Alaskan Way Viaduct Partnership
Scenario Development Documentation

Portfolio 4.3: Rapid Trolley Network

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METRO

Table of Contents

Portfolio Objective

The eight Alaskan Way Viaduct scenarios describe the inclusion of various intensities of a Rapid Trolley Network; low, medium and high. This portfolio is intended to define and establish design concepts for a Rapid Trolley Network in addition to defining networks specific to each scenario. The concepts included in this portfolio could be used irrespective of the final outcome chosen for the Alaskan Way Viaduct.

Background

The Metro Transit electric trolley bus network has several high ridership routes within a compact service area. Metro's current trolley bus network includes 159 coaches (100 standard coaches and 59 articulated coaches) serviced at Atlantic Base. The electric trolley bus network includes some of the most productive routes in the transit network, as measured in rides attracted per platform hour and carries about 25 million riders annually. The electric trolley bus routes serve the urban centers of Downtown Seattle, Uptown and South Lake Union, Capitol Hill and First Hill, the University District, as well as Ballard, the Central Area, Madrona, Beacon Hill, and the Rainier Valley. Most electric trolley bus routes are on former streetcar lines. The electric trolley bus network serves 1st and 3rd avenues in downtown Seattle, as well as several key east-west streets.

System Definitions: Rapid Trolley Network

Incorporating elements of RapidRide service to the electric trolley bus network, including priority through traffic, enhanced roadway presence, improved passenger facilities and real-time information could greatly benefit electric trolley bus riders. The inclusion of streetcars in this zero-emissions network would be dependent on resources available and willingness to invest in the infrastructure required for streetcars, including the minimum service levels described below. Expansion of the electric trolley bus network may not be necessary, as service efficiencies might be achieved though identifying possible route restructures. However, additional wire segments and substations may be desirable, so that trolley routes will have the ability to provide transit connections at the Link LRT stations.

The expansion of the electric trolley bus network would mitigate transit's impact on global warming. Metro's trolleybus operations consume 60% less direct energy consumed per passenger mile (1300 BTUs per passenger mile) than Metro's diesel fleet, (3300 BTUs per passenger mile) (2006). Service delivery characteristics for the network might include some of the same operational components in the RapidRide BRT system. Service design and stop spacing in particular will reflect the topographical and geographical environment in which they operate and the travel purposes for which they will be used. The below sections provide definitions of the key elements of a Rapid electric trolley bus network.

Service: Frequency, Span and Ease of Use

Frequent service is an essential component to provide direct service. Increased frequencies attract ridership and can make it easier for riders to use the system by providing reliable headways.

Service headways will be a minimum of 10 minutes on electric trolley bus routes, with some routes operating with 6 to 7.5 minute headways in the peak period (6-9 am, 3-6 pm). These headways could effectively address the demand for service between 5 am and 8 pm. Headways of 15 minutes from 8 pm until at least midnight would provide valuable night service for many areas that remain busy during these hours. This meets the frequency goals of the Urban Village Transit Network plan adopted in the Seattle Transit Plan. The span of service on the electric trolley bus network, from 5am to at least midnight may be supplemented with early morning OWL trips.

To increase ease of use and understanding of the trolley bus network, one option would be to add the electric trolley bus network as a component to the Rapid Network with branding somewhat distinct from RapidRide, which uses hybrid diesel buses. The rapid electric trolley bus network could also be added as a branch of RapidRide, providing fast, reliable and frequent trolley bus services.

Stop spacing

For the North American transit industry, stop spacing of ¼ mile is considered best practice and is consistent with the Seattle Transit Plan. With bus rapid transit systems, the stops are often spaced no less than ½ mile, in order to achieve higher operating speeds and overall time savings. Due to the characteristics of many trolley routes, ¼ mile average spacing would be most appropriate. Wider stop spacing along the main portion of the trolley routes would coaches to keep up operating speeds when passenger loads are the highest.

There would be exceptions to this ¼ mile spacing on steep hills where it would be easier for passengers to access routes with closer stop spacing.

Capital Elements

Flow Improvements

Operating speed of the trolley network could be improved through a number of methods to prioritize buses in traffic. The effects on other parts of the transportation system, including pedestrians, bikes, freight, and overall traffic must be considered when applying the methods below.

- **Business Access and Transit or BAT lanes** allow transit coaches to operate in the outside lane shared only with right-turning traffic. BAT lanes can help improve operation speeds and reliability of routes.

- **Bus bulbs** are another option to improve speed on trolley routes. Bus bulbs allow transit to stop in-lane, saving time necessary to re-enter traffic flow and provide additional space at bus stops for passenger facilities. Bulbed bus stops require less curb space than bus pullouts due to pull in and pull out distances.

- **Turn restrictions** that focus on areas with heavy pedestrian traffic or where left turns may be unprotected or where right turning vehicles may be delayed by large pedestrian flows.

- **Transit queue jumps** provide a lane or green time allowing transit to enter a signalized intersection ahead of general-purpose traffic.

- **Routing changes** could go around congested intersections but may require new segments of electric trolley overhead.

- **Transit signal priority** could provide trolley coaches with better speed and reliability through improvements in signal timing including adjustments to signal length and cycles. Transit Signal Priority allocates green time at signals to favor transit flow.

