# Establishment of Triggers

## Second Montlake Bridge Workgroup

**June 2012**

NELSON
NYGAARD

## Table of Contents



## Table of Figures and Tables

# 1 EXECUTIVE SUMMARY -- THE CONDTIONS AND TRIGGERS

## Brief Summary Conditions and the Triggers

Each trigger is addressed in far greater depth in an individual section in the report. The purpose of this section is to briefly introduce the issue and the trigger. Each issue was explored as an independent issue. The collection of research, background, and analysis is presented as a "white paper" dealing with the topic. Each of the white papers has been included in this document as discussed and accepted by the Second Montlake Bridge workgroup.

## Bicycle and Pedestrian Mobility

**Conditions:** The Montlake Bridge is a critical connection between the University of Washington and all of northeast Seattle with SR 520 and points east of Seattle, Interstate 5, and the neighborhoods of Montlake and Capitol Hill. For bicyclists, it is a key connection between the Lake Washington Loop and the Burke-Gilman trail. These two routes are among the most highly used bicycle routes in the region. Due to the multitude of activity centers and major vehicle and transit corridors converging at this point, the bridge is a highly used facility.

The bridge sidewalks are the main pathway for pedestrians and cyclists and are a bottleneck due to the narrowness of the facility and the volume of people crossing. The sidewalks for pedestrians and bicycles are operating at a level of service that is "very poor" and occasionally "failing" on average, during peak times. For example, volumes of pedestrians and bicycles observed and recorded during the 2011 Bicycle and Pedestrian count found that the west sidewalk of the bridge was operating at a "failed" level of service in the afternoon peak hour. These conditions marginally meet, and occasionally fail to meet, the policy standards set by the Seattle Comprehensive Plan and as delineated in the Seattle Bicycle Master Plan and the Pedestrian Master Plan.

Mobility improvement projects now funded and under construction, U-Link/Husky Stadium Station, SR 520 Bicycle and Pedestrian path over Lake Washington, and improvements to the Burke/Gilman Trail connections at the Montlake Triangle (as part of the University of Washington's Rainier Vista project) will improve access for growing numbers of pedestrians and cyclists in the area.

**Trigger:** If the calculated Shared Use Path Level of Service (SUPLOS), reaches level of service "F," or failed conditions, consistently during at least one peak period, for more than three months of a single year the trigger has been met. While any "failed" SUPLOS condition is incompatible with established City of Seattle policy, the condition must exist to the degree that addressing the condition provides significant benefits.

**Future Conditions:** The future events of U-Link and the SR 520 regional shared use path indicate that bicycle and pedestrian traffic on the Montlake Bridge are very likely to increase. The precise amount of increase is predicted, but unknown. There are many assumptions made about the daily and seasonal variation in pedestrian and bicycle traffic on the Montlake Bridge, yet little is actually known other than four annual one day counts each conducted in early fall. The annual monitoring program appears insufficient to determine on-going non-motorized level of service conditions on the bridge. A quarterly Montlake Bridge pedestrian and bicycle volume monitoring program should be developed and results should be reported annually to ascertain the current level of service being provided on the bridge. However, it must be recognized that the resources to conduct such a monitoring and reporting effort have not been identified.

## Transit Speed and Reliability

**Conditions:** The Montlake Bridge is an important linkage in the local and regional transit network. Metro operates 10 routes across the Montlake Bridge with seven routes coming from SR 520 and three operating locally through the Montlake corridor. There are over 600 transit trips with nearly 11,000 transit passengers that cross the Montlake Bridge daily. Of these 600 daily transit trips 55% of those trips make local connections between the University District and the Rainer Valley, First Hill, Central Seattle, and Capitol Hill. The slight minority of trips make regional connections between the University District and Eastside locations, such as Bellevue and Redmond.

The City of Seattle and King County Metro has made it clear through their policies that improvements in transit travel time and reliability in this corridor are important. Given the dynamic nature of pre-toll and post-toll traffic on the Montlake Boulevard corridor, 2011 performance data was selected as a baseline for comparison of transit travel time, speed, and passenger delay. In 2011 local transit routes serving the Montlake corridor fail to meet King County Metro service guidelines for reliability in some time periods while in other time periods they appear to be close to thresholds that indicate further action to ensure on-time performance.

A correlation between adopted transit performance standards and measures, current transit performance, and the traffic conditions directly related to the Montlake drawbridge could not be specifically established. However, because King County Metro schedule reliability thresholds have been reached or exceeded in some areas and time periods, the Second Montlake Bridge workgroup developed a transit trigger that provided for future flexibility. This trigger requires continued monitoring of the corridor and consideration of transit improvements that are consistent with adopted policies and plans.

**Trigger:**

**Step 1 --** If future conditions degrade beyond 2011 baseline conditions by any measure, speed or passenger delay, and for any time period, AM peak, midday, PM peak, a process to identify transit operating enhancements is triggered. The amount of change beyond 2011 baseline conditions will determine the level of transit enhancements indicated for the corridor. Metro, City of Seattle, and WSDOT will work to identify potential projects to bring transit travel times and passenger delay back to 2011 levels, or better.

**Step 2 --** If transit enhancement measures employed in **Step 1** are exhausted and are not able to improve transit operations to 2011 conditions based on a minimum of six months measurement following implementation of all transit enhancements, the trigger would then be met to consider the potential benefits to transit of constructing a second Montlake bridge. It is anticipated that additional analysis will be required if the second step trigger is met to determine the benefit to transit of a second bridge so that there is assurance that construction of a second bridge will actually resolve the speed and delay issues experienced by transit and improve conditions to the 2011 baseline, or better.

**Future Conditions:** Future conditions in the Montlake Corridor with respect to transit speed and total passenger delay will depend on several factors including but not limited to the following:

1. Traffic volume
2. Light rail implementation
3. Draw bridge opening frequency
4. Changes in transit ridership
5. Levels of boarding and alighting at transit stops
6. Traffic signal operations
7. Transit priority improvements

These conditions and projects in addition to general growth in the Greater Puget Sound area could have an effect on how people choose to travel in the area. In addition to meeting local policies to improve transit, these and potential other projects and policies illustrate the need for continued monitoring of transit conditions into the future. King County Metro currently collects the data necessary to monitor conditions in the corridor but the resources necessary to analyze the data and report the results of the analysis have not been identified.

## SR 520 Mainline Operations

**Conditions:** The Montlake ramps play a significant role in traffic delay and congestion on SR 520. Ramps that particularly influence mainline traffic flow are the eastbound off-ramp and the eastbound on-ramp. While the westbound on and off ramps also have an influence, it is far less of a "normal" condition than those produced by the eastbound ramps. The presence of the Montlake bridge plays no role in the on-ramps' impact on mainline operations. Therefore, the focus of existing conditions is on the eastbound off-ramp.

The bridge impacts this location in two ways, one as a capacity restriction and secondly due to marine operations which close the span to through traffic, particularly in midday, weekday operations. The first of these conditions was found to have minimal, if any, influence on SR 520 mainline operations. Other capacity restrictions in the corridor exert far more influence. Bridge operations do, however, impact mainline operations, particularly in the eastbound direction. Anecdotal information suggests that tolling has not influenced this particular aspect of mainline operations. In fact, there is evidence that suggests traffic volumes on the eastbound off ramp and westbound on ramp have increased in the post-tolling conditions. Nevertheless, due to the availability of data, the baseline conditions and analysis were conducted using pre-toll traffic conditions and data.

While a second bridge has no influence over the frequency of bridge lift activity, the presence of a second bridge does influence how quickly the traffic queues from bridge opening dissipate and traffic conditions return to "normal" following a bridge lift event. Traffic modeling for the second bridge predicts up to a 5% improvement in traffic flow recovery following a bridge lift event. Therefore, the trigger has been framed to focus on that influence.

**Trigger:** If SR 520 mainline congestion that occurs as a result of Montlake bridge openings exceeds an average of 100 minutes per day for any six month period, the trigger is met. If met, roadway improvements would be considered to reduce congestion. Those roadway improvements could include a second Montlake Bascule Bridge.

Congestion is defined as mainline average speed of 20 MPH, or less, in the right, or outside, lane. The threshold of 100 minutes is established in combination with the projected 5% reduction in recovery time from the ESSB 6392 traffic models to obtain a daily reduction in mainline congestion of five minutes. This is the minimum level at which a second bridge could provide meaningful traffic flow recovery benefit.

**Future Conditions:** Planned modifications with the SR 520 project include a reconstructed Montlake interchange that will include expanded storage for vehicles waiting to enter Montlake Boulevard as well as improved signal operations. The characteristics of traffic flow in the entire Montlake area have changed as a result of tolling. Over time, traffic volumes will likely continue to adjust to tolling in the corridor and in the region. Traffic volumes will also change as Sound Transit's various Link projects are implemented, roadway infrastructure improvements are constructed, and improved cross-lake regional transit services are implemented. Continued monitoring and reporting of traffic congestion will help decision makers understand how people respond to the future projects and determine what improvements might be necessary to maintain mobility in the region.

# 2 BACKGROUND AND HISTORY

The story behind consideration of a Second Montlake Bridge is long and is perhaps best told by tracking the development of the bridge and the varying viewpoints on its inclusion in the SR 520 I-5 to Medina Bridge Replacement and HOV Project through several stages of project records. While historically not the first mention of a second Montlake Bridge, the Supplemental Draft Environmental Impact Statement for the SR 520 I-5 to Medina Bridge Replacement and HOV Program includes the intent to build a second bascule bridge, parallel to the current Montlake Bridge as part of the project. The Seattle City Council provided a comment letter to WSDOT on the SDEIS that included one comment specific to the second Montlake Bridge which reads, in part:

> *Phase the decision on construction of the proposed second bascule bridge at Montlake Boulevard and test measures that may eliminate the need for construction. Require that the bridge be designed to provide priority for transit, pedestrian, and bicycle traffic if it is constructed.*
>
> > *We continue to have reservations about the potential construction of a second bascule bridge across the Montlake Cut at Montlake Boulevard. Building a parallel bascule bridge at Montlake will likely necessitate the removal of two residential properties and further divide the Shelby-Hamlin neighborhood, which is already bisected by a 4-lane Montlake Boulevard that is traveled by more than 50,000 vehicles each day. If a second bascule bridge is to be constructed at Montlake, we recommend it be built to meet the following conditions:*
> >
> > 1) *The second bridge should be built to accommodate no more than two lanes of traffic and include dedicated bicycle and pedestrian facilities. In order to reduce additional negative impacts on the Shelby-Hamlin neighborhood, the footprint of the new bridge should be as narrow as possible without compromising the safety of Montlake Boulevard, transit operations, or Seattle standards for bicycle and pedestrian facilities.*
> >
> > 2) *The existing Montlake Bridge should remain a 4-lane roadway.*
> >
> > 3) *If the second bridge is completed, the two crossings should operate in a 4+2 configuration, with four general purpose lanes and two dedicated HOV/transit lanes...*
> >
> > *…We will only consider supporting the construction of a second bridge across the Montlake Cut if the additional bridge is used to provide the capacity for dedicated facilities for HOV, transit, bicyclists, and pedestrians. We do not support the creation of additional roadway capacity along Montlake Boulevard for single occupant vehicles and other general purpose traffic.*
> >
> > *In order to determine whether the second bridge is needed, we ask that WSDOT, SDOT, Metro, and Sound Transit must work together to design and test systems that will facilitate the movement of transit through the Montlake corridor, such as signalization,*

> *signal timing, signal queue jumping for HOV/transit, dedicated HOV/transit lanes, and other techniques…*

In response to the Seattle City Council comment, WSDOT wrote in the FEIS:

> *The Preferred Alternative includes a second bascule bridge across the Montlake Cut that provides additional capacity for transit/HOV, bicycles, and pedestrians. The bridges would operate with three lanes in each direction (two general purpose and one HOV); the existing bridge would serve southbound traffic, and the new bridge would serve northbound traffic. In addition to the three travel lanes, each bridge would have a bicycle lane and sidewalks. However, WSDOT is developing measures to determine the appropriate timing for construction of the new bascule bridge. Please see Chapter 2 of the Final EIS for detailed information about the configuration of the bridges and the Final Transportation Discipline Report (Attachment 7 to the Final EIS) for transit effects in the Montlake area.*

### ESSB 6392 Workgroup

At nearly the same time and under the direction of Engrossed Substitute Senate Bill (ESSB) 6392 (legislation adopted in mid-2010 directing WSDOT to look at specific design refinements for the SR 520 Corridor), WSDOT included further consideration of the second Montlake Bridge as a design refinement in this phase of project planning. Co-led by WSDOT and the City of Seattle, a workgroup was tasked by the Executive Committee with refining the design of the corridor on the west side of the SR 520 bridge and enhancing transit connections. The ESSB 6392 Workgroup included representatives from WSDOT, Seattle Department of Transportation (SDOT), the Seattle City Council, University of Washington, King County Metro, Sound Transit, the Seattle Bicycle Advisory Committee, the Seattle Pedestrian Advisory Committee, and the Seattle Design Commission. The final report from the work group stated, in part:

> *…The Workgroup recommends including a second bascule bridge across the Montlake Cut in the SR 520 FEIS, and establishing transit travel time, bicycle/pedestrian level of service, and SR 520 operations measures to trigger construction of the second bridge….*

The Seattle City Council in October 2010 provided the following comment (partial) on the ESSB 6392 report:

> *…Identifying the three trigger factors to be measured (SR 520 mainline operations, transit travel times, and bike and pedestrian accommodation) represents an appropriate first step. Next, we believe that developing a clear process for monitoring and evaluating the timing and need for a second bascule bridge will be critical to ensure that a framework for decision-making is in place for future policymakers…*

As a result of this comment, as well as a request that the City and State jointly adopt a corridor management agreement,[1] WSDOT and the City of Seattle adopted a Memorandum of Understanding in October 2011 which states the intent which is the basis for this report:

> ***2.3.1*** *Collaborate in the City led effort to establish a joint decision-making process to decide whether to construct and timing to construct the second Montlake Bascule Bridge. The process will consider transit travel time, reliability, passenger delay, pedestrian and bicycle levels of service, SR 520 mainline operations and other appropriate factors. This process will include opportunities for community and neighborhood outreach and will be described in a detailed document that will either be attached to this MOU by amendment or established in a separate MOU or agreement.*

The agreement resulted in the convening of a workgroup, chartered to specifically identity the triggers for each of the component concerns. The workgroup includes representatives from Washington State Department of Transportation (WSDOT), Seattle City Council, the City of Seattle Department of Transportation (SDOT), and King County Metro. This report paper details and documents the efforts of the Second Montlake Bridge Workgroup to establish the triggers.

[1] The 6392 Workgroup report and the resulting Memorandum of Agreement contain agreements on many specific policy components. The Second Montlake Bridge is singled out in the introduction here to add some level of brevity to this introduction which sets the foundation for this report.

# 3 ASSESSMENT OF A BICYCLE AND PEDESTRIAN TRIGGER

## Background

This white paper seeks to define a "trigger" point at which the travel, congestion, and conflict conditions, current or future, on the current Montlake bridge sidewalks reach levels that are incompatible with City of Seattle policy established in the Comprehensive Plan, and the Pedestrian and Bicycle Master plans. The paper also details the pedestrian and bicycle volumes currently and historically experienced on the Montlake Bascule Bridge. Through the efforts of the workgroup the following factors were considered and a recommendation was developed that establishes a "trigger," which, when met, would initiate further consideration of improvements in the corridor for the benefit of non-motorized mobility which could include a second Montlake Bridge.

## Policy Guidance

Policy that relates to the operation, expected quality, design, and maintenance of pedestrian-bicycle shared use paths in the city is relevant to this discussion of the existing and future conditions for bicyclists and pedestrians on the Montlake Bridge. As will be discussed further in the existing conditions section below, the narrow sidewalks on the bridge and high volume of bicyclists and pedestrians using those facilities has a significant impact on the facility's capacity as a major transportation linkage. The following planning documents pertain directly to this issue:

- Seattle Comprehensive Plan (2004)
- Seattle Pedestrian Master Plan (2009)
- Seattle Bicycle Master Plan (2007)

### Seattle Comprehensive Plan

The Seattle Comprehensive Plan was fully adopted in 2004, and will next be updated in 2014, although plan amendments may occur annually.  The plan is the guiding document for growth and development in the city. The transportation element of the plan, *Section C: Increasing Transportation Choices*, addresses the goals of the city to promote transit, bicycling, and walking for transportation. *Section C-2: Bicycling & Walking* states the following policies relevant to this the effort to establish a "trigger:"

> *T30- Improve mobility and safe access for walking and bicycling, and create incentives to promote non-motorized travel to employment centers, commercial districts, transit stations, schools and major institutions, and recreational destinations.*

> *T35- Develop, apply and report on walking and bicycling transportation performance measures in the Transportation Strategic Plan to evaluate the functioning of the non-motorized transportation system; to ensure consistency with current industry standards; to identify strengths, deficiencies and potential improvements; and to support development of new and innovative facilities and programs.*[2]

## Seattle Pedestrian Master Plan

The Pedestrian Master Plan (PMP), adopted in 2009, establishes a policy framework for pedestrian facilities in Seattle. Strategies 2.1 and 2.2 address the importance of providing safe pedestrian access, particularly between major destinations:

> *Strategy 2.1: Create and maintain a walkable zone on all streets to enable a clear pedestrian path of travel […] Maintain a walkable zone coupled with ensuring attractive access to major pedestrian generators, particularly over barriers, such as waterways.*

> *Strategy 2.2: Improve pedestrian access to major destinations […] Prioritize walking connections to major pedestrian destinations. Provide attractive pedestrian access through and across major barriers, including freeways and rail corridors.*[3]

## Seattle Bicycle Master Plan

The Seattle Bicycle Master Plan specifically addresses the Montlake Bridge corridor as a high priority project:

> *The [SR 520 Bridge Replacement and HOV project] should incorporate trail connections to destinations in surrounding areas, including the University of Washington, new light rail transit service, Montlake Flyer station, and Montlake and Madison Park neighborhoods.*

The plan further denotes the importance of certain bridges as part of the bicycle network.

