Image from Nelson\Nygaard

3 CORRIDORS

King County Metro is guided by a new strategic plan that calls for the agency to invest resources in corridors that have the highest potential to generate ridership, as well as to serve regional equity and environmental goals. High ridership transit corridors serve dense neighborhoods, connect many and diverse land uses, have strong demand generators at their termini, and operate over direct routes that allow high levels of speed and reliability. The TMP included an in-depth process to study travel corridors in the city that delivered the greatest potential benefits by combining these features. Further, the study developed a broad set of evaluation measures, grouped under five evaluation "accounts" that included: Community, Economy, Environment and Human Health, Social Equity, and Efficiency. These measures were used to identify corridor investment priorities, including a top tier of modes recommended for high capacity transit (HCT) and 16 additional bus corridors where SDOT will prioritize speed and reliability improvements.

A LONG-RANGE VISION FOR SEATTLE'S HIGH CAPACITY TRANSIT NETWORK

WHY DOES SEATTLE NEED A LONG-RANGE VISION FOR HIGH CAPACITY TRANSIT?

The Transit Master Plan (TMP) articulates a long-range vision for a Seattle where most residents can walk or bike to high-quality, high-capacity transit and where a network of routes moves residents, visitors, and workers swiftly between major neighborhoods. The TMP is structured to help City staff and elected officials implement the vision and measure progress toward its achievement. A clear, long-range vision provides a tool to:

- Build consensus for action and priorities among local stakeholders and partner agencies
- Guide investment of limited resources to achieve the greatest benefit
- Develop a phased approach to implementing Seattle-focused high capacity transit (HCT) corridors that support the system of urban centers and villages set forth in the City's Comprehensive Plan
- Meet key City economic, environmental, equity, and livability goals, such as a significant reduction in greenhouse gas (GhG) emissions

WHAT WOULD IT TAKE TO REALIZE THE VISION IN 40 YEARS?

Realizing the vision will require sustained action by the City to:

- Develop new local funding sources to support both transit operations and significant transit corridor capital investments
- Provide initiative, staff capacity, and funding support for leading design and construction of rail and bus rapid transit (BRT) projects in priority citywide corridors
- Coordinate with Sound Transit to speed the prioritization in their long-range mass transit plan of studying and constructing HCT in western Seattle neighborhoods
- Continue to funnel growth to key urban centers and urban villages served by the long-range HCT network

LONG-RANGE HCT VISION: TARGETED TO SERVICE QUALITY

The long-range HCT network is illustrated in Figure 3-1. HCT goes beyond the existing regional vision for Link light rail and the Seattle Streetcar Network Concept for Center City neighborhoods. It defines a citywide network of bus rapid transit and rail corridors that will deliver transit service with high levels of capacity, frequency, and design quality linked by effective transfer facilities.

THE LONG RANGE HCT VISION GUIDES

The Long-Range HCT Vision can help to guide Seattle's land use and transportation investments and policy decisions to ensure that they are supportive of the Transit Master Plan. The Vision guides the City to:

- **Coordinate with partner agencies:** The Vision communicates Seattle's priorities for transit corridor connections to regional transit agencies.
- **Phase and prioritize investments:** The Vision ensures that major transit capital investments in Seattle move the City toward a clear goal, even as investments are phased toward full system development.
- **Focus all development around transit-oriented neighborhood principles (see Chapter 5):** The Vision recognizes where growth is planned and guides transit investments to meet future needs.
- **Coordinate modal investments:** The Vision informs the City's other modal investments by implementing the Bicycle and Pedestrian Master Plans and supporting seamless transfers where major transit facilities meet.

THE LONG RANGE HCT VISION INSPIRES

The Vision is a means for Seattle to come together around building the transit system that will help the City attain its economic, environmental, equity, and human health goals. Achieving the Vision is a powerful tool for fostering an economically healthy, low-carbon city. Specifically, a high quality HCT network will inspire:

- **A new mobility paradigm where walking, bicycling, and taking transit are the most convenient ways to travel for most trips in the city:** Seamless connections to the regional transit system will make transit the best option for Seattleites accessing other Puget Sound communities and for workers and visitors traveling to Seattle.
- **Most new development designed and constructed based on transit-oriented neighborhood principles (see Chapter 5):** Pedestrian-friendly transit nodes are the focal point of neighborhood centers and community interaction.
- **Low-carbon neighborhoods centered around transit nodes:** Transit helps Seattle achieve emissions reduction goals. It helps to shape development patterns that reduce the number and distance of driving trips.
- **A healthy, active lifestyle for Seattle residents of all ages:** Increased levels of walking, bicycling, and transit trips allow residents of all ages to incorporate physical activity into their daily routines.

FIGURE 3-1 SEATTLE LONG-RANGE HIGH CAPACITY TRANSIT VISION

TRANSIT CORRIDOR EVALUATION PROCESS

It will take decades to achieve Seattle's long range vision for transit. The TMP is a 20-year plan, designed to deliver near-term priorities for transit system investment. The TMP employed an outcome-based evaluation process to determine where and how to invest limited transit funding.

HOW THE TMP DETERMINED CORRIDOR INVESTMENT PRIORITIES

The TMP used an outcome-based process called multiple account evaluation (MAE) to identify capital and transit service investments that support the TMP goals. Figure 3-2 shows the evaluation accounts used to prioritize corridor investments. The MAE process provided a powerful tool to engage stakeholders in developing a set of corridor investment priorities. It also helped the City to make investment decisions in line with economic, environment, health, and community development goals. The evaluation led to the prioritization of five corridors that are poised for high-capacity transit investments, and 16 corridors where significant investments in rubber-tired transit improvements are merited. The MAE process identified a clear set of priorities for City transit investment that serve as a foundation for TMP recommendations.

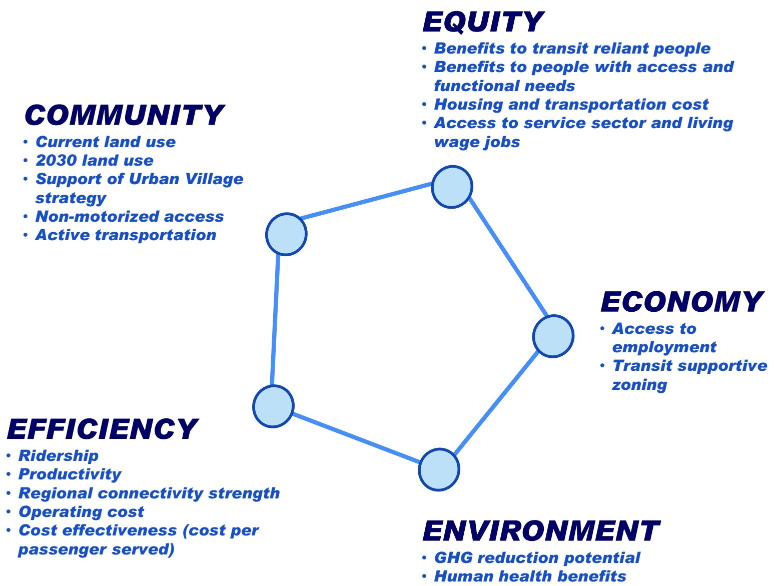
PUBLIC AND STAKEHOLDER PARTICIPATION

Three key groups were instrumental in developing the TMP and the corridor evaluation process:

- **Transit Master Plan Advisory Group (TMPAG):** The TMPAG included 25 members appointed by the Mayor and City Council. The group met monthly and provided detailed input at every phase of the corridor evaluation process.
- **City/County/Regional Interagency Technical Advisory Team (ITAT):** The ITAT included technical staff from SDOT

Image from Nelson\Nygaard

FIGURE 3-2 ACCOUNTS USED IN MULTIPLE ACCOUNT EVALUATION PROCESS



and a number of other City departments, the Seattle Planning Commission, King County Metro Transit and Roadway Division, Sound Transit, Puget Sound Regional Council, and Public Health – Seattle and King County.

- **City of Seattle Executive Steering Committee (ESC):** The ESC was an executive leadership team that provided high-level direction to the TMP technical team.

The project team also briefed the Seattle City Council, the Office of the Mayor, the Seattle Planning Commission, the Pedestrian Advisory Board, the Bicycle Advisory Board, the Freight Advisory Board, Seattle Center, Puget Sound Regional Council, and several neighborhood groups.

The public participated in developing the plan by participating in focus groups, completing an online survey that received over 12,000 responses, and providing comments at various stages of the planning process.

In a series of workshops, the ITAT and TMPAG helped to determine desired outcomes for the TMP. The most important outcomes identified by these groups—and supported through the public focus groups and the survey—were used to develop an evaluation framework for developing investment priorities. Both groups provided detailed input that influenced the evaluation measures used to prioritize corridors for transit investment.

CORRIDOR EVALUATION APPROACH AND STAGES

Corridors were evaluated against 16 criteria (a number of which had multiple sub-criteria) organized under the five evaluation accounts shown in Figure 3-2. The results were reviewed with the ITAT, TMPAG, and ESC at each stage, and their feedback was used to refine the analysis and methods.

Stage I: Screening For Demand Potential

The Stage I corridor evaluation analyzed transit corridors based on the Urban Village Transit Network (UVTN) to determine their potential to generate ridership. A detailed market analysis (see Chapter 2 of the TMP Briefing Book) also guided selection of initial corridor alternatives. Based on current and future land use and demographic characteristics, corridors least likely to deliver significant return on transit investments within the plan time-frame were screened out during this phase. The Stage I process narrowed the evaluation to a set of 15 priority corridors.

Stage II: Multiple Account Evaluation

The 15 Stage I corridors were evaluated against performance measures within each MAE account as illustrated in Figure 3-3. The measures were weighted for relative importance by ITAT, TMPAG, and ESC. The reviewers also assigned a weight to each account.

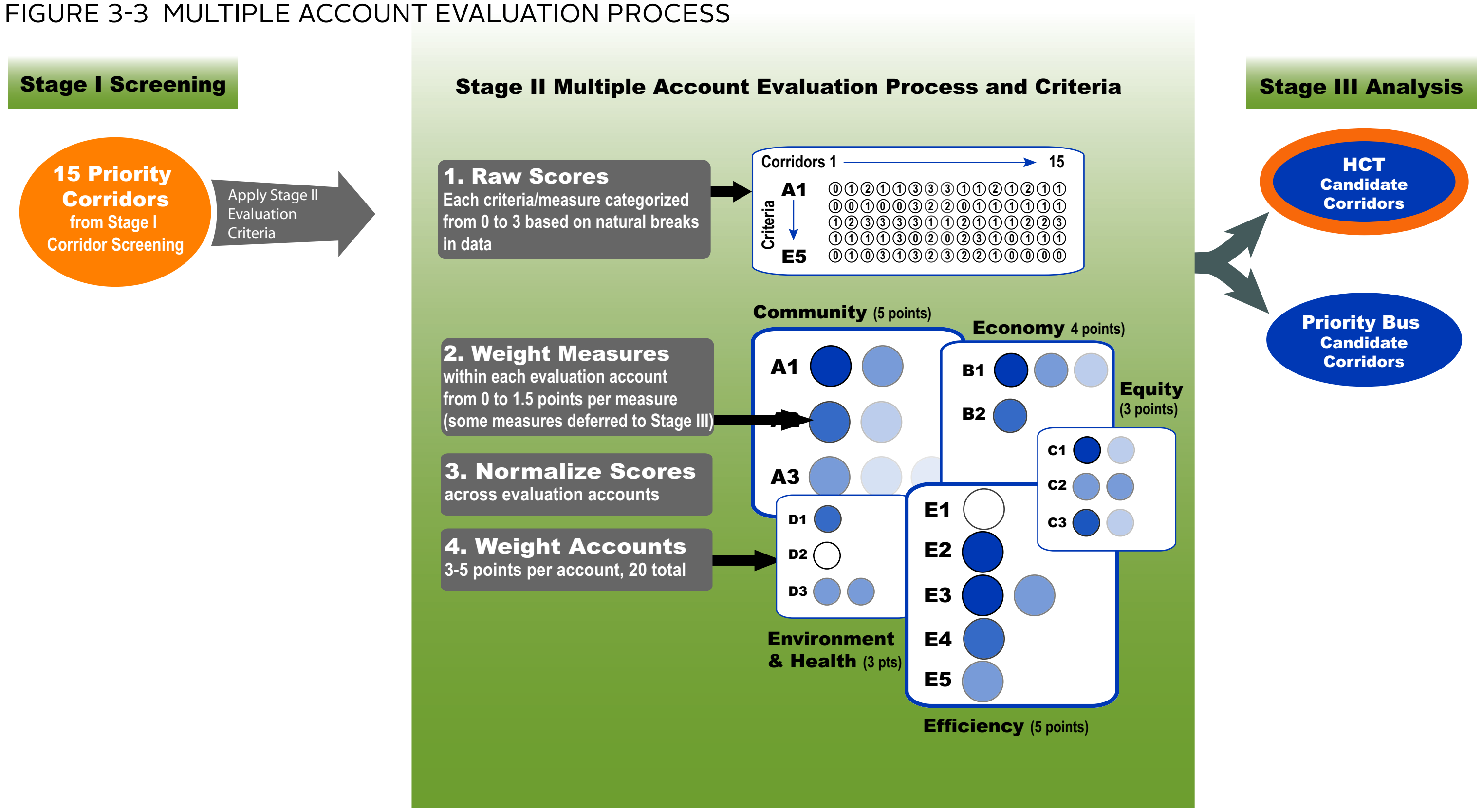
Stage III: High Capacity Corridor and Priority Bus Corridor Analyses

Based primarily on the Stage II evaluation, the corridors were prioritized into two tiers for more detailed analysis of potential transit investments:

- **High Capacity Transit (HCT) Candidate Corridors:** The top tier of corridors was evaluated for mode options for rail, bus rapid transit (BRT), and enhanced bus and for more detailed alignment considerations. Operating plans and planning level capital cost estimates were developed for each of these corridors.
- **Priority Bus Corridors:** The remaining corridors were evaluated for speed and reliability capital improvement opportunities and for service enhancements.

