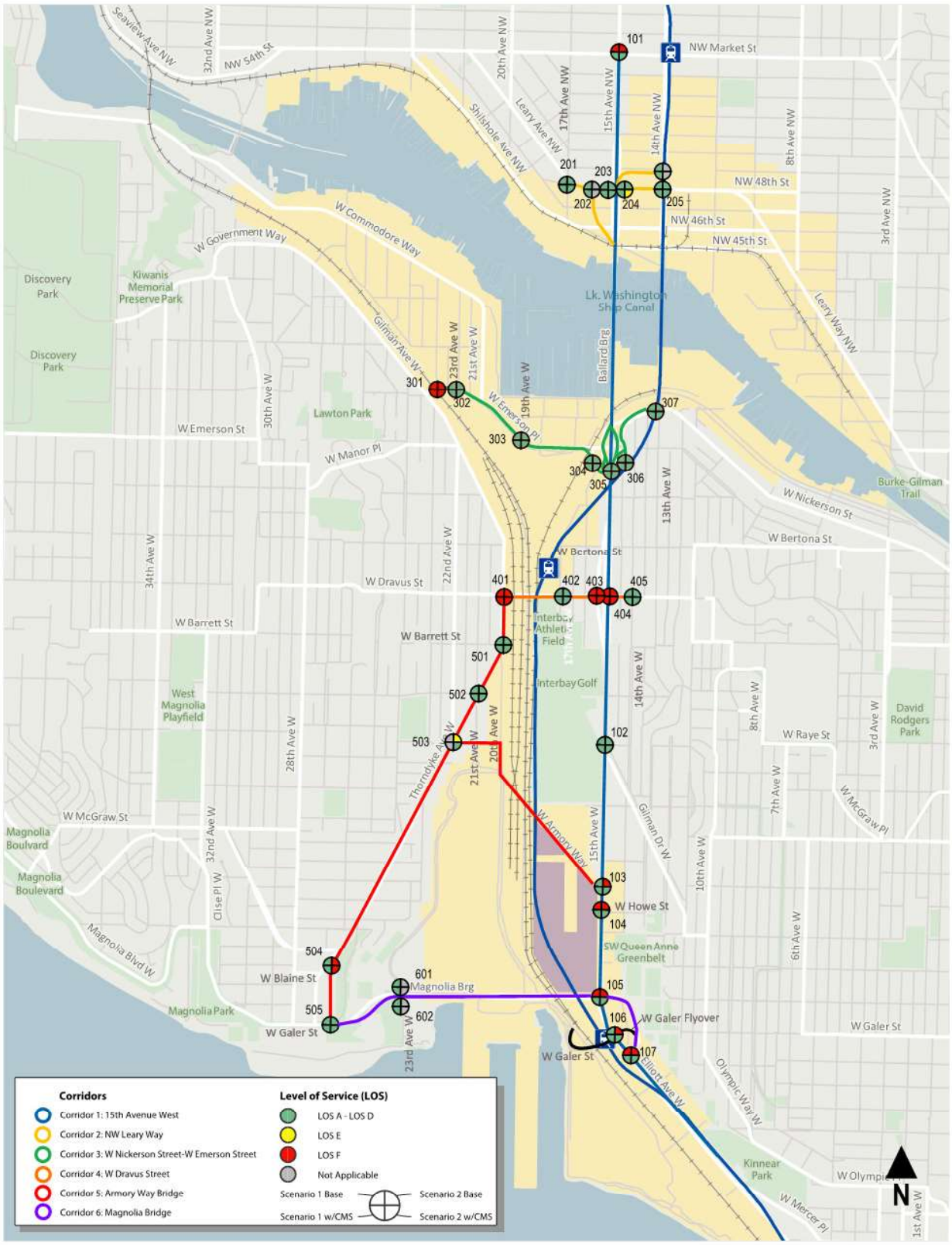

Figure 5 – Freight LOS (Scenario 1 and Scenario 2) – PM Peak Hour

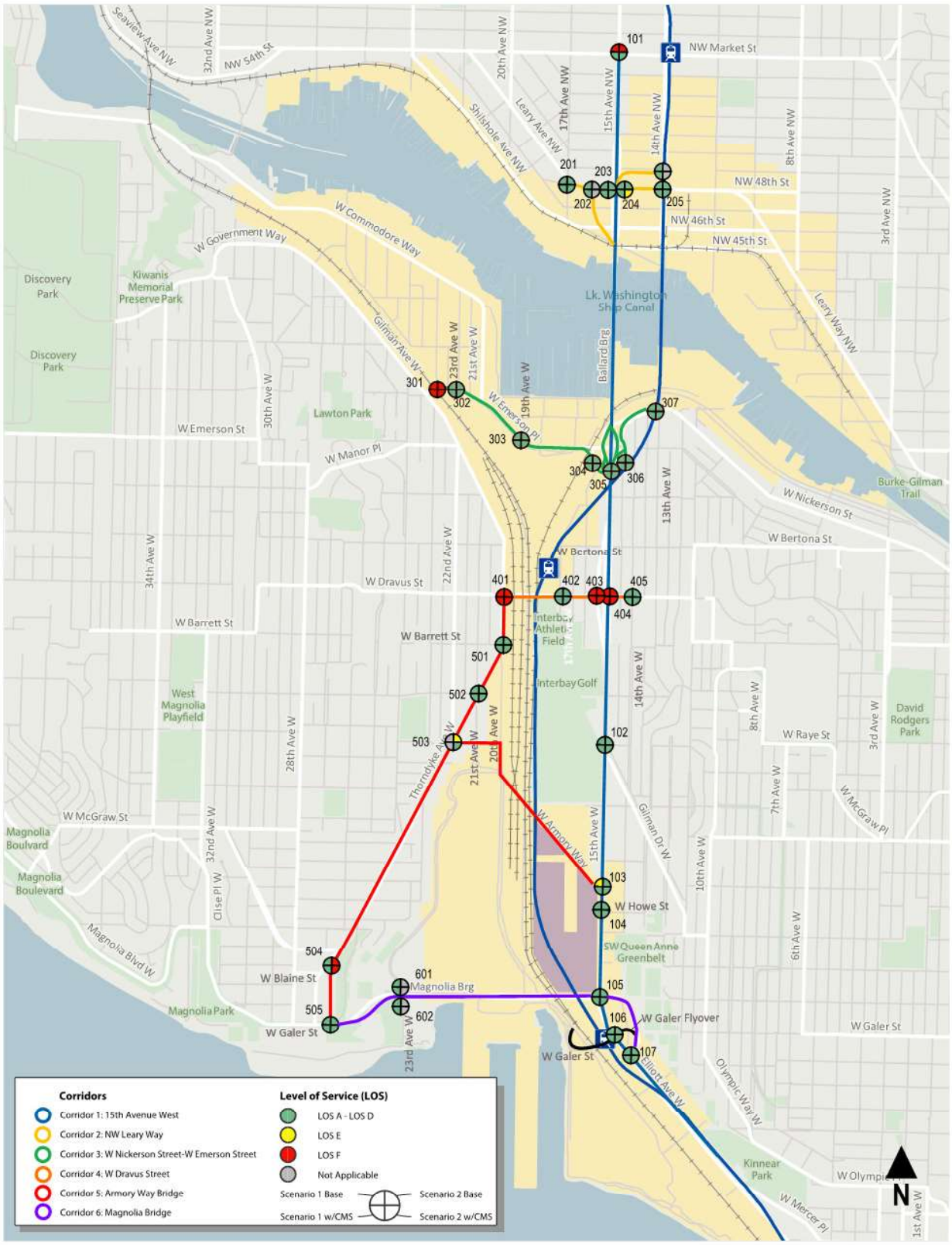

Figure 6 – Transit LOS (Scenario 1 and Scenario 2) – PM Peak Hour

Table 10. Corridor Travel Time Comparison: Freight and Transit: 2042 AM Peak Hour