> *Bicycle accommodations on bridges need to be improved as well as on their approaches and access ramps. In the short term, bicycle access should be improved using signage, marking, maintenance, and other spot improvements. In the long term, bridges should be replaced with new facilities or retrofitted with facilities that provide full bicycle access (e.g., bicycle lanes or wide sidewalks - minimum 10 feet wide). Bridges are critical for providing bicycle connectivity throughout Seattle. Critical bridges for bicyclists include […] the Montlake Bridge.*

In addition, the Bicycle Master Plan establishes standards for shared use facilities essential to ensuring high quality experiences:

> *Multi-use trails (also referred to as shared-use paths) are an important component of Seattle's bicycle transportation system. These facilities can provide a high-quality bicycling experience because they are separated from*

---

[2] Seattle Comprehensive Plan, 2005. Pg 3.11

[3] City of Seattle. *Pedestrian Master Plan*. Seattle Department of Transportation. 2009.

> *motor vehicle traffic and often provide an opportunity for extended landscaping and territorial views of the city. Multipurpose trails are usually paved and should be a minimum of 10-feet wide. Minimum width may be reduced to eight feet where physical or right-of-way constraints are severe. Trail widths of 12, 14, and even 16 feet are appropriate in high-use urban situations.*[4]

It's important to note that a 10-feet wide path was the standard when the plan was published in 2007, but national standards have changed and a 14-feet wide path is now the minimum standard.[5] This will be reflected in the 2012 BMP update.

These documents, read together, illustrate Seattle's overall direction for Bicycle and Pedestrian Policy. None of the above documents provide guidance that establishes measureable standards for the quality of experience of non-motorized users. The workgroup used the Federal Highway Administration's publication of the Shared Use Path Level of Service Handbook to establish a quantitative, measureable method intended to parallel and embody the qualitative words used to describe the City's adopted policies. In both the Pedestrian and Bicycle Master Plans, the Montlake Bridge has been identified as a critical linkage in the non-motorized network with existing deficiencies.

# Existing Conditions

The ESSB 6392 Workgroup Recommendations Report on the SR 520, I-5 to Medina project, which includes the Second Bascule Bridge, recommends exploration of the existing bicycle and pedestrian level of service on the Montlake Bridge. This white paper also projects future growth and the impact of new transportation projects on bicycle and pedestrian volumes on the Montlake Bridge.

The bridge is a critical connection between the University of Washington and all of northeast Seattle with SR 520 and points east of Seattle, Interstate 5, and the neighborhoods of Montlake and Capitol Hill. For bicyclists, it is a key connection between the Lake Washington Loop and the Burke-Gilman trail. These two routes are among the most highly used bicycle routes in the region. In the Puget Sound Regional Council's 2010 Bicycle Count, locations on these bicycle routes are in the top 15 locations in the entire Puget Sound region. Due to the multitude of activity centers and major vehicle and transit corridors converging at this point, the Montlake bridge is a heavily used facility for pedestrians and bicycles. Using information compiled by PSRC when the University of Washington is in session the Montlake Bridge is in the top ten bicycle and pedestrian total count locations of more than 200 locations counted in the Puget Sound region in October 2010.[6]

## Facilities Design

The sidewalks of the bridge are between seven and ten feet wide. At the supports, the sidewalks narrow to seven feet. There are three supports on each side of the bridge. There is a span of 60 feet between the supports over the span of the bridge. The sidewalk is 8 to 10 inches above the roadway, with that vertical "curb" being the only separation between sidewalk and road surface.

---

[4] City of Seattle. *Bicycle Master Plan.* Seattle Department of Transportation. 2007.

[5] AASHTO Guide for the Planning, Design, and Operation of Bicycle and Pedestrian Facilities, 2009

[6] http://psrc.org/data/transportation/bicycle-counts

There are no pavement markings on the sidewalk except where some elements of the bridge lift mechanism occupy part of the pathway in a low-lying intrusion.

Currently, almost all bicyclists use the sidewalks of the bridge, as the roadway surface is metal grate, and share that sidewalk space with pedestrians. A metal grate is a highly undesirable surface for bicycle and pedestrian facilities. The American Association of State Highway and Transportation Officials (AASHTO) recommends that decking materials used on shared use paths which cross over bridges are not slippery when wet or uneven.[7] Due to this standard and its very practical basis, the roadway of the current bridge deck is an unsuitable surface for bicyclists.

The narrowness of the existing bridge sidewalks creates conflicts and delays for pedestrians and bicyclists. The photos in Figure 3-1 were taken over a span of about one minute in the middle of the day on December 22, 2011. The pedestrian and bicycle volumes on the bridge were relatively light, yet the photo shows the issues caused by the limited width of the sidewalk even in off peak periods. Cyclists frequently must slow down at the bridge supports where the sidewalk narrows to avoid pedestrian collisions.

In the Shelby/Hamlin neighborhood to the south of the bridge, cyclists travel in a shared two-way residential street to reach the bridge. For segments along Montlake Boulevard, cyclists most commonly use the sidewalks. Travelling in-street on Montlake Boulevard is challenging for cyclists due to the high number of intersections, turning movements, and drop lanes. To the north of the bridge, cyclists and pedestrians must share the sidewalk and navigate a complicated three-way intersection at Montlake Boulevard and NE Pacific Street to reach the Burke Gilman trail or the main University of Washington campus. These conditions contribute to the travel experience for bicyclists and pedestrians in and around the Montlake Bridge, and should be considered as part of the corridor in the overall evaluation of the suitability and capacity of this important regional linkage.

Figure 3-1: Interaction between bicyclist and pedestrians on the Montlake Bridge

Source: Nelson\Nygaard

[7] AASHTO Guide for the Planning, Design, and Operation of Bicycle and Pedestrian Facilities, 2009

## Bicycle and Pedestrian Counts

WSDOT and the City of Seattle have performed bicycle and pedestrian counts on the Montlake Bridge for 2008 (SDOT, bicycles and AM peak only) and 2009-2011 (WSDOT/Cascade Bicycle Club, bicycles and pedestrians, AM and PM peak). The years of data that are used for this paper are 2008-2011 for bicycles and 2009-2011 for pedestrians.

Each year, these non-motorized traffic counts have been conducted on the Montlake Bridge for one day in September or October. This time of the year has been chosen as a representative of "average" travel volumes, but attempting to infer volume from a one day count comes with numerous limitations. October counts are consistent with national standards established by the National Pedestrian and Bicycle Documentation Project, see Figure 8. Weather, however, has been shown to have a significant impact on cycling rates. Recent studies have found that count volumes decrease by 15-25% on rainy days, and that lower temperatures (<55°F) decrease bicycle volume by 27%.[8] During the Seattle counts from 2008 through 2011, the weather and temperatures have been relatively mild and consistent. This indicates that the counts represent a relatively dependable average volume of cyclists, although great variation in volume would be expected during the course of the year. Details are listed below:

- 2008: September 17th AM 55/73 °F; Clear
- 2009: September 16th 60/72 °F; Scattered Clouds
- 2010: October 5th PM 46/63 °F; Clear
- 2010: October 6th AM 51/66 °F; Mostly Cloudy
- 2011: September 29th 46/75 °F; Clear

Figure 2 shows the average hourly volume for the east and west sides of the bridge during the AM and PM period. In 2010, pedestrians and bicyclists together accounted for about 280 crossings per hour in both directions during peak hours.

A 2011 study of the Burke-Gilman trail on the University of Washington campus found that, on average for the length of the trail through the university, over 350 cyclists and almost 250 pedestrians use the trail at its peak hour (5:00 PM).[9] The counts on the Burke-Gilman trail are somewhat higher than those seen on the Montlake Bridge as it is a major circulation system for the university and surrounding neighborhoods.

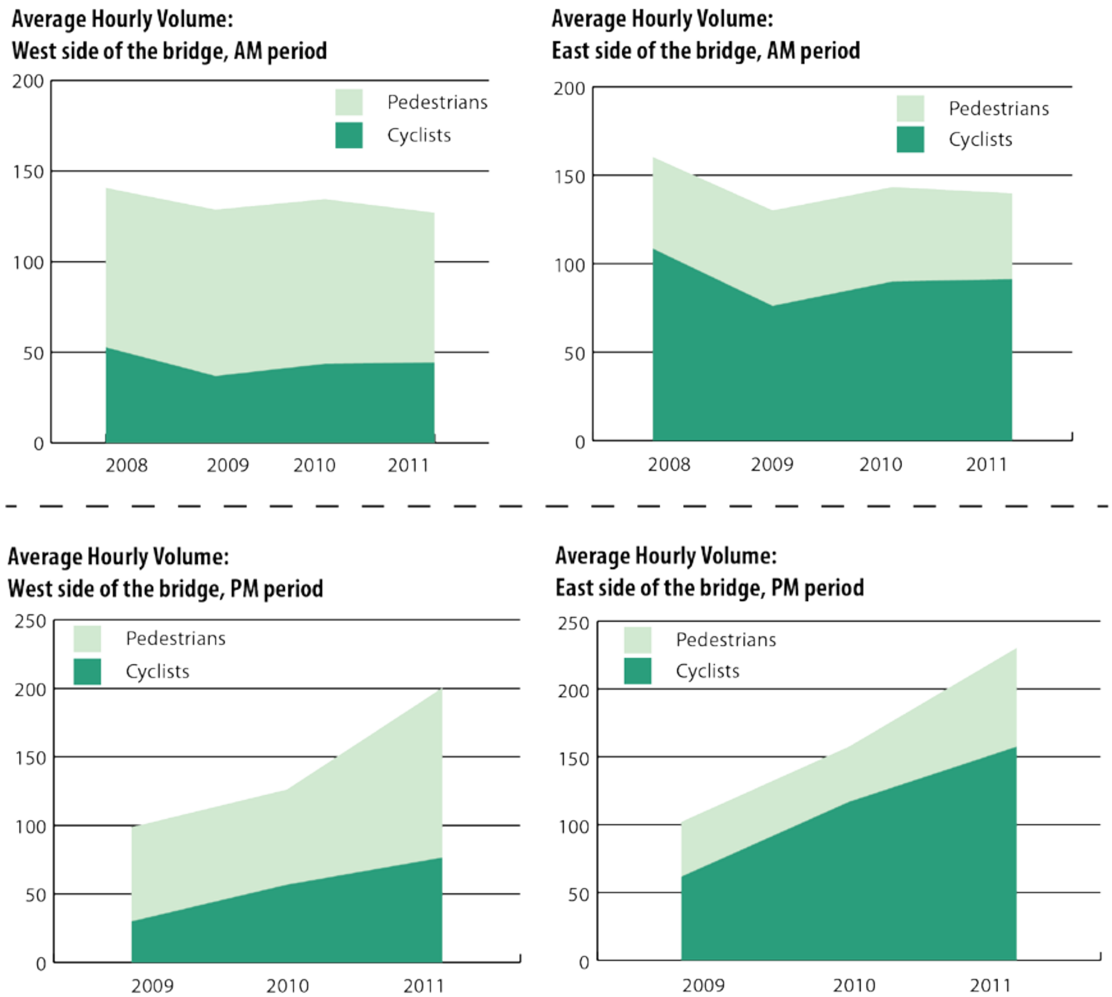
Importantly, the Burke-Gilman trail volumes and peaking characteristics lend further support to those observed on the Montlake Bridge. The 2011 pedestrian and bicycle counts on the Montlake Bridge recorded 234 bicyclists and 197 pedestrians in both directions during the peak hour. As can be seen in Figure 3-2, volumes of cyclists and pedestrians on the Montlake Bridge have continued to increase sharply in the PM period, and have remained relatively constant in the AM commute period. Bicycle and pedestrian volumes are explored further in the LOS Evaluation section of this report.

---

[8] Niemeier, Da. 1996. Longitudinal Analysis of Bicycle Count Variability: Results and Modeling Implications. *Journal of Transportation Engineering*. http://link.aip.org/link/?JTPEDI/122/200/1.

[9] SvR Design. *University of Washington Burke-Gilman Trail Corridor Study*. University of Washington. July, 2011

Figure 3-2: Average Hourly Volume, Bicyclists and Pedestrians on the Montlake Bridge (2008-2011)



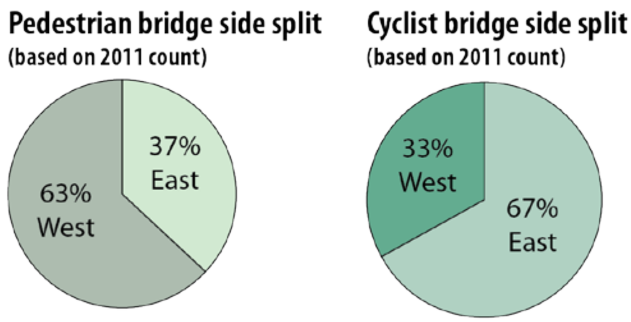

Data is based on the 2008, 2009, 2010 and 2011 WSDOT and SDOT bicycle and pedestrian counts.
Numbers show average hourly volume for both directions of travel.

## Bridge Side Split

In the most recent, 2011, counts on the bridge, not only was the direction of travel noted, north and south, but also which walkway, east or west, was used. The 2011 data shows that pedestrian and cyclists largely travel on opposite sidewalks. During this count, 63 percent of pedestrians used the west sidewalk, and 37 percent used the east sidewalk. Conversely, 67 percent of cyclists used the east sidewalk and 33 percent used the west sidewalk, as illustrated in Figure 3-3.

The cyclist split is likely because connecting between the Lake Washington Loop and the Burke Gilman trail requires fewer roadway crossings if the cyclist remains on the east side of the bridge, which is most proximate to the major Seattle bike boulevard/Montlake bypass route on 24th Avenue. For pedestrians, it is more difficult to predict the reasons for bridge side. A pedestrian survey would need to be conducted to understand this split more thoroughly. This bridge side split is likely to change when the Husky Stadium University-LINK station is opened in 2016, as it will become a new major pedestrian and bicycle generator in the area and attract people to the east side of Montlake Boulevard. This is discussed further in the Future Conditions section.

Figure 3-3: Bicycle and Pedestrian Current Bridge Side Travel




Source: WSDOT and Cascade Bicycle Club 2011 Bicycle and Pedestrian Counts

## Level of Service Evaluation

An objective of this white paper is to establish a relationship between the volumes of pedestrians and bicycles experienced on the Montlake Bridge and the level of quality of user experience implied in City of Seattle policy as earlier outlined. What makes an area a "walkable zone?" What conditions need to exist to "*Improve mobility and safe access for walking and bicycling, and create incentives to promote non-motorized travel to employment centers, commercial districts, transit stations, schools and major institutions, and recreational destinations?*"

Not surprisingly these same questions have arisen in other communities and ultimately caused the Federal Highway Administration (FHWA) to sponsor research, published in 2006, that would allow quantification of policy level statements like these based on the volume, mix of users (pedestrians and bicyclists), and pathway characteristics of shared use pathways.

The FHWA *Shared Use Path Level of Service Calculator – A Users Guide* establishes a method for determining the shared use path levels of service (SUPLOS) based on the quality of experience for shared use paths. The SUPLOS includes both bicyclist and pedestrian conditions, and is considered a shared level of service. The authors of the study used case studies to better understand shared use path traffic flow and surveyed trail users on level of comfort with passing conditions based on volume, mode types, and direction of traffic.[10] The SUPLOS was also used by the University of Washington to assess conditions and improvements on the Burke-Gilman Trail through the University campus.[11]

The Second Montlake Bridge workgroup used the method described by FHWA and data from the annual bicycle and pedestrian counts from 2008-2011 to determine the current SUPLOS of pedestrians and bicycles crossing the Montlake Bridge under existing conditions and to forecast for future conditions.

[10] R.S. Patten, R.J. Schneider, J.L. Toole, J.E. Hummer and N.M. Rouphail, North Carolina State University, July 2006

[11] University of Washington Burke-Gilman Trail Corridor Study, July 2011,

The University of Washington Study established that the lowest tolerable level of service should be LOS E (see accompanying sidebar for a description), but LOS C is preferable. A LOS F condition suggests action must be taken as the transportation function of the facility has been compromised to the point it has become a barrier and not an encouragement.

The work group reached a similar conclusion to the team that studied the Burke-Gilman Trail. Namely that LOS F for significant periods of the year during peak hours (see additional discussion below) is a condition that is incompatible with established city policy.

The volume of cyclists and pedestrians using the bridge on any given day is impacted by a number of factors. For example, one study found that bicycle volumes would decrease by 15–25% on rainy days.[12] The National Bicycle and Pedestrian Documentation Project studied the variation in bicycle volumes based on seasonal conditions. Figure 3-4 shows consistent seasonal variation in the volume of users on shared use paths around the country throughout a year. The data includes Vancouver, BC. In the "documentation project," bicycle volumes were found to be "average," or 8% of the annual total, in the month of October.

