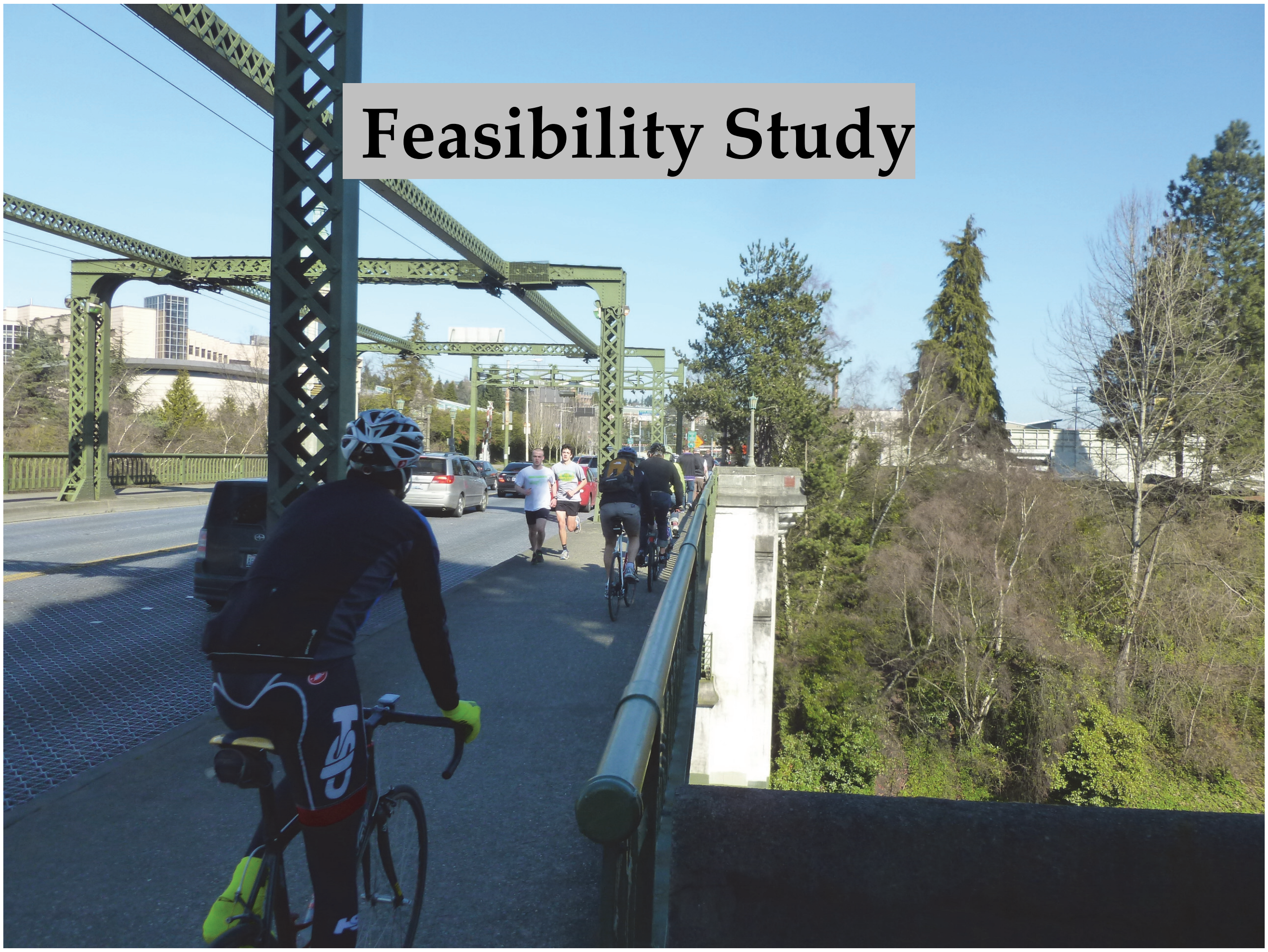


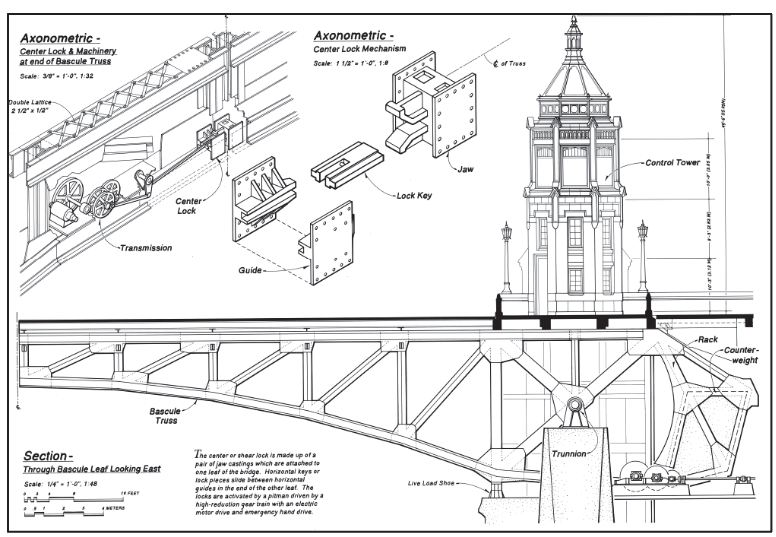
Montlake Bridge Crossing Enhancements for Bike & Pedestrian Users

Prepared for

Seattle Department of Transportation

INTEGRITY
STRUCTURAL
ENGINEERING
PLLC

September 2013



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APPENDIX

EXECUTIVE SUMMARY

The purpose of this feasibility study is the conceptual development of operational changes and a walkway widening for the Montlake Bridge. The bridge is WSDOT owned and operated as part of SR513 and an imperative bridge for the City of Seattle. This work has included the structural review of the Montlake Bridge, current SDOT collected bicycle traffic data (April to July 2013), and considers the major pedestrian/bicycle project use drivers of the Burke-Gilman Trail widening, newly constructed UW Montlake Triangle Pedestrian Bridge, on-going University Link light rail Transit Station, and the SR520 Bridge Replacements. The scope of work included an evaluation of three options: operational changes only, walkway modification/widening, or an added bascule bridge for only pedestrian/bicycles, and to provide a recommendation.

The major challenges affecting bicycle/pedestrian safety, mobility, and usefulness of the existing Montlake Bridge walkway width are: 1) Major fluctuations in the bicyclist volume; 2) Anticipated future increases in pedestrian/bicycle user volume; 3) Massive steel fixed objects placed within the walkway and longitudinal bascule joints at the trunnion causing dramatic constriction; and 4) Combination of slow moving pedestrians and fast moving bicyclists. Measurements of the Montlake Bridge walkways find 9'-10" of width on the concrete approaches narrowing to 9'-4" on the bascule bridge, plus the approximately 5-inches of roadway curb width at the top of walkway. The width narrows to only 6'-4" of minimum clear on the southeast approach at the road closing armature and to only 7'-2" clear width at the bascule support frames. The constriction point effects compound and the level of service is dramatically impacted, when taken along with the four to five times the average hourly trip volume increase routinely occurring at peak usage between 5pm and 6pm. Taken further, the combination of pedestrians and the faster bicyclists acclimated to the quick pace of the approach sections from the new Burke-Gilman/UW Pedestrian Bridge and the Lake Washington loop, cause situations where neither the overtaken pedestrian nor the bicyclist have adequate time to react. This active passing, considering constriction points, is also combined with the layering of users from opposite directions and that there is no set designation/understanding for which side pedestrians walk on relative to quick moving bicycles. Current peak service is poor and near functional capacity, but with the dramatic pedestrian increases anticipated from the new University Link Station and SR520 replacement, functional capacity will fail. The intent of the project's considerations is not to create a thoroughfare for high speed bicycle traffic, nor is such a widening feasible for the existing Montlake Bridge. A reduction in speed of bicycle users to make the crossing in general and for interactions with pedestrians and other multi-directional use is not considered by the City as detrimental. The City's goals are to enhance the existing facility to create the maximum long-term use and value from the existing historic Bridge.