Fare Collection

Many bus rapid transit systems throughout the U.S. and internationally utilize proof of payment systems to expedite travel. This system would also be valuable to a rapid trolley system to expedite boarding and alighting at all stops and to maintain operating speeds throughout the route. A proof of payment fare collection system, currently under consideration for RapidRide would be a valuable for the Rapid electric trolley bus network. The system would encourage riders to pay their fare off the coach and expedite boarding and alighting. All-door boarding and alighting is faster and reduces dwell times and would improve travel times for electric trolley routes.

Facilities and Passenger Amenities

Bus shelters and real-time information signs are key components to most bus rapid transit systems. Shelters and other passenger amenities would be provided as the highest ridership stops in the electric trolley bus system. Real-time information would also be vital to improving customer information; therefore real-time information signage could provide electric trolley bus arrival times.

Coaches

Metro's current trolley fleet includes both 40 foot and 60 Foot electric trolley buses, both of which are high-floor. The electric trolley bus fleet may be replaced in 2014. The following should be considered for the replacement fleet and for Rapid electric trolley bus operation:

- 100% Low-floor coaches
- 40-foot trolleys with four doors, to speed boarding and alighting and shorten dwell times
- Articulated trolleys with three doors to expedite passenger boarding and alighting
- Wider aisles with possible 2-1 seating configuration
- With enough service frequency and passenger loads shifted to Link LRT, and all standard electric trolley bus replacement fleet should be considered. Standard coaches may have shorter dwell times and certainly have a lower capital cost and draw less power.

Propulsion Systems

New wire for the electric trolley bus network would accommodate routing layover requirements. New substations would address the higher draw on current substations and allow more service frequency. Some off-wire propulsion capability would limit the disruption of electric trolley bus service by construction and would add flexibility to electric trolley bus operations.

Several routes in each of the scenarios will require new wire to accommodate new routing patterns.

Other Trolley Routes

Although, not all electric trolley bus routes will be part of the Rapid Trolley System, additional improvements would be made to increase the speed and reliability of these routes. Stop spacing improvements to would help reduce travel times on electric trolley bus routes for a 10% improvement in speeds. Additionally, headways on these routes would provide 15-minute service during 15 hours of the day, from 5am to 8pm. Many of these routes are included as part of the electric trolley bus network scenarios discussed below.

Developing a Rapid Trolley Network

Many of the routes chosen for inclusion in a Rapid Trolley system are high ridership and high frequency routes that would benefit from many of the system and capital improvement discussed in the previous section. These routes provide key connections between urban centers, such as the Route 49 (705), connecting the University District, Capitol Hill and Downtown Seattle. Other routes in the system, such as the Routes 11 and 12, which become Route 706, are included since they provide a better level of service coverage and extend the network to build a better urban network of trolley routes.

The Rapid Trolley network is designed to be a more efficient network that not only will provide service to Link stations, but serve areas of high density with short, direct trips between destinations. Each of the networks built in these scenarios is intended to build a grid of trolley services that provide fast and frequent service that enables riders to transfer to other services and make important connections to the places they wish to go.

Alaskan Way Viaduct Replacement Scenarios

King County Metro, in collaboration with the City of Seattle, worked to define the routes for the Rapid Trolley Network. Metro and the City of Seattle reviewed the various scenario components for the Alaskan Way Viaduct in determining which routes would best supplement the system. After evaluating the transit elements for the Alaskan Way Viaduct Alternatives, four scenarios were created, each composed of a high, medium or low electric trolley bus network. These networks build off current trolley and diesel routes.

The chart provided summarizes the electric trolley bus network levels shown for various alternatives for the Alaskan Way Viaduct. Scenario C has a level of electric trolley bus service with 10 Rapid electric trolley bus routes. Scenario B has nine routes and also a high-level of electric trolley bus service. Networks in "High" scenarios provided 10-minute headways or better on all Rapid Trolley routes 18 hours per day, seven days per week. Scenario A contains a medium range network of seven routes. The "Medium" scenario assumed all routes had 10-minute headways or better 15 hours of weekdays, and for 12 hours on Saturday, with 15-minute headways or better for 18 hours, 7 days per week. Finally, Scenarios D through H have a low network of four routes. This last and least expensive network provided routes with 10-minute headways or better for 12 hours for 6 days per week and 15-minutes or better, 18 hours per day, 7 days per week. In addition, these scenarios also include additional routes that would operate as part of the trolley system, but without the characteristics of the Rapid Trolley System.

Rapid Trolley Network for AWV Scenarios A-H	High ETB Network	High ETB Network 2	Medium ETB Network	Low ETB Network
Surface and Transit 1(A)			**X**	
Surface and Transit 2 (B)		**X**		
Surface and Transit 3 (C)	**X**			
Independent Elevated (D)				**X**
Integrated Elevated (E)				**X**
Bored Bypass Tunnel (F)				**X**
Cut & Cover Tunnel (G)				**X**
Lidded Trench (H)				**X**

Note: High electric trolley bus network includes 10 routes and High electric trolley bus Network 2 includes 9 routes.

For all scenarios, A through H, trolley wire at three locations will be implemented as part of the trolley network simplification project in the city center prior to implementation of the Rapid

Trolley Network. Trolley wire improvements will take place to add wire segments to Yesler Way, Denny Way between 1st and 3rd Avenues and at S Washington and 5th Ave S. Additional Denny Way past 3rd Ave will be needed in Scenarios C and B. For Scenario B, a project to build contra-flow lanes on Marion and Madison will take place. For Scenarios A and C, an additional wire segment will be added on Madison and Columbia to connect to Colman Dock.