If October pedestrian and bicycle counts (which are commonly utilized by many Puget Sound area agencies, including WSDOT, SDOT, and PSRC) were at levels where the SUPLOS borders on, or exceeds LOS F, then in November, December, January, February, and March, the volume of cyclists are likely to be lower and the facility is likely to operate at a higher level of service.[13] However, the degree to which the volume is lower depends on weather and temperature. For the PM peak period, if the facility is at a failing level of service, SUPLOS F, it is likely that the Montlake Bridge sidewalks operate at a failing condition, or SUPLOS "F," for a majority of the year, April through October.

## Level of Service Grades

**A: Excellent.** Trail has optimum conditions for individual bicyclists and retains ample space to absorb more users of all modes, while providing a high-quality user experience. Some newly built trails will provide grade-A service until they have been discovered or until their ridership builds up to projected levels.

**B: Good.** Trail has good bicycling conditions, and retains significant room to absorb more users, while maintaining an ability to provide a high-quality user experience.

**C: Fair.** Trail has at least minimum width to meet current demand and to provide basic service to bicyclists. A modest level of additional capacity is available for bicyclists and skaters; however, more pedestrians, runners, or other slow-moving users will begin to diminish LOS for bicyclists.

**D: Poor.** Trail is nearing its functional capacity given its width, volume, and mode split. Peak period travel speeds are likely to be reduced by levels of crowding. The addition of more users of any mode will result in significant service degradation. Some bicyclists and skaters are likely to adjust their experience expectations or to avoid peak-period use.

**E: Very Poor.** Given trail width, volume, and user mix, the trail has reached its functional capacity. Peak-period travel speeds are likely to be reduced by levels of crowding. The trail may enjoy strong community support because of its high usage rate; however, many bicyclists and skaters are likely to adjust their experience expectations, or to avoid peak period use.

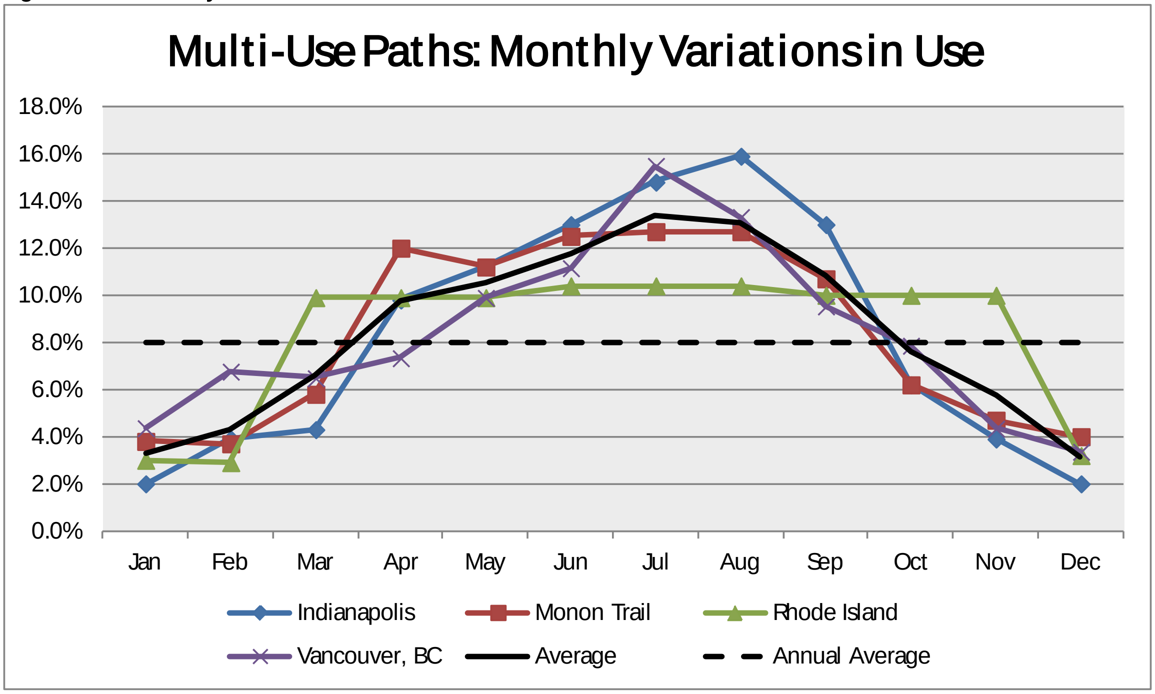
**F: Failing.** Trail significantly diminishes the experience for at least one, and most likely for all user groups. It does not effectively serve most bicyclists; significant user conflicts should be expected.

Source: Shared Use Path Level of Service Calculator – A Users Guide R.S. Patten, R.J. Schneider, J.L. Toole, J.E. Hummer and N.M. Rouphail, North Carolina State University, July 2006

[12] Niemeier, Da. 1996. Longitudinal Analysis of Bicycle Count Variability: Results and Modeling Implications. *Journal of Transportation Engineering*. http://link.aip.org/link/?JTPEDI/122/200/1.

[13] National Bicycle and Pedestrian Documentation Project. http://bikepeddocumentation.org/index.php/download_file/-/view/11.

Figure 3-4: Monthly Variation in Volume on Shared Use Paths around the US




Source: Michael Jones, Alta Planning and Design. National Bicycle and Pedestrian Documentation Project. Presentation to TRB. 2009 and data from the City of Vancouver (2011)

Table 3-1: Calculated LOS Scores and SUPLOS Grades

| Trail LOS Scale | |
|---|---|
| LOS Score | LOS Grade |
| X≥4.0 | A |
| 3.5≤X<4.0 | B |
| 3.0≤X<3.5 | C |
| 2.5≤X<3.0 | D |
| 2.0≤X<2.5 | E |
| X<2.0 | F |

Table3- 1 provides a reference that shows the numeric value derived from the SUPLOS calculator and relates that value to the letter grade. This is provided so that the reader gets some sense of whether a calculated SUPLOS grade is closer to the next higher or next lower grade or in the middle. The calculated values are provided in subsequent tables where the SUPLOS is calculated along with the letter grade scores.

Using the most recent bicycle and pedestrian count data taken on September 29, 2011, the existing SUPLOS for the Montlake Bridge are shown in Table 3-2 below. The average over the years of available data (4 years: 2008-2011 for bicycles, 3 years: 2009-2011 for pedestrians) is shown in Table 3-3. This 4year/3 year average is subsequently used to calculate future volume projections to help smooth out variations in the data. To illustrate the impact of variation, in the 2011 count data the west sidewalk in the PM peak experienced SUPLOS F. In this case the presence of heavy pedestrian flows accompanied by relatively low bicycle volumes calculate a negative impact on the SUPLOS, as pedestrians and bicyclists have very different movement patterns and travel at different speeds. This illustration is provided to demonstrate that bicycle and pedestrian volumes are variable, and that at times of year and times of day, the level of service could be considered "failing," while at other times, due to seasonal variation, conditions could be considered "poor," or "very poor." Should pedestrian and bicycle counts continue to rise, there would be an increasing percentage of days when operating conditions were tending toward "very poor" or "failing."

Table 3-2: 2011 Existing Level of Service – 2011 Count

| Side of Bridge | Width | Time Period | Average Hourly Volume (bicyclists/ pedestrians) | Overall LOS Score | Overall LOS Grade |
|---|---|---|---|---|---|
| East | 8.0ft | AM | 140 (91/49) | 2.95 | D |
| East | 8.0ft | PM | 231 (158/73) | 2.54 | D |
| West | 8.0ft | AM | 127 (44/83) | 2.57 | D |
| West | 8.0ft | PM | 201 (77/124) | 1.91 | F |

Source: 2011 WSDOT and Cascade Bicycle Club Annual Bicycle and Pedestrian Counts, City of Seattle

Table 3-3: Existing Level of Service -- Four Year Average (2008-2011)

| Side of Bridge | Width | Time Period | Average Hourly One-way Volume (bicyclists/ pedestrians) | Overall LOS Score | Overall LOS Grade |
|---|---|---|---|---|---|
| East | 8.0ft | AM | 143 (91/52) | 2.92 | D |
| East | 8.0ft | PM | 164 (112/52) | 2.88 | D |
| West | 8.0ft | AM | 132 (44/88) | 2.49 | E |
| West | 8.0ft | PM | 141 (54/87) | 2.44 | E |

Note: Pedestrians were not counted in 2008, and pedestrian levels are an average of three year counts (2009-2011). PM peak are three years 2009 to 2011 as PM peak period counts did not occur in 2008.
Source: WSDOT and Cascade Bicycle Club Annual Bicycle and Pedestrian Counts, City of Seattle.

As can be seen, in Table 3-3, the east side of the bridge, which experiences the majority of cyclist traffic, maintains an LOS that is acceptable in the both AM and PM peak periods over the four year average. On the west side of the bridge, which is mainly used by pedestrians, AM and PM peak conditions are poor and showing signs, based on the 2011 count data, that the bridge is reaching maximum capability to accommodate pedestrian and bicycle traffic in that time period and under those flow conditions.

## A Pedestrian-Bicycle Trigger

The existing Montlake Bridge for pedestrians and bicycles is operating at a level of service in peak hours that is between "poor" and "very poor," on average, for a majority of the year, April through October. This statement assumes that non-motorized traffic on the Montlake Bridge follows the pattern of non-motorized traffic seasonality demonstrated in North America. The facility occasionally drops to "failing" during peak times. These conditions marginally meet, and occasionally fail to meet, the policy standards set by the Seattle Comprehensive Plan or as delineated in the Seattle Bicycle Master Plan and the Pedestrian Master Plan. Further growth in pedestrian and bicycle traffic on the Montlake Bridge will result in "very poor" or "failed," barrier producing conditions for pedestrian and bicycle travel for significant periods of the year during peak hours based on expected seasonal trends.

**Trigger Definition:** If the calculated level of service, or SUPLOS, reaches level of service "F," or failed conditions, consistently during at least onepeak period, for more than three months of a single year, the trigger is met. While any "failed" SUPLOS condition is incompatible with established City of Seattle policy, the condition must exist to the degree that addressing the condition provides significant benefits.

# Future Conditions

In the Montlake Bridge corridor there are three future events which are projected to affect the future number of pedestrians and bicyclists crossing the Montlake Bridge.

## Growth in Pedestrian and Bicycle Travel

The *Burke-Gilman Trail Corridor Study* (July 2011) made a careful evaluation of the growth in bicycle and pedestrian volumes in the vicinity of the University of Washington based on a number of factors related to changes in land use, density, and the movement toward non-motorized transportation.[14] The study concluded that a range of 4.5 to 6 percent annual growth rate in peak hour bicycle volume is a reasonable expectation given the levels of activity in the immediate area. Given the proximity of the Burke-Gilman trail to the Montlake study area, it is reasonable to assume a similar rate of background growth will occur over the Montlake Bridge. For purposes of reaching a conservative evaluation of future conditions, the lower rate of 4.5 percent is evaluated for the impact of such an increase in volume on the Montlake Bridge.

In the Burke-Gilman Trail study the background level of pedestrian growth was estimated to be substantially lower due to the lesser proximity of closely spaced major generators and activity centers reachable within reasonable walking distances. Consistent with the Burke-Gilman Study and the Environmental Analysis for U-Link, a background growth rate of 1 percent per year is assumed for pedestrian growth

These background growth rates in bicycle and pedestrian activity were applied to the 2008 to 2011 bicycle/pedestrian counts to project a 5 year planning horizon to be in the same time horizon with the start-up of U-Link and the SR 520 Cross-lake Regional Trail discussed earlier.

## SR 520 Regional Shared Use Path

As part of the SR 520 Bridge Replacement project now under construction and scheduled to open within the next 4 years, a new cross-lake shared use path will be provided. Completion of the SR 520 shared use path will tie together the Burke-Gilman and the Lake Washington Trails while also connecting dense employment and residential areas on the either side of the lake. To illustrate, locations on the Burke Gilman Trail and the Sammamish River Trail in Redmond are among the top ten bicycle count locations in the Puget Sound region.

### Facility Design

The shared use path construction as currently envisioned could include improvements to connections between the Lake Washington Loop and the 24th Avenue Bicycle Boulevard across the Montlake Bridge to Husky Stadium and the Burke Gilman Trail. The improvements are

[14] University of Washington Burke-Gilman Trail Corridor Study, July 2011, Pages 25 -27.

several coordinated projects and may not all be part of the SR 520 project. The connections through the Montlake neighborhood, for example, could be a City of Seattle project. The Design Refinements and Transit Connections Workgroup (ESSB 6392) considered improvements for Montlake Boulevard and the route to connect to 24th Avenue and the SR 520 Regional Path. The route utilizes E Shelby Street to connect to Montlake Boulevard just south of the bridge and the new trail on the new lid crossing SR520. Figures 3-5,3- 6, and 3-7 show the designs and cross sections for the Montlake Bridge, Montlake Boulevard, and Shelby/Hamlin considered by the workgroup.

The ESSB 6392 workgroup recommended a 14 foot wide path between the Burke Gilman Trail and the new SR 520 Shared Use Path. This includes the 18 foot path over a second Montlake Bridge. Preliminary concept designs were included in that workgroup's report to the legislature.