Corridor/ Segment	Direction	Free Flow Travel Time^	Freight Travel Time						Transit Travel Time					
			2042 Scenario 1: *Mid-Height Ballard Bridge with Magnolia 1-1 Bridge Replacement*			2042 Scenario 2: *Low-Height Ballard Bridge with Armory Way Bridge*			2042 Scenario 1: *Mid-Height Ballard Bridge with Magnolia 1-1 Bridge Replacement*			2042 Scenario 2: *Low-Height Ballard Bridge with Armory Way Bridge*		
			Base	w/CMS	% Change	Base	w/CMS	% Change	Base	w/CMS	% Change	Base	w/CMS	% Change
Corridor 1: 15th Ave W	SB	5.2	14.8	6.9	-53.4%	21.9	7.5	-65.8%	10.6	9.1	-14.2%	12.0	10.9	-9.2%
	NB	5.2	8.2	7.6	-7.3%	8.4	7.6	-9.5%	12.6	10.4	-17.5%	12.9	11.8	-8.5%
Corridor 2: NW Leary Way	EB	0.5	1.7	1.6	-5.9%	1.9	1.4	-26.3%	2.2	1.9	-13.6%	2.4	1.9	-20.8%
	WB	0.5	1.7	1.1	-35.3%	1.0	1.3	30.0%	2.2	1.5	-31.8%	1.5	1.8	20.0%
Corridor 3: W Emerson Pl / W Nickerson St	EB	2.0	5.3	5.2	-1.9%	5.3	5.2	-1.9%	4.8	4.8	0.0%	4.8	4.8	0.0%
	WB	2.0	4.7	5.9	25.5%	4.7	5.9	25.5%	4.3	5.5	27.9%	4.3	5.5	27.9%
Corridor 4: W Dravus St	EB	0.6	4.6	4.6	0.0%	5.0	4.9	-2.0%	4.5	4.5	0.0%	4.9	4.9	0.0%
	WB	0.6	2.2	2.2	0.0%	2.3	2.3	0.0%	2.1	2.1	0.0%	2.2	2.2	0.0%
Corridor 5: Thorndyke Ave W / W Armory Way	EB	3.5	NA	NA	NA	7.3	5.3	-27.4%	NA	NA	NA	8.5	6.2	-27.1%
	WB	3.5	NA	NA	NA	16.0	10.1	-36.9%	NA	NA	NA	11.8	10.9	-7.6%
Corridor 6: Magnolia Bridge	EB	2.0	4.9	6.6	34.7%	NA	NA	NA	4.4	6.1	38.6%	NA	NA	NA
	WB	1.9	3.8	3.9	2.6%	NA	NA	NA	3.3	3.4	3.0%	NA	NA	NA

Notes:

- Green highlight indicates delay reduction of greater than 10%, red highlight indicates delay increase of greater than 10%

^ Freeflow travel time represents the travel time a general purpose vehicle would experience when no traffic congestion is present

- Expected travel times are calculated by the vehicle running time plus average intersection delay, with dwell time added to transit movements and reduced turning speeds for turns and grade for freight vehicles. Travel times during congestion expected to be up to 50% greater than the values listed
- Scenario 1 Strategies include: 100-102, 103a&b, 104a&b, 105a, 106, 107, 200-202, 203b, 204b, 205, 300-307, 400, 401a&b, 403-405, 500a, 501, 502, 505, 601-602
- Scenario 2 Strategies include: 100-102, 103a&b, 104a&b, 105b, 106, 107, 200, 201, 203a, 204a, 205, 300-307, 400, 401a&b, 403-405, 500a&b, 501-505

Table 11. Corridor Travel Time Comparison: Freight and Transit: 2042 PM Peak Hour