High Electric Trolley Bus Network for Scenario C

The High electric trolley bus network includes 10 routes that provide transit service between urban villages and urban centers. The High electric trolley bus Network provides service both South and North of Downtown Seattle, capturing high-density areas such as the University District, Capitol Hill, Queen Anne and several urban villages and hubs including Beacon Hill and Rainer Beach. In addition, several Rapid Trolley routes connect with the light rail system, facilitating more trips downtown.

In developing this network, several assumptions were made regarding streetcar service. Streetcar service is expected from the International District to the Broadway Station/First Hill, on 1st Ave, and along the Waterfront Alaskan Way in this scenario. The following chart shows trolley routes and headways for Scenario A.

Scenario C: Rapid Trolley Network

Route	Description	Headways	
		Peak	Midday
702	Downtown Seattle to Madison Park via Madison St/Union St	10	10
703	Between Seattle Pacific University to Madrona via Queen Anne (Taylor Ave), Seattle Center and Downtown Seattle.	6	6
705	Between University Heights and Pioneer Square via University District, Capitol Hill and First Hill	10	10
707	Between UW Medical Center/University District to Pioneer Square via Eastlake Ave, Fairview Ave N and 3rd Ave, Downtown Seattle	6	10
708	From Downtown Seattle to Capitol Hill via Pike/Pine to 15th Ave NE	7.5	10
709	Between Mount Baker Station at S. McClellan St via Rainer Ave S to S Jackson via 3rd Ave, Downtown Seattle to Route 13 Queen Anne	7.5	10
711	Between South Othello Station and East Aloha St in Capitol Hill via Beacon Hill, First Hill and Broadway	7.5	10
712	Between Kinnear and Madison Park via West Queen Anne, Uptown, Denny Way, Capitol Hill	10	10
714	Between Ballard to University of Washington/ Husky Stadium via Wallingford and the University District	6	10
717	Between Rainier Beach to University Heights via Rainier Ave S, Central Area, Montlake and University District.	6	6

Other Trolley Routes

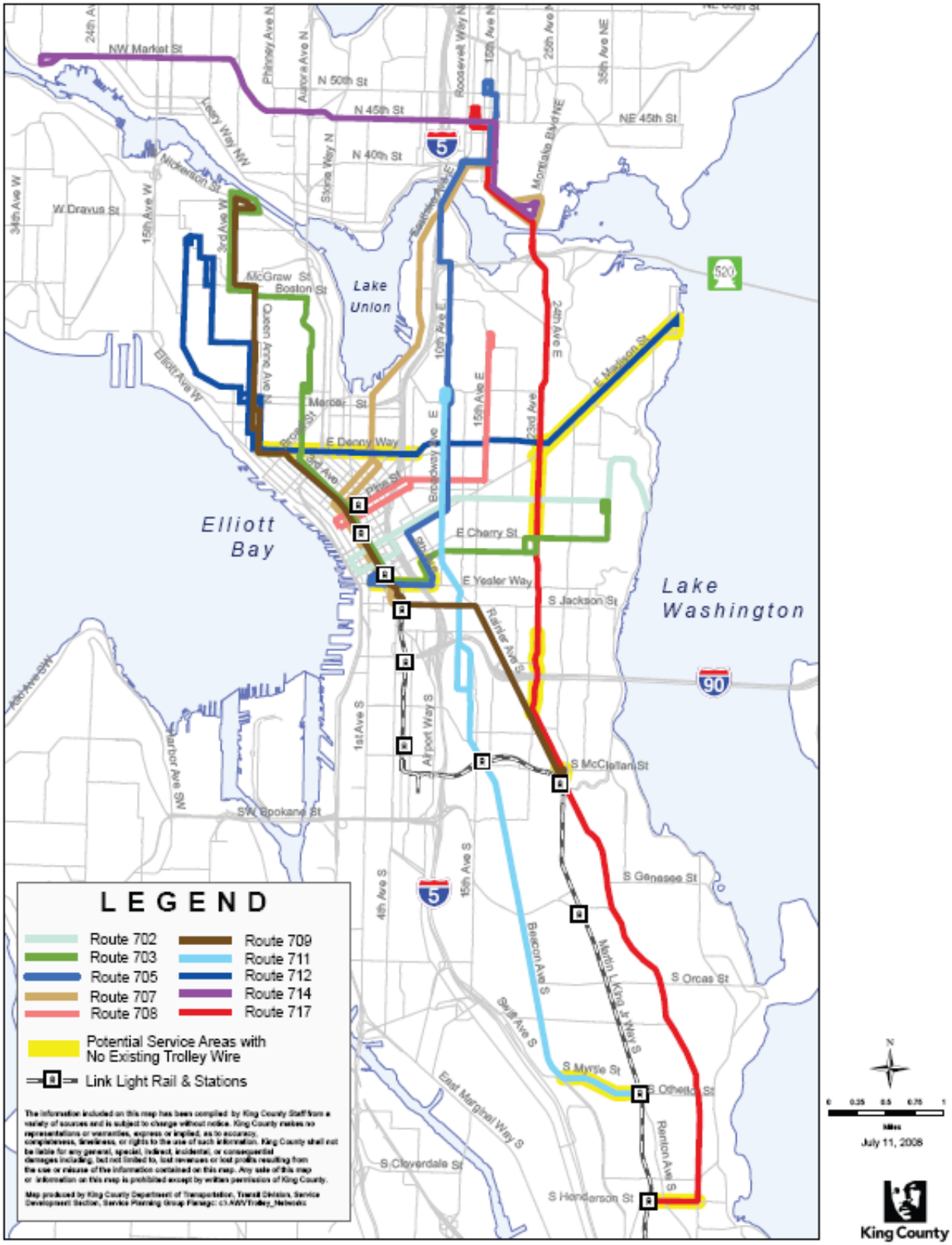
- Between Mt. Baker, Mt. Baker Station and Downtown Seattle via 31st Ave S to Bellevue Ave/Summit Ave E