Figure 3-5: 6392 Workgroup Route Recommendations

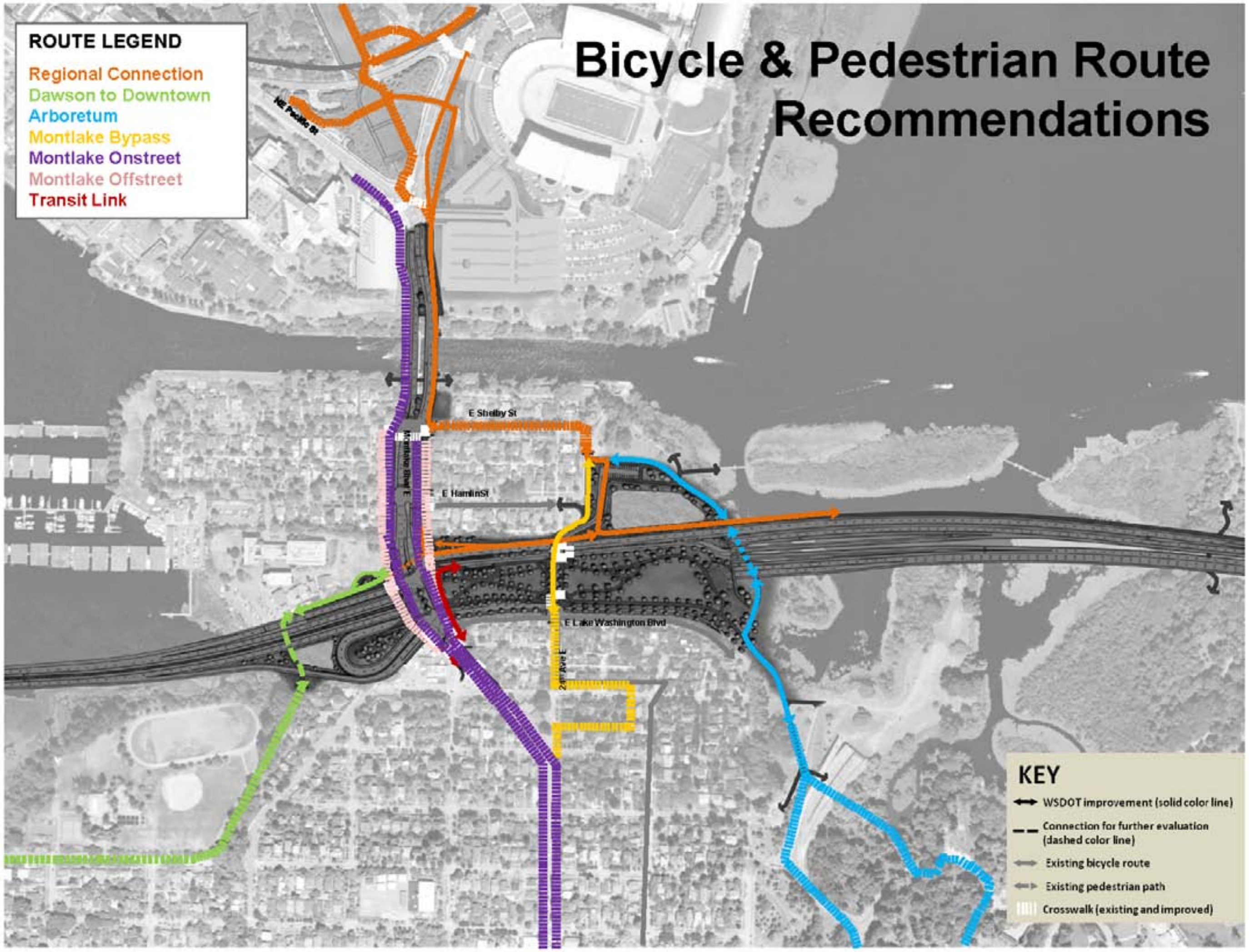


Figure 3-6: Montlake Bridge Proposed Cross-section

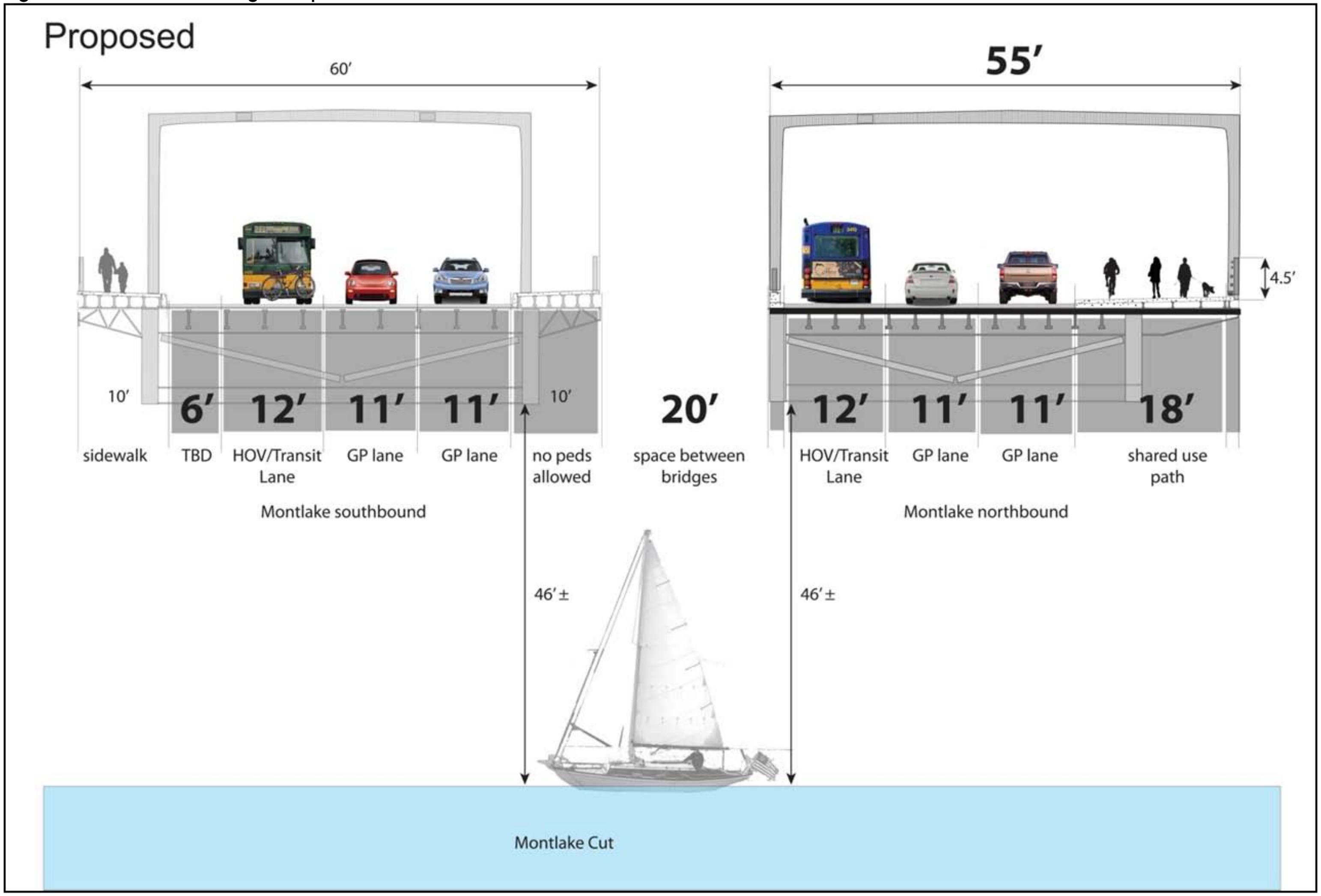
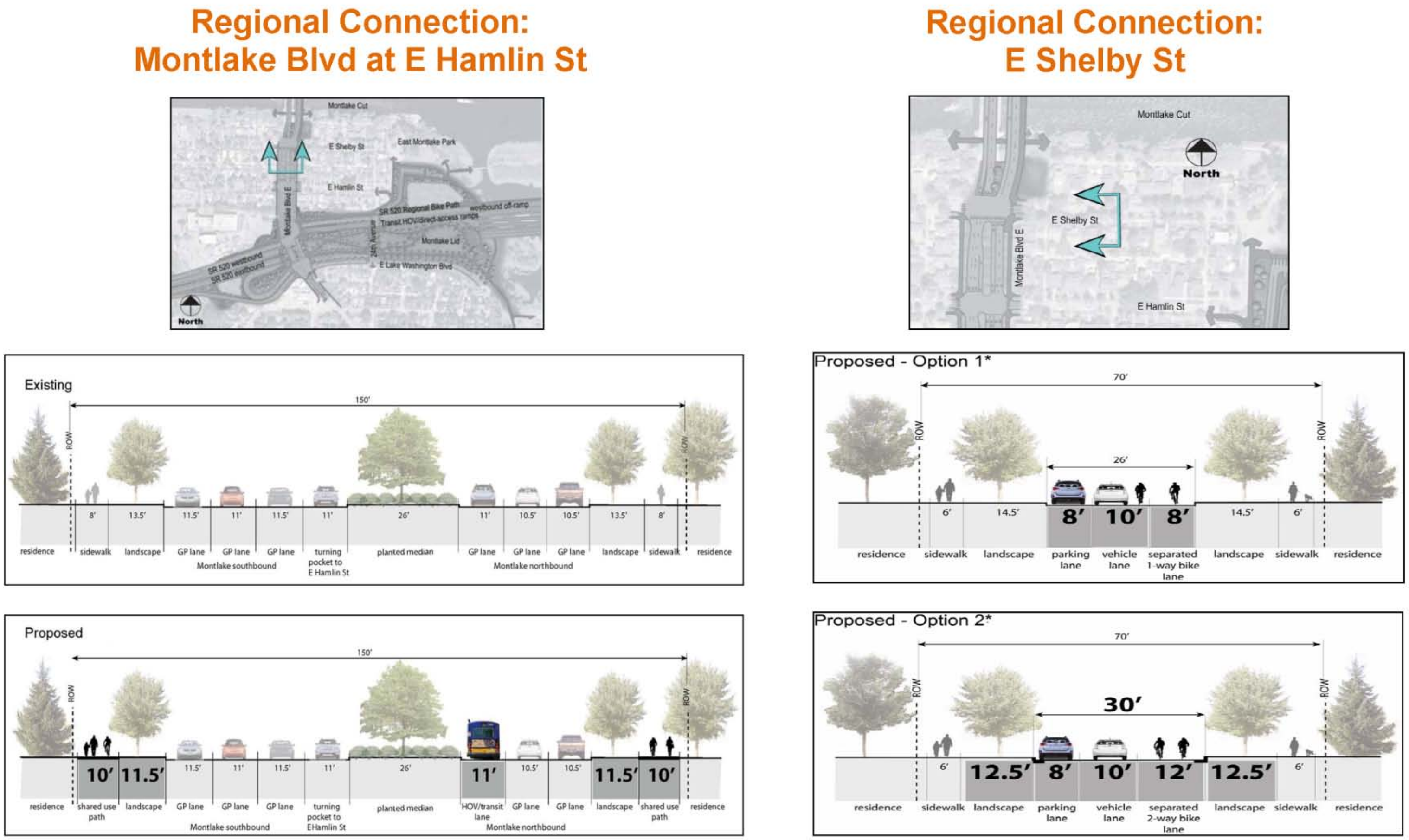


Figure 3-7: ESSB 6392 Workgroup Route Recommendations, Sections at Hamlin and Shelby streets



### Effect on Volume

It is likely that the presence of a new SR 520 cross-lake path will increase pedestrian and bicycle demand for the route. An indicator might be the current peak hour bicycle and pedestrian volume on the I-90 floating bridge shared use path. The bicycle volume is about 80 bicycles per hour in the AM peak hour and 104 in the PM peak hour.[15] This would be a reasonable number of bicycle users to expect on the new SR 520 shared use path, with some number of cyclists heading north onto the Montlake Corridor. This likely presents a conservative picture given that the SR 520 corridor has a much higher incidence of adjacent activity centers on both sides of Lake Washington and better connectivity to a continuous regional pathway system. Given the attractiveness of the University of Washington and Burke-Gilman Trail as regional trip generators, it is assumed that 50 percent of cross-lake traffic on SR 520 would use the Montlake Bridge. The remainder of cyclists using SR 520 are assumed to be destined for locations that would not include a crossing of the Montlake Bridge.

The volume of pedestrians that might be attracted by the new linkage is difficult to estimate. The likelihood of significant pedestrian volumes crossing the 1.5 mile SR 520 Bridge over Lake Washington is fairly low. Again, using I-90 as an indicator, peak hourly pedestrian volumes on the I-90 trail are 3 and 10 pedestrians per hour, respectively, in the AM and PM peak.[16]

## University Link and Husky Stadium Station

In 2016, Sound Transit will begin operating University Link service to the Husky Stadium station. The area will become a major regional transportation hub. Based on research performed for the U-Link EIS, it is projected to attract 13,000 boardings on day of opening and 21,500 boardings per day by 2030. Given the attractiveness of the service (six minute travel time to downtown Seattle every seven minutes), this will become a major attraction for the residential population south of the Montlake Bridge, as well as the entire NE Seattle and University of Washington communities.

### Station Design Features

The Montlake Triangle Plan will implement a grade-separated crossing of Montlake Boulevard that will connect the University of Washington Campus, the Burke-Gilman Trail, and the Husky Stadium Link Station on the east side of Montlake Blvd. The volumes of pedestrians and cyclists intersecting at the Burke-Gilman Trail and the Rainier Vista "Land Bridge" are projected to be high enough to require a grade-separated crossing to avoid conflicts between user groups. Given that this new crossing will emphasize the east side of Montlake Boulevard, it is quite possible that the east sidewalk of the Montlake Bridge will experience increased pedestrian and bicycle traffic, as it will be a faster connection with fewer high volume, that is intersecting vehicle volume, at-grade intersections.

### Effect on Volume

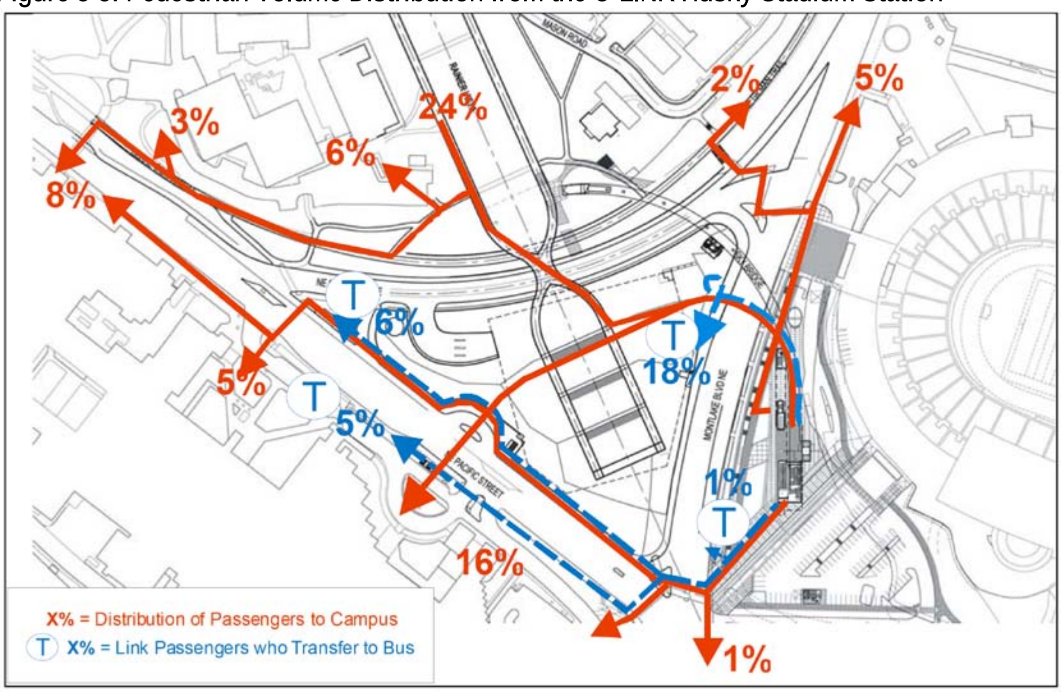
The EIS Addendum for the Montlake Triangle/Husky Stadium Station projects an additional 60 bicycles and pedestrians per hour at average daily weekday peak hour conditions (1% of 5950 peak hour boardings and alightings) will be accessing the approaches to the Montlake Bridge in

[15] http://psrc.org/data/transportation/bicycle-counts -- 2 Hour Counts (Coordinated): 2-Hour_2010.xlsx
[16] http://psrc.org/data/transportation/bicycle-counts -- 2 Hour Counts (Coordinated): 2-Hour_2010.xlsx

both directions.[17] Given that there are few other destinations for these pedestrians, it is safe to assume these will be additive to the observed average volumes. The EIS addendum estimates that twenty percent of travelers will be cyclists with the remainder as pedestrians. Figure 3-8 provides an overview of the pedestrian distribution patterns from the Husky Stadium Link Station in the Montlake Triangle area.

With respect to pedestrian volumes, in particular, the affect of changing the operation of the Montlake Freeway Flyer stop could also change the number of pedestrians crossing the Montlake Bridge, particularly at peak times. Currently, passengers on any bus crossing SR 520 can exit at the Montlake Freeway Flyer stop and walk to the University area. In the future, transfers between buses will occur on the east side of the lake and buses will carry riders directly to or from the Montlake triangle and the Link station. In the SR 520 I-5 to Medina FEIS Transportation Discipline report, it is reported that there were about 120 passengers who exit buses at the Montlake freeway transit station during the average morning peak period in 2010. That number increases to over 150 in the evening peak period. These passengers distribute into the neighborhood with some getting on local buses, some going south, and some going north. A change in transit access patterns could, therefore, also change pedestrian volumes on the Montlake Bridge in like amounts.

Figure 3-8: Pedestrian Volume Distribution from the U-LINK Husky Stadium Station




*Source: Sound Transit Link Ridership Forecast and Distribution, January 2009. Reassigned to routes by Heffron Transportation.*

Each of the three future conditions described above in the section on future conditions was modeled independently through the SUPLOS calculator to assess the impact of that particular event on the quality and usability of the bridge sidewalks. Then all three conditions are combined to assess conditions when all three circumstances occur. The combined effect is displayed in Table 3-4 below.

[17] University of Washington to Sound Transit U-Link Pedestrian Connection Project EIS Addendum, Appendix C Transportation Technical Memorandum

Table 3-4: 2017 LOS Combined Forecasts

| Side of Bridge | Time Period | 4/3 Year Avg Base Line | + Five Years Background Growth (Bike/Ped) | + U Link Opening (Bike/Ped) | + 520 Shared Use Path (Bikes/Ped) | Combined Forecast (Bike/Ped) | Overall LOS Score (Bike/ Ped) | Overall LOS Grade (Bikes/ Peds) |
|---|---|---|---|---|---|---|---|---|
| East | AM | 143 (91/52) | 23(20/3) | 60(12/48) | 28(27/1) | 253 (150/103) | 2.12 | E |
| East | PM | 164 (112/52) | 28(25/3) | 60(12/48) | 37(35/2) | 288 (184/104) | 2.07 | E |
| West | AM | 132 (44/88) | 14(10/4) | 0(0/0) | 14(13/1) | 160 (67/93) | 2.38 | E |
| West | PM | 141 (54/87) | 16(12/4) | 0(0/0) | 20(17/3) | 177 (83/94) | 2.36 | E |

Basis of Forecast: WSDOT and Cascade Bicycle Club Annual Bicycle and Pedestrian Counts as recorded by PSRC for I-90, University of Washington to Sound Transit U-Link Pedestrian Connection Project EIS Addendum, Appendix C, and University of Washington Burke-Gilman Trail Corridor Study

Table 3-4 represents a likely near term condition for the Montlake Bridge, as Sound Transit's U-Link Station is funded, under construction, and currently on schedule. WSDOT has secured funding for the first stage and has begun construction of the SR 520 project with a bicycle/pedestrian shared use path crossing Lake Washington. The background growth in pedestrian and bicycle use will likely continue as forecast in the Burke-Gilman Trail study. These near-term conditions can be expected to cause the east side of the bridge to reach a very poor, SUPLOS E, to nearly failed level of service in the afternoon peak hours.

To provide perspective on the potential benefits of the second bascule bridge for pedestrians and bicyclists as described in the SR 520 I-5 to Medina EIS Preferred Alternative, the SUPLOS that would be derived at the same volumes but with the presence of an 18 foot wide pedestrian and bicycle path on the east side of a new bridge is displayed in the Table 3-5 below. The table displays the LOS of an 18 foot wide path with the projected volumes expected to occur within five years. The SUPLOS has only been calculated for the east side of the bridge, which represents a new walkway. It is assumed the west sidewalk of the current Montlake Bridge will be used predominantly by pedestrians once a new 18-foot path is constructed. Note that under the Preferred Alternative conceptual design, the current east walkway on the historic Montlake Bridge would no longer be accessible to pedestrians and bicycles.

Table 3-5: Combined 2017 Forecast with 18-foot Path on East Side

| Side of Bridge | Width | Time Period | Average Hourly Volume (bicyclists/ pedestrians) | Overall LOS Score | Overall LOS Grade |
|---|---|---|---|---|---|
| East | 18.0ft | AM | 314 (211/103) | 3.84 | B |
| East | 18.0ft | PM | 363 (259/104) | 3.80 | B |
| West | 8.0ft | AM | 100 (7/93) | - | - |
| West | 8.0ft | PM | 103 (8/95) | - | - |

Basis of Forecast: WSDOT and Cascade Bicycle Club Annual Bicycle and Pedestrian Counts as recorded by PSRC for I-90, University of Washington to Sound Transit U-Link Pedestrian Connection Project EIS Addendum, Appendix C, and University of Washington Burke-Gilman Trail Corridor Study

## Conclusions

1. **Trigger Definition:** If the calculated level of service, or SUPLOS, reaches level of service "F," or failed conditions, consistently during at least one peak period, for more than three months of a single year, the trigger is met. While any "failed" SUPLOS condition is incompatible with established City of Seattle policy, the condition must exist to the degree that addressing the condition provides significant benefits.
2. The future events of U-Link and the SR 520 regional shared use path indicate that bicycle and pedestrian traffic on the Montlake Bridge are very likely to increase. The precise amount of increase is predicted, but unknown. Given the current marginal performance of the Montlake Bridge in terms of pedestrian and bicycle level of service, increases could drive the level of service to a point it is incompatible with established City policy. There are many assumptions made about the daily and seasonal variation in pedestrian and bicycle traffic on the Montlake Bridge, yet little is actually known other than four annual one day counts each conducted in early fall. The annual monitoring program appears insufficient to determine on-going non-motorized level of service conditions on the bridge. A quarterly Montlake Bridge pedestrian and bicycle volume monitoring program should be developed and results should be reported annually to ascertain the current level of service being provided on the bridge. However, it must be recognized that the resources to conduct such a monitoring and reporting effort have not been identified.