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Structural capacity of the 1925 steel Montlake Bascule Bridge is adequate for increased widening of the walkways. Currently the critical load rating of the bridge is governed by the concrete approach spans; but walkway widening of the approach spans occurs only over the exterior support walls and substructure. Such a widening does not influence the bridge load rating. The bascule bridge's machinery and lift capacity is negatively affected by added weight and therefore this study focused only on solutions to increase bascule walkway width without increasing load to the bascule. Approach bridge walkway width was not so restricted. Numerous walkway replacement systems were evaluated, but only an exodermic steel deck with composite lightweight concrete met the necessary structural stiffness, achieved equivalent longevity of the steel bascule, and still matched existing weight for an increased walkway width. This proposed system increased the bascule walkway width by 18% from 9'-4" to 11"-0" without an increase in weight. As per the original Design Plan Sheet 20 Railing Details-Bascule Leaf, the rails were shop fabricated, brought to the field as a unit, and then connected with 4-7/8" diameter rivets at 15'-5.25" on center. The proposed widening would temporarily remove the rails as a unit, shop paint them, and restore them using 4-7/8" diameter high strength bolts. Thus, the City's goal to widen the walkway as much as possible would be achieved and the Secretary of the Interior's Standards for Rehabilitation would be applied to preserve the critical Montlake Bridge historic features without adjustment. The approach span walkway could be widened, but only through demolition of the historic concrete approach bridge railing and significant damage to the historic features (rails and lighting) of the bridge, so that project permitting may not be possible. Also given the short length of the approach spans, the existing towers, and local constriction points, retaining the approaches at 10'-3" including the 5-inch roadway curb width at top of the walkway is reasonable.

The recommendation is for replacement of the existing bascule walkway with a wider 11'-5" top of curb to outside of deck width, which has equivalent weight. The wider walkway construction uses the existing supports with minor adjustment and reuse of the historic existing rails without any adjustment. The estimated project cost is $3,648,000. Recommended operational changes include immediate addition of a posted speed and at future area project build-out a required bicycle dismount to adjust the facility from multi-use to pedestrian use only. This will eliminate the passing/overtaking actions and with all users moving at the same speed the challenges of constriction points are mitigated, and the two directional pedestrian level of service is upgraded to meet the projected future demands.

SECTION 1 MONTLAKE BRIDGE BACKGROUND

1.1 Scope of Work and Study Purpose

The objective of the Feasibility Study is the evaluation of possible enhancements of the Montlake Bridge walkway to improve crossings for bicycle and pedestrian users. The scoped completed work will take the form of a draft feasibility study including engineering recommendations, schematic drawings and figures, as well as cost estimates, and likely permit listing for the recommended adjustments. Three primary options for consideration include: 1) Operational Changes; 2) Modify/Widened Bridge; 3) New Bike/Pedestrian Bridge. Necessary background to accomplish this work has included the review of available bridge documentation, review of current area bicycle and pedestrian use/planning studies, a site visit and general observation of the bridge, calculations of the existing walkway loads, and review of the existing bridge load rating. The study is divided into three primary Sections and one Appendix section as follows:

Section 1 Report purpose, introduction, existing conditions, SDOT bike volume study, structure description, and existing information.

Section 2 Operational Considerations, Structural Assessment and Modifications, New Bridge feasibility and requirements.

Section 3 Conclusions and Engineering Recommendations.

Appendix

Appendix A Structural Modification Cost Estimates

1.2 Introduction

The Montlake Bridge was built in 1925 and consists of steel deck trusses for the bascule lift span and reinforced concrete approach structures. Spread footings support both the bascule structure and approach structures with their retaining walls. The main lift spans are double leaf bascule structures 91-feet long each, opening joint to trunnion, and 182-feet between centers of rotation. The concrete approach structures are approximately 81-feet long from the center of the bascule trunnion to the end retaining wall. This creates a total bridge length of approximately of 344-feet. At the time of its original construction the bridge was configured with the same sidewalks and pedestrian rails as seen today, but the roadway provided for one outside lane of traffic each direction and the central 18-feet of the bridge was lower in elevation and used for two street-car tracks. In the distant past, the lower central portion was filled with concrete and the tracks removed to allow for two lanes of traffic in each direction. Today the bridge provides a necessary connection between SR520, University of Washington, Montlake and Capitol Hill neighborhoods, as well as I-5 and points east of Seattle. For pedestrians and bicyclists it is a critical connection between the Lake Washington Loop and the Burke-Gilman trail.

Figure 1.1 Montlake Bridge Vicinity Map

Existing Walkway

Measurements of the Montlake Bridge walkways find 9'-10" width on the concrete approaches, narrowing to 9'-4" on the bascule bridge; plus approximately 5-inches of added width for the roadway curb at the top of walkway. On the concrete approaches this clear of 10'-3" width narrows to only 6'-4" minimum clear on the southeast approach at the road closing armature (see Figure 1.2). The northeast road closing armature on the approach span is not as restrictive and narrows to 7'-2" clear width. On the bascule bridge, the overhead wire support frames include a 26-inch wide base within the walkway narrowing the usable clear width to only about 7'-2" at the four support frames on the bascule structure (see Figure 1.3). At the trunnion near the ends of the bascule span, the walkway width is again narrowed, but for a longitudinal joint, to a maximum width of 7'-8" between the movable bascule and fixed concrete approach. This joint runs parallel to bicycle and pedestrian movement and includes a raised surrounding protective area with an open joint of approximately 1" at the south approach and 1/2" wide at north (see Figure 1.4). A Plan view of the existing conditions is provided as Figure 1.5.

Figure 1.2 Walkway Narrow Point at Southeast Approach

Figure 1.3 Typical Walkway Width at Fixed Object on Bascule Span

Figure 1.4 Typical Bridge Longitudinal Joint at Trunnion

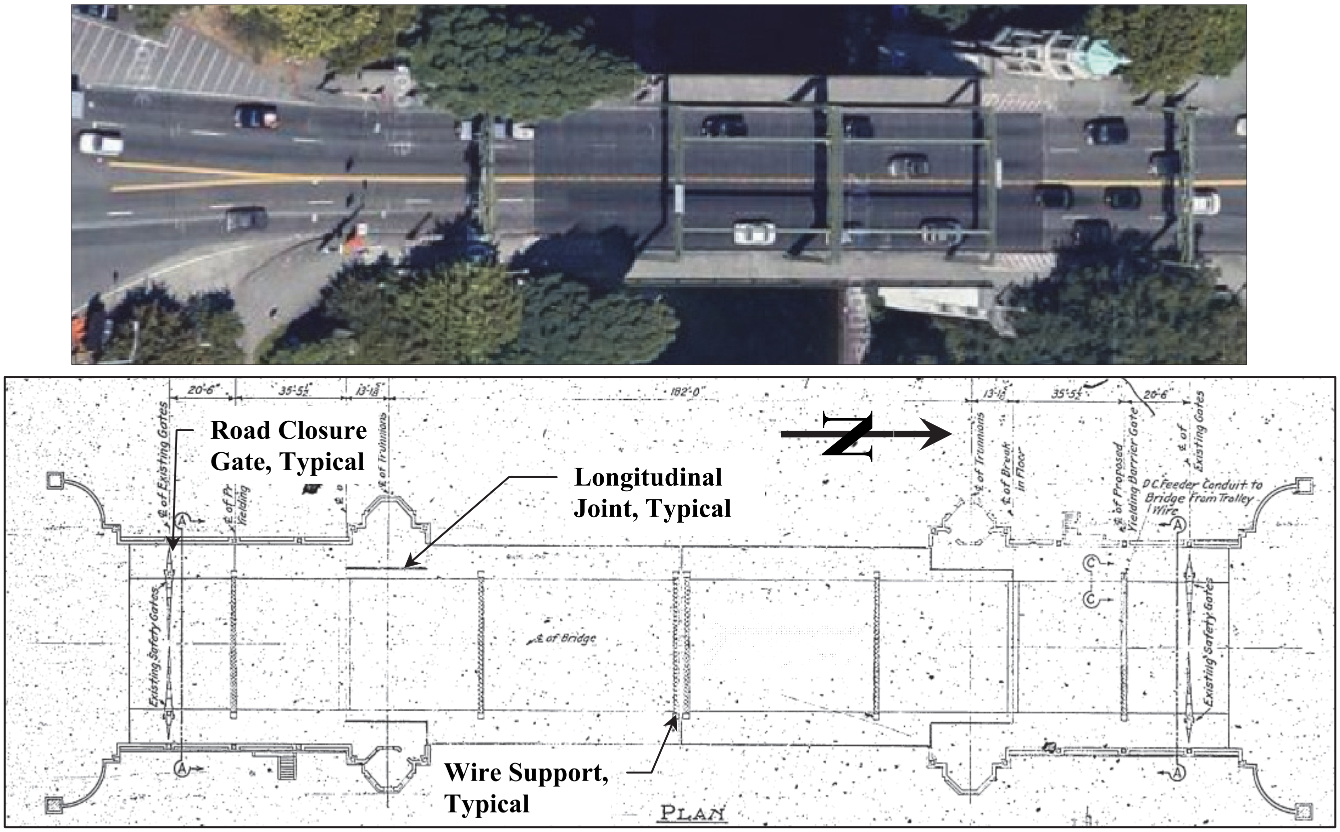

Figure 1.5 Existing Bridge Walkway Plan View

1.3 Existing Information and Background

The following existing documents, in conjunction with two site visits, and multiple meetings with City personnel provided the basis for the existing conditions analyzed:

- *Montlake Double Leaf Trunnion Bascule Bridge Plans 1925* - City of Seattle
- *Montlake Bridge HAER Record WA-108 Figures* - US Dept. of Interior
- *Center Lock Mechanism and Live Load Shoe Repair Plans 1994* - WSDOT
- *Bridge Live Load Rating April 1995* - Lin & Associates
- *Bridge Deck Replacement & Seismic Retrofit Plans November 1998* - WSDOT
- *Mechanical Rehabilitation Plans March 1999* - WSDOT
- *University of Washington Station Pedestrian and Bicycle Evaluation December 2008* - Grijalva Engineering
- *Construction Documentation as was available from 1995 & 1996*
- *Draft SR520 Project Enhancement March 2010* - Nelson/Nygaard
- *Technical Memo North Link FSEIS Addendum December 2010* - Heffron
- *Montlake Triangle Project Open House January 2011* - Sound Transit & UW
- *UW Burk-Gilman Trail Corridor Study July 2011* - SVR Design
- *Trolley Coach Overhead & Priority Route Corridors December 2011* - SDOT
- *Establishment of Triggers 2nd Montlake Bridge June 2012* - Nelson/Nygaard
- *Montlake Bridge Condition Inspection Report 2012* - WSDOT
- *SR520 Neighborhood Traffic Management Plan February 2013* - WSDOT
- *Montlake Bridge Bicycle Count Data April to June 2013* - SDOT
- *Seattle Bicycle Master Plan Update 2013* - SDOT

1.4 Existing Conditions

Rail and Walkways

The existing rails are the original system constructed in 1925. The ornamental steel rails used on the bascule bridge were shop fabricated and assembled in typical 15'-5.25" long panels matching at the existing bascule floor beams. These rails were brought to the field and then riveted to the walkway supports with four (4) 7/8-inch diameter field rivets as detailed on sheet 19 and 20 of the original 1925 Plans. This makes the rails of the bascule easy to remove and restore after any proposed walkway adjustments. The sidewalk of the bascule consists of 3.5 to 4-inch thick reinforced concrete supported by six steel channels, including one at each edge, each connected to riveted clip angles. The rails, walkway, and walkway support system are in satisfactory condition as noted in the WSDOT inspection report.

The approach rails and walkway are supported directly by the reinforced concrete curtain wall and reinforced concrete edge beam along the outside edge. These loads are transmitted directly to the spread footings. Because these concrete approach rails are poured in-place and integrally connected to the poured edge beams and curtain walls, the rails can only be modified through demolition and then new construction without re-use of the existing historic rails. The approach rails and sidewalks are also listed in good to satisfactory condition in the WSDOT inspection report.

Figure 1.6 Existing Approach Rail and Bascule Rails

Pedestrian and Bike Counts

The recent traffic data study by Seattle Department of Transportation obtained bicycle-crossing data and update pedestrian data. Including the using of past pedestrian counts from 2008, 2009, 2010, and 2011 as presented by Nelson/Nygaard (June 2012) demonstrated that the average pedestrian usage was approximately equal on the east and west side of the bridge at about 150 pedestrians per hour in the AM and about 200 pedestrians per hour for the PM period. This data also demonstrated the mix of users and that the majority of bicycle traffic occurs on the east side of the bridge. These past study results further demonstrate that pedestrian users were typically 33% more than the number of bicycle users on the east side of the bridge and about 300% more than the number of bicycle users on the west side of the bridge.

Data from SDOT's recent April to July 2013 bicycle counts indicated a similar pattern of bicycle usage with three times as many bicycle counts on east side of the bridge than on the west side. This follows the anticipated greater use of the Montlake Bridge as a connection between the Lake Washington Loop and Burke-Gilman trail. The recent study also indicated a peak hourly bicycle volume of about 215 bicyclists per hour between 5pm and 6pm during the week, but an even higher peak hour was obtained for select Sunday afternoon bicyclists at 220 bikes per hour between noon and 1pm. Similar to the historic data Nelson/Nygaard the utilized average bicycle counts were not consistent day-to-day or even week to week and varied greatly, possibly with the weather. In addition, special event variations were not noted. Current feasibility work of the project is limited structurally such that improvements are assessed against their costs to determine value for consideration, rather than an established targeted of 20-year projected pedestrian/bicycle use.

Metro Transit Use

The Montlake Bridge is part of the City and Metro's priority route plan with improvements including Transit Signal Priority (TSP), future extension of the overhead electric trolley wire north of the Montlake Bridge, and an anticipated increase in the number of buses crossing the bridge and using the existing trolley wire. As noted in Section 1 the existing large steel supports for the overhead electric wires create major constriction points on both the approaches and on the main bascule span. It would be operationally beneficial to the crossing pedestrians and bicycle users to eliminate some or all of these constriction points. However, in meeting with the City's transit specialist to understand the current uses, it was noted that Metro is expanding future uses of this overhead wire system. In addition, considering the narrow lanes on the Montlake Bridge for busses, the number of steel supports and their beneficial stiffness, these support systems could not be reduced without negatively affecting the system's reliability, safety of the bus drivers, and traveling public should reconnection be necessary. The frames are supported directly by the bascule truss below. Shifting the frames to span the additional 20-feet to load a cantilever support at the outside of the sidewalk was not possible. Therefore, this operational improvement was eliminated from consideration.

Figure 1.7 Route 43 - Hybrid Powered Bus Crossing

Bridge Historic Considerations

Overall, the Montlake Bridge is generally in fair to satisfactory condition. The bridge is well maintained including replaced center lock mechanism and buffer cylinders in 1994, seismic upgrade and new steel decking for the bascule in 1998, and mechanical/electrical repairs in 1999. The bridge, approach, and towers are a Seattle Landmark and on the National Register of Historic places. Retaining and restoring the Landmark Bridge's historic appearance is always a priority, however the design review process acknowledges that changes are often needed to extend the life of the property. This includes extending the useful life of the bridge by preventing functional obsolescence as may occur for the existing walkway. When preparing a project for design review, the following information is required: 1) *Define the Scope of the proposed project; 2) Document the present condition; 3) Describe the historic appearance; 4) Evaluating Alternatives and Most Appropriate Action.*

Permitting prior to initiating modification/restoration activities will include necessary pre-approval by the Washington State Office of Archaeology and Historic Preservation. Because of the structure's National Register, modification/restoration of the bridge would follow the *Secretary of the Interior's Standards for Rehabilitation*. The applicable criteria for cultural significance include:

- The structure's distinctive features and its Gothic architectural character in the design of its two operating towers and concrete approaches.
- The property's association with events of the area and adjacent to the University of Washington campus that have made a significant contribution to the broad patterns of our history.
- The property embodies the distinctive characteristics of a type, period, or method of construction and represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.

It is anticipated that methods of improvement to the walkways that do not damage the existing structure, rail, or historic appearance will be accepted and well received by the Landmarks commission as a demonstrated preservation of the structures' continued usefulness. Proposals that negatively affect the historic bridge such as revised bridge rails that negatively affect the appearance and without structural necessity for preservation of the bridge, will at the least require substantial mitigation and at worst may not be accepted.

Environmental Permitting

The Montlake Bridge is WSDOT owned and maintained and therefore with or without federal funding, WSDOT would be the lead agency. The environmental procession would commence with close coordination with WSDOT for the creation of an Environmental Classification Summary (ECS) and added necessary documentation listed in the Table 1.1 below. Typical project permits for the bridge's walkway widening will include those listed in Table 1.2.