New Wire Segments

The following routes require additional wire for operation in Scenario C:

Route	Wire Segment	Miles (new wire)
712	E Denny Way (east of 3rd Ave)	3.18
717	23rd Ave and S Henderson St	1.24

Map of Rapid Trolley Network High for Scenario C



High Electric Trolley Bus Network for Scenario B

This network serves many of the same areas as the High electric trolley bus network. This network for scenario B brings connections between the University District and Beacon Hill, as well as connection Downtown and Madison Park and also to Madrona. This network include 9 routes, provides connections to light rail, and service between urban villages and through major urban centers.

Streetcar service from the International District to the Broadway Station/First Hill, on 1st Ave, from Ballard/Fremont to Downtown and University District to Downtown is assumed in this option.

Scenario B: Rapid Trolley Network

Route	Description	Headways	
		Peak	Midday
702	Downtown Seattle to Madison Park via Madison St/Union St	10	10
703	Between Seattle Pacific University to Madrona via Queen Anne (Taylor Ave), Seattle Center and Downtown Seattle.	10	10
706	Between Downtown Seattle to Madison Park via E Madison St	10	10
708	From Downtown Seattle to Capitol Hill via Pike/Pine to 15th Ave NE	7.5	10
709	Between Mount Baker Station at S. McClellan St via Rainer Ave S to S Jackson via 3rd Ave, Downtown Seattle to Route 13 Queen Anne	7.5	10
713	Between South Othello Station and East Aloha St in Capitol Hill via Beacon Hill, First Hill and Broadway	6	6
714	Between Ballard to University of Washington/ Husky Stadium via Wallingford and the University District	6	10
717	Between Rainier Beach to University Heights via Rainier Ave S, Central Area, Montlake and University District.	6	7.5
718	Between Kinnear/Queen Anne/South Lake Union/Capitol Hill and Madison St	10	10

Other Trolley Routes

- Between Mt. Baker, Mt. Baker Station and Downtown Seattle via 31st Ave S to Bellevue Ave/Summit Ave E

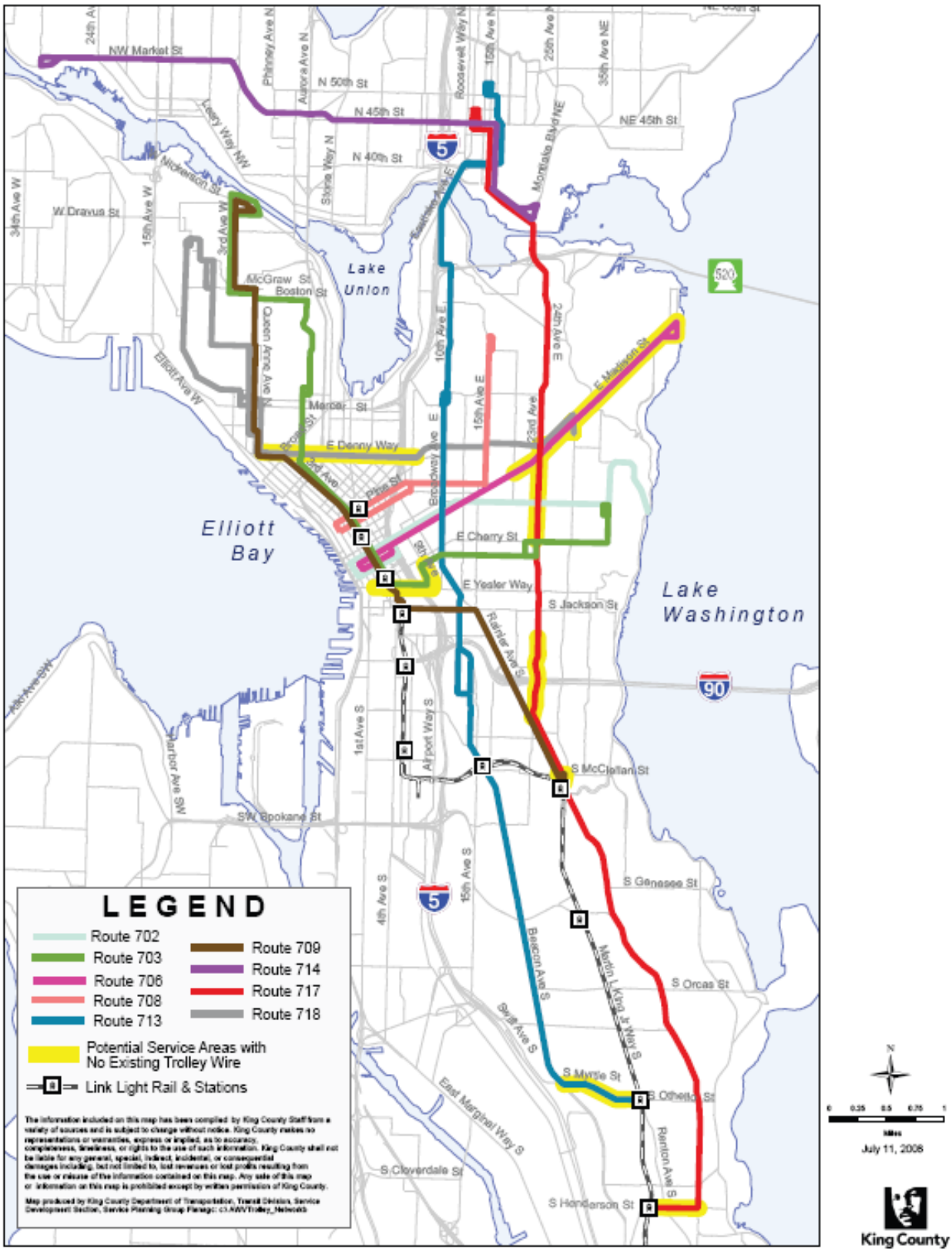
The routes included in this scenario versus Scenario C, include a connection for Kinnear and Queen Anne to E Madison St and Martin Luther King Jr Way, with a connection to Madison Park via the route from Downtown Seattle via E Madison St. This electric trolley bus network also provides a connection from the Othello Station to the University District through the neighborhoods of Beacon Hill and Capitol Hill, rather than a connection from University District to Pioneer Square.