Corridor/ Segment	Direction	Free Flow Travel Time^	Freight Travel Time						Transit Travel Time					
			2042 Scenario 1: *Mid-Height Ballard Bridge with Magnolia 1-1 Bridge Replacement*			2042 Scenario 2: *Low-Height Ballard Bridge with Armory Way Bridge*			2042 Scenario 1: *Mid-Height Ballard Bridge with Magnolia 1-1 Bridge Replacement*			2042 Scenario 2: *Low-Height Ballard Bridge with Armory Way Bridge*		
			Base	w/CMS	% Change	Base	w/CMS	% Change	Base	w/CMS	% Change	Base	w/CMS	% Change
Corridor 1: 15th Ave W	SB	5.2	7.4	7.0	-5.4%	7.7	7.2	-6.5%	10.7	10.4	-2.8%	12.1	13.3	9.9%
	NB	5.2	21.0	7.3	-65.2%	24.6	7.3	-70.3%	13.3	10.5	-21.1%	17.3	12.8	-26.0%
Corridor 2: NW Leary Way	EB	0.5	1.9	2.4	26.3%	1.5	1.3	-13.3%	2.4	2.8	16.7%	2.0	1.8	-10.0%
	WB	0.5	2.2	1.7	-22.7%	1.5	2.0	33.3%	2.7	2.0	-25.9%	2.0	2.5	25.0%
Corridor 3: W Emerson Pl / W Nickerson St	EB	2.0	4.1	4.1	0.0%	4.1	4.2	2.4%	3.6	3.7	2.8%	3.7	3.7	0.0%
	WB	2.0	10.8	7.1	-34.3%	10.8	7.1	-34.3%	10.4	6.7	-35.6%	10.4	6.7	-35.6%
Corridor 4: W Dravus St	EB	0.6	3.2	3.2	0.0%	3.6	3.5	-2.8%	3.1	3.1	0.0%	3.5	3.5	0.0%
	WB	0.6	4.8	4.8	0.0%	6.2	5.8	-6.5%	4.7	4.7	0.0%	6.1	5.7	-6.6%
Corridor 5: Thorndyke Ave W / W Armory Way	EB	3.5	NA	NA	NA	18.4	5.5	-70.1%	NA	NA	NA	11.3	6.3	-44.2%
	WB	3.5	NA	NA	NA	7.9	7.5	-5.1%	NA	NA	NA	8.8	8.3	-5.7%
Corridor 6: Magnolia Bridge	EB	2.0	2.7	2.9	7.4%	NA	NA	NA	2.2	2.4	9.1%	NA	NA	NA
	WB	1.9	3.8	4.0	5.3%	NA	NA	NA	3.3	3.5	6.1%	NA	NA	NA

Notes:
- Green highlight indicates delay reduction of greater than 10%, red highlight indicates delay increase of greater than 10%
- ^ Freeflow travel time represents the travel time a general purpose vehicle would experience when no traffic congestion is present
- Expected travel times are calculated by the vehicle running time plus average intersection delay, with dwell time added to transit movements and reduced turning speeds for turns and grade for freight vehicles. Travel times during congestion expected to be up to 50% greater than the values listed.
- Scenario 1 Strategies include: 100-102, 103a&b, 104a&b, 105a, 106, 107, 200-202, 203b, 204b, 205, 300-307, 400, 401a&b, 403-405, 500a, 501, 502, 505, 601-602
- Scenario 2 Strategies include: 100-102, 103a&b, 104a&b, 105b, 106, 107, 200, 201, 203a, 204a, 205, 300-307, 400, 401a&b, 403-405, 500a&b, 501-505

Attachment A:

Corridor Management Strategies

Attachment A.1. Detailed Summary of Corridor Management Strategies

Corridor	Location/ Intersection	Description of Transportation Need	ID	Strategy Type	Strategy to Address Need	Primary Modes	Category	Performance Improvement w/Implementation	Strategy Source
15th Avenue West (Corridor 1)	Corridor Wide	• Peak period congestion in Northbound and Southbound direction	100	ITS Strategies	Install adaptive signal system along 15th Ave NW/W	Vehicle, Freight, Transit	Small, not bridge-related	• Improved corridor signal coordination • Adaptive timings to current conditions to minimize corridor delay	SDOT
	NW Market Street/ 15th Avenue NW	• Northbound thru LOS E in AM / LOS F in PM • Southbound thru LOS F in AM / LOS E in PM	101	Channelization & Striping	Convert Bus-Only Lanes (BOL) to Freight and Transit (FAT) lanes on 15th Ave NW, NB and SB movements	Freight, Transit	Large, not bridge-related	• FAT reduces freight delay by 0.5-3 minutes, slight increase in transit delay	BIRT
	Gilman Drive/ 15th Avenue W	• Northbound thru LOS E in AM / LOS F in PM • Southbound thru LOS F in AM	102	Channelization & Striping	Convert Bus-Only Lanes (BOL) to Freight and Transit (FAT) lanes on 15th Ave NW, NB and SB movements	Freight, Transit	Large, not bridge-related	• FAT reduces freight delay up to 2 minutes, transit has a slight reduction	BIRT
	W Armory Way/ 15th Avenue W	• Southbound thru LOS F in AM • Northbound thru LOS F in PM	103a	Channelization & Striping	Convert Bus-Only Lanes (BOL) to Freight and Transit (FAT) lanes on 15th Ave NW, NB and SB movements	Freight, Transit	Large, not bridge-related	• FAT reduces freight delay up to 2 minutes, transit has a slight reduction	BIRT
		• SE right turn in both peaks	103b	Access Management	Eliminate southern pedestrian crossing to decrease green time needed for Armory approach	Vehicle, Freight, Transit	Small, not bridge-related	• Fewer pedestrian conflicts for SE right turn	BIRT
	W Howe Street/ 15th Avenue W	• Southbound thru LOS F in AM • Northbound thru LOS F in PM	104a	Channelization & Striping	Convert Bus-Only Lanes (BOL) to Freight and Transit (FAT) lanes on 15th Ave NW, NB and SB movements	Freight, Transit	Large, not bridge-related	• FAT reduces freight delay by 2-3 minutes, transit reduced a half minute NB PM	BIRT
		• Eastbound/Westbound approaches LOS F in both peaks	104b	Access Management	Eliminate southern pedestrian crossing to decrease green time needed for Howe/Whole Foods approaches	Vehicle	Small, not bridge-related	• Fewer pedestrian conflicts for EB right • More efficient pedestrian crossings	BIRT
	W Garfield Street/ 15th Avenue W.	• Southbound thru LOS F in AM • Northbound thru LOS F in PM	105a	Channelization & Striping	Convert Bus-Only Lanes (BOL) to Freight and Transit (FAT) lanes on 15th Ave NW, NB and SB movements	Freight, Transit	Large, not bridge-related	• FAT reduces freight delay by 50-70 seconds, transit has a slight reduction	BIRT
		• Traffic signal may cause unwarranted delay for 15th Ave	105b	Traffic Control	Remove traffic signal, prohibit left turn movements. Reroute left turns to/from Terminal 91 to Galer Street flyover	Freight, Transit	Requires Scenario 2	• Under two way stop control 15th Ave northbound and southbound have no delay	BIRT