Additional factors considered included the viability of the corridor for high-capacity transit (e.g., grade, availability of right-of-way) and potential overlap with current and planned Link light rail or other major transit investments.

FIGURE 3-3 MULTIPLE ACCOUNT EVALUATION PROCESS



PRIORITY INVESTMENTS IN THE FREQUENT TRANSIT NETWORK

PRIORITY CORRIDOR INVESTMENTS – BUILDING THE FREQUENT TRANSIT NETWORK

The Frequent Transit Network builds upon the city's Urban Village Transit Network (UVTN)—a vision for a network of transit corridors that connect the City's urban centers and villages with high-quality transit service within a short walk for most residents (see Chapter 4 for a more complete description). The UVTN, part of the 2005 Seattle Transit Plan, provided a framework for measuring transit performance on important arterial corridors, but it gave limited direction for how the City should invest capital resources in operable, end-to-end transit corridors. The FTN replaces the UVTN by developing a program of coordinated transit corridor capital investments, with project-level detail on how to implement speed and reliability improvements. Volume I of the TMP (Briefing Book), page 4-16, provides a map of the UVTN, while pages 4-34 to 4-36 of the same chapter illustrate UVTN performance measures.

Making capital investments in priority transit corridors that develop and enhance the FTN is a key focus of the TMP. Investments in the 15 corridors identified through the TMP have the highest potential benefits to Seattle and its residents. In addition to the 15 citywide corridors, investments in the FTN include:

- Enhancements to Center City transit corridors to improve circulation and broadly benefit transit service operating in and through downtown
- Support of Link light rail, which serves important regional connections but is not funded or developed by the City
- Coordination with neighboring jurisdictions to ensure that transit speed and reliability improvements on Seattle streets are carried across city boundaries, particularly in corridors where predominant travel demands are between northern, southern, or eastern Seattle neighborhoods and neighboring jurisdictions

Chapter 4 (Service) provides a detailed description of the service design principles, service levels, and performance characteristics of the FTN.

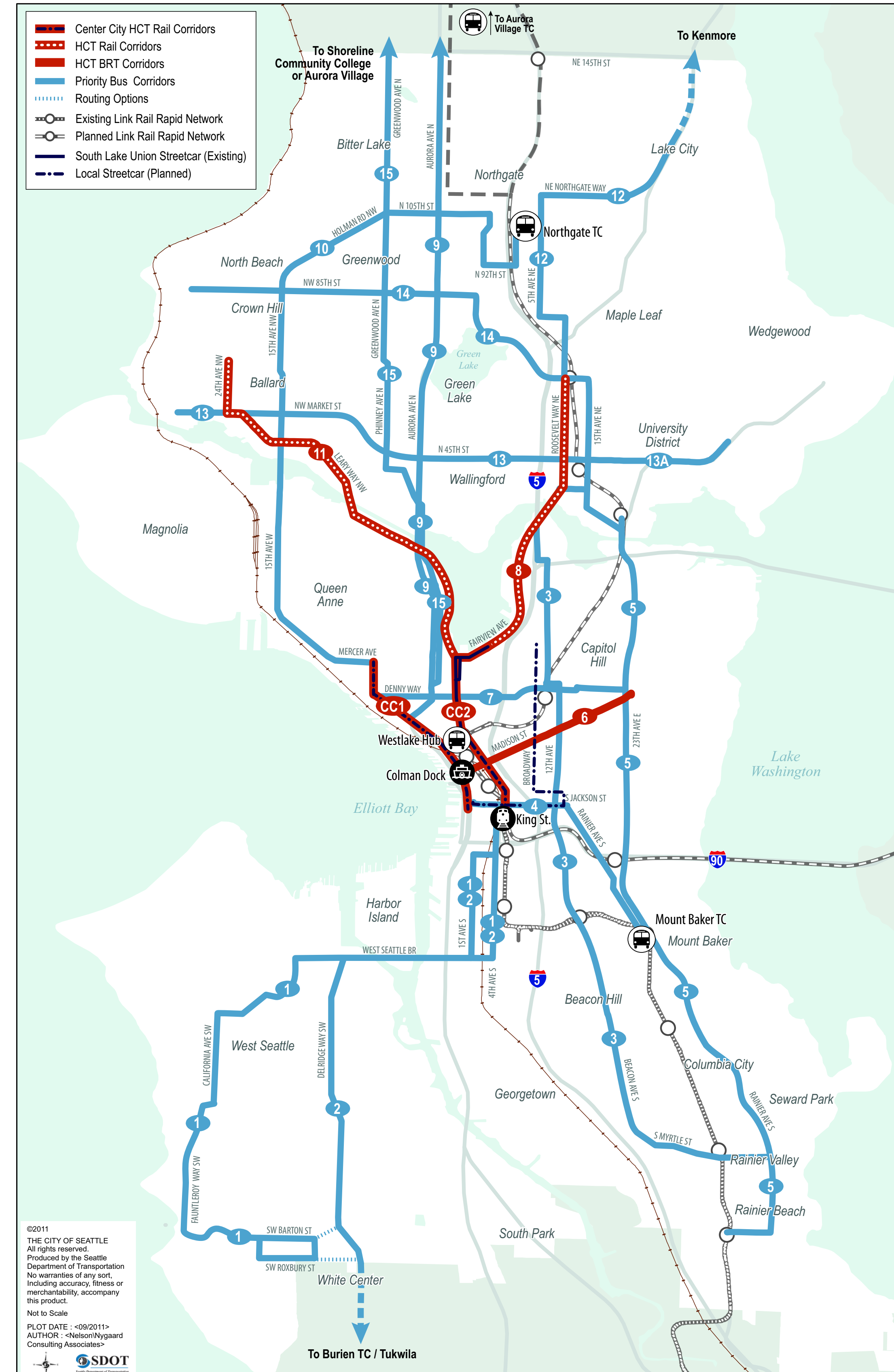
PRIORITY INVESTMENTS IN THE FREQUENT TRANSIT NETWORK

Priority investments in the FTN fall into three general categories, summarized below and illustrated in Figure 3-4:

- **High Capacity Transit Corridors:** These represent the top tier of citywide corridors that were evaluated for suitability for rapid street-car and BRT modes.
- **Bus Priority Corridors:** The remaining citywide corridors were considered for transit priority and infrastructure improvements, assuming rubber-tired transit would continue to be the dominant mode.
- **Center City Corridors:** These corridors include a focus on Center City circulation and serve critical connections between many of Seattle's densest neighborhoods.

The following three sections describe each category of corridors in detail.

FIGURE 3-4 FREQUENT TRANSIT NETWORK CORRIDORS



HIGH CAPACITY TRANSIT CORRIDORS

High Capacity Transit in Seattle

For Seattle, high capacity transit consists of both rail and rubber-tired transit modes that can provide residents with high-quality transit service, consistent with the design principles and FTN service levels (see Chapter 3 description of the FTN). The HCT corridors identified in the TMP fill a key service need between Link light rail and local bus service. Seattle's HCT service will be distinguished by the following factors:

- Seattle HCT provides locally-focused service for transit markets within the city of Seattle and surrounding areas. Link light rail focuses on regional connectivity and longer-distance trips; by design, it is more of an intercity commuter rail model of transit operation than an urban light rail service.
- Seattle HCT operates primarily on local streets using a combination of exclusive and shared right-of-way. Link light rail uses exclusive right-of-way with partial grade separation.

DIFFERENTIATING LINK LIGHT RAIL FROM SEATTLE HCT

Much of the existing and planned Sound Transit Link light rail system has attributes of a rapid rail system (e.g., fully exclusive and grade-separated right of way and off-board fare payment), providing fast regional connections with limited stops. The segment of Central Link in Southeast Seattle that operates on MLK Jr Way is a notable exception since it operates in the street right-of-way and crosses intersections at grade, yet even here stop spacing is wide. The Link service design model compares to BART in the San Francisco Bay Area or SkyTrain in Vancouver, B.C. Light rail systems in places like Portland and San Diego share some similar features to Link, but operate on-street (both in mixed traffic and exclusive lanes) in the most urban areas of their service areas. The HCT or urban rail modes evaluated in the TMP would use a similar model, operating in existing street rights-of-way, with modest stop spacing, and mix of priority treatments to gain advantage over traffic.

The San Diego Trolley (photo) and Portland MAX system operate on-street in the most urban parts of their service areas.

Image from Nelson\Nygaard

THE HCT MODES

Seattle's HCT corridors have the potential to be served by multiple modes. However, steep topography or constrained rights-of-way limit the available mode options for some corridors. The Transit Master Plan considers three high-capacity modes, plus an enhanced bus service, for developing transit corridors in Seattle:

- **Rapid Streetcar** is the rail mode considered for HCT corridors. It uses longer articulated or coupled street-running vehicles and is envisioned to operate like the European street tram systems described in the callout on page 3-6. Rapid streetcar achieves faster operating speed and greater reliability through longer spacing between stops and more extensive use of exclusive right-of-way than is typical of U.S. streetcar lines that emphasize Center City circulation. Rapid streetcar stations would be on-street and would be designed to include high volume shelters, real-time passenger information, level boarding, off-board fare payment, and enhanced station amenities. Rapid streetcar would have higher capacity trains, greater priority over traffic, and operate at higher speeds compared with a local streetcar circulator, such as the South Lake Union streetcar.
- **Local Streetcar** is the rail mode considered for Center City corridors and functions as an urban circulator. It has relatively short distances between stops and operates primarily in mixed traffic.
- **Bus Rapid Transit** is one of the two bus modes considered for HCT corridors. BRT combines a rubber-tired transit vehicle with the operating characteristics of a rapid streetcar, including longer stop spacing and use of exclusive right-of-way. BRT stations similarly include real-time passenger information, level boarding, off-board fare payment, and enhanced station amenities. BRT vehicles are often "branded" or stylized to distinguish them from buses providing local service, and they may have features such as multiple, wide doors to increase boarding capacity. King County Metro's RapidRide service falls into a "light" category of BRT service with less extensive priority features, but it does include branded, stylized vehicles and some well-developed station features. BRT may be implemented using diesel or electric trolley buses.
- **Enhanced Bus** assumes a more basic level of improvements and priority features for existing transit service, with increased hours of operation and frequency comparable to BRT, but generally operating in mixed traffic. As with BRT, diesel or electric trolley buses could be used.

Volume I of the TMP (Briefing Book), Section 6, provides a more in-depth discussion of transit modes.

The T3 tram line is one of four tram lines in Paris that exemplify the Rapid Streetcar mode. Typical of European street trams, it uses articulated, higher-capacity trains and exclusive right-of-way. Although Paris historically had an extensive network of street trams, predating its Metro system, its modern tram lines have all been constructed since the 1990s.

Image from Wikimedia Commons user Pline

The South Lake Union Streetcar is an example of the local streetcar mode.

Image from Nelson\Nygaard

Los Angeles MTA operates the Orange and Silver line BRT services, branded as "Metro Liner." They have silver vehicles that utilize exclusive right-of-way and receive priority at intersections. These services are designed to look and operate like Metro Rail services; the Orange line has exclusively off-board fare payment and all-door boarding, which is also planned for the Silver Line. The Silver line primarily runs along a freeway right-of-way while the Orange line utilizes an old rail right-of-way, which has implications for access and land use integration (discussed in Chapter 5).