New Wire Segments

The following wire segments would be required for Scenario B:

Route	Wire Segment	New Wire (in miles)
706	E Madison	2.88
717	23rd Ave and S Henderson St	1.24
718	E Denny Way (East of 3rd Ave)	3.18

Map of Rapid Trolley Network High for Scenario B



Medium Electric Trolley Bus Network for Scenario A

This electric trolley bus network for Scenario A includes 7 routes, providing service to high-density areas of Queen Anne, Capitol Hill and the University District as well as providing connections to light rail station at Henderson St and at Othello Station. The assumptions for streetcar service include streetcar lines on the Alaskan Way Waterfront and from the International District Station to Broadway Station/First Hill.

Scenario A: Rapid Trolley Network

Route	Description	Headways	
		Peak	Midday
703	Between Seattle Pacific University to Madrona via Queen Anne (Taylor Ave), Seattle Center and Downtown Seattle.	10	10
705	Between Downtown Seattle to Madison Park via E Madison St Between University Heights and Pioneer Square via University District, Capitol Hill and First Hill	10	10
707	Between UW Medical Center/University District to Pioneer Square via Eastlake Ave, Fairview Ave N and 3rd Ave, Downtown Seattle	6	10
709	Between Mount Baker Station at S. McClellan St via Rainer Ave S to S Jackson via 3rd Ave, Downtown Seattle to Route 13 Queen Anne	7.5	10
711	Between South Othello Station and East Aloha St in Capitol Hill via Beacon Hill, First Hill and Broadway	7.5	10
714	Between Ballard to University of Washington/ Husky Stadium via Wallingford and the University District	6	10
717	Between Rainier Beach to University Heights via Rainier Ave S, Central Area, Montlake and University District.	6	7.5

Other Trolley Routes

- Between Mt. Baker, Mt. Baker Station and Downtown Seattle via 31st Ave S to Bellevue Ave/Summit Ave E
- From Downtown Seattle to Capitol Hill vi a Pike/Pine to 15th Ave NE
- From Downtown Seattle to First Hill, via E Madison to 19th Ave E
- Between West Queen Anne and Madrona via Uptown, Downtown Seattle, E Union St.