Attachment A.1. Detailed Summary of Corridor Management Strategies

Corridor	Location/ Intersection	Description of Transportation Need	ID	Strategy Type	Strategy to Address Need	Primary Modes	Category	Performance Improvement w/Implementation	Strategy Source
	W Galer Street/ 15th Avenue W.	• Southbound thru LOS F in PM	106	Channelization & Striping	Convert Bus-Only Lanes (BOL) to Freight and Transit (FAT) lanes on 15th Ave NW, NB and SB movements	Freight, Transit	Large, not bridge-related	• FAT reduces freight delay by 0.5-2 minutes, no change to transit	BIRT
15th Avenue West (Corridor 1)	W Galer Flyover/ Elliott Avenue	• Northwest bound thru LOS F in both peak hours • Delay for southeast bound left turn in AM, southwest bound left turn in both peak hours northwest bound through in both peak hours	107	Channelization & Striping	Convert Bus-Only Lanes (BOL) to Freight and Transit (FAT) lanes on 15th Ave NW, NB and SB movements	Freight, Transit	Large, not bridge-related	• FAT reduces freight delay by 2-3 minutes in PM, not effective in AM	BIRT
NW Leary Way (Corridor 2)	Corridor Wide	• Peak period congestion in Eastbound and Westbound direction impedes freight and transit	200	ITS Strategies	Install adaptive signal system along NW Leary Way	Vehicle, Freight, Transit	Small, not bridge-related	• Improved system coordination performance expected	MB
	NW Leary Way/ 17th Avenue NW	• Southbound stop-controlled approach LOS F	201	Signal Operations	Adjust signal coordination at adjacent signals to provide gaps for egressing trucks along mainline	Vehicle, Freight, Transit	Small, not bridge-related	• Reduced delays for side street approaches expected	BIRT
	NW Leary Way/15th Avenue SB On Ramp	• Ballard Bridge replacement	202	Capital Improvements	Install new southbound 15th Ave on ramp intersection on Leary Ave east of 17th Ave associated with Mid-Height Ballard Bridge scenario	Vehicle, Freight, Transit	Requires Scenario 1	• Eastbound delay reduced by ~30 seconds	BBPS
	NW Leary Way/ 15th Avenue SB Ramps	• Eastbound approach LOS E in AM due to left turns • Congestion impedes freight and transit	203a	Access Management	Prohibit WB left, force through movement then right turn loop via 17th/49th	Vehicle, Freight, Transit	Small, not bridge-related	• Freight delay reduced 10-30 seconds, but increased travel time for on ramp left turn movements	BIRT
			203b	Channelization & Striping	Install Freight and Transit (FAT) lanes	Freight, Transit	Small, not bridge-related	• Slight delay reductions for freight and transit	SDOT/BIRT
	NW Leary Way/ 15th Avenue NB Ramps	• Westbound approach high LOS D due to left turns • Congestion impedes freight and transit	204a	Access Management	Prohibit EB left, force through movement then right turn loop via 14th/Ballard Way	Vehicle, Freight, Transit	Small, not bridge-related	• Negative benefits for westbound, ITS and adaptive signals could help further	BIRT
			204b	Channelization & Striping	Install Freight and Transit (FAT) lanes	Freight, Transit	Small, not bridge-related	• Slight delay reductions for freight and transit	SDOT/BIRT