TABLE 1.1 ENVIRONMENTAL PROCESS

NEPA	Documented Categorical Exclusion or Environmental Assessment.
SEPA	SEPA Checklist (Determination of Non-significance) or EIS (Determination of Significances). SDOT needs to include discussion on impacts to cultural resource and City landmarks (City of Seattle Ordinance 106348, CAM 3000).
Section 106 and 4(f) Evaluation	Due to historic nature of the bridge, (it is listed on the National Register of Historic Places) and evaluation of other cultural/historic resources as well.
Endangered Species Act Section 7	Biological Assessment/Evaluation or No Effects Letter

TABLE 1.2 PROJECT PERMITS

PERMIT	**TRIGGER REQUIREMENT (AGENCY)**
Shoreline Permit	Shoreline exemption or Substantial Development Permit (City of Seattle).
Section 401	Clean Water - Water Quality Certification - Trigger: obtaining Section 10 and Section 404. (Department of Ecology)
Section 10	Rivers and Harbors Act - General Bridge Permit (U.S. Coast Guard).
Coastal Zone Management Act (CZM)	Program Consistency Determination - if a federal nexus (Department of Ecology).
Hydraulic Project Approval (HPA)	Washington State Department of Fish and Wildlife (WDFW).
Street Use Permit	SDOT
Certificate of Approval and Determination of Non-significance	Bridge listed as a City Landmark and on National Register of Historic Places. (Seattle Landmarks Commission, Seattle Department of Neighborhoods, and WSDOT/DAHP)

Bridge Load Rating

The Montlake Bridge was load rated in 1995. The analysis and basic factors for impact, dead load, live load, redundancy and material type, were reviewed and are noted as correctly applied. The results of the load rating found that the steel truss and floor beams were not the critical members and significant redundancy is present with LRFD load rating for the HS-20 at 2.18 for the truss and 1.17 for the steel floorbeams. Therefore, modifications to the walkway within the main bascule span would not likely be limited because of load rating capacity. The reinforced concrete approach structures were verified as continuous longitudinal members and were the critical members for load rating. Where the streetcar rails were removed and the height difference filled with concrete the longitudinal slab structure capacity governs and spans as a cantilever continuous over transverse crossbeams. However, this governing rating is for loads within the central portion of the bridge roadway where the streetcar rails were located, concrete was used to fill, and where vehicle live loads occur. Modifications to the rail or walkway system would occur at the exterior only, which is not critical for load rating and has spread footing support. These adjustments at the approach walkways, if any, should not significantly affect the load rating. Final load rating adjustment would be reviewed along with any walkway proposal to assure no detrimental impacts to the final bridge load rating.

Bridge Mechanical and Electrical Systems

The electrical systems of the Montlake Bridge and some of the mechanical systems were rehabilitated in 1999 by WSDOT. Investigation of this rehabilitation and consideration of the bridge's mechanical system and its ability or limitations to lift additional weight from the walkway widening is beyond the scope of this study. To assure balance of the existing counterweight system and that the existing mechanical and electrical system is not damaged nor over-tasked beyond current design, a limitation that the new walkway must equal the weight of the existing system was established. This is however, an important limitation for which additional consideration could be made in a future scoped work.

Existing Signage

Existing signage from the Montlake Bridge along the Lake Washington Loop are well placed and easy to follow (see Figure 1.8). The established trail selected one direction down toward the lake and a different coming back match the roadway flow, and is successful. Signs from the Burk-Gilman trail to the bridge are not currently complete, but may be in a flux until the new bicycle and pedestrian bridge over Montlake Boulevard is finished. The sight distance can be improved at the Montlake Bridge by cutting back over growth on the adjacent trees, but the current signs are thought to match the present uses well without recommendations.

Figure 1.8 Typical Trail and Existing Montlake Bridge Signage

Road Closure Gates

Existing road closure gates and armatures are located within the sidewalk at each of the four corners of the bridge. The mechanical elements of the road closure gates are contained within large steel boxes and are operated from the control tower to close the road and sidewalk. The road closure armatures consist of one longer double folded armature for the roadway lanes and a single armature for the sidewalk (see Figure 1.9). These are existing safety elements, along with the traffic signal, that are operated to close the sidewalk and roadway areas to traffic before opening the bascule bridge. The foot print of the existing road closure gates is approximately 26-inches wide transverse by 32-inches long parallel to the length of the bridge. The four gates are constriction points on the bridge walkway with the narrowest on the southeast corner at approximately 6'-4" from face of approach rail to face of gate mechanical box. Other locations are less restrictive at approximately 7'-2" from face of approach rail to face of gate mechanical box, with similar clear width to that of the wire support frames. These road closure gates are safety features that cannot be eliminated. However, it is possible that other gate mechanical systems are available to replace the existing ones, which may have smaller foot prints and longer armatures that would thereby improve clearance between the existing approach rail and closure gate. A mechanical system might also be designed that could be attached at the first wire support frame on the north and south approach and therefore combined it into just one constriction point rather than two separate, which would eliminate four constriction points of the bridge. This mechanical research was not part of the current study, but could be added to explore improvements at these four constriction points without widening the concrete approach sidewalks.

Figure 1.9 Road Closure Gate at Southeast Approach

SECTION 2 IMPROVEMENT ANALYSIS

The Montlake Bridge is a critical link for pedestrians and bicyclists. In the Seattle Bicycle Master Plan Network, it is a constriction point in the connection between the major off street Burke-Gilman Trail and the neighborhood greenway connection to the Lake Washington Loop. The existing walkway width of the Montlake bridge is challenged by: 1) Major fluctuations in the bicyclist volume; 2) Anticipated increase future pedestrian/bicycle needs; 3) Massive steel fixed objects and longitudinal joints placed within the walkway; and 4) Combination of two-way slow moving pedestrians and faster moving bicyclists.

2.1 Operational Changes

SDOT does not consider the present Level of Service D as unacceptable and the need for bicycle traffic to reduce speed in order to safely share the existing walkway with pedestrians is not detrimental. Intermixing of shared bike and pedestrian to create optimum density as a facility at slower safe speeds is an objective for the City. Operational changes, if any, are made to improve constriction points and usage throughout the existing facility and not to eliminate the safe interaction of various users or create a bike thoroughfare. Operational considerations are made by defining the users, movement goals and location targets, and then facilities.

The Montlake Bridge users are a combination of two-directional slow moving pedestrians and two-directional fast and slow moving bicyclists. Unfortunately, these two user types also have very different speeds even along the bridge walkway with pedestrian walking speeds faster at mid-bridge locations than at the end intersections, while bicycle users are likely to have speeds that are more constant except that their speeds are extremely influenced by crowding and navigation of fixed objects in the walkway. In consideration of speed and volume density there is an optimum pedestrian speed under which the walkway will carry the largest volume of pedestrians. Because of the necessary navigation of numerous large fixed objects within the walkway that limit the use of the full walkway, this speed and density is also very different from the optimum speed and density for the bicycle users. Furthermore, the user types greatly influence each other.

Present movement goals for pedestrian users are the connection of local neighborhoods to the university/hospital, bus and transportation hubs such as the SR520 stop to the university/hospital and to a much lesser extent the Burke-Gilman trail and Lake Washington loop. Bicycle users will match some of the same movement goals and location targets of the pedestrians, but because distance range is not as critical, the Burke-Gilman trail and Lake Washington loop link are most important. Future Sound Transit Link light rail station as an anticipated terminus for

4,730 passengers per hour in 2016 and new SR520 developments will become very significant pedestrian movement targets in the area that are anticipated to drive the creation of dramatically large pedestrian volumes.

As discussed previously, pedestrian counts historical are greater than the bicycle counts indicating greater utilization of both the east and west Montlake Bridge walkways by pedestrians. Pedestrians are also very influenced by distance, weather, and feelings of comfort, much more so than bicycle users. Pedestrians also have a practical limitation as a mode of transportation of about one mile such that the areas of pedestrian generation and their target locations can be readily mapped out, bicycle users are not limited to this short distance. Also in consideration of a walking pedestrian, even a short distance will greatly affect the pedestrian's choices more so than for bicycles. For instance in considering operational changes at the Montlake Bridge the east walkway might be selected as bicycle only and the west walkway as pedestrians only. Normally such a selection may make reasonable sense since as depicted in Figure 1.1 bicycle trail users between the Burke-Gilman trail and Lake Washington Loop use almost exclusively the east walkway, and the west walkway has therefore only about 1/3 of the bicycle volume of the east, though east and west walkways are identical and globally serve nearly identical purpose. The pedestrian volumes however are nearly equal between both the east and the west walkway. To close the east walkway to pedestrians via directed signs will add significant wait time for half the pedestrian users at both the NE Pacific Place intersection and again at East Shelby Street as they cross back to reach their original destination generation points. To a pedestrian user this distance will also seem to add nearly double the walking distance of this one segment and the time added will be a large portion of that pedestrian's full travel duration such that pedestrians will just not follow the signed directions and the separated facility will not be successful. Similar arguments for bicycle users occur as their use is shifted exclusively to one side of the bridge. While the added wait time and distance will seem extremely insignificant relative to the full travel time and distance of the bicycle user, it will become a nuisance rather than a routine travel delay and direction from the signs would likely be disregarded instead of followed effectively eliminating any planned benefit from a single user walkway facility. This and other discussions made in meetings with the City concluded that the possible use of user specific sides of the bridge and/or directional sides of the bridge was eliminated from consideration as not beneficial.