Image from Los Angeles Metro Transportation Library and Archive

Los Angeles MTA offers a 26-route network of Metro Rapid bus service, distinguished by red and silver low-floor vehicles (left). Metro Rapid service is characterized by longer stop spacing, transit priority features, and clearly branded enhanced stations. It is differentiated from Metro Local service, which uses similar vehicles (right), but Metro Local buses are painted orange and are not exclusively low-floor vehicles.

Image from Los Angeles County MTA (left) and Flickr user LA Wad (right)

INTRODUCING THE RAPID STREETCAR MODE VIA EUROPEAN STREET TRAMS

Modern streetcar development in the United States is often characterized by low-speed urban circulators designed to make short connecting trips in dense urban districts. It is not surprising, then, that people's vision of "streetcars" is of a mode designed more like the South Lake Union streetcar than an urban tram lines over which U.S. travelers to Europe marvel. The rapid streetcar mode considered in the TMP models the European street tram more than the Portland or South Lake Union streetcars.

COMPARING RAPID STREETCAR TO LOCAL STREETCAR CIRCULATORS

"Rapid streetcar" is a term coined to differentiate the high-capacity transit rail mode identified in the Seattle TMP from modern U.S. streetcar lines that typically serve downtown circulation, are low speed, and operate in mixed traffic with limited priority over general traffic. These lines consequently have short stop spacing and operate at relatively low average speeds.

Cities are attracted to the lower capital costs of building streetcar lines relative to light rail; lighter weight streetcar vehicles require less extensive street reinforcement and utility relocation. Although they operate at much lower speeds in urban environments, streetcar vehicles are capable of traveling at a comparable speed to light rail—44 miles per hour for vehicles manufactured by United Streetcar. Design features of Rapid Streetcar that differentiate it from local streetcar models include:

- Use of dedicated rights-of-way, where conditions allow
- Provision of high levels of traffic signal priority and other transit priority treatments to allow transit to bypass general purpose traffic in intersections and congested parts of the transit corridor where rail cars mix with traffic
- Use of larger or coupled vehicles to accommodate high passenger loads
- A higher level of station investment design and amenity development
- A higher level of investment in station access and wayfinding

These features produce a traveler experience that is more comparable to what Americans think of as urban light rail. The following European street tram examples are instructive as to the potential for Rapid Streetcar in Seattle.

EUROPEAN STREET TRAMS AS A MODEL FOR SEATTLE

Dozens of mid- and large-sized European cities have built new surface-running tram lines in the last decade; the mode has become popular due to its modest cost compared with subways and popularity with riders. These European trams provide context for the Rapid Streetcar mode identified for HCT corridors in the TMP. European trams that have longer spacing between stops and make use of exclusive right-of-way are able to attain higher average speeds than is typical of U.S. streetcar systems. Many lines carry large passenger volumes. Several examples of such tram lines or systems are described below.

*Nice**

The Nice T1 tram line uses Alstom Citadis 302 5-section trains that are about 100 feet long and hold up to 56 seated and 144 standing passengers. (The Citadis trains include versions with up to seven sections that are about 130 feet long and hold 70 seated and 230 standing passengers). The nearly 5.5 mile line, which opened in 2007, replaced four bus lines and carries about 90,000 passengers per day. Trains run from 5 am to 2 am seven days per week. During peak service hours of 8 am to 9 pm, Nice T1 trams run every five minutes on weekdays, every six minutes on Saturdays, and every 10 minutes on Sundays.

As illustrated in the photo, trams in Nice are visibly branded and operate in dense urban neighborhoods, including traveling through busy pedestrian plazas and crossing at-grade intersections with high volumes of pedestrians and cyclists. A strength of the European Street Tram/Rapid Streetcar model is that it puts transit where people are and want to be, breaking down the challenge of directing people to grade-separated stations that can be challenging to reach.

Lyon†

The modern tramway network in Lyon consists of four lines, all built since 2001, and complements the city's four-line metro system. The simple fact that a network of four lines covering 31 miles of the city was built in a 10 year timeframe is instructive. The ability to contextually integrate tram lines into the existing urban fabric allows for relatively rapid development. The nine-mile T3 line, completed in 2006, initially used the 5-section Citadis train, although 7-section Citadis 402 trains have been ordered. The line runs at a maximum speed of 43 mph and averages 23 mph; some of the line operates in relatively low-density areas where higher speeds are attainable. An extension of the T4 line is planned. The Lyon tramway is designed to complement intercity and regional transit systems as well as the higher capacity Lyon Metro system. Following the completion of a four line metro system in the 1970s and 1980s, the city has transitioned to the development of a surface tramway system as the more cost effective way to serve mobility needs.

APPLICABILITY OF THE EUROPEAN MODEL TO THE U.S.

European trams operate the type of high-quality service—high frequency and high speed—that is proposed in the TMP. While U.S.-based streetcar manufacturers such as United Streetcar have not yet produced longer articulated or coupled vehicles, or expressed interest in doing so, they likely would be able to license designs from other manufacturers and produce the vehicles given sufficient demand. There are few existing U.S. examples of Rapid Streetcar lines, although portions of the Portland, San Diego, and San Francisco light rail systems operate in a similar fashion. Further, a number of cities are exploring streetcar development projects that cover longer distances and provide a much higher level of priority for streetcar vehicles.

T1 tram in Nice's Place Girabaldi, where the tram runs without overhead wires, using batteries for a short section.

Image from Wikimedia Commons user Myrbella

A train on Lyon's T2 tram line.

Image from Wikimedia Commons user Alain Caraco

* Wikipedia, http://fr.wikipedia.org/wiki/Lignes_d%27azur; http://en.wikipedia.org/wiki/Tramway_de_Nice. Lignes d'Azur. http://www.lignesdazur.com/ftp/lignes_FR/tram%20horaires%20%2821%2004%2010%29.pdf

† Wikipedia, http://en.wikipedia.org/wiki/Lyon_tramway

THE HCT CORRIDORS

The three citywide corridors selected for full modal evaluation and two Center City corridors included in the TMP high-capacity transit evaluation are highlighted in Figure 3-6. The citywide HCT corridors are:

- Capitol Hill - Downtown, via Madison (Corridor 6 (Capitol Hill - Downtown, via Madison))
- Roosevelt - University District - South Lake Union - Downtown, via Eastlake (Corridor 8)
- Loyal Heights - Ballard - Fremont - South Lake Union – Downtown, via Westlake (Corridor 11)

> The Center City Connector corridors (CC1 and CC2) are discussed in the Center City Circulation section of this chapter.

Modal Evaluation

Corridor 6 (Capitol Hill – Downtown, via Madison) was evaluated only for BRT and Enhanced Bus service, since rail is not feasible due to steep grades. Corridors 8 and 11 were evaluated for all three modes. Center City corridors were evaluated for local streetcar and bus service.

The table below illustrates the modes evaluated for each corridor along with the preferred mode, selected based on the evaluation results and detailed corridor evaluation presented below.

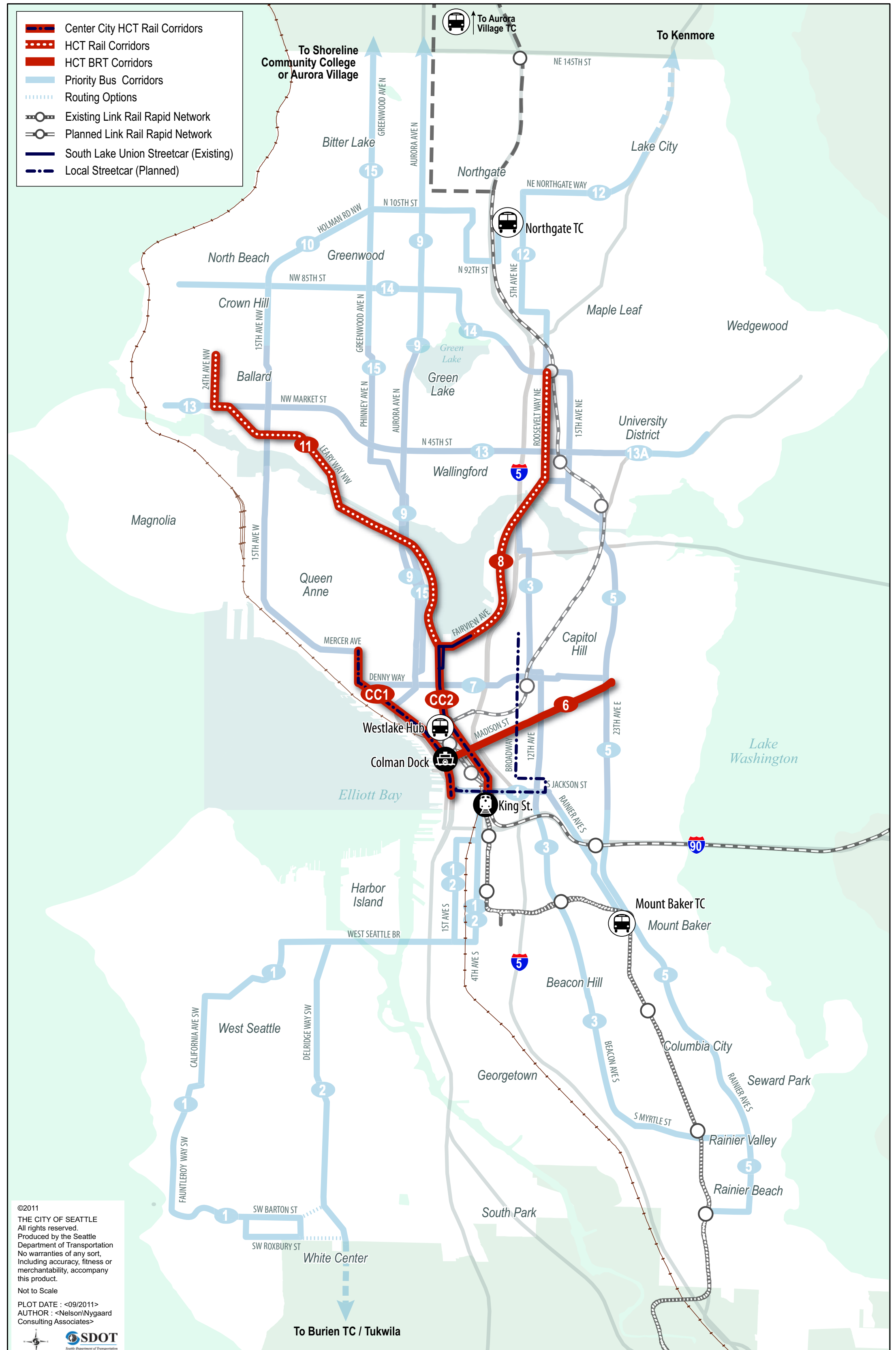
FIGURE 3-5 HCT CORRIDOR MODE OPTIONS AND PREFERRED MODE

Corridor	Rapid Streetcar	BRT	Enhanced Bus
6 - Capitol Hill - Downtown, via Madison	Not Evaluated	Preferred	Evaluated
8 - Roosevelt - University District - South Lake Union - Downtown	Preferred	Evaluated	Evaluated
11 - Ballard – Fremont – South Lake Union – Downtown	Preferred	Evaluated	Evaluated

HCT CORRIDOR EVALUATION RESULTS

Figure 3-7, Figure 3-8, Figure 3-9 provide more detailed descriptions of the three citywide HCT corridors. Metrics developed as part of the HCT corridor evaluation are shown in Figure 3-10 for all three corridors and each mode, along with a brief explanation of each metric.

FIGURE 3-6 CORRIDORS EVALUATED FOR HIGH CAPACITY TRANSIT



IMPLEMENTATION STRATEGIES

STRATEGY AREA: IMPLEMENTING HIGH CAPACITY TRANSIT CORRIDORS

Corridor 6: Capitol Hill – Downtown, via Madison

- **Strategy HCT 6.1:** Coordinate with King County Metro to develop a Very Small Starts Application for a first phase of this project (or for the complete project if viable within funding limits).
- **Strategy HCT 6.2:** Coordinate vehicle specifications with Metro's electric trolley bus procurement process.
- **Strategy HCT 6.3:** Develop conceptual and detailed design of BRT facilities.
- **Strategy HCT 6.4:** Use SDOT funds to develop in-lane, intersection TSP, and station improvements (as necessary to supplement potential federal funding).
- **Strategy HCT 6.5:** Ensure major development projects in the corridor consider station area placement and design needs.
- **Strategy HCT6.6:** Use redevelopment as an opportunity to set back development from the street by 20 feet, providing additional right-of-way for transit lanes and passenger waiting areas on sidewalks.
- **Strategy HCT 6.7:** Conduct outreach to corridor neighborhoods to discuss the benefits and tradeoffs of BRT implementation and related potential service restructuring.
- **Strategy HCT 6.8:** Adopt Frequent Transit Network branding.
- **Strategy HCT 6.9:** Conduct traffic analysis of various right-of-way configurations in corridor, particularly at major intersections including Boren, Broadway, 12th and 23rd. Traffic analysis should consider various right-of-way configurations and alternative lane configurations in downtown. Waterfront turn-around options will be studied through the Central Waterfront process.