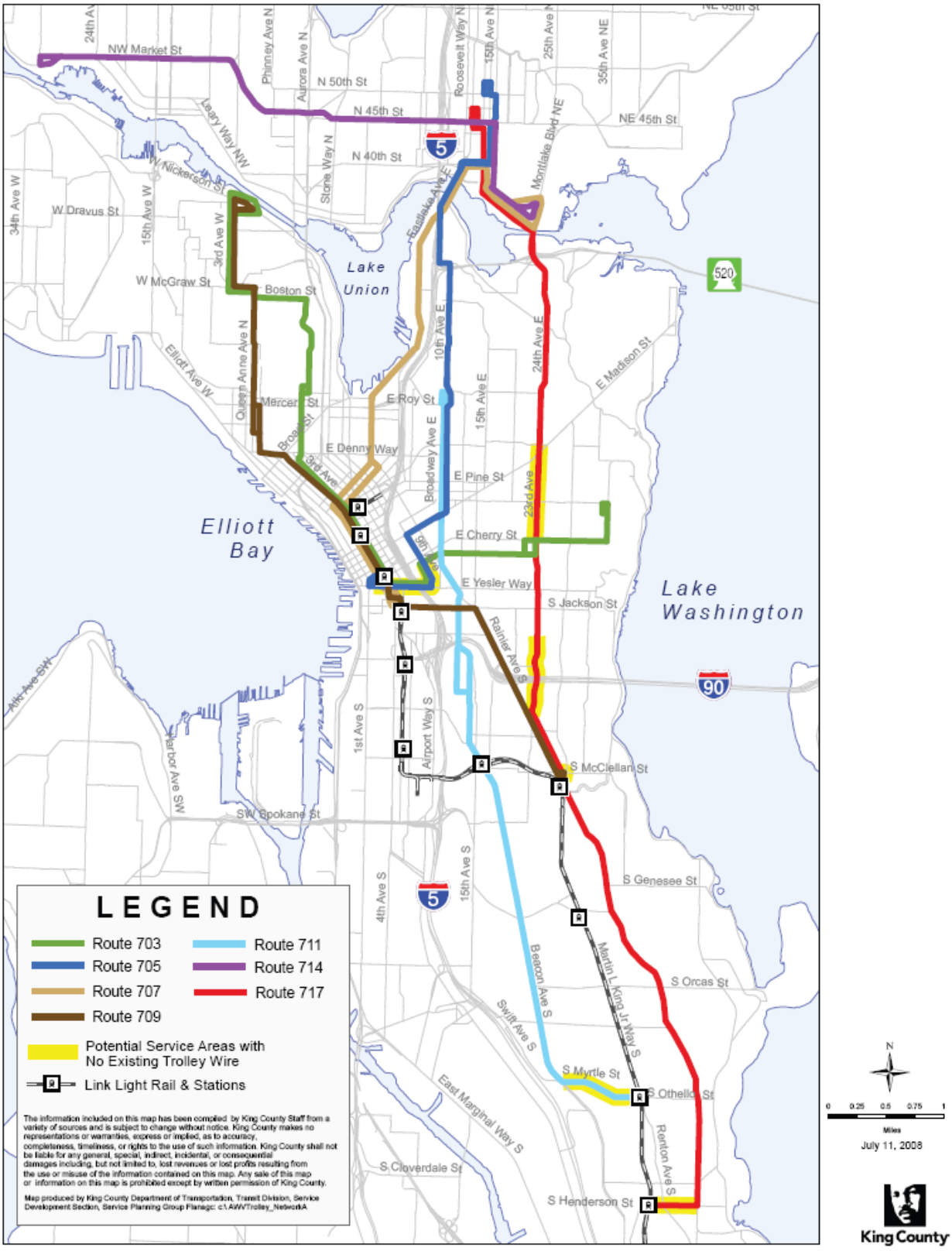
This electric trolley bus network serves the Central Area in the same way as the network in Scenario C. It does not provide a direct trolley bus connection from Queen Anne Hill to Capitol Hill as in Scenario B and C. It makes many of the same connections, ensuring rapid trolley service between urban villages in the Rainer Valley, Central Area, Queen Anne, and Beacon Hill to major urban centers of Capitol Hill, the University District and Downtown Seattle.

New Wire Segments:

The following wire segments would be required for Scenario A:

Route	Wire Segment	New Wire (in miles)
717	23rd Ave and S Henderson St	1.24

Map of Rapid Trolley Network Medium for Scenario A



Low Electric Trolley Bus Network for Scenarios D thru H

The Low electric trolley bus network has fewer routes and provides service to and through major urban centers of the University District and Downtown Seattle. The routes also connect to light rail stations at Henderson and Othello and provide service for Beacon Hill, Rainier Valley and Central District into Capitol Hill and Queen Anne.

The assumptions for streetcar service vary among these alternatives. D, F, H assumes streetcar service along Waterfront Alaskan Way, and from the International District Station to Broadway Station/ First Hill. E has streetcar service provided in the International District and along 1st Ave (23rd and Jackson to Seattle Center Uptown). Alternative G provides for streetcar service in the International District, along the Waterfront Alaskan Way and along 1st Ave.

Scenarios D-H: Rapid Trolley Network

Route	Description	Headways	
		Peak	Midday
701	Between Seattle Pacific University to South Othello Station via Queen Anne, Downtown Seattle and Beacon Hill	6	7.5
705	Between University Heights and Pioneer Square via University District, Capitol Hill and First Hill	10	10
714	Between Ballard to University of Washington/ Husky Stadium via Wallingford and the University District	10	10
719	Between Rainer Beach (Henderson Station) and Capitol Hill (Aloha St) via Rainer Ave and Broadway Ave	6	10

Other Trolley Routes

- Between Mt. Baker, Mt. Baker Station and Downtown Seattle via 31st Ave S to Bellevue Ave/Summit Ave E
- Between Downtown Seattle to Capitol Hill via Pike/Pine to 15th Ave NE
- Between Downtown Seattle to First Hill, via E Madison to 19th Ave E
- Between University District to Downtown Seattle from via Eastlake Ave E, Fairview Ave and 3rd Ave.
- Between North Queen Anne to Madrona via Taylor Ave N, Seattle Center and Downtown Seattle.
- Between Queen Anne to Judkins Park, via Seattle Center, E Jefferson and Martin Luther King Jr. Way.
- Between Queen Anne and Madrona via Uptown and Downtown Seattle and E Union St.