Bicycle Usage

Bicycle and pedestrian traffic counts were obtained and provided from Seattle DOT Traffic Management Division for the period between April and July 2013. Pedestrian usage is significantly higher than bike usage as they had for the years 2008, 2009, 2010, and 2011. From the data, trends in the bicycle counts made are highly variable, even day over day. The significance of fluctuations in usage can be quantified by example in the City's count data on Wednesday May 1st showing the peak hourly volume between 5pm and 6pm of 215 bicycle trips and that this is more than four times the average hourly of 55.8 trips and median of 49.5 trips. This high variability is expected to increase with the Sound Transit station as passengers who enter or leave the station will come in surges to either catch trains, exit trains, or possibly off loading from the bus and Metro system connections at SR520, especially with SR520 tolling increased costs.

Operational speed is also a significant consideration of the bike usage. Bicycle users will consist of both commuters that are riding at faster speeds and slower riders that use the system's facilities for pleasure and not commuting. The approaching trail connection north of the Montlake Bridge are wide, open trails, with grades conducive to fast movements on a bike. Approaches south of the bridge are joint use roadways and therefore speeds are again high. With all approaches to the Montlake bridge favorable to and encouraging of faster bicycle movements, speed adds to the challenge, impact of narrowness at the existing Montlake Bridge walkway.

Walkway Capacity

Major variables influencing the walkway capacity for the Montlake Bridge include:

- User Type (bicycle or pedestrian)
- User Maneuverability and Effects of Fixed Objects and Obstructions
- Speed and Direction
- Signage
- Passing (and on which side?)
- Crowding and Density
- Weather and Visibility
- Bridge Openings and Special Events at the University

Traffic movement and flow longitudinally along the bridge is highly disjointed. Each walkway includes nine major obstructions along the length of the bridge, each precluding the full use of the walkway width and requiring significant maneuvering, timing and speed adjustment, as well as layering of users. Five constrictions are at the large steel overhead wire support frames. Two constriction points, one near each end of the bridge, for the large road closure mechanical armature. As well as two approximately 26.5-foot long longitudinal joints, one at each bascule trunnion to allow for the bascule bridge rotation. At some points for a short distance, reducing the walkway width by 37% to only 6'-4" at the road closing mechanical armature (see Figure 1.2) or reduced by 27% to 7'-2" at the steel overhead wire support frame (see Figure 1.3). At the longitudinal joint the walkway width is reduced 31% for a significant 26.5-foot length to only 6'-9" (see Figure 1.4).

Speed is also an important consideration where bicyclists approaching from the wide and open trails with favorable grades are at relatively high speeds. Then at the Montlake Bridge, the two very different movements of the fast moving bicycles are combined with slow moving pedestrians, which are easily over taken by the faster bicycles. These passing movements taken with the narrowing points and the two directional component of the bridge also does not always allow for a normal designation as to which side for passing, nor does it give pedestrians adequate time to react. Reduced sight lines from trees also created conflicts between pedestrians and bicyclists. Influences of layering for the same and opposite direction movements, fast and slow speeds, nine constriction points, and peak and low travel volumes; created high reduction in the user speed, crowding, and reduced capacity.

Level of Service

The minimum standard width for multipurpose (combined bicycle and pedestrian users) has been recommended by the City at 10-feet and national standards from the AASHTO Guide for Planning, Design, and operation of Bicycle and Pedestrian Facilities have increased standards to 14-feet of usable full walkway width. Current level of service has been documented as operating at Level-of-Service (LOS) D with individual speed selection and ability to bypass others restricted, as well as frequent changes in speed and position required. With anticipated increases in pedestrian usage from the SR520 and Sound Transit improvements, by the year 2016 the level-of-service is expected to fall to LOS F with significant waiting times, walking by shuffling, unavoidable contact with others, and would not serve most bicyclists.

Figure 2.1 View of Current Peak Usage at Typical Constriction

(A) Operation Recommendations

The Operational recommendations are grouped for specific applications relative to timing and/or associated triggers as follows:

Immediately Recommendations

- Use a bicycle speed advisory sign to further moderate bike speeds and reduce the negative effects of differential speed's on the capacity and level of service at the Montlake Bridge
- Update the pedestrian bridge counts and conduct a survey to understand the directional influence of travel and also the pedestrian/bike user split

After Structural Modifications or included under Temporary Observation

- Include a 4-foot pedestrian lane along the rail with a solid paint line broken at the constriction points to direct and designate slower pedestrian movements to one side only and the faster bicycles to one side only

At Level of Service F: Walking by shuffling with frequent unavoidable contact

- Removal of the above pedestrian lane paint stripe.

- Addition of directive signs and required bicycle dismount at ends of the bridge to eliminate passing/overtaking actions and mitigate constriction points and simplify considerations to that of a single user type facility.

2.2 Structural Modifications and Bridge Walkway Widening

This section explores the opportunities to widen the Montlake Bridge and approach walkway. The existing Montlake Bridge walkway width is less than the 10-foot width multi-use facility originally established as criteria in meeting with the City of Seattle. The existing width is further narrowed, at some locations to only 6'-4" clear width, by large fixed objects in the walkway. Widening of the walkway and the associated necessary structural modifications will work to mitigate the narrow points, enhance user safety, and improve or maintain the level-of-service as future demands increase. Work of this section explores:

– Existing Montlake Bridge systems' ability to accept a wider walkway
– Establish assumed Criteria for walkway widening
– Develops, per current criteria, material types and the maximum widening
– Provides cost estimate, scope, and schematics for the proposed widening

(A) Bridge Assessment for Walkway Widening

The existing bridge Plans, WSDOT Inspection Reporting, and load rating calculations were considered in detail. A widening of the walkway at the approach structure is located over the exterior wall and foundations. Therefore widening of the approach walkway would likely have little to no negative effect on the approach bridge's capacity. The bascule span walkway however is supported differently than at the approach bridge structures and a widening could adversely affect the bascule bridge. Loading from a bascule walkway widening is first transmitted through intermediate walkway supports to the exterior trusses at each of the intermediate transverse floorbeam locations. The load at the truss node points is then transmitted internally as stress and strain of the truss members and ultimately again as force to the trunnion and load support shoes. This force caused from a bascule walkway widening finally is transmitted into the foundations supporting the bascule bridge. A widened bascule walkway could also negatively affect the mechanical and electrical systems necessary to lift and open the bascule spans. Fatigue of the steel members and useful life impacts from a walkway widening are also important considerations.

Considering the bascule bridge's live load rating and inspection condition, the bascule bridge structure is not limiting the widening available. The fatigue life of the bridge steel and useful life of the bridge are also not negatively impacted by a proposed walkway widening. The steel truss is susceptible to only fatigue caused by frequent cyclical loadings that generate cyclical tensile stress. The dead load, if any added by the walkway, is not a cyclical loading and the pedestrian live load will not create tensile cycles of significance that would degradation the steel members remaining life, as a large truck might. Furthermore, riveted built-up steel members, as was utilized to fabricate the Montlake truss and floorbeam members, have very low susceptibility to fatigue and are fatigue detail Category B members.

The bridge member inspected conditions are also satisfactory and the most critical load rating members of the bascule bridge truss have significant reserve capacity to transmit most widenings, probably up to 5-feet wider at each side. The foundation system, bearings, and load shoe also appear to be adequate for such a widening. The walkway support brackets however are spaced at 15'-5" on center and an added 5-foot widening would require further verification including considerations specific to the material type and added weight applied, but still might be acceptable with local strengthening of the support bracket members. The mechanical and electrical systems however are also challenged from proposals that increase the bascule weight and the counterweights would require rebalance. These verifications and calculations are beyond the current scope of work and therefore are the limiting assumptions.

Assumed Walkway Criteria

The following criteria are developed for the walkway widening/modifications:

1) Approach bridge walkway may be widened without further load considerations.
2) The bascule bridge walkway may be widened only to the extent that the weight of the new wider system is equal to existing and therefore not impacting the mechanical and electrical systems.
3) Bridge rail systems shall have similar weight to the existing, to not impact the mechanical and electrical systems.
4) Materials selected for the widening shall have similar and/or comparable maintenance and useful life to that of the existing bridge and walkways.
5) Modifications and widening adjustments to the historical structure must be permitted and shall modify the structure to the least extent possible.