# 4 ASSESSMENT OF A TRANSIT TRIGGER

## Background

This white paper seeks to define a "trigger" point at which the transit travel conditions on Montlake Boulevard reach a level that warrant consideration of transit enhancements that could include a second bascule bridge. Consideration has been given to existing policies established in the City of Seattle Comprehensive Plan, City of Seattle Transit Master Plan, and the King County Metro Transit Strategic Plan for Public Transportation, 2011-2021. Through an extensive coordination effort between WSDOT, Seattle, and King County Metro, the following criteria were considered and a recommendation has been developed .

## Policy Guidance

Policy that relates to the operation and expected quality of local and regional transit service is relevant to the discussion of the existing and future conditions for transit that crosses the Montlake Bridge. The following planning documents pertain directly to this issue:

- Seattle Comprehensive Plan (2004)
- Seattle Transit Master Plan (2012)
- King County Metro Strategic Plan for Public Transportation (2011)

### Seattle Comprehensive Plan

The Seattle Comprehensive Plan was fully adopted in 2004, and will next be updated in 2014, although plan amendments may occur annually. The plan is the guiding document for growth and development in the city. The transportation element of the plan, Section C, Increasing Transportation Choices, addresses the goals of the city to promote transit, bicycling, and walking for transportation. Section C-1 Increasing Transportation Choices: Making Transit a Real Choice states the following policies relevant to this the effort to establish a "trigger."

> *T20 - Work with transit providers to provide transit service that is fast, frequent, and reliable between urban centers and urban villages and that is accessible to most of the city's residences and businesses. Pursue strategies that make transit safe, secure,* comfortable, and affordable.[18]

### Seattle Transit Master Plan

The current Seattle Transit Master Plan, adopted in 2012 identifies a vision for transit in Seattle that is development of a Complete Transit Network. The plan defines that network as a system that has five essential elements:

- ***Put the Passenger First***

[18] Seattle Comprehensive Plan, 2005.

- ***Make Transit a Convenient Choice for Travel***
- ***Use Transit to Build Healthy Communities***
- ***Improve Transit Service and Quality Through Partnerships***
- ***Reduce Environmental Impacts of Personal Mobility***

This vision illustrates Seattle's desire to ensure transit is an effective and desirable mode of transportation. For purposes of this paper particularly the strategies designed to support the second element illustrate Seattle's willingness to make the necessary infrastructure improvements throughout the city to ensure transit is a convenient and effective mode of travel.

- ***Make Transit a Convenient Choice for Travel***
  - *Provide mobility to a wide range of destinations*
  - *Facilitate fast and reliable operations*
  - *Increase ridership by integrating other modes and making access safe and easy*
  - *Invest in infrastructure where it can attract the most users*

Within the policy framework of the transit master plan, the Rainier Valley to U-District via Rainier Avenue and 23rd Avenue corridor is identified as a "priority bus corridor." The policy establishes the benefits of reliable service in priority bus corridors:

*Priority bus corridors are the cornerstone of Seattle's transit system. Investing in speed and reliability improvements and dramatically improved passenger amenities and facilities in these corridors yields not only direct benefits for passengers and transit operators, but complements HCT[19] investments. Benefits include:*

***Travel time savings for riders:*** *Implementing corridor improvements that mitigate the impact of congestion on buses and make them more reliable leads to transit that is more competitive with the automobile and provides a heightened passenger experience on- and off- vehicle.*

***Reduce impacts of delay on transit operating and capital costs:*** *Travel time savings can improve transit's bottom line if the time savings avoid the need to add runs and purchase additional vehicles to keep up with delay caused by increased traffic congestion.*

***Improved access to local and regional HCT:*** *The bus network facilitates access to high capacity service in Seattle and connections to regional destinations. Bus corridor improvements are also investments in future potential HCT corridors.*

The Transit Master plan enumerates specific and generic transit priority treatments for each priority bus corridor. The Rainier Valley to U-District corridor is identified as "Corridor 5" in the TMP and is specifically named in Strategy PBC 4 (PBC= priority bus corridor):

*Target Corridor 5, Corridor 7, and Center City Priority Corridors as high priority corridors for development.*[20]

[19] HCT= High capacity transit

[20] City of Seattle Transit Master Plan, 2012

In addition the TMP establishes performance standards for transit routes that connect the City's Urban Villages. The local routes serving the Rainier Valley to U-District corridor all meet the criteria of connecting Urban Villages. The performance standard requires that travel time between urban villages not degrade over time and that the routes serving the corridors meet Metro's adopted standards of performance for reliability.

## Metro Strategic Plan for Public Transportation (2011-2021) and Service Guidelines

King County Metro's recently adopted strategic plan (2011) establishes goals, objectives, strategies and performance measures. King County Metro Service Guidelines, also adopted in 2011, provide guidance to the design and management of the transit system. These documents are particularly of value in establishing the state of transit quality in the Montlake corridor.

One goal established in the Strategic Plan is Service Excellence:

> ***Goal 5: Establish a culture of customer service and deliver services that are responsive to community needs.***
>
> *Metro seeks to provide reliable, safe and convenient transportation services that are valued by customers and responsive to the needs of people, businesses and communities.*
>
> ***Strategy 5.1.3: Improve transit speed and reliability***
>
> *Transit speed and reliability is an important aspect of customer satisfaction. Metro regularly monitors its on-time performance and strives to achieve its performance guidelines. To help improve transit speed and reliability, Metro is committed to managing transit pathways. Its speed-and-reliability program places high priority in corridors with high ridership and bus volumes, such as Metro's six RapidRide corridors, and on corridors impacted by major construction projects such as replacement of the Alaskan Way Viaduct and the SR-520 Bridge. A range of speed and reliability improvements including traffic signal coordination, transit signal priority, bus lanes, queue bypass, safety improvements and stop consolidation can be implemented in a corridor or spot basis. Metro works independently and in coordination with local jurisdictions to make improvements that enhance the speed and reliability of bus service, help maintain even intervals between buses and reduce overcrowding and delays.*[21]

### Metro Service Guidelines

These guidelines were adopted simultaneously with the strategic plan and establish performance measures in several areas including productivity, passenger loads, and schedule reliability.

> *Metro measures schedule reliability to identify routes that are candidates for remedial action due to poor service quality.*

[21] King County Metro Strategic Plan for Public Transportation (2011-2021) Adopted July 2011) , page 27 and 28

*Schedule adherence is measured for all Metro services. Service should adhere to published schedules, within reasonable variance based on time of day and travel conditions. When measuring schedule adherence, Metro focuses on routes that are regularly running late. On-time is defined as a departure that is five minutes late or better at a scheduled time point.*

| ***Time period*** | ***Lateness threshold*** *(Excludes early trips)* |
|---|---|
| *Weekday average* | *> 20%* |
| *Weekday PM peak average* | *> 35%* |
| *Weekend average* | *> 20%* |

*Investment can include route design, schedule, or traffic operations improvements. Routes that operate with a headway less frequent than every 10-minutes that do not meet performance thresholds will be prioritized for schedule adjustment or investment. Routes that operate with a headway of every 10-minutes or more frequent that do not meet performance thresholds will be prioritized for traffic operations (speed and reliability) investments. It may not be possible to improve through-routed routes that do not meet performance thresholds because of the high cost and complication of separating routes.*

*Other considerations: External factors affecting reliability*[sic][22]

## Existing Conditions

This section examines existing conditions during the time prior to the implementation of the SR 520 toll. As outlined in the 2012 Seattle Transit Master Plan, the Montlake Bridge is an important linkage in the local and regional transit network. King County Metro operates 10 routes across the Montlake Bridge with seven routes coming from SR 520 and three operating locally through the Montlake corridor. There are over 600 transit trips with nearly 11,000 transit passengers that cross the Montlake Bridge daily. Of these 600 daily transit trips 55% of those trips make local connections between the University District and the Rainer Valley, First Hill, Central Seattle, and Capitol Hill. The slight minority of trips make regional connections between the University District and Eastside locations, such as Bellevue and Redmond. This means that transit moves about 15% of all person trips that cross the bridge in motorized vehicles in just over 1% of all of those motor vehicles.

According to King County Metro the current transit operating conditions in the Montlake corridor are among the least reliable within the City of Seattle. King County Metro has identified historical scheduling issues for the corridor's two heaviest local routes, 43 and 48. They have attributed those difficulties to variability in traffic congestion along the Montlake corridor. Transit data provided illustrated that in Spring 2011, during the p.m. peak, 23% of trips on the Route 43 and

[22] King County Metro Strategic Plan (adopted July 2011), Service Guidelines, page SG-10

29% of trips on the Route 48 were late. Late is defined as a departure that is five or more minutes later than a scheduled departure at time points. This data illustrates that the on-time performance of the two local routes serving the Montlake corridor were regularly late prior to implementation of tolls on SR 520 tolls. Additional information provided by King County Metro regarding Routes 43 and 48 includes the following:

- Route 48 is a high ridership route and ranks in the top 25% of routes serving the Seattle core in terms of riders per platform hour, a measure of transit effectiveness. The high ridership on this route means transit delays affect a lot of riders, ultimately contributing to passenger delay. Passenger delay for routes 43 and 48, combined, is in the range of 11,000 to 25,000 person hours per year.
- Route 48 currently fails to meet the established performance thresholds for weekday average and weekend (Saturday) on-time performance with buses arriving late 21% and 28% of the time, respectively. As noted above, Route 48 is also close to failing to meet the performance threshold for PM peak on-time performance, 29% late performance with a threshold of 35% late. Per Metro Service Guidelines, these conditions demonstrate the need for investing resources to improve the on-time performance for Route 48.
- Route 43 is also late 21% of the time on Saturdays, which fails to meet the established performance threshold for weekend on time performance of 20% late.
- Data show that travel times in the corridor which includes the Montlake Bridge, vary widely by time of day, but the specific causes of that time/speed variation are not well understood.

Table 4-1 shows travel time and speed conditions in the corridor for each portion of weekday operation.

Table 4-2 shows passenger delay which is defined as the time difference between "normal" operating speeds and peak operating speeds multiplied by the number of passengers on board the vehicle and the number of trips. The larger the difference in speed between "normal" conditions and peak conditions, the more delay that accrues to passengers. If the difference in speed remains constant and the number of passengers increases, an increase in passenger delay would also be indicated.

Table 4-1: Average Travel Time and Speed for Montlake Corridor

| **Spring 2011 Baseline Transit Travel Time and Transit Speed** | | | | |
|---|---|---|---|---|
| **Peak One-Hour Time Period** | **Direction** | **Average Travel Time (min)[a]** | **Standard Deviation Travel Time (min)** | **Average Speed (mph)** |
| AM | Northbound | **10.8** | 1.4 | **14** |
| | Southbound | **11.1** | 1.8 | **13** |
| Midday | Northbound | **10.2** | 1.8 | **15** |
| | Southbound | **10.5** | 1.4 | **14** |
| PM | Northbound | **12.6** | 3.6 | **12** |
| | Southbound | **12.9** | 1.5 | **11** |

Table 4-2: Passenger Delay in Montlake Corridor

| **Spring 2011 Passenger Delay** | | | | | | |
|---|---|---|---|---|---|---|
| **Peak One-Hour Time Period** | **Direction** | **Average Travel Time (min)** | **Delay Per Trip (min)[b]** | **Average Passenger Load Per Peak Hour Trip** | **# Trips Per Peak Hour** | **Annual Person Delay (in annual person-hours)** |
| AM | Northbound | 10.8 | 0.9 to 2.8 | 42 | 10 | **1,607 to 4,998** |
| | Southbound | 11.1 | 1.2 to 3.1 | 28 | 10 | **1,428 to 3,689** |
| Midday | Northbound | 10.2 | 0.3 to 2.2 | 32 | 9 | **367 to 2,693** |
| | Southbound | 10.5 | 0.6 to 2.5 | 37 | 8 | **755 to 3,145** |
| PM | Northbound | 12.6 | 2.7 to 4.6 | 20 | 12 | **2,754 to 4,692** |
| | Southbound | 12.9 | 3 to 4.9 | 27 | 11 | **3,787 to 6,185** |

a- Travel time segments between bus stops at 15th Av NE & NE Pacific St and 23rd Av E & E Thomas or E John St, about 2.5 miles.
b- Delay per trip based on Spring 2011 automated passenger count data for non-peak period transit travel times ranging from 8.0 to 9.9 minutes.

## A Transit "Trigger"

The City of Seattle and King County Metro have made it clear through their policies that improvements in transit travel time and reliability in the Montlake Boulevard corridor are important. Given the dynamic nature of pre-toll and post-toll traffic in the corridor, as mentioned in the Existing Conditions section, 2011 pre-toll performance data was selected as a baseline for comparison of transit travel time, speed, and passenger delay. Lateness thresholds, identified in the King County service guidelines, were exceeded by Routes 43 and 48 for weekends and weekday average in Spring 2011. During the PM peak time period these routes appear to be close to the thresholds that require further action to ensure on-time performance and customer satisfaction. The three performance measures presented in the Existing Conditions section were collected through King County Metro on-board systems and can be readily available for future analysis and monitoring.

A correlation between adopted transit performance standards and measures, current transit performance, and the traffic conditions directly related to the Montlake drawbridge could not be specifically established. However, because King County Metro schedule reliability thresholds have been reached or exceeded in some areas and time periods, the Second Montlake Bridge workgroup developed a transit trigger that provided for future flexibility. This trigger requires continued monitoring of the corridor and consideration of transit improvements that are consistent with adopted policies and plans.

Two factors were identified that could contribute to a transit "trigger" that would indicate a need to improve transit operating conditions in the entire corridor and that could include construction of a second Montlake bridge. These factors are:

- Transit travel time and speed
- Passenger delay

The Second Montlake Bridge workgroup established that it is clear from a policy perspective that improving the conditions and not experiencing additional degradation for transit speed and reliability and passenger delay are consistent with the policy directions of the City of Seattle and King County Metro.

**Trigger Definition:**

**Step 1 --** If future conditions degrade beyond 2011 baseline conditions by any measure, speed or passenger delay, and for any time period, AM peak, midday, PM peak, a process to identify transit operating enhancements is triggered. The amount of change beyond 2011 baseline conditions will determine the level of transit enhancements indicated for the corridor. Metro, City of Seattle, and WSDOT will work to identify potential projects to bring transit travel times and passenger delay back to 2011 levels, or better.

**Step 2 --** If transit enhancement measures employed in **Step 1** are exhausted and are not able to improve transit operations to 2011 conditions based on a minimum of six months measurement following implementation of all transit enhancements, the trigger would then be met to consider the potential benefits to transit of constructing a second Montlake bridge. It is anticipated that additional analysis will be required if the second step trigger is met to determine the benefit to transit of a second bridge so that there is assurance that construction of a second bridge will actually resolve the speed and delay issues experienced by transit and improve conditions to the 2011 baseline, or better.

The travel time, travel speed, and passenger delay values located in Tables 4-1 and 4-2, in bold face type, constitute the 2011 baseline values for each of the listed time periods and form the basis of comparison referred to in the trigger definition. The data to quantify these three performance measures is collected through the King County Metro on-board systems and can be summarized, as needed, for continued monitoring. However, the resources necessary to analyze the data and produce a report summarizing the results of the analysis have not been identified.

## Future Conditions

Future conditions in the Montlake Corridor with respect to transit speed and total passenger delay will depend on several factors including but not limited to the following:

1. Traffic volume
2. Light rail implementation
3. Draw bridge opening frequency
4. Changes in transit ridership

5. Levels of boarding and alighting at transit stops
6. Traffic signal operations
7. Transit priority improvements

The Puget Sound Regional Council's (PSRC) land use estimates showed that population in the three county area will increase by over 1 million people and jobs will increase by over 640,000 by 2030. These changes in population and economic activity will almost certainly result in modifications to travel patterns and behaviors. These factors when combined with Sound Transit's U-Link Husky Stadium Station opening, progress on East Link, and North Corridor Link projects are likely to further affect travel patterns. PSRC has also identified regional tolling as a strategy to manage traffic in the Puget Sound area. This, too, could have an effect on how people choose to travel in the area. In addition to meeting local policies to improve transit, these and potential other projects and policies illustrate the need for continued monitoring of transit conditions into the future.

## Conclusions

1. **Trigger Definition:**

   **Step 1 --** If future conditions degrade beyond 2011 baseline conditions by any measure, speed or passenger delay, and for any time period, AM peak, midday, PM peak, a process to identify transit operating enhancements is triggered. The amount of change beyond 2011 baseline conditions will determine the level of transit enhancements indicated for the corridor. Metro, City of Seattle, and WSDOT will work to identify potential projects to bring transit travel times and passenger delay back to 2011 levels, or better.