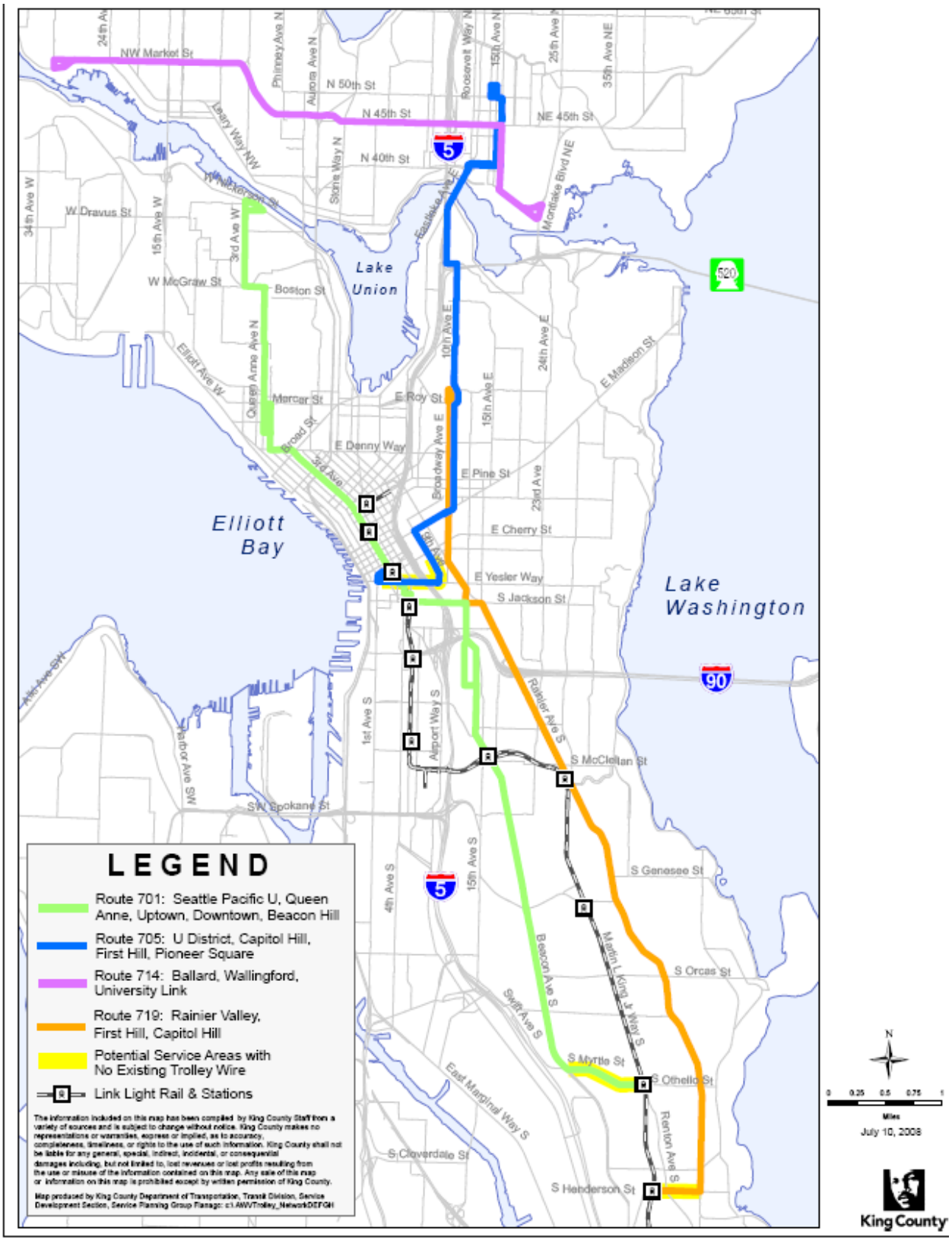
The Low electric trolley bus network provides for a route between Ballard and the University District, as included in all scenarios. This network also adds service between Rainer Beach and Capitol Hill and from Seattle Pacific University to the light rail station at Othello St through Downtown Seattle and the Beacon Hill neighborhood and Uptown/Belltown.

New Wire Segments:

The following wire segments would be required for Scenarios D thru H:

Route	Wire Segment	New Wire (in miles)
719	S Henderson St	0.29

Map of Rapid Trolley Network Low for Scenarios D thru H



Summary

The chart included below summarizes the all rapid trolley routes included in each of the scenarios as described above.

Washington State Department of Transportation | King County | City of Seattle

Alaskan Way Viaduct and Seawall Replacement Program

Rapid Trolley Routes	Route	Route Miles	New Wire	A: Surface & Transit 1	B: Surface & Transit 2	C: Surface & Transit 3	D: Independent Elevated	E: Integrated Elevated	F: Bored Bypass Tunnel	G: Cut & Cover Tunnel	H: Lidded Trench
Between Ballard and UW Husky Stadium via Wallingford and University District	714	5.77		✓	✓	✓	✓	✓	✓	✓	✓
Between Kinnear and Madison Park via West Queen Anne, Uptown, Denny Way, Capitol Hill and Madision Park	712	6.78	3.18			✓					
Between Kinnear/Queen Anne/South Lake Union/Capitol Hill/ Arthur Pl & Madison Street	718	5.55	1.39		✓						
From Downtown to Capitol Hill via Pike/Pine to 15th Ave NE	708	2.62			✓	✓					
Between South Othello LINK station and East Aloha Street via Beacon Hill, First Hill and Broadway	711	7.07		✓		✓					
Between Mt. Baker Station at S. McClellan Street via Rainier Ave S to S Jackson St via 3rd Ave to Route 13 Queen Anne	709	6.93		✓	✓	✓					
Between UW Medical Center/University District to Pioneer Square via Eastlake Ave, Fairview Ave N and 3rd Ave	707	5.87		✓		✓					
Between University Heights and Poineer Square via University District, Capitol Hill and First Hill.	705	5.57	0.74-1.00	✓		✓	✓	✓	✓	✓	✓
From Seattle Pacific University to Madrona via Queen Anne (Taylor Ave), Seattle Center and Downtown Seattle	703	6.34	0.74-1.00	✓	✓	✓					
Between Rainier Beach and University Heights via Rainier Ave S, Central Area, Montlake and University District	717	9.79	1.24	✓	✓	✓					
Between Downtown Seattle to Madison Park via Madison St/ Union St	702	3.03			✓	✓					
From Dowtown Seattle to Madison Park via E Madison Street	706	3.78	2.88		✓						
Between Rainer Beach (Henderson Station) and Capitol Hill (Aloha Street) via Rainier Ave and Broadway Ave	719	7.96	0.29				✓	✓	✓	✓	✓
Between University Heights and Othello Station via Broadway and Beacon Hill	713				✓						
Between Seattle Pacific University to S Othello Station via Queen Anne Avenue N, Downtown Seattle and Beacon Hill	701	10.01					✓	✓	✓	✓	✓