Corridor 8 Roosevelt – University District – South Lake Union – Downtown

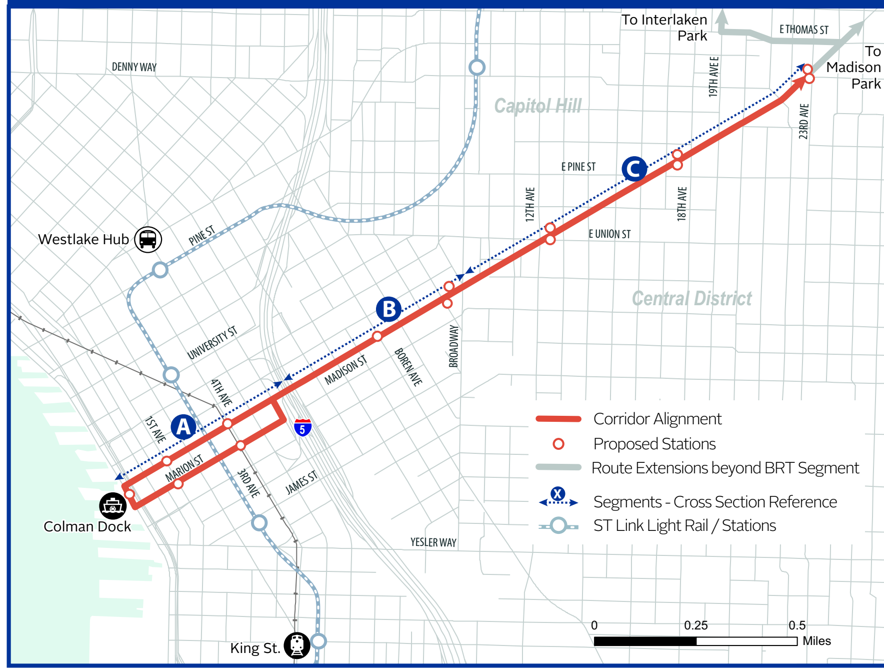
- **Strategy HCT 8.1:** Fund and conduct an alternatives analysis study to confirm rapid streetcar as the preferred mode and to position the project for federal funding. This should follow the completion of a full funding grant agreement for Corridor 11 (Loyal Heights - Ballard - Fremont - South Lake Union - Downtown).
- **Strategy HCT 8.2:** Conduct a detailed study of terminus locations, including: 1) development of a southern terminal that is integrated with the International District Station and does not require transferring passengers to cross a major arterial street, and 2) consideration of northern terminus options and phasing, including a terminus at the Brooklyn Station, a terminus at the Roosevelt Station (as shown in the corridor map included in Figure 3-9), or a terminus at Northgate.
- **Strategy HCT 8.3:** Integrate South Lake Union streetcar service in corridor operation and design.
- **Strategy HCT 8.4:** Increase station spacing on Westlake between Valley and Westlake Center and add traffic signal priority to reduce travel times.
- **Strategy HCT 8.5:** Design the downtown segment between Westlake and King Street/International District hubs to maximize travel speeds, increasing the value of the line as fast inter-neighborhood transit service and an effective connector between major downtown multimodal hubs.
- **Strategy HCT 8.6:** Study in detail the impacts and benefits of various design options for rapid streetcar service on 4th and 5th Avenues, including various two-way and couplet designs, replacement of lost bicycle capacity, bicycle crossing safety, traffic impacts and transit reliability impacts of traffic chokepoints, and tradeoffs between mixed traffic and dedicated operations.
- **Strategy HCT 8.7:** Conduct traffic analysis of various right-of-way configurations in corridor, particularly on 4th and 5th Avenues in down-town, on Eastlake Avenue, and for various right-of-way configurations on Roosevelt and 11th Avenue NE.
- **Strategy HCT 8.8:** Develop a detailed operating plan that considers opportunities for replacement of existing corridor bus service and restructuring opportunities in northeast Seattle.
- **Strategy HCT 8.9:** Conduct outreach to corridor neighborhoods to discuss corridor design options and tradeoffs.

Corridor 11: Loyal Heights – Ballard – Fremont – South Lake Union – Downtown

- **Strategy HCT 11.1:** Prioritize project development and construction of Corridor 11 (Loyal Heights - Ballard - Fremont - South Lake Union - Downtown) before Corridor 8 (Roosevelt - University District - South Lake Union – Downtown).
- **Strategy HCT 11.2:** Fund and conduct an alternatives analysis study to confirm rapid streetcar as the preferred mode and to position the project for federal funding.
- **Strategy HCT 11.3:** Target a full funding grant agreement with the Federal Transit Administration by 2014.
- **Strategy HCT 11.4:** Conduct a detailed study of terminus locations, including: 1) development of a southern terminal that is integrated with the International District Station and does not require transferring passengers to cross a major arterial street, and 2) consideration of northern terminus options and phasing, including a terminus at N 85th Street, a terminus at N 65th Street (as shown in the corridor map included in Figure 3-10), or a terminus in the center of Leary Ave NW and NW Market Street.
- **Strategy HCT 11.5:** Continue to operate South Lake Union streetcar service to Fred Hutchinson and extend this service to the existing International District Station. This would provide improved headways on the South Lake Union to South Downtown segment.
- **Strategy HCT 11.6:** Increase station spacing on Westlake between Valley and Westlake Center and add traffic signal priority to reduce travel times.
- **Strategy HCT 11.7:** Design the downtown segment between Westlake and King Street/International District hubs to maximize travel speeds, increasing the value of the line as fast inter-neighborhood transit service and an effective connector between major downtown multimodal hubs.
- **Strategy HCT 11.8:** Study in detail options for crossing the Ship Canal, which could include various design and operational alternatives for use of the existing Fremont Bridge (likely first phase) and the development of a new high bridge to cross the Ship Canal (likely in the vicinity of 3rd Avenue W).
- **Strategy HCT 11.9:** Study in detail the impacts and benefits of various design options for rapid streetcar service on 4th and 5th Avenues, including various two-way and couplet designs, replacement of lost bicycle capacity, bicycle crossing safety, and transit reliability impacts of traffic chokepoints, and tradeoffs between mixed traffic and dedicated operations.
- **Strategy HCT 11.10:** Conduct traffic analysis of various right-of-way configurations in corridor, particularly on 4th and 5th Avenues in downtown, at the intersection of Nickerson and Fremont, north of the Fremont Bridge, and on Leary and Ballard Avenues.
- **Strategy HCT 11.11:** Develop a detailed operating plan that considers opportunities for replacement of existing corridor bus service and restructuring opportunities in northwest Seattle.
- **Strategy HCT 11.12:** Expand City priorities and programs for incentivizing and implementing transit-oriented neighborhood development along the corridor.
- **Strategy HCT 11.13:** Conduct outreach to corridor neighborhoods to discuss corridor design options and tradeoffs.

FIGURE 3-7 CORRIDOR 6 PROJECT SHEET: CAPITOL HILL- DOWNTOWN

Corridor 6 Overview



Length: 2.1 miles

Major Stations: Colman Dock, 1st Ave, 3rd/4th Ave, Boren Ave, Broadway, 12th Ave, 18th Ave, 23rd Ave

Average Stop Spacing: 1,500 feet

Key Connections:

- Colman Dock
- 3rd Ave Transit Spine
- First Hill Streetcar
- Bus Square on 3rd Ave

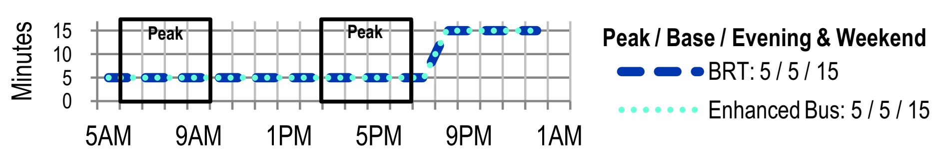
Service Restructuring

- Route 11 (Interlaken Park via 19th) and Route 12 (Madison Park) are folded into this concept.
- Under both the BRT and Enhanced Bus options, the route splits east of 23rd with one leg using John/Thomas to 19th and Interlaken Park while the other leg continues on Madison to Madison Park.

Operating Plan

Headway by Mode

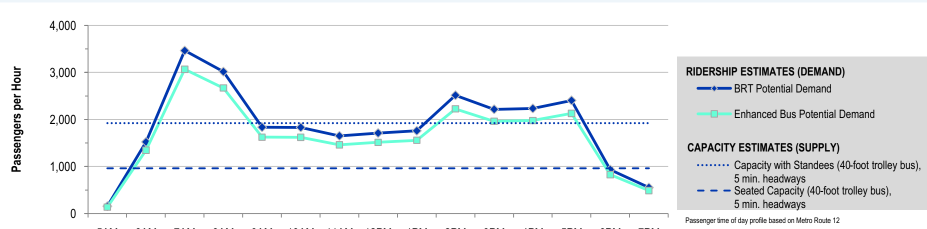
The operating plan for Corridor 6 assumes five minute peak and off-peak headways for both BRT and enhanced bus options, given the vehicle capacity analysis shown below.



Vehicle Capacity Requirements

The graphic at right shows a time-of-day profile of potential ridership demand for each mode compared to capacity (supply) for different vehicle-mode options. It illustrates where demand exceeds standing capacity.

Planned headways were adjusted based on the analysis. Longer, higher capacity vehicles are not feasible on Madison due to steep grades.



Preferred Mode

Rail is the recommended mode for corridor 11, based on the vehicle capacity needs illustrated in the chart above.

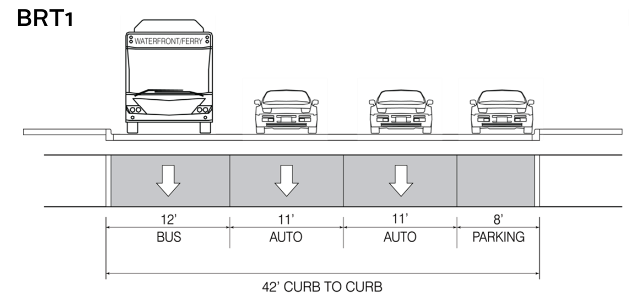
Implementation Actions

- Detailed implementation actions are described on page 3-8.

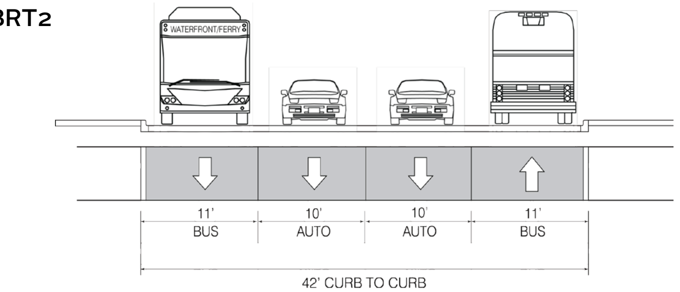
Sample Cross-Sections

Segment A

BRT1



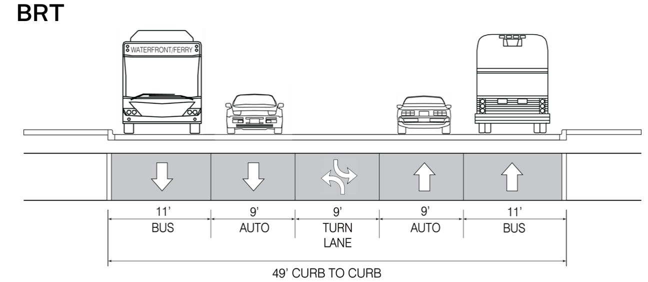
BRT2



Madison/Marion, Alaskan Way to 6th: The Madison/Marion Couplet is a primary option; a 2-way Madison is also feasible (keeping 1-way general auto traffic). Parking removal would be required on Marion and Madison to provide dedicated lane operations. No substantial engineering issues are anticipated with shared-lane operation on Madison, but dedicating a travel lane for exclusive BRT could increase traffic delay for general purpose traffic.