   **Step 2 --** If transit enhancement measures employed in Step 1 are exhausted and are not able to improve transit operations to 2011 conditions based on a minimum of six months measurement following implementation of all transit enhancements, the trigger would then be met to consider the potential benefits to transit of constructing a second Montlake bridge. It is anticipated that additional analysis will be required if the second step trigger is met to determine the benefit to transit of a second bridge so that there is assurance that construction of a second bridge will actually resolve the speed and delay issues experienced by transit and improve conditions to the 2011 baseline, or better.

The travel time, travel speed, and passenger delay values located in Tables 4-1 and 4-2, in bold face type, constitute the 2011 baseline values for each of the listed time periods and form the basis of comparison referred to in the trigger definition.

2. Transit performance in the corridor should be monitored and reported on an annual basis. The annual report would assess the relationship of current transit performance to the 2011 baseline conditions, recommend enhancements that could improve transit speed, reliability, and passenger delay, and report on progress of identified enhancements including an indication of their degree of effectiveness following implementation. The data to quantify the performance measures is collected through the King County Metro on-board systems and can be summarized, as needed, for continued monitoring. However, the resources necessary to analyze the data and produce a report summarizing the results have not been identified.

# 5 ASSESSMENT OF A SR 520 MAINLINE OPERATIONS TRIGGER

## Background

This white paper explores the relationship between SR 520 mainline traffic delay and traffic operations on Montlake Boulevard including the impact of Montlake Bascule Bridge openings for marine traffic. The goal is to assess the degree to which mainline traffic delays are caused by operations of the Montlake Bridge and if the addition of a second bridge over the Montlake Cut, as included in the Preferred Alternative, provides a potential benefit to ensuring reduced or no delay on the SR 520 mainline. The paper further explores the establishment of a trigger for considering construction of a second Montlake bridge if the second bridge provides benefits to SR 520 mainline operations. To accomplish these objectives, the working group explored vehicular volumes and delay currently and historically experienced on the SR 520 mainline near and on the Montlake Boulevard off -ramps, in the eastbound and westbound directions.

## Existing Conditions

### Montlake Bridge Operations and Influence on SR 520 Mainline

Two possible interactions between the Montlake Bridge and congestion on the SR 520 mainline are explored in this paper. The first interaction is whether the presence of the capacity limitation on the Montlake bridge plays a discernible role in creating congestion on SR 520 as a result of traffic queued on the off-ramps and onto the mainline. This was tested by establishing the theoretical capacity for the Montlake bridge at approximately 3,000 to 3,500 vehicles per hour in each direction. Figures 5-1 and 5-2 show historic trends in daily and hourly traffic volumes on the Montlake Bridge. Figure 5-2, shows that peak hourly volumes do not exceed 2500 vehicles per hour in one direction. Therefore, the bridge, in and of itself, is not a capacity limitation that could cause queuing onto SR 520. While the bridge plays a role as part of this roadway system it is not the key element. Therefore, this particular element of Montlake Bridge capacity was not analyzed further in this white paper.

Figure 5-1: Montlake Bridge Average Daily Traffic

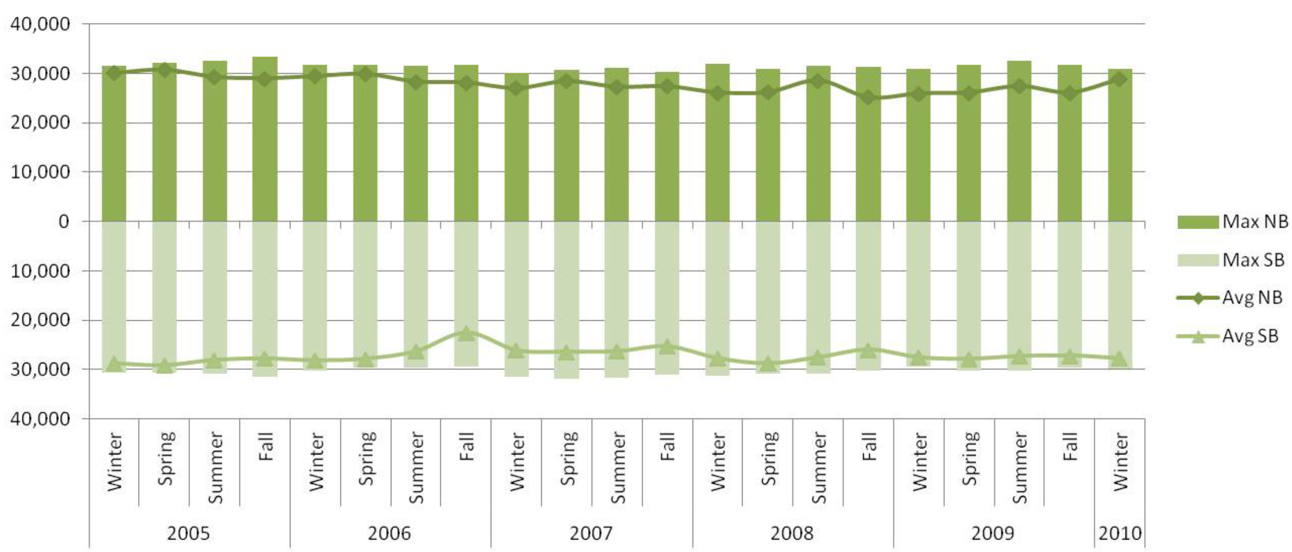
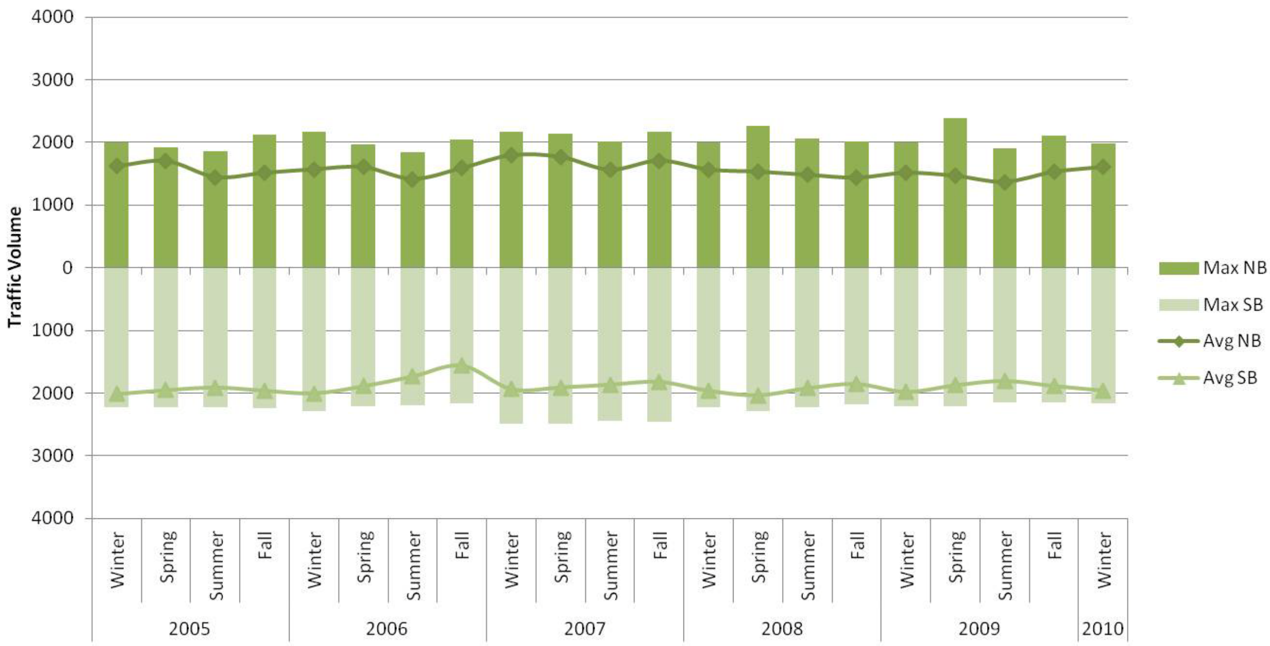


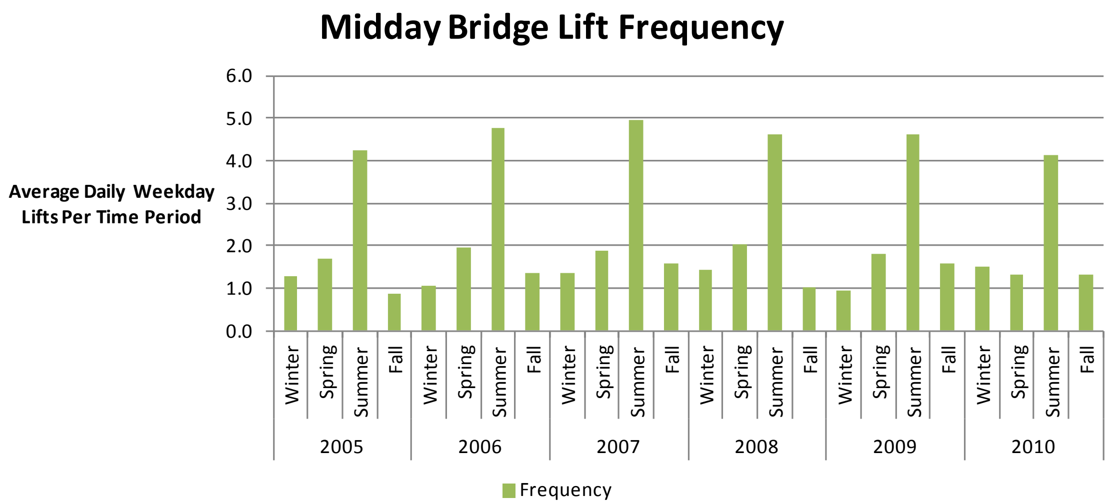
Figure 5-2: Montlake Bridge PM Peak Hour Traffic




The second interaction of the bridge and associated intersections is the degree to which marine traffic operations, the bridge lifting to allow marine traffic to pass, effect congestion on the SR 520 mainline and how long it takes for the mainline to recover from a bridge lift event. The bridge has two restricted periods when it will not raise for marine traffic. The bridge remains closed to boaters from 7:00 am to 9:00 am, and from 3:30 pm to 6:30 pm, excluding weekends and holidays in the spring and summer and 7:00 am to 10:00 am and 3:30 to 7:00 pm in fall and winter. This nearly coincides with the AM and PM peak periods, and is meant to minimize the disruption of bridge lifts on Montlake Boulevard traffic. For this white paper analysis of bridge operations was conducted using five years of bridge lift data and correlating that lift data with ramp and mainline operational delays.

In reality, bridge lifts, particularly in the weekday midday period, are not common events, as depicted in Figure 5-3. The normal range of a bridge opening event is three to six minutes, but the typical delay to traffic can be as much as 20 to 30 minutes. This cause-effect relationship is described by Figure 5-9.

Figure 5-3: Montlake Bridge Midday Lift Frequency (2005-2010)



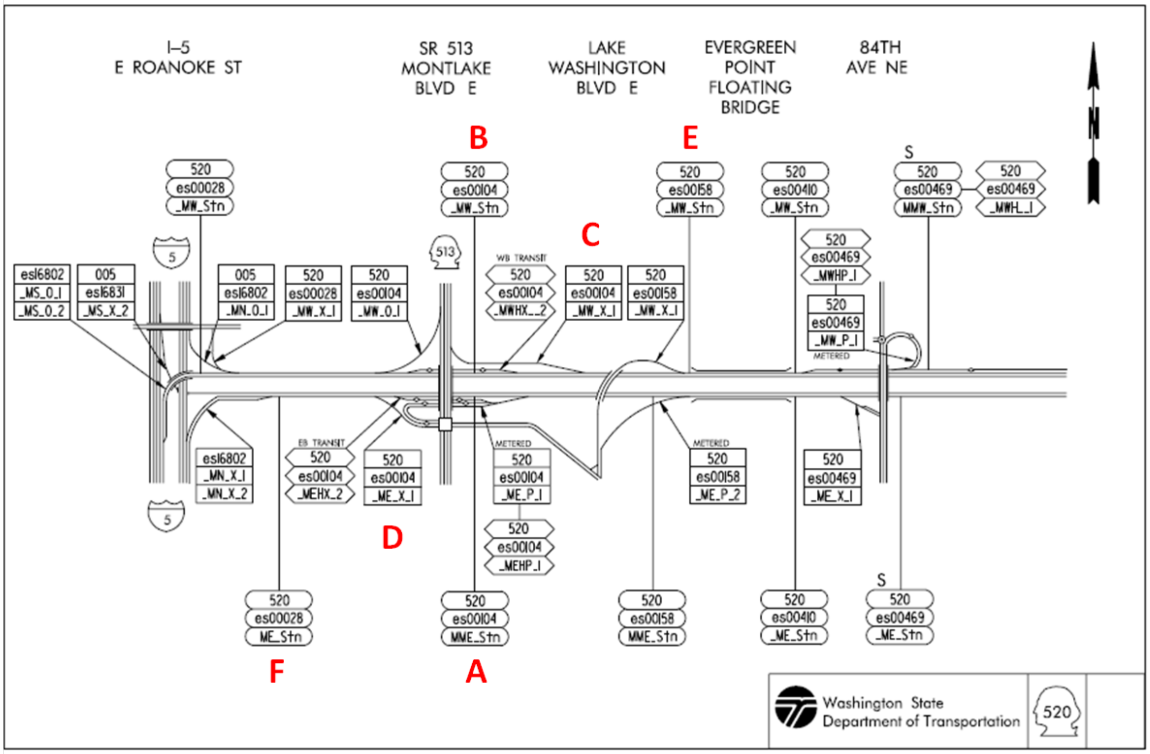

As shown in Figure 5-3, bridge lifts are more frequent in the summer months, with an average of four lifts during the midday period (9:00 am to 3:30 pm). Because of this seasonal impact and the relationship with SR 520 volumes, an analysis period from April to September was chosen to represent worst case conditions. While the findings reported below have application to the other parts of the year, the most likely period for significant issues is in the spring/summer period due to the higher incidence of bridge lift events.

In addition to the seasonality, time of day also plays a role in determining the impact of bridge lift events. For example, traffic conditions on eastbound SR 520 approaching Montlake (see Figure 5-7) can be congested in the 9 to 10 am period immediately following the morning peak. In this case a bridge lift event has little impact on travel speeds but may extend the duration of the congestion.

Traffic volumes and delay on SR 520 are monitored with permanent loop detectors that measure the 60 second occupancy rate (updated to 20 second occupancy in Spring 2012) and then average this data for every five minute period, 24 hours a day, year round. Data from 2005 to 2011 was made available to the working group by WSDOT. The data and analysis conducted for this paper precedes the implementation of tolls on SR 520. Therefore, potential impacts of tolling have not been accounted for in this white paper. Six locations with loop detectors were selected as ones that could have traffic conditions that are related to Montlake Bridge openings (see Figure 5-4 for a schematic map of these locations):

- **A**: Eastbound mainline downstream of the Montlake Blvd off ramp
- **B**: Westbound mainline downstream of the Montlake Blvd off ramp
- **C**: Westbound Montlake Blvd off ramp
- **D**: Eastbound Montlake Blvd off ramp
- **E**: Westbound mainline upstream of the Montlake Blvd off ramp
- **F**: Eastbound mainline upstream of the Montlake Blvd off ramp

Figure 5-4: SR 520 Location of Loop Detectors




Note: Not to scale. Source: Washington State Department of Transportation.

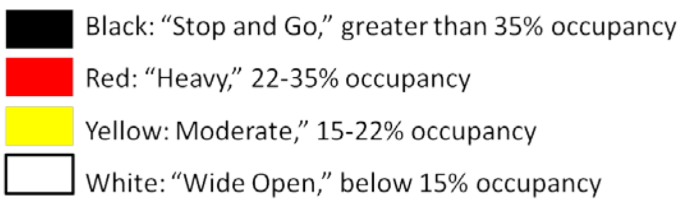
## SR 520 Mainline and Montlake Off-ramps Vehicular Congestion

The loop detector occupancy data contains a large number of records, over 100,000 records per year, per loop detector, which are challenging to display in a comprehensive or simple manner. However, selected snapshot images of the data have been captured, and displayed in the figures that follow. The data focuses on weekday traffic conditions and does not display weekend traffic.

*How to Read the Graphs*

- Each column represents one year of data, and reading left to right the tables show 2005 to 2010.
- Data has been averaged for each five minute interval of weekdays for each year shown. On average, very few time periods at each location experience delay of any magnitude.
- Peak travel times (7:00AM-9:00AM and 4:00PM -6:00PM) are indicated with horizontal black lines on the graph
- Colors represent delay (also called occupancy) experienced over a five minute time period based on the WSDOT rating scale (see Figure 5-5).

Figure 5-5: Legend for Occupancy Delay Graphics




Generally vehicle speed cannot be derived from occupancy alone. Also required is the volume of vehicles passing over the loop and a constant that reflects the median length of the vehicles. However, in general, WSDOT reports that loop occupancy of 12%, or less, speeds are set to 60 MPH. If loop occupancy is 95%, or more, speed is automatically set to 0 MPH and occupancy of 35% is equivalent to 20 MPH. Given the factors cited earlier, loop occupancy versus speed is not precise, but the Table 5-1 presents general sense of loop occupancy versus speed.