Attachment A.1. Detailed Summary of Corridor Management Strategies

Corridor	Location/ Intersection	Description of Transportation Need	ID	Strategy Type	Strategy to Address Need	Primary Modes	Category	Performance Improvement w/Implementation	Strategy Source
	NW Leary Way/ 14th Avenue NW	• Freight mobility along Leary Way	205	Signal Operations	Emphasize green time for freight movements and provide gaps for egressing trucks along mainline	Freight	Small, not bridge-related	• Improved system coordination performance expected	MB
W Emerson Place – W Nickerson Street (Corridor 3)	Corridor Wide	• Peak period congestion in Eastbound and Westbound direction • Enhance freight mobility along corridor	300	ITS Strategies	Install adaptive signal system along W Nickerson Street and W Emerson Street	Vehicle, Freight, Transit	Small, not bridge-related	• Improved system coordination performance expected	BIRT
	W. Emerson Place/ Gilman Avenue NW	• Overall intersection LOS F in both peak hours	301	Traffic Control	Install traffic signal to improve multi-modal interaction and replace inefficient all-way stop control	Vehicle, Freight, Transit	Small, not bridge-related	• Intersection remains LOS E/F but delays reduced 40-60 seconds	MBPS
	W Emerson Place/ 23rd Avenue NW	• Long gaps needed in Emerson Pl traffic to serve stop-controlled side streets	302	Signal Operations	In conjunction with traffic signal installed at Gilman & Emerson, coordinate timing to optimize gaps for mid-block side streets between Gilman Ave & 21st Ave	Freight	Small, not bridge-related	• Ensures freight movement not penalized by minor street movements	BIRT
	W Emerson Street/ 19th Avenue W	• Maintain freight mobility on Emerson Pl	303	Signal Operations	Maintain maximum green time for Emerson Pl approaches	Freight	Small, not bridge-related	• Ensures freight movement not penalized by minor street movements	BIRT
	W Emerson Street/ 15th Avenue W Southbound Ramps	• Eastbound left turn high LOS D in both peak hours	304	Signal Operations	Monitor signal timing and maintain mobility to and from 15th Ave	Vehicle, Freight, Transit	Requires Scenario 1 or 2	• Monitor operations to prevent freight delays	BIRT
	W Emerson Street/ 15th Ave North Ramps	• Eastbound and Westbound through movements high LOS D in both peak hours	305	Signal Operations	Monitor signal timing and maintain mobility to and from 15th Ave	Vehicle, Freight, Transit	Requires Scenario 1 or 2	• Monitor operations to prevent freight delays	BIRT
	W Nickerson Street/ 15th Avenue W Ramps	• 15th Ave. off ramp queuing and delay	306	ITS Strategies	Monitor queues and conflicts with ship canal trail, local business access points, consider queue detectors	Vehicle, Freight, Transit	Requires Scenario 1 or 2	• Prevents queue spillback to 15th Ave mainline	BIRT
	W Nickerson Street/ 13th Avenue W	• Conflicts between general purpose traffic, freight, non-motorized traffic	307	ITS Strategies	Monitor queues and conflicts with ship canal trail, local business access points, consider queue detectors	Vehicle, Non-Motorized	Small, not bridge-related	• Reduces vehicular/non-motorized conflicts and maintains freight access	BIRT

Attachment A.1. Detailed Summary of Corridor Management Strategies

Corridor	Location/ Intersection	Description of Transportation Need	ID	Strategy Type	Strategy to Address Need	Primary Modes	Category	Performance Improvement w/Implementation	Strategy Source
W Dravus Street (Corridor 4) W Dravus Street (Corridor 4)	Corridor Wide	• Truck turning maneuvers at tight intersections • Multi-modal trip interactions	400	Channelization & Striping	Improve intersection corner radii Monitor signal operations Maintain traffic control devices	Freight	Small, not bridge-related	• Enhanced freight mobility through intersections	FMP
	W Dravus Street/ 20th Avenue W	• Southbound left LOS F, northbound right LOS F	401a	Signal Operations	Implement flashing yellow arrow for southbound left and maintain bike/ped phases Add northbound right turn overlap phase	Vehicle, Non-Motorized	Small, not bridge-related	• Overall peak hour delays reduced by 10-20 seconds	BIRT
		• Driveways near intersection	401b	Access Management	Restrict adjacent driveways and on street parking	Vehicle, Freight, Transit	Small, not bridge-related	• Enhanced freight mobility through intersection	BIRT
	W Dravus Street/ 17th Avenue W	• Maintain freight mobility on W Dravus St	402	Signal Operations	Maintain maximum green time for W Dravus St approaches	Freight	Small, not bridge-related	• Monitor operations to prevent freight delays	BIRT
	W Dravus Street/15th Avenue W SB Ramps	• Insufficient space for truck turning maneuvers	403	Channelization & Striping	Channelization and minor curbing adjustments to better accommodate truck turning maneuvers	Freight	Small, not bridge-related	• Enhanced freight mobility through intersection	FMP
	W Dravus Street/ 15th Avenue W NB Ramps	• Insufficient space for truck turning maneuvers	404	Channelization & Striping	Channelization and minor curbing adjustments to better accommodate truck turning maneuvers	Freight	Small, not bridge-related	• Enhanced freight mobility through intersection	FMP
	W Dravus Street/ 14th Avenue W	• Maintain freight mobility on W Dravus St	405	Signal Operations	Adjust signal coordination to provide gaps for egressing trucks along mainline	Freight	Small, not bridge-related	• Monitor operations to prevent freight delays	FMP
Armory Way Bridge (Corridor 5)	Corridor Wide	• Freight mobility on Thorndyke/Armory Bridge	500a	ITS Strategies	Install dynamic message signs displaying routing and travel time information	Vehicle	Small, not bridge-related	• Improved wayfinding and routing decisions	BIRT
			500b	Channelization & Striping	Install Freight and Transit (FAT) lanes on Thorndyke from Blaine to Armory and on Armory from Thorndyke to 15th Ave	Freight	Requires Scenario 2	• Improved freight travel time through congested areas	BIRT
	Thorndyke Ave. W/20th Ave. W	• Insufficient space for freight turning maneuvers	501	Channelization & Striping	Improve turn radii for trucks	Freight	Small, not bridge-related	• Enhanced freight mobility through intersection	BIRT
	Thorndyke Ave. W/21st Ave. W	• Conflicts between general purpose traffic, freight, non-motorized traffic	502	Channelization & Striping	Improve visibility of traffic control devices	Vehicle, Non-Motorized	Small, not bridge-related	• Enhanced non-motorized safety	BIRT