(B) Alternatives for Walkway Widening

Bascule Bridge and Materials

Materials considered for the bascule bridge have included carbon fiber, FRP, timber, steel, concrete, and prestressed concrete. Timber has an excellent weight to strength ratio, but does not match the maintenance requirements of the existing system and was eliminated. Carbon Fiber was possible from strength and durability standpoint, but was unreasonably expensive and could not be successfully applied to this case. FRP beams could be created that would match the strength requirements with necessary weigh benefits but was extremely flexible at 1/10 the Modulus of steel and could not be utilized without extreme changes to the existing structure for additional bracket supports and was therefore eliminated. Concrete is much lighter than steel with a high durability, but because of the span required between existing brackets it could not be successfully utilized. Prestressed concrete may be possible, but because the bridge is lifted and lowered as a bascule span the center of gravity relative to prestressing will create forces that could destroy the system. The most applicable system developed for this project's criteria was the use of an Exodermic deck system. This system consists of a composite steel deck that is cast integral with a toping of lightweight concrete and acts as the formwork for the pour, which allows for high strength, rapid construction, and the durability of a composite concrete deck. The calculations worked out directly with the manufacture demonstrate that the combined system would be 6.45-inches thick, can be used to widened bascule bridge walkway 18% from 9'-4" to 11'-0" wide without increase in weight. The deck would need to be temporarily shored at quarter points, a very simple matter, during casting of the lightweight concrete, but will support the AASHTO 90psf live load capacity and has a deflection of only L/951 under full live loading. The proposed exodermic deck system consists of shop-fabricated panels that are galvanized, easily placed in the field as single units and cast composite with lightweight concrete meeting all criteria including weight, useful life expectancy, maintenance, and inspection.

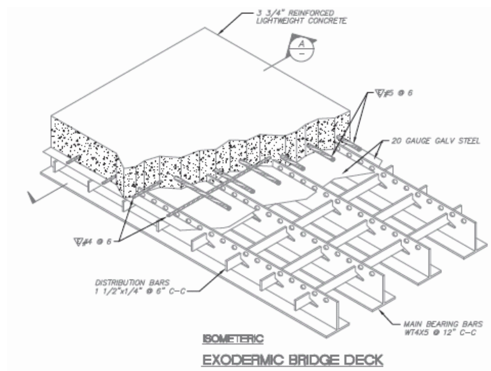

Figure 2.2 Galvanized Steel Exodermic Deck System

The existing Montlake Bridge ornamental steel rail was shop fabricated as typical rail panels and installed in the field via four 7/8"-diameter rivets at support bracket every 15'-5" on center. The work of this walkway widening would therefore remove the four field rivets, take the rail in typical panels to the shop for preparation and painting. After shop preparation of the rail and installation of the composite galvanized exodermic deck, the existing bridge rail would be brought back to the field and again installed with four 7/8-inch diameter high strength bolts without modification. This work uses the existing historic bridge rail and support, does not change the historic appearance of the structure in anyway, and would be permitted per the *Secretary of the Interior's Standards for Rehabilitation*.

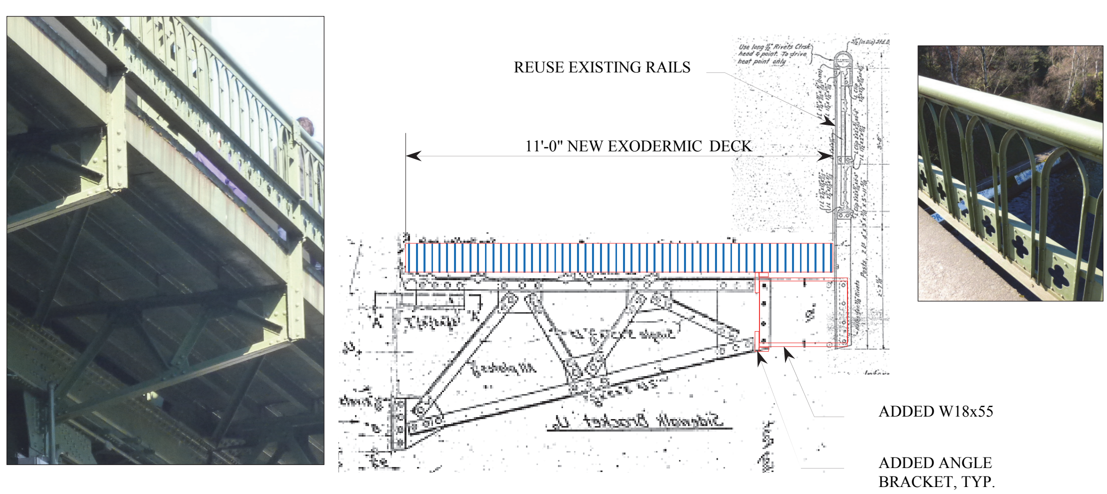

Figure 2.3 Existing and Revised Bascule Bridge Walkway

Figure 2.4 Portion of Rail Removal for Walkway Widening

Approach Bridge

At the Montlake approach bridge, the walkway and rail system were cast as integral with each other during the original construction. Architectural relief, edging, and features of the rail are significant throughout the bridge approaches and match the towers. Since the approach walkway cannot be widened without permanent damage and removal of the existing rails that aid in creating the Gothic architectural characteristics of the historic bridge and landmark designation, it may not be permitted. Initial discussions with WSDOT/DAHP indicated an understanding of the proposal, and the possibility of acceptance at the state level, but the replacement details and mitigation requirements could not be identified. Because the widening is not fundamental to the bridge's structural rehabilitation and preservation, and the current proposal would damage the structure's historic characteristics, it is possible that this work may not be permitted. This proposal and permitting for the rail replacement should be explored separately with the State, the US Dept of Interior, and the Seattle Department of Neighborhoods to determine feasibility.

From a structural standpoint, the widening of the approach bridge is feasible. As discussed under the heading *Bridge Load Rating* of page 1.8, the reinforced concrete approaches are the critical members of the bridge's live load rating. Yet again, the governing member is the continuous interior longitudinal slab structure where vehicle live loads are applied. The approach walkway widening, however, occurs over the exterior support wall and spread footings with a direct foundation support such that the governing load rating will not be affected. Widening at the existing towers is not possible and remains a constraint. For cost estimating and comparison purposes, a 4-foot approach walkway widening to a general approach width of 14-feet is selected.

Cost Estimate

The project cost estimate for this walkway-widening alternative of both the east and west bascule walkway is approximately $3,648,000 as detailed in Appendix A. The work is for the widening of the walkway on the existing bascule bridge only approximately 91.5-feet long at the four quarters of the double leaf bascule. This includes the removal and shop repainting of the existing bridge rail, as well as its reinstallation after the widening. The work will be staged construction with one sidewalk to remain open at all times and shall require significant nighttime work and traffic control. Demolition will include saw cutting a portion of the existing rails at each end of the bascule and removal of the existing walkway concrete and steel channel stringers. Shop fabricated exodermic deck panels will be installed, bolted to the existing walkway brackets, and the system cast composite with lightweight concrete. Construction may require four months including steel order, fabrication, and installation. Assuming permitting for the approach could be obtained, but is not certain due to historic preservation concerns, an estimate is also provided in Appendix A that includes demolition of the existing approach rail, widening of the east and west approach walkway by an additional 4-feet, and use of a decorative baluster type bridge rail. The project cost for this alternative if permitted is approximated at $5,681,000 plus mitigation costs as required by permits.

2.3 New Bascule Bridge for Pedestrians/Bicycles

Location

The construction of a separate bascule bridge structure for bicycle and pedestrian traffic is possible. Two crossing locations were evaluated and considered. The first location was immediately adjacent to and east of the existing bridge and a second location still further east near McCurdy Park. The location immediately east of the bridge (see Figure 2.5) has the best connections to the existing trail and Lake Washington loop such that the existing Montlake Bridge walkway could be utilized exclusively for pedestrians. It also has access advantages and similar geographic contours with the existing bridge eliminating some approach structures that would be necessary at the other location. Finally, this location allows for simultaneous operation of the lift bascule from the existing southeast tower reducing on-going maintenance costs and the initial capital costs. One significant detriment to this location is that its footprint is at the same point as the WSDOT proposed new northbound bascule bridge structure and would therefore have to be demolished in the future if the SR520 second bascule bridge over Montlake cut continued forward.