Table 5-1: Loop Occupancy versus Speed

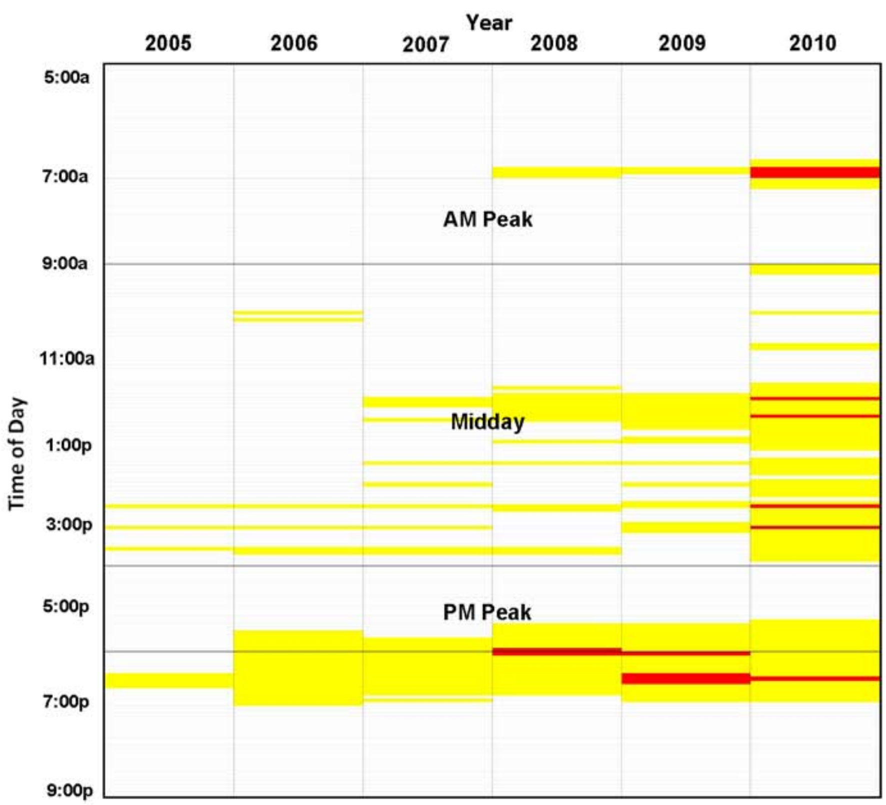
| Loop Occupancy | Approximate range of resulting speeds (MPH) |
|---|---|
| 95% or greater | 0 |
| 35% to 95% | 0 to 20 |
| 30 to 35% | 20 to 25 |
| 22 to 30% | 25 to 45 |
| 15 to 22 % | 45 to 55 |
| Less than 15% | 60+ |

Locations A and B are the locations are least likely to be impacted by Montlake Bridge operations. Location A (eastbound direction) experiences very peak-oriented congestion and is very congested (stop and go conditions) in the AM period. Location B westbound on the mainline, by yearly average, experiences free flow conditions. These locations are downstream of the Montlake Boulevard off-ramps, so traffic delayed exiting to Montlake Boulevard would not be passing through these locations. Therefore these locations were not analyzed further in assessing the potential for a trigger for mainline SR 520 operations. Traffic entering SR 520 from Montlake Boulevard that has crossed the Montlake Bridge does not influence SR 520 based on varying traffic operational conditions on the Montlake Bridge. Therefore, consideration of traffic entering SR 520 from Montlake, is also excluded in this analysis.

Locations C and D which are the westbound and eastbound off ramps, respectively, are more likely to be influenced by Montlake Bridge operations. When the Montlake bridge opens for boating traffic, traffic on Montlake Boulevard must stop. This type of delay results in congestion that often backs onto the SR 520 off-ramps and the mainline. This cause- effect relationship is seldom observed in the SR 520 mainline upstream of the westbound off ramp given the amount of storage available on the ramp. The westbound off ramp is nearly ½ mile long and has twice the amount of storage as the eastbound off-ramp. Figure 5-8 shows that the westbound off-ramp does experience delay during bridge openings, but the congestion does not back onto or influence mainline operations. Therefore, Location C and westbound SR 520 mainline operations are not discussed further with respect to establishing a relationship between bridge operations and SR 520 mainline traffic delays.

As can be seen in Figure 5-6, Location D, the eastbound off-ramp that meets Montlake Boulevard at a signalized intersection, has been experiencing worsening congestion from 2005 to 2010, particularly in the midday and PM periods. It is also observed that the delay patterns are not restricted to peak travel, but these locations experience delay throughout the day. This delay is most often the result of traffic operations at the intersection of the off ramp at Montlake Boulevard, East Montlake Place, and Lake Washington Boulevard. But it can also be caused by bridge opening delays and other factors.

Figure 5-6: Location D Montlake Exit Off Ramp -- Eastbound




Location F (Figure 5-7) is the section of the eastbound SR 520 mainline located upstream of the eastbound Montlake off-ramp. This location is effected by spill-over traffic from the downstream off-ramp, congestion on SR-520, and congestion that results from traffic entering SR 520 on the on ramps. Figure 5-7 shows that while the worst congestion is concentrated during peak travel time, delay in the midday period is also increasing over time. Of particular note is the delay that occurs just after the AM peak and just before the PM peak begins, which notably increased in 2010.

Figure 5-7: Location F Upstream of the Montlake Off Ramp -- Eastbound

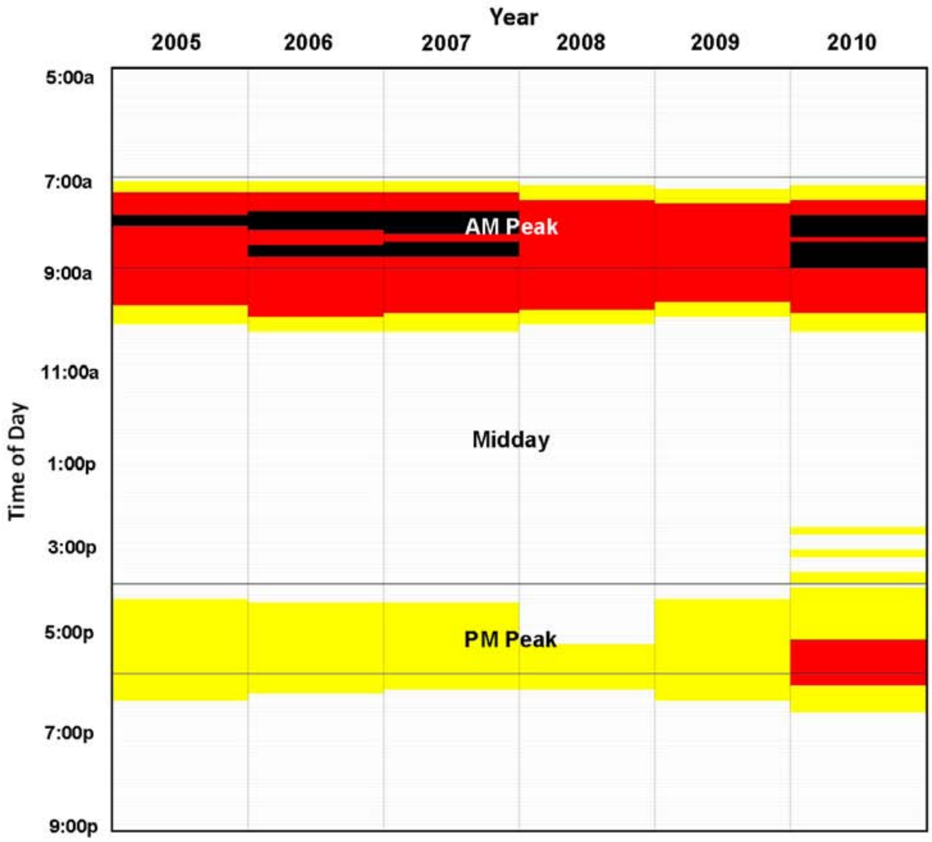
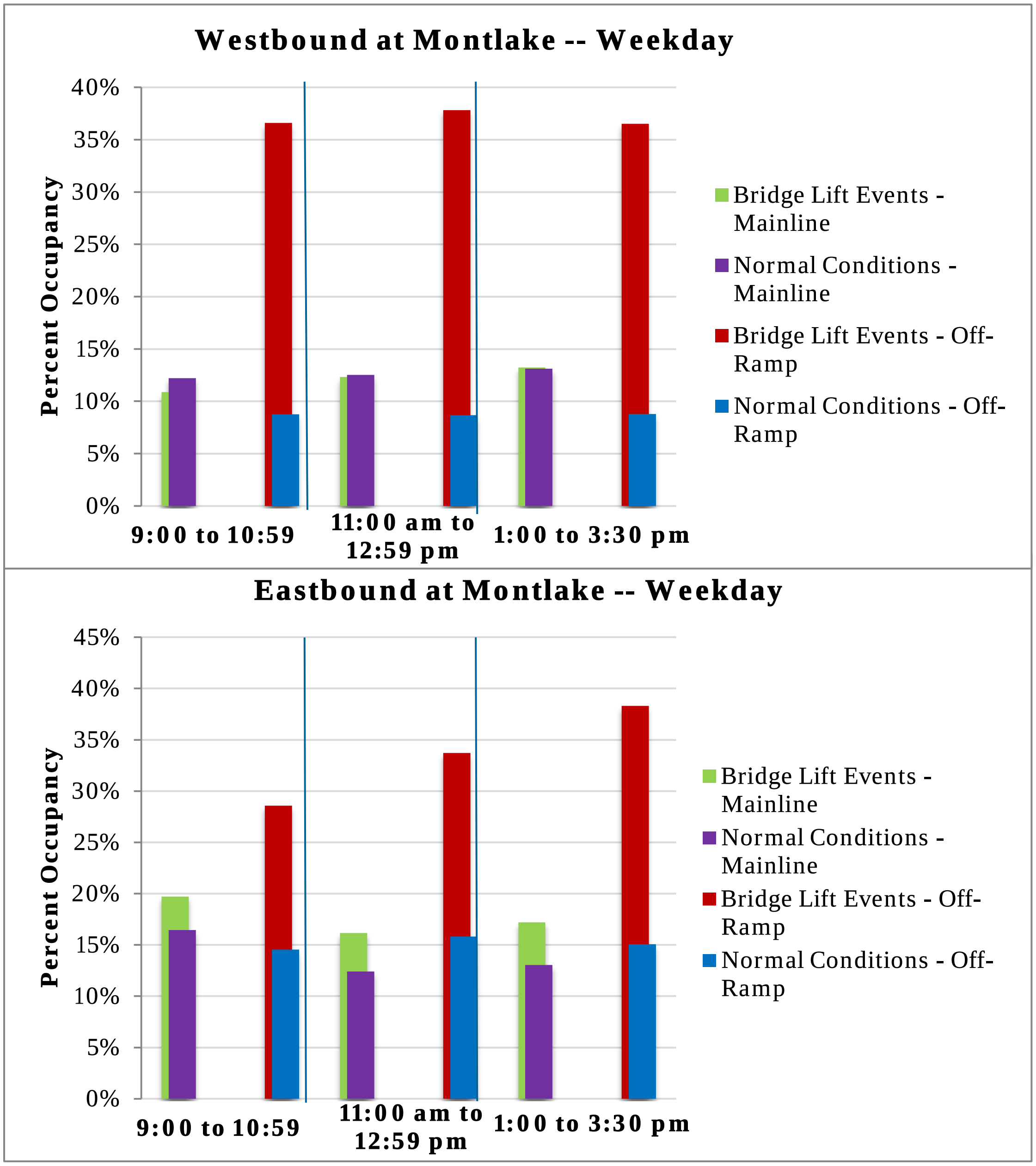



Figure 5-8 shows the impact of bridge lift events, in terms of average loop occupancy for time periods throughout the day as experienced in the April through September period of 2010. There are two important conclusions to be drawn from the graphic depicted in this figure:

First, the westbound lanes of SR 520 are seldom impacted by bridge lift events, as previously discussed.

Secondly, the mainline traffic impacts in the eastbound direction are present and measureable. More detail is provided later in the analysis on this conclusion. From modeling work conducted for the ESSB 6392 design refinement process, one of the benefits of the second Montlake Bridge, when coupled with an increase of 20% in traffic volume on Montlake Boulevard (projected to occur in the year 2030), is that recovery from a lift event is improved with a slightly faster, about 5%, improvement, compared to conditions after a bridge lift event when only one bridge is present. In the ESSB 6392 Design refinement process conditions were modeled to establish the benefits to traffic flow if a lift event occurred just prior to the PM peak period, or about 3:30 pm.

Figure 5-8: Ramp and Roadway Normal Levels of Congestion and under Bridge Lift Events




An important point to restate is that a second Montlake Bridge neither increases, nor decreases, the level of bridge lift activity. What the second bridge can do is to help traffic flow recover more quickly following a lift event. Figure 5-9 was derived by assembling all the bridge lift events that occurred between 3 and 3:30 pm over the summer months of 2010. What the data show is that the effects of a lift event linger on the mainline well after the Montlake Bridge has re-opened to traffic. It is somewhat difficult in this particular "pre-peak" period to ascertain the "normal" loop occupancy and speed versus the degree to which flow recovers after a bridge lift event. As seen in the figure even 30 minutes after the lift event, traffic flow on the eastbound mainline has not quite returned to "pre-lift" conditions. However, the inside lane is approaching free flow and the outside lane has nearly recovered. Again, the degree of recovery is likely due to background traffic conditions as opposed to congestion caused solely by the bridge lift event as peak traffic does begin to occur in the 3:00 pm hour, see Figure 5-7.

Figure 5-9: Anatomy of a Bridge Lift Event – Summer 2010

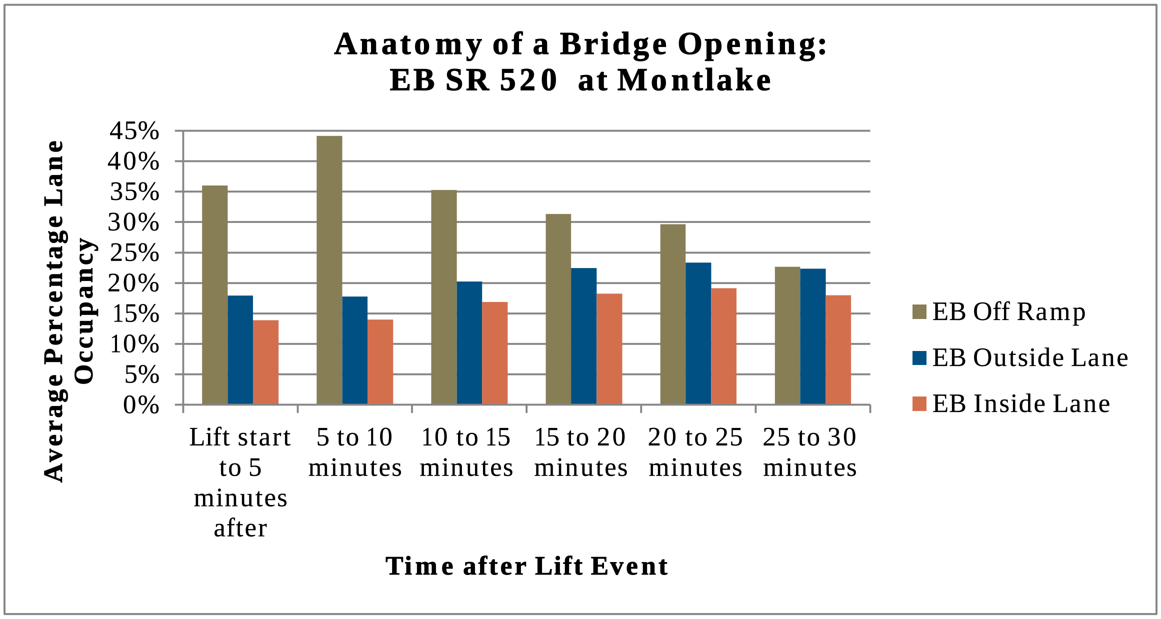
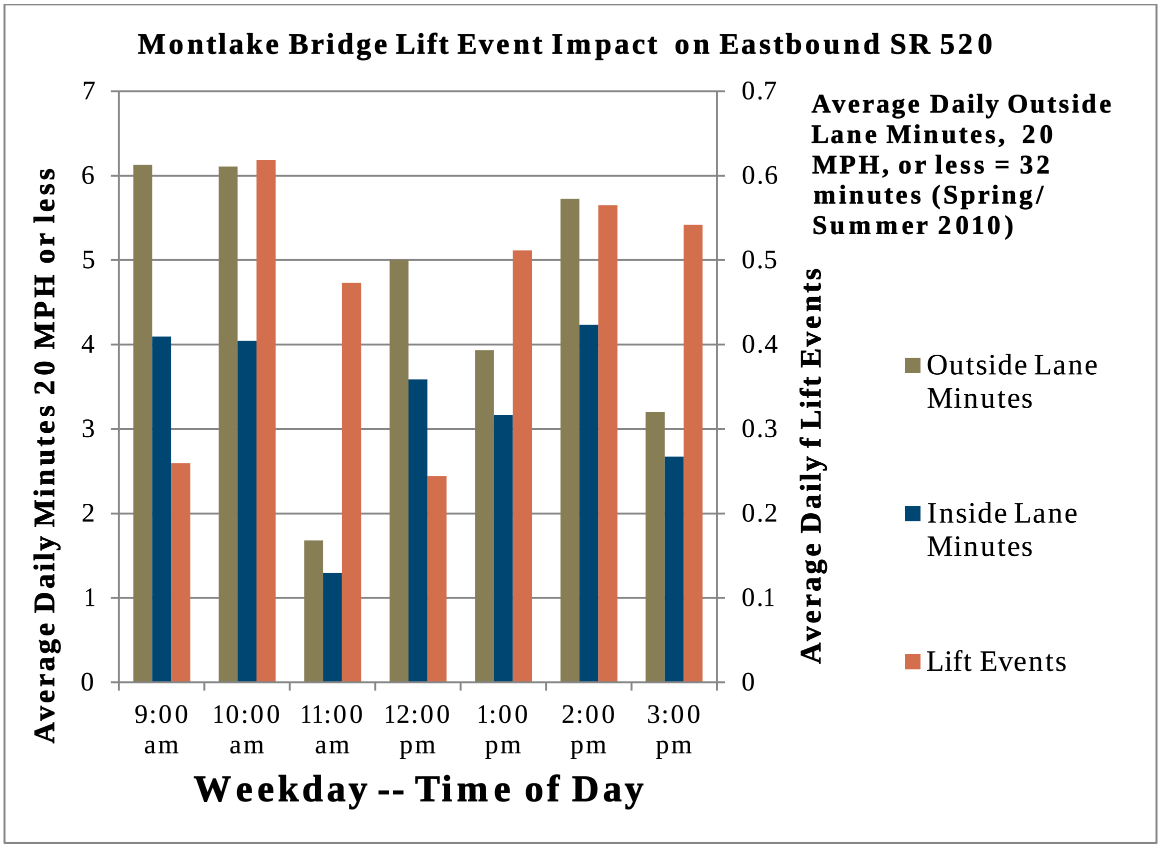



Figure 5- 10 illustrates the average daily number of minutes where congestion, traffic 20 MPH or slower, occurs on eastbound SR 520 as a result of Montlake Bridge lift events. The data presented are for April through September 2010 and "normal" background traffic has been excluded to assess only the impact of bridge operations. For example, in the Spring/Summer of 2010 traffic congestion in the hour from 9 to 10 am was very nearly a daily occurrence, yet bridge lift events only occurred in that hour about once every four days. The data in Figure 5-10 is displayed to show the increase in congestion over "normal conditions." In other words, when traffic is normally congested in the 9 to 10 am hour eastbound on SR 520, a bridge lift event only extends length of the congestion. Overall, in spring/summer 2010, Montlake Bridge lift events contributed a daily average of 32 minutes of congestion, or speeds below 20 MPH, to the outside lane of eastbound SR 520.