Segment B

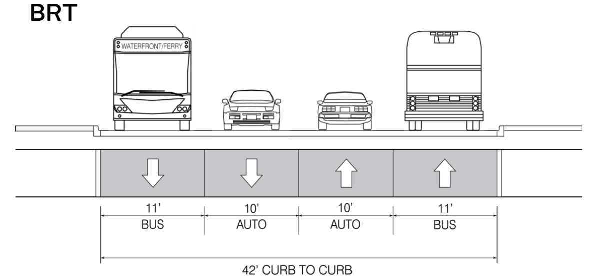
BRT



Madison, I-5 to Broadway: This segment features lanes as narrow as nine feet for cars. Frequent signalized cross-streets, alleys, and driveways are likely to keep speeds down. BRT is shown in curb lanes that could be used for business access as well as BRT, or if buses with left-side doors are used in conjunction with shared-lane operation, center platforms could also be used in this segment.

Segment C

BRT

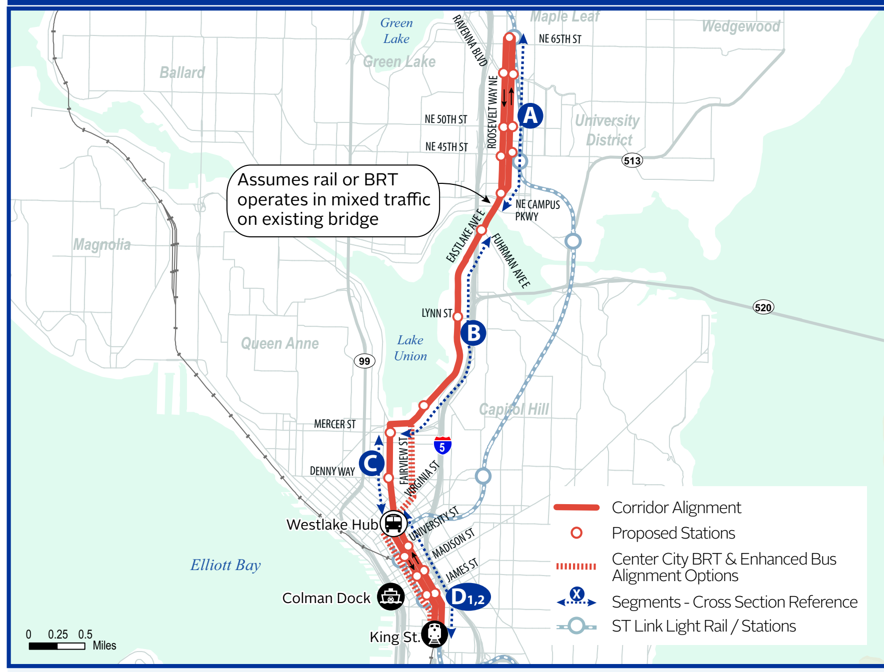


Madison, Broadway to 23rd: The easternmost Madison segment is 42' curb-to-curb and has no left turn lanes, which places a premium on space for automobiles. Exclusive BRT could be harder to implement within the existing cross-section for this reason. The diagonal nature of Madison (which leads to many intersections and odd traffic movements) and the frequency of signals will keep speeds low in this segment.

Note: All cross sections are representative of a possible design option for a corridor segment. Right-of-way widths, utility constraints, and competing street use needs vary in each of the representative segments.

FIGURE 3-8 CORRIDOR 8 PROJECT SHEET: ROOSEVELT - UNIVERSITY DISTRICT - SOUTH LAKE UNION - DOWNTOWN

Corridor 8 Overview



Length: 6.1 miles

New Track Length: 7.6 single-track miles (rail)

Stations: Roosevelt Way/12th Ave NE - 65th St, Ravenna Blvd, 50th St, 45th St, Campus Pkway, Eastlake Ave E - Fuhrman Ave, Lynn St, Aloha St; Westlake Ave - Mercer St, Denny Way, Westlake Hub, 4th/5th Ave - Union/University St, Madision/Marison St, James St, King Street Hub

Average Stop Spacing: 1,700 feet

Key Connections:

- King Street Hub
- Financial District Station

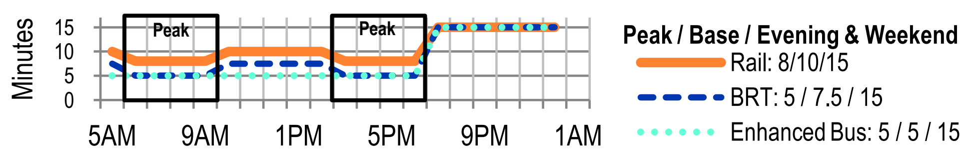
Service Restructuring

- The SLU Streetcar would be folded into the Rapid Streetcar concept.
- Route 70 would be discontinued under all mode options.
- For all modes, Routes 66/67 would operate every 15 minutes throughout the day between UW and Northgate and Route 66 would be converted into Route 67 trips to better serve campus.

Operating Plan

Headway by Mode

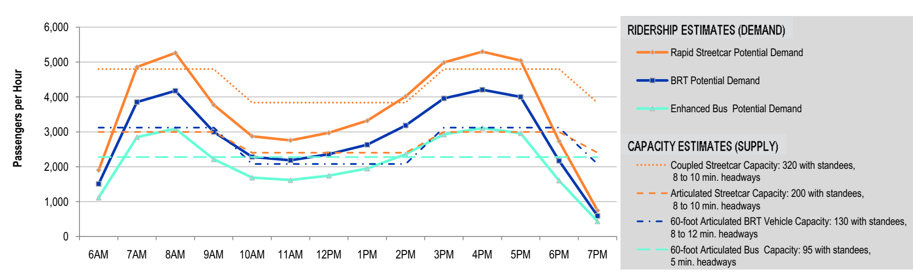
The operating plan for Corridor 8 assumes eight minute peak headways for rail, but five minute headways for bus options, given the vehicle capacity analysis shown below. 7.5 minute off-peak headways are assumed for the BRT option and five minutes for the enhanced bus, compared to 10 minutes for rail.



Vehicle Capacity Requirements

The graphic at right shows a time-of-day profile of potential ridership demand for each mode compared to capacity (supply). It illustrates where demand exceeds standing capacity.

Planned headways were adjusted based on the analysis, which suggests higher capacity rail vehicles (coupled or articulated streetcars) will be required.



Preferred Mode

Rail is the recommended mode for corridor 8, based on the vehicle capacity needs illustrated in the chart above.

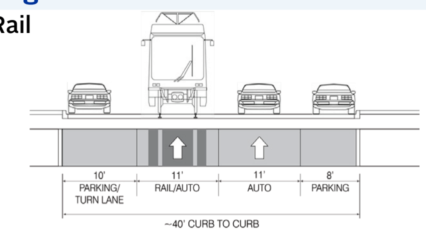
Implementation Actions

- An alternatives analysis (AA) process would be required to secure federal funding for the corridor and analyze alternative alignment options.
- Detailed implementation actions are described on page 3-8.

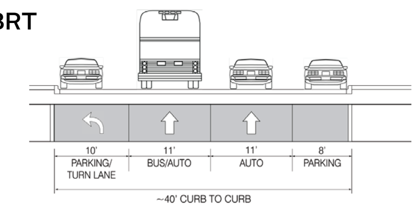
Sample Cross-Sections

Segment A

Rail



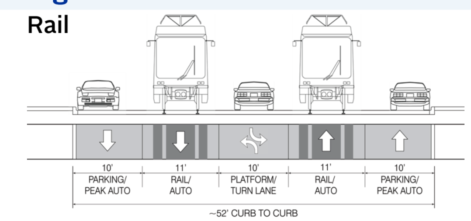
BRT



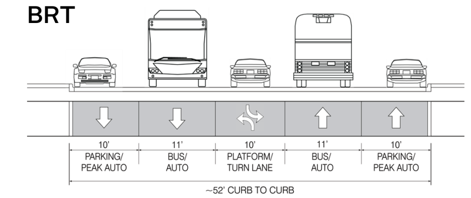
Roosevelt/11th-12th Couplet: Rail could operate in mixed traffic or a dedicated lane. Sound Transit 65th Avenue LINK LRT station is along 12th, straddling 66th Avenue, so the Corridor 8 alignment would serve it best by turning around on 66th Avenue with a terminal station on 66th.

Segment B

Rail



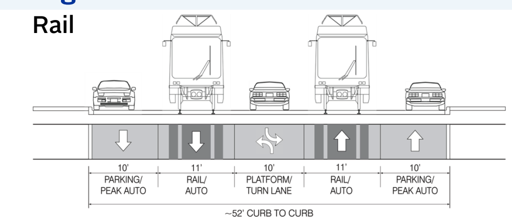
BRT



University Bridge: University Bridge is not expected to have the same traffic congestion issues as Fremont, so a basic retrofit to place rail tracks on the inside lanes is recommended.

Segment C

Rail



BRT

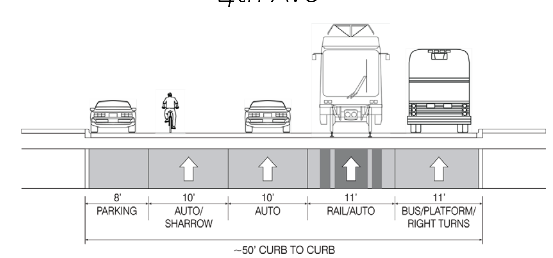
Operates in exclusive lanes on Fairview Ave and Virginia St/Stewart St

Fairview/Eastlake Ave. E: Between the existing SLU terminus and the University Bridge, Fairview and Eastlake are consistently 5 lanes wide, and the center-platform/center station configuration should work well. Transit could operate in mixed traffic or a dedicated lane. Few issues are anticipated assuming current peak-direction parking restrictions on Eastlake are continued.

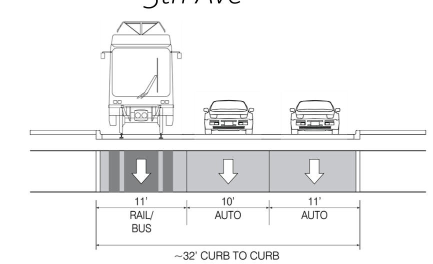
Segment D1

Rail

4th Ave



5th Ave



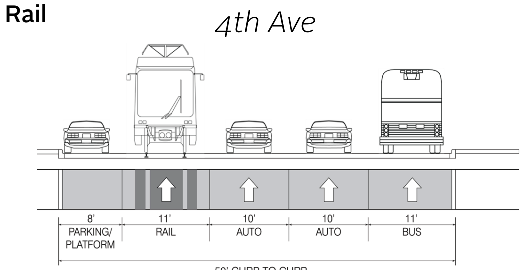
4th Avenue: Rail operates in two eastern lanes using a "weave" pattern to allow curb stations and right turn movements for traffic.

5th Avenue: Rail operates in western lane with buses.

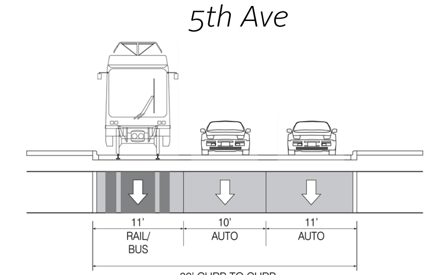
Segment D2

Rail

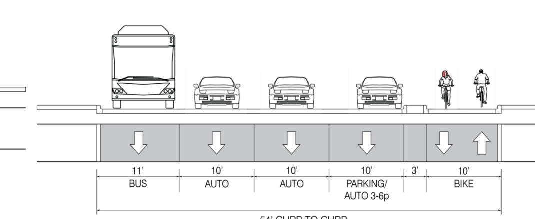
4th Ave



5th Ave



2nd Ave



BRT Operates in exclusive lanes on 3rd Avenue

4th Avenue: Rail operates in western lane to reduce conflicts with regional bus traffic.

2nd Avenue: Two-way cycle track could be evaluated to mitigate loss of bike lane segments on 4th Ave.

Note: All cross sections are representative of a possible design option for a corridor segment. Right-of-way widths, utility constraints, and competing street use needs vary in each of the representative segments.

FIGURE 3-9 CORRIDOR 11 PROJECT SHEET: LOYAL HEIGHTS-BALLARD-FREMONT-SOUTH LAKE UNION-DOWNTOWN

Corridor 11 Overview

Length: 7.0 miles

New Track Length: 10.6 single-track miles (rail)

Stations: 24th Ave NW - NW 65TH St, Leary/ Ballard Ave - NW Market St, 15th Ave NW, 8th Ave NW, 3rd Ave NW, Fremont Ave N, Westlake Ave N - Nickerson St, Galer St, Mercer St, Denny Way, Westlake Hub, 4th/5th Ave - Union/ University St, Madison/Marison St, James St, King Street Hub

Average Stop Spacing: 2,400 feet

Key Connections:

- Pioneer Square Station
- Westlake Hub
- King Street Hub
- Financial District Station

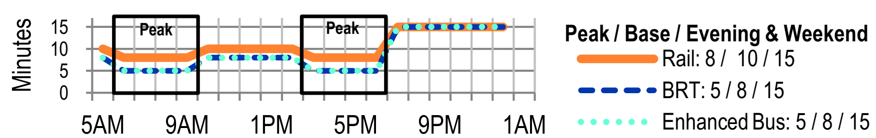
Service Restructuring

- **Streetcar and BRT options:** Route 17 would operate on Dexter between Nickerson and downtown Seattle, replacing Route 28 in that segment.
- **Enhanced Bus option:** Route 17 would remain unchanged.
- **All Options:** Route 28 truncated to only serve areas north of the 45th/Leary stop.