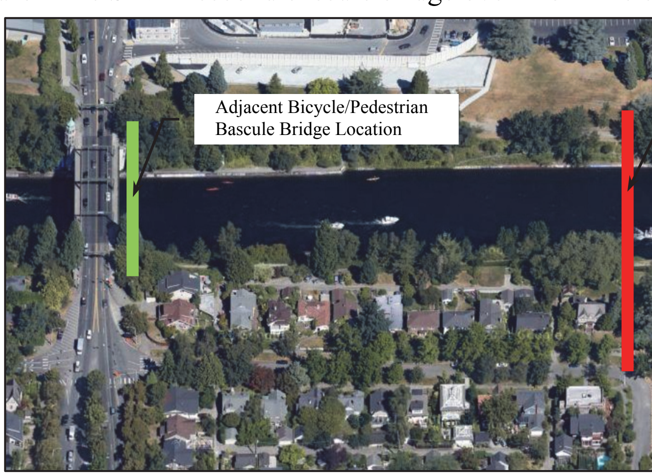

Figure 2.5 Approximate Bascule Bridge Locations

General Criteria

The bridge will be designed for pedestrians and bicycles, but signs would be utilized to focus bicycle users to the new bridge facility. Three possible bascule type bridges are applicable for the bicycle/pedestrian bridge including a double leaf trunnion, a rotational swing bridge, and a vertical lift bascule. The alternative types have not been explored to resolution, but the vertical-lift bridge is anticipated as the most cost effective. As a Vertical-lift bridge, the machinery is half that of the double leaf and swing bascule, but the maximum lift height is limited for this bascule type, which is significantly different from all the other City bascule bridges, which have no limited height clearance once opened. The new bridge would be relatively lightweight using a standard steel Pratt type truss including an 18-feet wide usable concrete deck and steel tube rails. Pedestrians will likely continue to use the existing Montlake Bridge walkway as the shortest route, while bicycles would use the new facility as the fastest connection. If located adjacent to the existing bridge, it is assumed that the narrow bascule bridge can be constructed within the existing right-of-way and would be operated from the existing Montlake Bridge tower. Additional right-of-way is still required at either possible bridge location. Adjacent to the existing bridge would have impacts to the south property access requiring purchase of the property, and the more easterly location required right-of way at both ends of the structure.

The bascule would be similar in length with the Montlake Bridge at about 200-feet long and with the approaches would be have a total length of about 360-feet for the adjacent location or about 500-feet for the bridge located farther east. The bridge would be constructed having a closed position clear above the water of 53-feet, which is better than the Montlake Bridge's 46-foot clear in the closed position. In past coordination from the City of Seattle with Corps of Engineers and US Coast Guard, the vertical lift position needed a 140-foot clear above the water. Therefore, this conceptual bridge design is assumed to lift the bridge 140-feet above the water, or another 90-foot above its down and locked position. This equates to an approximately 100-foot tall tower that would be located 1,800-feet from UW's fountain. It may not be visible depending upon specific elevation, but would have to be reviewed with the University of Washington for approval and affect on the Mount Rainer view at the campus fountain. (Example Vertical Lift Bridge across the Columbia River to Vancouver Washington, the raises 136-feet above the roadway.)

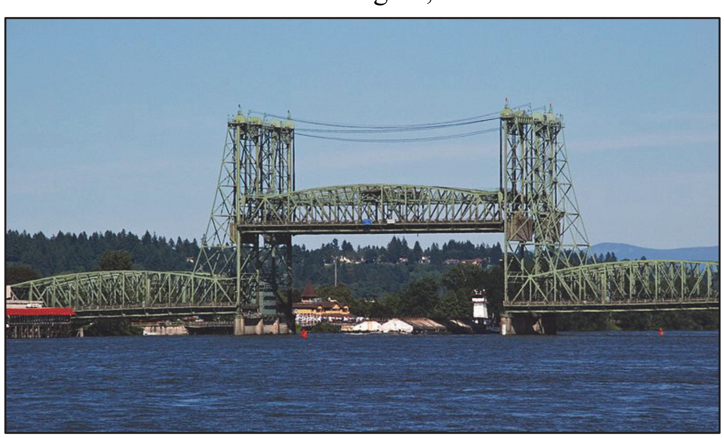

Figure 2.6 WSDOT Vertical Lift Bridge at Vancouver WA

Cost Estimate

The cost estimate for this project is developed on an approximate square foot basis using information provided from King County for the South Park Bascule bridge and approaches that are currently be constructed for approximately $96 million dollars. It is assumed for cost estimating purposes that the narrow bascule bridge can be constructed within the existing right-of-way. New project costs for the bicycle/pedestrian bascule bridge are estimated at about $25 to $40 million.

SECTION 3 CONCLUSION AND RECOMMENDATION

3.1 Feasibility, Engineering Recommendations, and Discussion

Widening of the existing bascule bridge walkway is feasible and is recommended. In this proposal, a lightweight exodermic deck system is used to replace the existing walkway with a wider walkway, at the same weight without increase. The existing rail of the bascule bridge is also preserved and its connection is conducive to the proposed widening construction as shown in Figure 2.3 and 2.4. The recommended walkway system will provide a widening along the east and west bascule walkway of almost 2-feet. This provides approximately 605-square feet of added walkway area at a project cost of approximately $3,648,000 (see Table 3.1). This proposal enhances the usefulness of the existing structure by mitigating contraction points without negative impact to the structure's historic character or landmark status. The ten challenging constriction points improved include six at wire support structures and the four longitudinal joints. Unfortunately, the extent of added width recommended is limited because of the criteria established. The criteria was to equate existing and new walkway weights and thereby maintain the existing load rating, eliminate possible challenges for the existing mechanical and electrical systems, and help assure WSDOT's acceptance. To increase the widening available a study of the bascule lift system's capacity could be initiated and any reserve discovered used to increase the bascule widening. The current widening proposal is also for the bascule structure only. This is because permitting for the demolition and replacement of the approach rail, necessary for approach walkway widening is not anticipated as allowed. Again, this permitting criteria limitation of the proposal must be reviewed in detail and contacts made with the State and US Interior agencies. If permitting is possible, a widening for the shorter approach structures could also be undertaken and the Montlake Bridge concrete approach rail system replaced.

Operational changes were also considered to improve and mitigate the narrow walkway and level-of-service that is anticipated to approach LOS F after construction of the Sound Transit Link Station and SR520 Bridge improvement. Several steps w outlined to continue further investigation of the operation improvements. However, because of surges in volume from light rail combined with the fluctuation in bicyclist volume and the speed differential between users given the number of major fixed objects in the walkway, it is anticipated that the year 2016 peak volumes of pedestrian traffic will required dismount of all bicyclists before crossing the bridge. This change is expected to alleviate the LOS F condition since the bicyclists are very susceptible to the influence of crowding. Speeds would be reduced, but the level-of-service will be improved for all users by trending toward a more uniform user type with common speeds. This allows more time to react to multi-direction flows, narrow points, and with the elimination of the overtaking movements, it will increase safety at the fixed object narrow points. This recommended operational change is a dramatic relative to current usage and as discussed in Section 2.1 is not recommended until the level-of-service is consistently failing and operating in a LOS F condition.

TABLE 3.1 SUMMARY OF PROJECT ALTERNATIVES

Alternatives	# of Unmitigated Constriction Points	Minimum Constriction Width	Walkway Total Area	Anticipated Impact to Historic Character	Conceptual Project Cost
Existing Walkway	18	6'-4" (Approach)	6,562 SF	-	$0
Bascule Walkway Widening (Only)	**8**	**6'-4" (Approach)**	**7,167 SF**	**Negligible**	**$3.65 Million**
Approach & Bascule Walkway Widening	0	9'-0" (Bascule)	8,518 SF	Very Significant	$5.68 Million + Mitigation
Unchanged Existing Walkway and New Bridge	18	6'-4" (Approach, but pedestrian use only)	13,762 SF	Significant (adjacent structure)	$25 Million to $40 Million