Attachment A.1. Detailed Summary of Corridor Management Strategies

Corridor	Location/ Intersection	Description of Transportation Need	ID	Strategy Type	Strategy to Address Need	Primary Modes	Category	Performance Improvement w/Implementation	Strategy Source
	Thorndyke Ave W & Armory Bridge	• Westbound approach LOS E / F, southbound left LOS E	503	Capital Improvements	Install a northbound right turn lane on Thorndyke Ave	Vehicle, Freight, Transit	Requires Scenario 2	• Overall delay reduced 15-30 seconds in peak hours	BIRT
	W. Blaine St./Thorndyke Ave. W	• Freight mobility on Thorndyke • Eastbound approach LOS F	504	Channelization & Striping	Install Freight and Transit (FAT) lanes on Thorndyke	Freight	Requires Scenario 2	• Overall peak hour delays reduced by 20-30 seconds	BIRT
	W. Galer St./Thorndyke Ave. W	• Southbound approach LOS F in AM peak	505	Traffic Control	Install a traffic signal	Vehicle, Freight, Transit	Small, not bridge-related	• Overall peak hour delays reduced 10-15 seconds	EXP
Magnolia Bridge (Corridor 6)	23rd Ave. NW/Magnolia Bridge EB on-ramp	• Unclear intersection control	601	Channelization & Striping	Improve visibility of traffic control devices	Vehicle, Freight, Transit	Requires Scenario 1	• Enhanced vehicular traffic safety	BIRT
	Terminal 91 Gate/Magnolia Bridge WB off-ramp	• Unclear intersection control	602	Channelization & Striping	Improve visibility of traffic control devices	Vehicle, Freight, Transit	Requires Scenario 1	• Enhanced vehicular traffic safety	BIRT

Notes:

- Scenarios are described below:

- Network Scenario 1 (higher cost) - Land uses consistent with Needs Assessment Scenario 1; mid-height Ballard Bridge, which includes new access and signals north of bridge in Ballard and SPUI south of bridge; Magnolia Bridge Scenario 4 (one-to-one replacement of Magnolia Bridge)
- Network Scenario 2 (lower cost) - Land uses consistent with Needs Assessment Scenario 2; low-height Ballard Bridge (one-to-one replacement of Ballard Bridge) and new SPUI south of Ballard Bridge; Armory Way Bridge Scenario 1 (new bridge between 15th Avenue W & Armory Way and Thorndyke Avenue), Thorndyke Improvements, 20th Avenue Improvements, Alaskan Way Connector, Magnolia Bridge Spur, and West Uplands Perimeter Road

- Area Studies

- BIRT = Ballard-Interbay Regional Transportation Study (2020)
- MBPS = Magnolia Bridge Planning Study/Traffic Maintenance Plan (2019)
- BBPS = Ballard Bridge Planning Study (2020)
- FMP = Freight Master Plan (2016)
- SDOT = SDOT Programmed Improvement
- EXP = Expedia Campus Transportation Technical Report
- MB = Move Ballard (2016)

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