Operating Plan

Headway by Mode

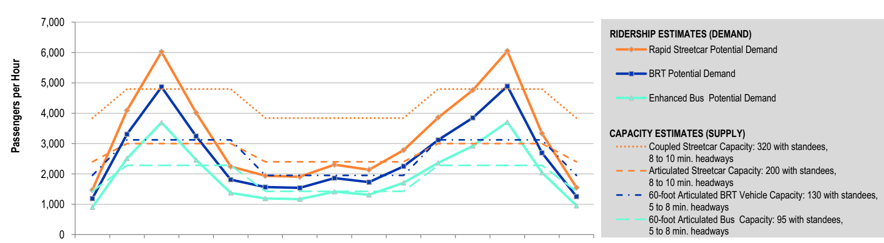
The operating plan for Corridor 11 assumes eight minute peak headways for rail, but five minute headways for bus options, given the vehicle capacity analysis shown below. Eight minute off-peak headways are assumed for the bus options, compared to ten minutes for rail.



Vehicle Capacity Requirements

The graphic at right shows a time-of-day profile of potential ridership demand for each mode compared to capacity (supply) for different vehicle-mode options. It illustrates where demand exceeds standing capacity.

Planned headways were adjusted based on the analysis, which suggests higher capacity rail vehicles (coupled or articulated streetcars) will be required.



Preferred Mode

Rail is the recommended mode for corridor 11, based on the vehicle capacity needs illustrated in the chart above.

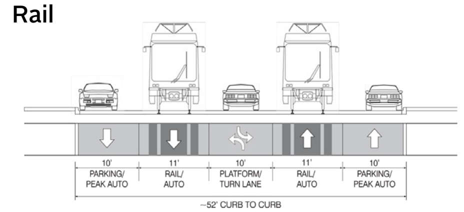
Implementation Actions

- An alternatives analysis (AA) process would be required to secure federal funding for the corridor and analyze alternative alignment options.
- Detailed implementation actions are described on page 3-8.

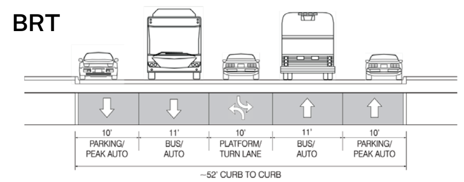
Sample Cross-Sections

Segment A

Rail



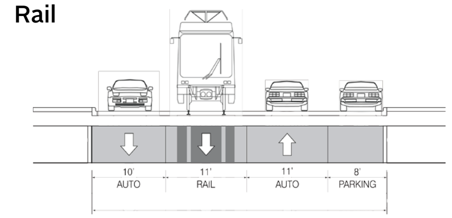
BRT

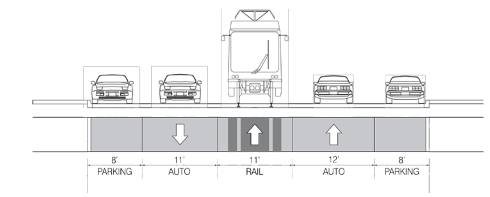


24th Avenue NW: This neighborhood collector is low-volume and has a 3-lane section with bike lanes and parking on both sides. Adding rail to the auto lanes is not expected to have a substantial impact, but the center platform station in the vicinity of 64th Street could benefit from parking removal to allow cars to pass stopped transit vehicles.

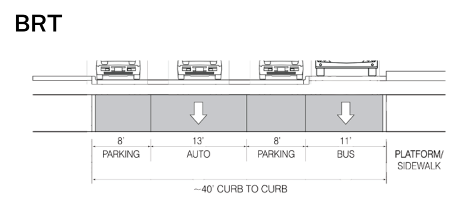
Segment B *Ballard Ave* / *Leary Ave*

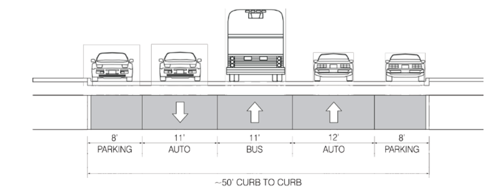
Rail





BRT

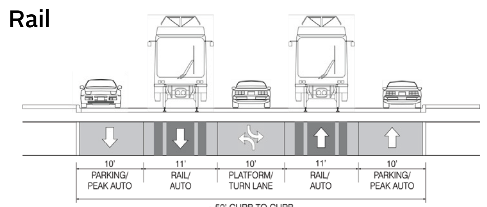




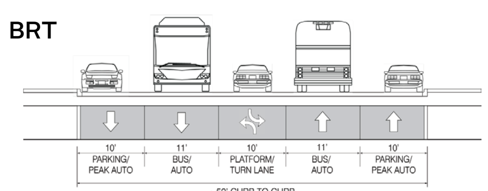
Ballard/Leary Couplet: Traffic on Ballard Avenue and Leary Way would remain 2-way (with the exception of the northernmost block of Ballard Ave, just S. of Market); rail would operate a 1-way couplet. There are no signals and few traffic impacts would be expected. Signalization/sequencing for rail on the short segment of Market between Leary Avenue and 24th Ave. NW would require further analysis.

Segment C

Rail



BRT

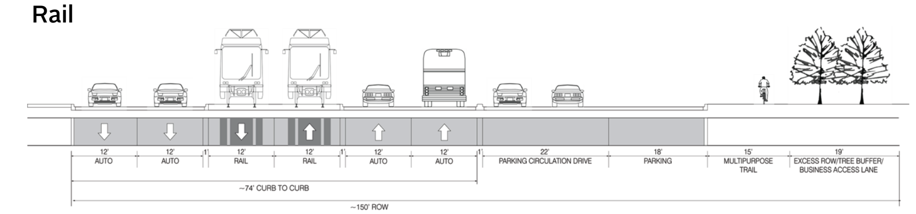


Fremont to 15th Avenue: The Fremont bridge can accommodate a streetcar in mixed traffic. There are several alternatives to simply adding streetcar tracks to the existing bridge, including replacing the Fremont Bridge with a wider span, adding a second adjacent span, or continuing the streetcar line to the west on Nickerson and adding a new transit and non-motorized bridge near Seattle Pacific University. The cost of a new bridge is not likely to be offset by substantial travel time savings associated with either an exclusive crossing or the alternative Nickerson alignment; however, it would provide benefits for bikes, pedestrians, and buses.

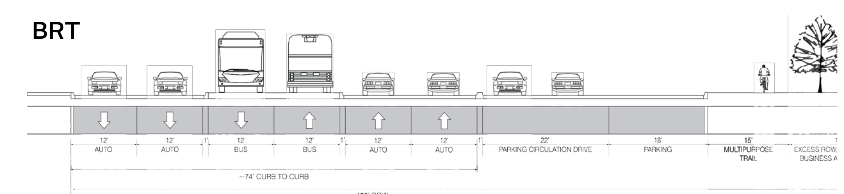
36th Avenue NW and Leary: Center-running/ center platform on 36th, Leary Way, and potentially Nickerson are all straightforward.

Segment D

Rail



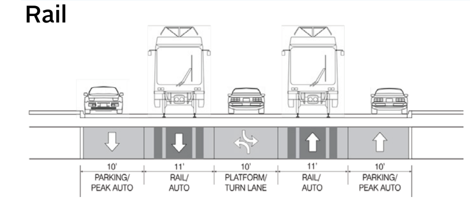
BRT



Westlake, Valley to Nickerson: Westlake has very wide ROW in this segment, and could support an exclusive guideway configuration to optimize safety, speed/reliability and traffic operations. Redesigning the public space east of the current Westlake Alignment (mostly parking) would provide sufficient space for a rail guideway without sacrificing the traffic capacity on Westlake. There is opportunity for a joint multi-use path project, along with numerous possible ROW configurations.

Segment E

Rail



BRT

Operates in exclusive lanes on Aurora Avenue,Wall St / Battery St, and 3rd Avenue

Westlake: This segment would operate in the path of the existing SLU streetcar and would be double tracked. This could use a new center median alignment as shown below (preferred) or utilize the existing southbound track with a new northbound track on the eastern curb. Terry track could be maintained for the SLU streetcar.

Note: All cross sections are representative of a possible design option for a corridor segment. Right-of-way widths, utility constraints, and competing street use needs vary in each of the representative segments.

FIGURE 3-10 HCT CORRIDOR EVALUATION RESULTS

	Corridor 6	Corridor 8	Corridor 11
Weekday riders (2030) and Net New Riders			
Ridership potential in 2030 is based on service improvements and projected land use changes. • Weekday riders (2030) estimated from Fall 2009 stop/route-level boardings assigned to each corridor. Center City ridership potential based on comparable urban rail circulators (Portland, Seattle SLU Streetcar, Tacoma, Memphis, and San Francisco). • Net new weekday riders are those: 2030 estimate of potential ridership - current (2009) ridership estimate for the corridor.			
Rail	N/A	up to 25,000 Riders (Net New Riders - 10,700 Riders)	up to 26,000 Riders (Net New Riders - 12,500 Riders)
BRT	up to 14,000 Riders (Net New Riders - 6,200 Riders)	up to 20,000 Riders (Net New Riders - 7,500 Riders)	up to 21,000 Riders (Net New Riders - 9,500 Riders)
Enhanced Bus	up to 12,500 Riders (Net New Riders - 4,500 Riders)	up to 15,000 Riders (Net New Riders - 4,300 Riders)	up to 16,000 Riders (Net New Riders -6,400 Riders)
Productivity (Weekday Riders per Revenue Hour)			
Efficiency with which provided transit capacity is utilized. • Productivity = weekday ridership/weekday revenue hours. • Weekday hours of revenue service calculated through development of corridor-specific operating plan..			
Rail	N/A	170 Riders/Hour	175 Riders/Hour
BRT	125 Riders/Hour	95 Riders/Hour	105 Riders/Hour
Enhanced Bus	75 Riders/Hour	50 Riders/Hour	65 Riders / Hour

	Corridor 6	Corridor 8	Corridor 11
Annual Operating Cost (Operating Cost per Boarding Ride)			
Cost to deliver service on the proposed line, annually and for a single boarding ride. • Annual operating cost based on the number of hours of revenue service, calculated through development of corridor-specific operating plan, multiplied by the 2011 operating cost for each mode: Bus: $135, Electric Trolley: $129, Rapid Streetcar: $187. • Operating cost per boarding ride is the cost to deliver a single boarding ride: weekday operating cost/weekday boardings.			
Rail	N/A	$8.9 million ($1.10)	$9.1 million ($1.10)
BRT	$4.6 million ($1.05)	$8.1 million ($1.35)	$8.0 million ($1.25)
Enhanced Bus	$6.1 million ($1.70)	$11.4 million ($2.65)	$10.4 million ($2.15)
Net Operating Cost per Net New Ride (Accounts for Service Restructuring and Consolidation Opportunities)			
Operating cost to deliver a new boarding ride considering potential cost savings. • Planned weekday operating cost - weekday operating cost savings, divided by the number of net new boarding rides projected for 2030			
Rail	N/A	$0.65	$1.85
BRT	$2.25	$1.60	$2.20
Enhanced Bus	$4.00	$5.65	$4.55

HCT Evaluation Results: Capital Costs, Travel Time Savings, and GhG Emissions

	Corridor 6	Corridor 8	Corridor 11
Total Capital Costs (and Cost per Mile)			
Cost to construct the project, including planning and engineering, vehicles, complementary infrastructure/roadway improvements, and contingency costs. • Rail mode would use a "rapid streetcar" vehicle larger than the South Lake Union or First Hill streetcar vehicles. BRT mode would use electric trolley buses. Enhanced bus assumes new vehicle fleet.			
Rail	N/A	$278 million ($46.0 million per mile)	$335 million ($47.9 million per mile)
BRT	$87 million ($42.2 million per mile)	$88 million ($14.6 million per mile)	$132 million ($18.9 million per mile)
Enhanced Bus	$20 million ($9.8 million per mile)	$28 million ($4.6 million per mile)	$18 million ($2.5 million per mile)
Annualized Cost per Rider (Operating and Capital)			
Value of investment over time, including cost of operation and annualized cost of capital investment, fleet replacement and maintenance. • Annualized operating and capital cost per rider = annual operating cost + annualized capital costs/annual boarding rides. • Operating cost adjusted for inflation by 3% annually. Infrastructure life held constant. Assumed vehicle life: Streetcar: 30 years, Electric Trolley: 15 years, Bus: 12 years			
Rail	N/A	$2.75	$2.95
BRT	$2.40	$2.55	$2.60
Enhanced Bus	$2.65	$4.10	$3.45