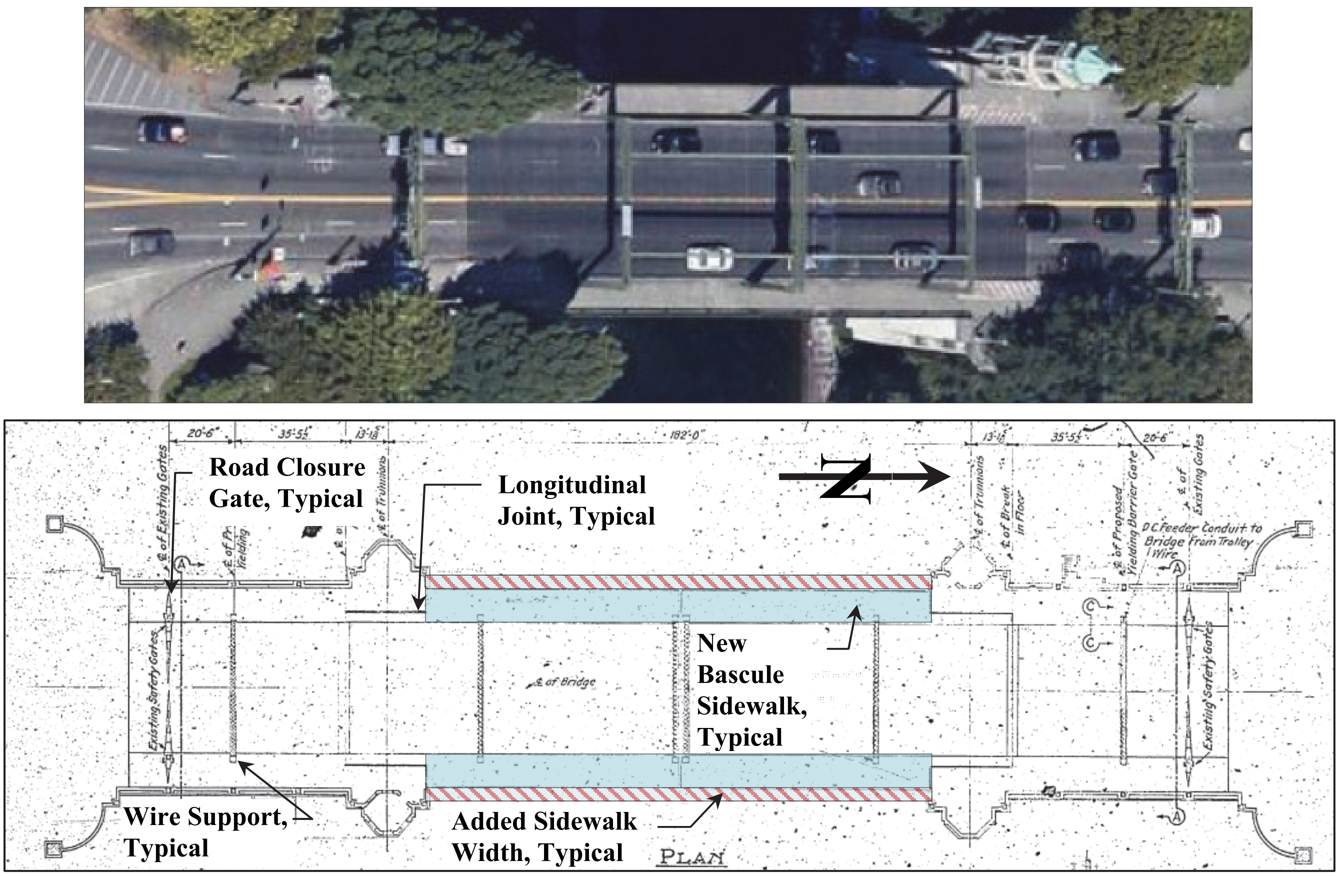

Figure 3.1 Recommended Bascule Walkway Widening

Appendix A: Walkway Widening Alternative Cost Estimates

- Bascule Only Walkway Widening Alternative
- Approach and Bascule Walkway Widening Alternative

BASCULE ONLY WALKWAY WIDENING ALTERNATIVE*

Sept., 2013

Quantity Summary East and West Widenings (Conceptual - Technical Report)
CITY OF SEATTLE - Montlake Bridge No. 513/12

Bascule Walkway Widening Alternative

Traffic Control, removal of existing rail, shop painting, and restoration, demolition of existing bascule bridge walkway, modification of existing supports, installation of exodermic walkway deck and casting of composite lightweight concrete.

BASCULE ONLY WALKWAY WIDENING

BID	ITEM DESCRIPTION	QTY	UNITS	UNIT PRICE	UNIT PRICE EXTENSION	
	PREPARATION					
104901	Minor Changes	1	LS	$25,000	$25,000	
105005	Construction Surveying	1	LS	$20,000	$20,000	
107110	Community Communications Officer	250	HR	$100	$25,000	
109005	Mobilization	1	LS	$108,492	$108,492	
110005	Maintenance and Protection of Traffic Control Incl Flagging	1	LS	$50,000	$50,000	
110020	Traffic Control Peace Officers	250	HR	$100	$25,000	
	Temporary Removal of Bascule Pedestrian Rail	1	LS	$40,000	$40,000	
	Demolition of Existing Bascule Walkway	1	LS	$72,800	$72,800	$366,292
	STRUCTURE					
	Bascule Walkway Widening					
	Install Modification to Intermediate Walkway Support	20	EA	$4,000	$80,000	
	Install Modification to End Walkway Support	4	EA	$5,000	$20,000	
	Walkway Deck System & Lightweight Concrete	1	LS	$310,596	$310,596	
	Shop Cleaning and Painting Existing Pedestrian Rails	1	LS	$63,700	$63,700	
	Installation of Existing Bascule Pedestrian Rail	4	EA	$8,000	$32,000	
	Falsework	1	LS	$50,000	$50,000	
	Containment	1	LS	$50,000	$50,000	
	Minor Repairs	1	LS	$25,000	$25,000	$631,296
	OTHER ITEMS					
801001	Construction Stormwater and Erosion Control Plan (CSECP)	1	LS	$5,000	$5,000	
801002	Tree, Vegetation & Soil Protection Plan (TVSPP)	1	LS	$5,000	$5,000	
801003	Spill Plan	1	LS	$5,000	$5,000	$15,000
				Sub-total	$1,012,588	
				Estimating Contingency	$405,035	
				Sales Tax	$141,762	
				Engineer's Estimate	**$1,559,385**	
				Design & Permitting	$779,692	
				Design & Permitting Contingency	$155,938	
				Construction Management	$701,723	
				CM Contingency	$140,345	
				Construction Contingency	$311,877	
				***TOTAL PROJECT COST**	**$3,648,960**	

* Note: Mitigation Requirements for Bascule Walkway Widening are not known, if any, and are not included.
Right-of-Way is not anticipated and no costs are included.

APPROACH + BASCULE WALKWAY WIDENING ALTERNATIVE*

Sept., 2013

Quantity Summary East and West Widenings (Conceptual - Technical Report)
CITY OF SEATTLE - Montlake Bridge No. 513/12

Approach 4-FT widening and Bascule 1.75-FT Walkway Widening Alternate

Traffic Control, removal and salvage of existing steel bascule rail, saw cut concrete approach rail and demolition, demolition of existing bascule bridge walkway, connection to existing approach wall and walkway construction, modification of existing steel bascule walkway supports, installation of exodermic deck walkway and casting of composite lightweight concrete, shop painting, restoration, and installation of existing steel bridge rails, forming and casting of new approach rails, and revised HAER Permitting

BASCULE & APPROACH WALKWAY WIDENING

	BID ITEM DESCRIPTION	QTY	UNITS	UNIT PRICE	UNIT PRICE EXTENSION	
	PREPARATION					
104901	Minor Changes	1	LS	$40,000	$40,000	
105005	Construction Surveying	1	LS	$20,000	$20,000	
107110	Community Communications Officer	250	HR	$100	$25,000	
109005	Mobilization	1	LS	$168,912	$168,912	
110005	Maintenance and Protection of Traffic Control Incl Flagging	1	LS	$75,000	$75,000	
110020	Traffic Control Peace Officers	250	HR	$100	$25,000	
	Temporary Removal of Bascule Pedestrian Rail	1	LS	$40,000	$40,000	
	Sawcut and Demolition of Existing Approach Rail	305	LF	$125	$38,125	
	Demolition of Existing Bascule Walkway	1	LS	$72,800	$72,800	$504,837
	STRUCTURE					
	Bascule and Approach Walkway Widening					
	Install Modification to Intermediate Walkway Support	20	EA	$4,000	$80,000	
	Install Modification to End Walkway Support	4	EA	$5,000	$20,000	
	Walkway Deck System & Lightweight Concrete	1	LS	$310,596	$310,596	
	Widened Approach Walkway & Supports	1288	SF	$125	$161,000	
	Shop Cleaning and Painting Existing Pedestrian Rails	1	LS	$63,700	$63,700	
	Baluster Type Traffic Barrier	305	LF	$375	$114,375	
	Installation of Existing Bascule Pedestrian Rail	4	EA	$8,000	$32,000	
	Falsework	1	LS	$75,000	$75,000	
	Containment	1	LS	$75,000	$75,000	
	Reconstruct Salvaged Bridge Lamp Post and Lighting	20	EA	$2,000	$40,000	
	Minor Repairs	1	LS	$35,000	$35,000	$1,006,671
	OTHER ITEMS					
801001	Construction Stormwater and Erosion Control Plan (CSECP)	1	LS	$5,000	$5,000	
801002	Tree, Vegetation & Soil Protection Plan (TVSPP)	1	LS	$5,000	$5,000	
801003	Spill Plan	1	LS	$5,000	$5,000	
	Replacement Tree Mitigation	1	LS	$50,000	$50,000	$65,000
				Sub-total	$1,576,508	
				Estimating Contingency	$630,603	
				Sales Tax	$220,711	
				Engineer's Estimate	**$2,427,822**	
				Design & Permitting	$1,213,911	
				Design & Permitting Contingency	$242,782	
				Construction Management	$1,092,520	
				CM Contingency	$218,504	
				Construction Contingency	$485,564	
				***TOTAL PROJECT COST**	**$5,681,102**	

* Note: Widening of Approach Walkway may not be permitted due to historic preservation concerns. Also Mitigation Requirements, if widening is permitted, are not known and mitigation costs are not included. Right-of-Way is not anticipated and no costs are included.