Costs

There are two types of costs that would be associated with the implementation of a Rapid Trolley Network, annual hour costs and capital costs. Annual hour costs are the annual bus hours that it would take to operate each of the routes. Capital costs refer to the costs of capital projects such as additional wire segments, substations or fare collection systems. This section provides more information about the methodology and assumptions that were made during the costing process in terms of operating and capital costs.

Costing Methodology – Operating Costs

In order to come up with the operating cost estimates for the Rapid Trolley routes and associated changes to the network, a costing methodology was followed. This methodology follows the following steps:

1. Determine the routing
Brainstorm with different planners in the various groups at Metro to decide on appropriate routing for the proposed networks.

2. Estimate the revenue travel time
Using time schedules and route knowledge, estimate the time it takes for a bus to travel the route at various times of the day; the peak period (3-6 PM), midday (1-2 PM) and night (9-10 PM).

3. Estimate travel time savings
Estimate the percentage of travel time saved due to speed and reliability improvements along the corridors.

4. Determine frequency of service
Determine the target frequencies for service for the new routes various times of the day; peak, midday, evening, night, Saturday and Sunday.

5. Determine hours of operation
Determine how many hours a day the buses will run for each frequency of service.

6. Calculate the cost of the routes
Once these variables are determined, they are inputted into a spreadsheet and the cost of each route, as well as all of the routes are calculated using predetermined formulas.

Costing Assumptions – Capital Costs

In order to come up with the cost estimates for the capital improvements that would accompany these new Rapid Trolley routes, the following assumptions were made:

- Additional substations would be required to operate all Rapid Trolley networks; the number of substations is largely dependent on the number of buses per hour. Therefore, higher service frequencies require more substations.

- New stations and shelters would be added to upgrade passenger amenities as discussed earlier in this portfolio.

- Fare collection system and equipment would be added to expedite boarding and alighting.

- Additional trolley wire is required as discussed in each of the trolley networks. Given the miles of additional trolley wire added, the cost per mile of wire is provided below. These cost estimates do not include substations and right of way required for trolley operation

Trolley Network/ Scenario	Total New Wire (in miles)	Cost per mile
Rapid Trolley Network High for Scenario C	4.42	$5.0 million
Rapid Trolley Network High for Scenario B	8.30	$3.4 million
Rapid Trolley Network Medium for Scenario A	1.42	$4.9 million
Rapid Trolley Network Low for Scenarios D thru H	4.42	$2.3 million

Capital costs for each scenario reflect these additional costs that are related to the number of Rapid Trolley routes that each scenario has. A summary of the capital and operating costs for each of the trolley networks and their corresponding scenario can be found below.

Summary of Costs for Rapid Trolley Networks

Rapid Trolley Network High –Scenario C

This scenario includes 10 Rapid Trolley routes in addition to capital costs associated with additional stations, fare collection systems, as well as a substation and trolley wire.

Scenarios C	
Routes	**Total Service Hours**
702, 703,708 707,709,711,714,717 705, 712*	**132,100**

Scenario C	
Capital Costs	
Phase I	$58,371,798
Phase II	$50,917,025
Phase II	$32,578,848
Total	**$141,867,672**

Rapid Trolley Network High –Scenario B

Below are the operating costs and capital costs for Scenario B, which has nine Rapid Trolley Routes and many of the same costs associated with Scenario C. A major reasons that operating costs differ so much from Scenario C is that the current Route 70 is decommissioned and service hours are reallocated within the trolley network. Decommissioning of trolleybus wire on Route 70 path is associated with the implementation of streetcar operations to the U District from South Lake Union.

Scenario B	
Routes	**Total Service Hours**
702, 703, 706, 708 709, 714,717 713,718	**54,900**

Scenario B	
Capital Costs	
Phase I	$70,651,776
Phase II	$22,213,760
Phase II	$41,964,992
Total	$134,830,529

Rapid Trolley Network Medium –Scenario A

The operating and capital costs for this scenario can be found below. Scenario A contains seven Rapid Trolley routes with lower capital costs as compared to Scenarios C and B.

Scenario A	
Routes	**Total Service Hours**
703, 705, 707, 709, 711, 714, 717	**53, 100**

Scenario A	
Capital Costs	
Phase I	$70,651,776
Phase II	$7,353,562
Phase II	$11,648,499
Total	$89,653,837

Rapid Trolley Network High –Scenarios D thru H

Scenarios D through H have the lowest capital and operating costs of all scenarios due to a limited number of Rapid Trolley routes (4) and reductions in capital costs associated with the number of Rapid Trolley routes.

Scenarios D - H	
Routes	**Total Service Hours**
701, 705, 714, 719	**35,250**

Scenarios D-H	
Capital Costs	
Phase I	$35,399,174
Phase II	$11,376,346
Phase II	$11,648,499
Total	**$58,424,018**