	Corridor 6	Corridor 8	Corridor 11
End-to-End Travel Time Savings (Average Savings per Ride, including In- and Out-of-Vehicle Time)			
In-vehicle travel time savings (compared to current service) for a passenger riding between two terminus stations. • Projected 2030 corridor travel time with current road design - estimated travel times under each mode, alignment, and design. **Average in-vehicle travel time savings + out-of-vehicle waiting time savings.** • In vehicle travel time savings average estimated length of passenger ride + out of vehicle time savings (reduced wait time resulting from improved frequency). Note: applies to comparing modes, but not corridors.			
Rail	N/A	15 Minutes (average 9 minutes)	11 Minutes (average 8 minutes)
BRT	8 Minutes (average 8 minutes)	15 Minutes (average 10 minutes)	11 Minutes (average 9 minutes)
Enhanced Bus	1 Minutes (average 3 minutes)	2 Minutes (average 3 minutes)	2 Minutes (average 3 minutes)
Annual GhG Savings			
Annual reduction in greenhouse gas emission equivalents from reduced vehicle miles traveled and net change in transit emissions. Emissions savings from reduced VMT based on an assumed rate of displaced light duty vehicle trips per new transit rider, average trip length by corridor, average fuel economy, and resulting fuel savings. Emissions savings from net change in transit emissions = planned service – existing service (based on conceptual operating plans). Emissions factors applied based on mode (diesel bus, electric trolley bus, and streetcar).			
	← Emissions Decrease / Increase →	← Emissions Decrease / Increase →	← Emissions Decrease / Increase →
Rail	N/A	-1315 (VMT); -250 (transit)	-1764 (VMT); -223 (transit)
BRT	-258 (VMT); +11 (transit)	-918 (VMT); -267 (transit)	-1338 (VMT); -245 (transit)
Enhanced Bus	-189 (VMT); +11 (transit)	-522 (VMT); -266 (transit)	-900 (VMT); +1315 (transit)
	MT CO2e	MT CO2e	MT CO2e

Investments in priority bus corridors provide faster travel speeds, a more comfortable wait, and easier connections to other transit lines.
Image from Nelson\Nygaard

FREQUENT TRANSIT NETWORK PRIORITY BUS CORRIDORS

MAXIMIZING INVESTMENTS IN FREQUENT TRANSIT NETWORK PRIORITY BUS CORRIDORS

Frequent Transit Network (FTN) priority bus corridors represent the most immediate opportunity for the City to make dramatic and meaningful improvements in development of the FTN. These corridors were not selected for detailed analysis for high capacity transit modes, but they complement HCT corridor investments and merit both capital and service-quality improvements.

Value of Investment

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

- **Travel time savings for riders:** Implementing corridor improvements that mitigate the impact of congestion on buses and make them more reliable leads to transit that is more competitive with the automobile and provides a heightened passenger experience on- and off-vehicle.
- **Reduced impacts of delay on transit operating and capital costs:** Travel time savings can improve transit's bottom line if the time savings avoid the need to add runs and purchase additional vehicles to keep up with delay caused by increased traffic congestion.
- **Improved access to local and regional HCT:** The bus network facilitates access to high capacity service in Seattle and connections to regional destinations. Bus corridor improvements are also investments in future potential HCT corridors.

Supporting the Frequent Transit Network

Developing a FTN on the priority bus corridors will maximize the impact of capital investments in the corridors. Key attributes of a FTN include:

- **Convenience:** Frequent transit service, operating every 15 minutes or better, 18-24 hours per day, allows passengers to take a bus without consulting a schedule and enables choices to increase transit use and/or reduce dependence on a car.
- **Branding:** Marketing the frequent transit network as a distinct service offering ensures that passengers connect high service quality with all service elements, including routes, vehicles, stops, and printed and electronic transit information.
- **Legibility:** A branded FTN provides a high-quality core route system with wider coverage than rail and other high-capacity service.

Volume I of the TMP (Briefing Book), pages 5-27 to 5-29, provides a discussion and examples of branding elements, including frequent service networks in other cities. Chapter 4 of this report describes the service attributes of the FTN in more detail.

INVESTMENT PHASING PRINCIPLES

Given limited resources for transit investments for the City and its partners, transit improvements will need to be implemented in phases. Principles for making investment phasing decisions include:

- **Leverage:** Consider the ability for a corridor project to complement and/or enhance projects currently underway or planned by the City's partners, e.g., Link and RapidRide corridors.
- **Demand:** Invest where need is greatest. The corridor evaluation process provides detailed modeling of potential ridership and related benefits.
- **Anticipated Growth:** Invest in transit where the greatest growth is planned, allowing developers to make design and construction decisions based on the knowledge that the neighborhood will have high-quality, permanent transit infrastructure.
- **User Benefits:** Investments that lead to significant travel time benefits will attract the most new riders and merit priority.
- **Grant Opportunities:** Include partnership and grant funding opportunities as important inputs when developing project implementation schedules.

These priorities are implicit in the TMP recommendations and should serve as guidelines as the TMP is used to make decisions about project priority.

THE FREQUENT TRANSIT NETWORK PRIORITY BUS CORRIDORS

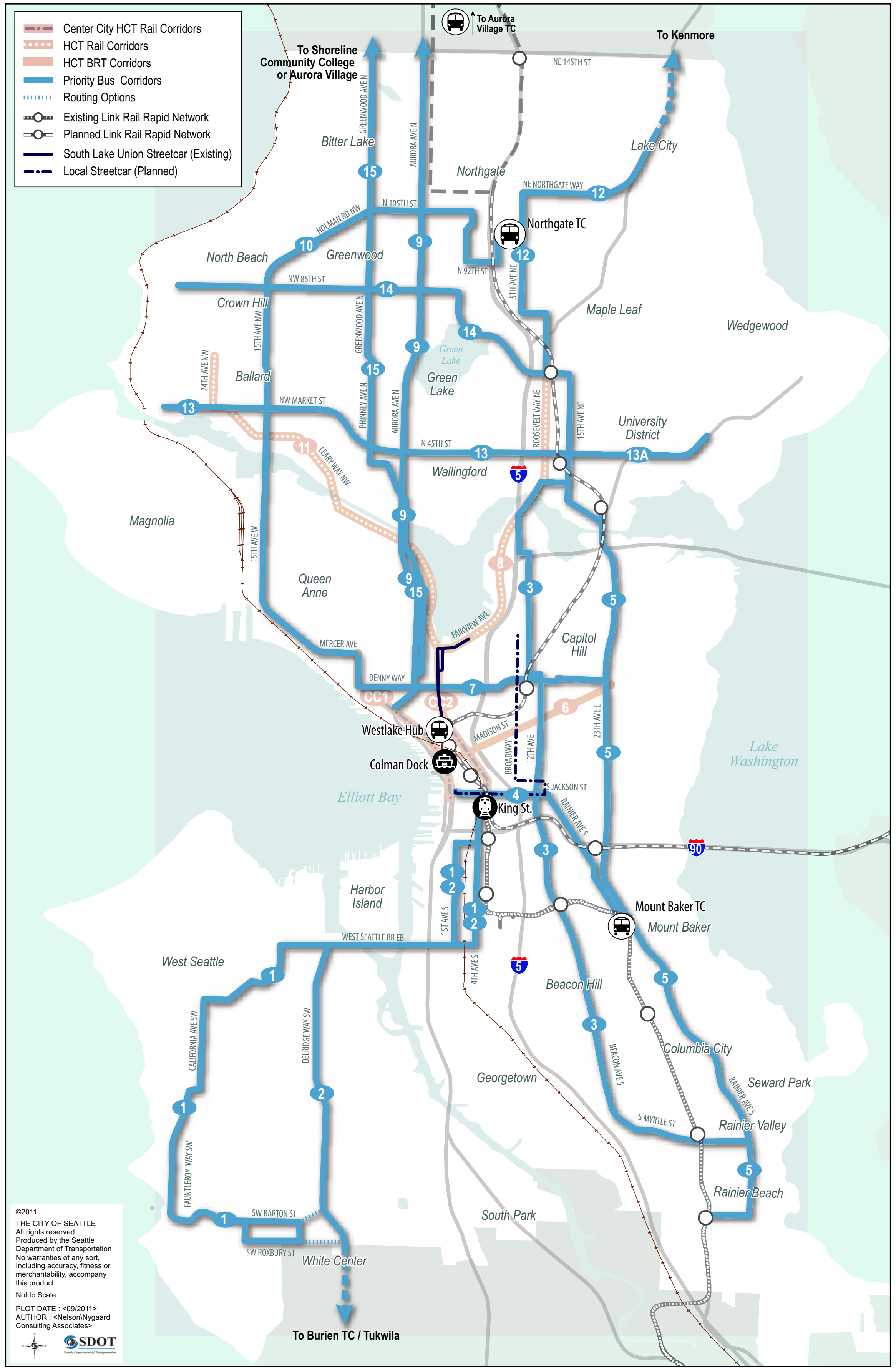
Figure 3-11 lists the FTN priority bus corridors along with the existing and proposed bus mode(s) (diesel bus or electric trolley). The corridors are illustrated in Figure 3-12.

FIGURE 3-11 PRIORITY BUS CORRIDOR SUMMARY

Corridor	Description	Existing/Planned Bus Service
1	West Seattle - Downtown via Fauntleroy/California	54 RapidRide C-Line
2	Burien TC - Downtown via Delridge	120 RapidRide Delridge Corridor (Proposed)
3	Othello – U-District via Beacon Ave and Broadway	49
4	Mount Baker – Downtown via Rainier Ave	36, 60
5	Rainier Valley – U-District via Rainier Ave and 23rd Ave	7
7	Queen Anne/Magnolia – South Lake Union – Capitol Hill via Denny	8
9	Aurora Village to Downtown via SR 99	358 Rapid Ride E-Line
10	Northgate – Ballard – Downtown	15, 18, 75 Rapid Ride D-Line
12	Lake City – Northgate – U District	66, 67, 73
13	Ballard – U District - Laurelhurst via Market St and 45th St	44
14	Crown Hill – Greenlake – U District	48
15	Phinney Ridge – Greenwood – Broadview	5

Note: Does not include corridors 6, 8, and 11, which were evaluated for high-capacity modes (see High Capacity Transit section)

FIGURE 3-12 FTN PRIORITY BUS CORRIDORS



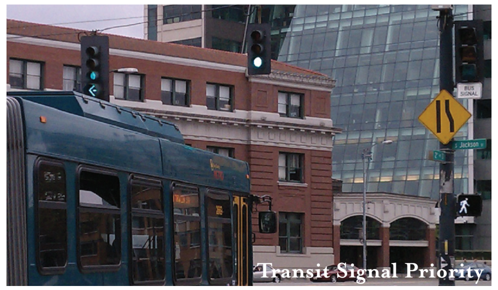
IMPLEMENTATION STRATEGIES

STRATEGY AREA: IMPLEMENTING FREQUENT TRANSIT NETWORK PRIORITY BUS CORRIDOR IMPROVEMENTS

- **Strategy PBC 1:** Develop a coordinated approach to corridor development that integrates other modal plans (see mode detailed recommendation in Mobility Corridors section of Chapter 5).
- **Strategy PBC 2:** Set targets to design and implement three corridors every two years starting in 2012.
- **Strategy PBC 3:** Focus early investments in completing RapidRide Corridors (Corridors 1, 9, and 10) and Market/45th Street and Rainier/Jackson improvements already underway by SDOT to include all additional TMP-recommended corridor design and access elements. Work with Metro to target completion by 2015.
- **Strategy PBC 4:** Target Corridor 5, Corridor 7, and Center City Priority Corridors as high priority corridors for development (see Figure 3-14).
- **Strategy PBC 5:** Focus next investments on high demand corridors that do not require major system restructuring (Corridors 2, 13, 14, 15).
- **Strategy PBC 6:** Share funding responsibility with King County Metro to conduct full bus system restructuring study designed to: (1) find opportunities to reduce system inefficiencies and reinvest operating funds to meet FTN service targets, (2) identify layover space and design options in the Center City and elsewhere that will reduce downtown bus throughput and service hours required to operate the system, (3) develop restructuring opportunities around North Link and RapidRide lines, (4) refine TMP system design proposals (e.g., grid development through corridors 3, 4, 5, and 12), and (5) continue to simplify downtown operations.