Figure 5-10: Assessment of Congested Traffic Resulting from Montlake Bridge Lifts




## Formulation of a Trigger

In the ESSB 6392 workgroup there was also a programmatic discussion of how the SR 520 corridor will be managed from a demand standpoint. WSDOT committed to operating SR 520 in a manner that is consistent with freeway management practices throughout the Puget Sound Region. WSDOT's Moving Washington decision framework calls for strategies that operate efficiently, manage demand, and add capacity strategically. As part of the strategy to improve efficiency, WSDOT seeks to maintain freeway speeds at or above the maximum throughput range, or 70% to 85% of the posted speed.

Montlake Bridge lift related congestion that spills back onto an otherwise uncongested SR520 decreases efficiency and increases collision risk. Given that the estimated benefit to the SR 520 mainline from a second Montlake bridge is a potential 5% improvement in recovery time following a lift event, there is a rational nexus to establish a trigger that focuses on recovery of traffic flow and relate that to standard WSDOT freeway management practices. This led the Second Montlake Bridge workgroup to devise a trigger that depends on the interaction of two data sets, bridge lift data, and loop occupancy/volume/calculated speed data.

**Trigger Definition:** If SR 520 mainline congestion that occurs as a result of Montlake bridge openings exceeds an average of 100 minutes per day for any six month period, the trigger is met. If met, roadway improvements would be considered to reduce congestion. Those roadway improvements could include a second Montlake Bascule Bridge.

Congestion is defined as mainline average speed of 20 MPH, or less, in the right, or outside, lane. The threshold of 100 minutes is established in combination with the projected 5% reduction in recovery time from the ESSB 6392 traffic models to obtain a daily reduction in mainline congestion of five minutes.

## Future Conditions

Planned modifications with the SR 520 project include a reconstructed Montlake interchange that will include expanded storage for vehicles waiting to enter Montlake Boulevard as well as improved signal operations. Vehicle storage on the eastbound off ramp in the current stage of design is an 11% increase and the westbound off ramp is designed for a 157% increase in storage capacity. It should be recognized that neither of these are final design parameters and that these values may change as the design proceeds.

The characteristics of traffic flow in the entire Montlake area have changed as a result of tolling. Over time, traffic volumes will likely continue to adjust to tolling in the corridor and in the region. Traffic volumes will also change as Sound Transit's various Link projects are implemented, roadway infrastructure improvements are constructed, and improved cross-lake regional transit services are implemented. Continued monitoring and reporting of traffic congestion will help decision makers understand how people respond to the future projects and determine what improvements might be necessary to maintain mobility in the region.

## Conclusions

1. **Trigger Definition**: If SR 520 mainline congestion that occurs as a result of Montlake bridge openings exceeds an average of 100 minutes per day for any six month period, the trigger is met. If met, roadway improvements would be considered to reduce congestion. Those roadway improvements could include a second Montlake Bascule Bridge.

   Congestion is defined as mainline average speed of 20 MPH, or less, in the right, or outside, lane. The threshold of 100 minutes is established in combination with the projected 5% reduction in recovery time from the ESSB 6392 traffic models to obtain a daily reduction in mainline congestion of five minutes. This is the minimum level at which a second bridge could provide meaningful traffic flow recovery benefit.

2. The traffic flow conditions in and around the Montlake ramps are presently in a state of change. The changes are mostly related to traffic shifts after tolls were implemented. Montlake Bridge operations also continue to evolve. Over the past few years the number of daily lift occurrences has declined. The trigger has been intentionally set such that it can be measured and assessed with information already collected by WSDOT and is consistent with WSDOT freeway management practices. For these reasons it is suggested that an annual report be established to document conditions in the Montlake interchange and report on the magnitude of influence of Montlake Bridge operations, specific to the definition of the trigger.

# 6 NEXT STEPS

**Where do the issues go from here?**

Of the many issues addressed by the workgroup, this particular issue remains with some question marks. Ultimately, the decision to build, or not build, a second Montlake Bridge will be a policy decision that is made at several levels, including the state legislature. As referenced in the Memorandum of Understanding between WSDOT and the City of Seattle, October 2011, the decision about what a trigger means and a policy course of action is one joined by the various policy bodies.

Another open question is what it means if only one trigger is met while the others show no clarity in direction. Does an action require all three triggers be met, or only one? The Second Montlake Bridge workgroup concluded this decision was best left to the same policy makers who would need to consider construction of a second bridge. Rather than construct some set of logic, i.e. if the pedestrian bicycle trigger is met but step 1 of the transit trigger is not then…., it seemed more appropriate to the workgroup to monitor and report on current conditions and where each of the three the triggers stand at any given time. The assessment of the situation and a decision to move forward on any particular course of action would be left to the decision-makers.

**Monitoring and Reporting**

Concurrent and currently, there are efforts both locally and within WSDOT that may be logical "homes" for the issues raised by the triggers, the need for monitoring and the need for reporting on their current status.

**Bicycle and Pedestrian Mobility**

The task going forward is to establish a plan that will allow the trigger to be monitored quarterly and reported on an annual basis. The City has recently begun a process to update the Bicycle Master Plan. This appears to be a logical home for monitoring and reporting to be considered and implemented as well as consideration of possible alternatives, including a second Montlake Bridge, that can enhance non-motorized operation in the Montlake corridor so that it continues to meet city standards and policies. It must be noted, however, that the City does not currently have resources available to establish a monitoring plan for the Montlake Bridge that is more rigorous than the once per year voluntary plan operated by WSDOT and the Cascade Bicycle Club.

### Transit Travel Time and Reliability

Implementation of the recently adopted Seattle Transit Master Plan would appear to be the logical place for trigger monitoring and reporting as well as for implementing the programmatic elements established in step 1 of the trigger and inherent in City and Metro policy. The coordinated effort between these two agencies has a long history of implementing corridor improvements, such as for RapidRide implementation. It seems logical the same approach would be continued and applied to the Montlake Corridor. It must be noted, however, that while Metro regularly collects the data necessary to monitor the Montlake corridor, the resources necessary to analyze that data and publish a report summarizing the results have not been identified.

### SR 520 Mainline Operations

WSDOT has an on-going traffic monitoring function for both the marine operations of the Montlake Bridge and the mainline and ramp operations of SR 520. It would seem logical that the responsibility for monitoring and reporting on the trigger conditions would be lodged with WSDOT.

[Comment from Sound Transit staff on "Establishment of Triggers" report, July 16, 2012]

The only content suggestions I would make are to include mention of the fact that Sound Transit also operates bus routes across the Montlake Bridge (currently four routes), and to also make reference to the SR 520 High Capacity Transit Plan (December 2010) that was developed by though a collaboration of WDOT, King County Metro, Sound Transit and UW. The HCT Plan describes long-term goals for bus service along the 520 corridor and includes routes that would utilize the Montlake Bridge going between the freeway and the UW area. Text for these items could go in the Background and/or Transit trigger sections.

Thanks for the opportunity to review the document. . . .
Eric

**Eric Chipps**
Sound Transit
Office of Planning and Development
Office: (206) 398-5020
Mobile: (206) 255-1867
Email: eric.chipps@soundtransit.org

UNIVERSITY OF WASHINGTON

OFFICE OF REGIONAL AFFAIRS
*Theresa Doherty, Director*

July 16, 2012

Peter Harris
Seattle Legislative Department
Central Staff
PO Box 34025
Seattle, WA 98124-4025

E-mail: Peter.Harris@seattle.gov

**RE: Second Montlake Bridge Workgroup Report on Establishment of Triggers**

The University of Washington has reviewed the *Establishment of Triggers* report.[1] We concur with the workgroup's findings that the triggers should focus on bicycle and pedestrian mobility, transit speed and reliability, and operations and safety of the SR 520 mainline. The measures and methods to monitor the established triggers also seem reasonable.

We agree with report's final conclusion that, "Ultimately, the decision to build, or not build, a second Montlake Bridge will be a policy decision that is made at several levels, including the state legislature." To that end, ongoing monitoring and even forecasting of pedestrian, transit, and traffic will be required so that the decision makers can track operations and safety conditions of the existing bridge long before it reaches the established triggers.

Thank you for including the University of Washington in this round of review, and we look forward to being involved in the future monitoring processes.

Sincerely,

Theresa Doherty

Theresa Doherty, Director
Office of Regional and Community Relations
150 YEARS W UNIVERSITY of WASHINGTON

[1] *Establishment of Triggers, Second Montlake Bridge Workgroup,* Nelson Nygaard, June 2012.

225 Gerberding Hall Box 351243 Seattle, Washington 98195-1243 206/221-2603 FAX: 206/685-1201 tdoherty@u.washington.edu
www.washington.edu/community/

U.S. Department
of Transportation

**Federal Highway
Administration**

Washington Division

Suite 501 Evergreen Plaza
711 South Capitol Way
Olympia, Washington 98501-1284
(360) 753-9480
(360) 753-9889 (FAX)
http://www.fhwa.dot.gov/wadiv

July 26, 2012

HMP-WA/WA 649

Peter Harris
Seattle Legislative Department, Central Staff
PO Box 34025
Seattle, WA 98124-4025

**Second Montlake Bridge Workgroup
Report on Establishment of Triggers**

Dear Mr. Harris:

As a result of the October 2011 Memorandum of Understanding signed between the city of Seattle and WSDOT, a city-led technical workgroup was chartered to identify triggers for construction of the second Montlake bascule bridge. The workgroup appeared to be a successful technical coordination effort across multiple agencies, resulting in the development of a report outlining triggers for construction of a second bascule bridge.

Following WSDOT's review of the *Establishment of Triggers, Second Montlake Bridge Workgroup* report, we want to ensure the Federal Highway Administration's commitment to a transportation system that functions effectively is considered as part of the decision-making process. We believe the workgroup's triggers related to bicycle and pedestrian mobility, transit speed and reliability, and the operations and safety of the SR 520 mainline are the right triggers, and that they be monitored closely.

Sincerely,

DANIEL M. MATHIS, P.E.
Division Administrator

By: Randy Everett
Major Projects Oversight Manager

cc: Kerry Pihlstrom, WSDOT Engineering Manager
Michael Fong, Seattle Legislative Department, Central Staff
Jennifer Wieland, Seattle Department of Transportation
Tim Payne, Nelson Nygaard Associates

**Washington State Department of Transportation**
**Paula J. Hammond, P.E.**
Secretary of Transportation

**Engineering and Regional Operations**
**SR 520 Bridge Replacement and HOV Program**
999 3rd Avenue, Suite 900
Seattle, WA 98104

Phone: 206-770-3500
Fax: 206-770-3569
TTY: 1-800-833-6388
www.wsdot.wa.gov/projects/SR520Bridge

July 26, 2012 LTR – 2369

Peter Harris
Seattle Legislative Department, Central Staff
PO Box 34025
Seattle, WA 98124-4025

RE: Second Montlake Bridge Workgroup Report on Establishment of Triggers

Dear Peter:

As part of the October 2011 Memorandum of Understanding between the city of Seattle and WSDOT, a city-led technical workgroup was formed to identify triggers for construction of the second Montlake bascule bridge. We have appreciated being part of the workgroup process along with city of Seattle and King County Metro representatives, as well as your inclusion of other important SR 520 stakeholders such as the University of Washington and Sound Transit.

WSDOT has reviewed the *Establishment of Triggers, Second Montlake Bridge Workgroup* report. We agree with the workgroup's finding that triggers to construct a second Montlake bascule bridge should focus on bicycle and pedestrian mobility, transit speed and reliability, and the operations and safety of the SR 520 mainline. We also agree with the conclusion that the decision to build or not to build a second Montlake bascule bridge is a future policy decision.

We thank you again for leading this workgroup effort, and we look forward to continued coordination with the city as we monitor the triggers consistent with the methods identified in the report.

Sincerely,

Kerry Pihlstrom, P.E.
WSDOT Engineering Manager

cc: Michael Fong, Seattle Legislative Department, Central Staff
Jennifer Wieland, Seattle Department of Transportation
Tim Payne, Nelson Nygaard Associates

King County
Department of Transportation
**Metro Transit Division**
**General Manager's Office**
201 S. Jackson Street
KSC-TR-0415
Seattle, WA 98104-3856

August 7, 2012

The Honorable Richard Conlin
Chair, Committee of the Whole
Seattle City Council
600 4th Avenue, 2nd Floor
Seattle, WA 98104

Re: *Establishment of Triggers Report*

Dear Councilmember Conlin:

King County Metro (Metro) has been an active participant in the Second Montlake Bridge technical work group for over a year. Metro has been supportive of this process to define the factors appropriate to determine whether and when to construct the second Montlake Bascule Bridge, as recommended by the ESSB 6392 work group and in accordance with City of Seattle Ordinance 123733. The final product of the work group, the Establishment of Triggers report, sets trigger definitions for the second bascule bridge for pedestrians and bicycles, transit and State Route 520 mainline operations.

The transit trigger was developed by Metro staff, who worked closely with the Washington State Department of Transportation (WSDOT) and Seattle Department of Transportation (SDOT) to come to agreement on the trigger. Metro staff identified spring 2011 transit service levels as the baseline against which to measure future conditions. These pre-toll conditions were chosen given current issues with on-time performance and transit delay in the Montlake corridor.

As a participant in the work group, Metro supports the triggers identified in the Establishment of Triggers report, but also has several concerns.

- *Ambiguity of trigger process.* The work group did not provide direction on how many triggers had to be met to consider construction of a second bascule bridge. While the group agreed this is a policy decision at several levels, Metro remains concerned with the lack of clarity in the requirements. Further discussion among Metro, the City of Seattle and WSDOT is necessary to determine whether one or all triggers are to be met in order to analyze the need for a second bascule bridge. In addition, the work group did not identify responsibility or possible financial resources to support the monitoring of future conditions. This needs to be agreed upon by the agencies represented in the work group.

- *Implementation of current transit elements.* While State Route 520 tolling and changes to the Montlake interchange as part of the State Route 520: Interstate 5 to Medina project may improve transit operations, it is crucial that the planned transit-supportive elements are built and implemented to ensure transit is fast and reliable in the Montlake corridor. Future increases in traffic volumes, ridership and other factors may result in transit performance at or worse than 2011 levels. Investment in transit improvements, including the transit and HOV lanes on Montlake currently planned as part of the State Route 520 project, make transit more attractive when implemented and hedged against other deteriorating traffic conditions.

- *Adequate resources.* Metro recognizes that the decision to build or not to build a second Montlake bridge will be a policy decision that includes the state legislature. However, adequate resources should be identified and available to fund a second bridge if and when the need for a second bascule bridge is determined. This requires a commitment to a financing plan that the City of Seattle, King County, and state can implement when it is needed.

Metro will continue to work with Sound Transit, the state, local jurisdictions, and the public to ensure that transit elements are incorporated on the Montlake and State Route 520 corridors and to make certain that attractive travel options are provided for those traveling within the State Route 520 corridor, as well as within Seattle and eastside neighborhoods adjacent to the corridor.

Thank you for the opportunity to share our interests on the State Route 520 project.

Sincerely,

Kevin Desmond
General Manager
Metro Transit Division

cc: Michael Fong, Legislative Analyst, Seattle Legislative Department
Peter Harris, Legislative Analyst, Seattle Legislative Department
Chris Arkills, Transportation Policy Advisor, King County Executive Office
Victor Obeso, Manager, Service Development, Metro Transit Division, Department of Transportation (DOT)
Christina O'Claire, Supervisor, Strategic Planning and Analysis, Service Development, Metro Transit Division, DOT