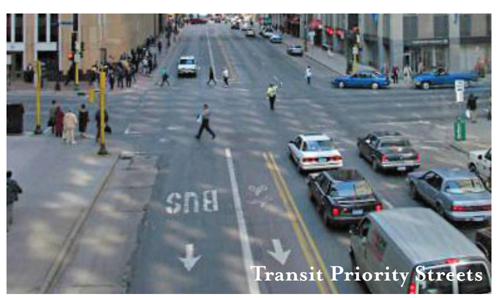
BUILDING TRANSIT CORRIDORS - A TOOLBOX

This section provides an overview of a toolbox of corridor treatments and interventions that was developed to guide capital improvements in priority transit corridors. The toolbox was used in a planning-level assessment of improvement options for each of the priority bus corridors. Estimated travel time improvements were incorporated into revised ridership estimates.


Transit Signal Priority


Queue Jump Lanes

BAT Lanes


Transit Priority Streets


Bus-Bike Treatments

All images from Nelson\Nygaard

Treatment	Definition	Caveats	Effectiveness[1]
Roadway Treatments			
Transit signal priority (TSP)	At traffic signals, buses communicate with the traffic signal system to provide a green signal indication to an approaching bus. Delay for buses may be reduced at intersections as a result.	Less effective when signals are operating at capacity	Up to 10% reduction in signal delay
Queue Jump Lanes	At signalized intersections, a bus is provided with a lane, adjacent to general-purpose traffic, and an advanced green signal indication to bypass congested areas. Buses "jump" the queue of waiting cars.	Lane must be as long as the typical queues TSP makes these much more effective, particularly if there is no far-side receiving lane May increase pedestrian crossing times	5-25% reduction in travel times at a signal
Dedicated Bus Lanes (Business Access and Transit or BAT Lanes)	A lane is reserved for exclusive use by buses. It may also be used for general-purpose traffic right-turn movements onto cross streets and for access to adjacent properties. This treatment would speed bus travel times.	Conflicts with right-turn and delivery vehicles Strong opposition from businesses that may lose on-street parking	5-25% reduction in travel times
Dedicated Bus Median Lanes	A median lane is reserved for exclusive use by buses. This treatment speeds bus travel times.	Conflicts with left-turn vehicles Signalization challenges	5-25% reduction in travel times
Contra-flow lanes	A contra-flow bus lane is a dedicated lane of an otherwise one way street reversed for buses and other mass transit. It is typically used to get around bottle-necks or access limited access facilities.	Loss of roadway capacity Pedestrian safety considerations Signalization challenges	Varies based on access needs
Transit Priority Streets	A street that is dedicated to transit or is designed primarily as a transit corridor. Leading examples include 3rd Ave. in Seattle, the Portland (OR) Transit Mall, and Nicollet Mall or Marquette/2nd in Minneapolis.		Highly effective strategy for moving high volumes of buses in urban centers. Effectiveness peaks at 80-100 buses per hour per lane
Limited or time prohibited general public (GP) turning movements:	GP turning movements are restricted at all times or during peak periods. May be implemented with queue jump or dedicated bus curb lanes.		Highly effective means to implement peak period queue jump lanes or transit only lanes
Innovative bus-bike treatments	Treatments to provide bicycles with safe routes along high-volume transit corridors, manage bicycle-transit vehicle interactions, and allow bicycles to share transit lanes. Examples include shared lane markings, colored pavement, and bicycle-only signals.	Highly contextual and must be considered within balance of person travel delay/ benefit for specific street or corridor conditions	Difficult to measure impacts on transit, but can reduce transit delay on busy bicycle corridors and improve bicycling experience
Trolley Bus-Specific Treatments			
Electrification	Convert a diesel bus corridor to electric trolley buses by adding wire in missing segments.		Effective in increasing use of zero-emissions electric fleet
Enhanced Trolley Wire Switching	Allows an electric trolley bus route to more efficiently branch into two routes.		Effective in increasing use of zero-emissions electric fleet
Trolley Passing Wire	Allows an electric trolley bus to operate limited stop service.		Effective in increasing use of zero-emissions electric fleet


Bus Bulb


Boarding Island

Off Board Fare Payment

Treatment	Definition	Caveats	Effectiveness[1]
Stop Treatments			
Curb extensions/ Bus Bulbs/Boarding Platforms	Sidewalks are extended into the street so that buses would stop in the lane of traffic. This prevents buses from getting trapped by passing vehicles, unable to return to the flow of traffic. The delays from merging back into lane may be minimized as a result.	Only applicable where an on-street parking lane exists Impacts to traffic flow must be accounted for	Depends on traffic. 8 seconds per stop is the assumed[2]
Boarding Islands	A transit access point constructed in a lane that allows buses to use the faster moving left-lane of a roadway. It also removes side friction caused by right-turning vehicles, parking maneuvers, and delivery vehicles.	Pedestrian safety and ADA access requirements Effects on overall traffic due to taking an additional lane	Varies based on access needs. At 5th & Jackson, it saves approximately 1 minute per run
Level Boarding Platforms	A boarding platform that is level with the bus to enable easier and faster boarding, particularly for passengers with mobility impairments, using wheelchairs, or bringing a stroller on-board the bus.		Varies depending on number of wheelchair and assisted boardings. Can provide significant time benefit.
Defined Platform Loading Locations	Defining the locations where doors will open allows passengers to wait in nearest proximity to their bus and can reduce dwell times.	May be most effective in a proof-of-payment system where passengers may board through any door	Saves less than 1 second per boarding passenger
Defined Bus Loading Positions	Defining the platform loading locations at a stop can reduce dwell times by allowing passengers to more quickly find/walk to their bus and ensure that a bus is correctly positioned to be able to depart before a bus in front of it.	Most effective with "platooned" bus arrivals (e.g., buses timed to leave a common origin point at the same time)	Effectiveness decreases as the number of loading locations at a stop increases
Bus stop consolidation	Reducing the number of stops on a route, particularly where spacing is less than a stop every 3 blocks, can result in travel time savings.	ADA and elderly/disabled access Grades must be accounted for in this	2-20% of overall run time (4% in recent Line 28 consolidation), up to 75% of dwell time
Off board fare payment	Fare payment typically delays the loading and unloading of buses, as only one door may be used. Off-board fare payment may speed boarding and allow full utilization of all doors.	Capital and O&M expense of off-board payment machines Passenger safety at night	Saves 1 second per boarding passenger
Vehicle Treatments			
Low-floor, Wide-Door Vehicles	Low-floor vehicles (including in conjunction with level boarding platforms) allow passengers to board more quickly without climbing steps, particularly for passengers with mobility challenges. Wheelchair lifts on low-floor vehicles operate more quickly and with fewer mechanical problems. Wide-door vehicles allow large volumes of passengers boarding at a stop to enter and exit vehicles more efficiently.	Wide-door vehicles are most effective if implemented in conjunction with prepaid fare payment	
On-Vehicle Perimeter Seating	On heavily loaded routes, increases standing capacity, makes more efficient use of seating capacity, and allows passengers to exit the vehicle more quickly, reducing dwell times.	More appropriate for shorter-distance routes	

Transit Toolbox Notes and Sources

1 The measures of effectiveness are derived from data found in the Transit Capacity Quality of Service Manual, unless a specific local measure is cited

2 King County Metro, Stop Spacing Program Description, 7/7/2011

BUS IMPACTS ON PAVEMENT

The weight and repetitious patterns of transit vehicles can cause significant wear on asphalt and Portland cement pavement. This is particularly true where bus routes are consistently heavily loaded (exceeding 150% of loaded capacity) and/or on streets that have thin pavement layers. A study* conducted by the University of Washington and the City of Seattle determined that a fully loaded Metro Breda bus (exceeds legal axle loads) would exert four times as much damage on pavement as a similar bus that met legal axle loads, but that over time these impacts accounted for less than a quarter of pavement damage on a given street. SDOT should consider the following to minimize impacts of transit on street pavement conditions:

- Work with Metro to provide frequent service that better distributes passenger loads in high demand corridors
- Develop thick and durable pavement designs for FTN and high volume bus corridors
- Use Portland Cement Concrete (PCC) paving materials (or other highly durable materials) on transit streets or at high volume transit stops/stations
- On asphalt streets, install PCC pads at bus pullouts or curb stops that have high bus volumes


Image from SDOT

* Chinn, Esther and De Bolt, Peter. Washington State Transportation Commission, Heavy Vehicles vs. Urban Pavements, 1993.

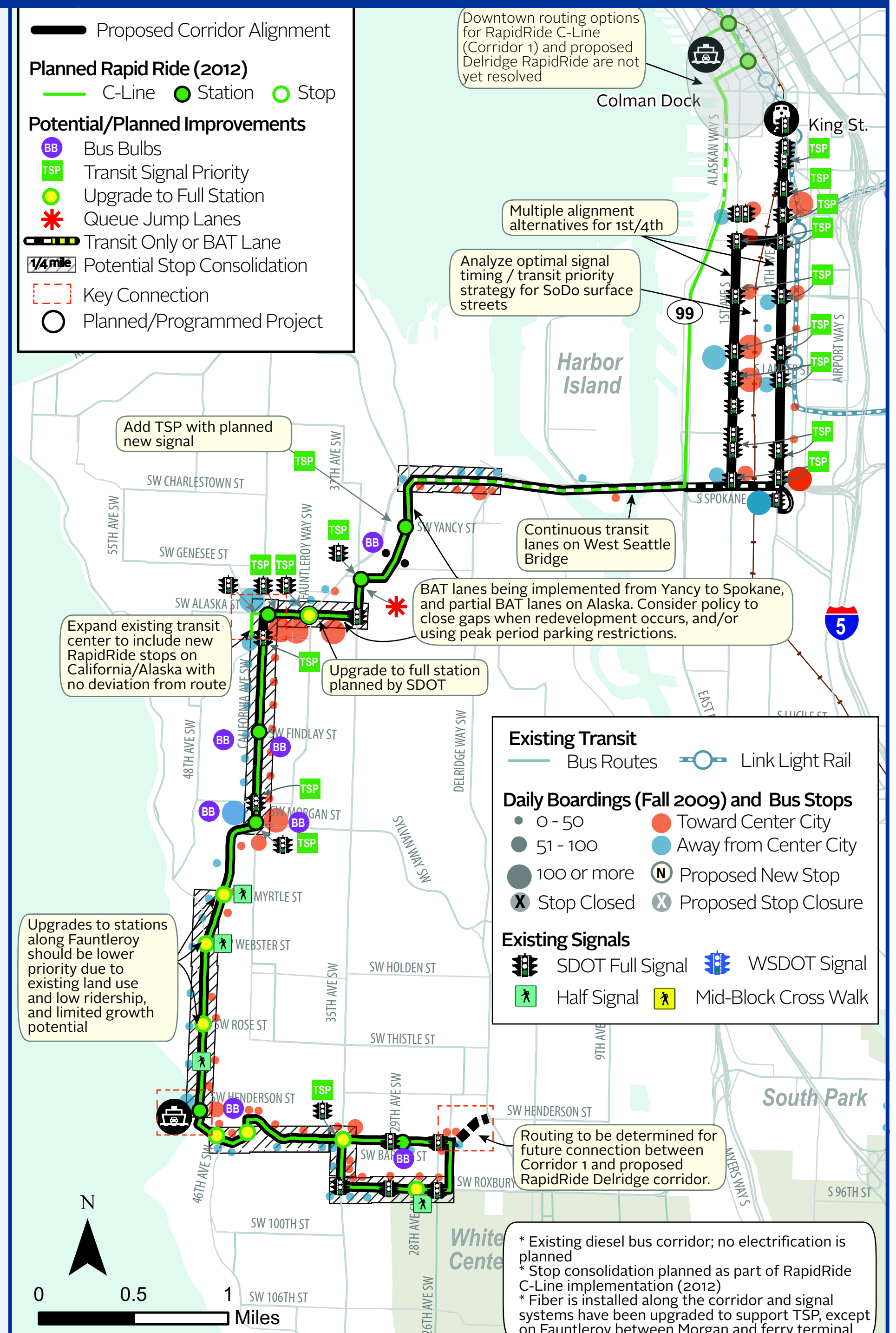
Corridor 1: West Seattle - Downtown

Corridor Length: 6.8 miles

Key Connections:
- King Street Hub
- Alaska Junction
- Fauntleroy Ferry Terminal
- Delridge RapidRide (Proposed)

Neighborhoods Served:
- White Center
- Fauntleroy
- West Seattle Junction
- SODO
- Downtown

Key Improvements
- Bus Bulbs
- Transit Lanes
- Station Upgrades



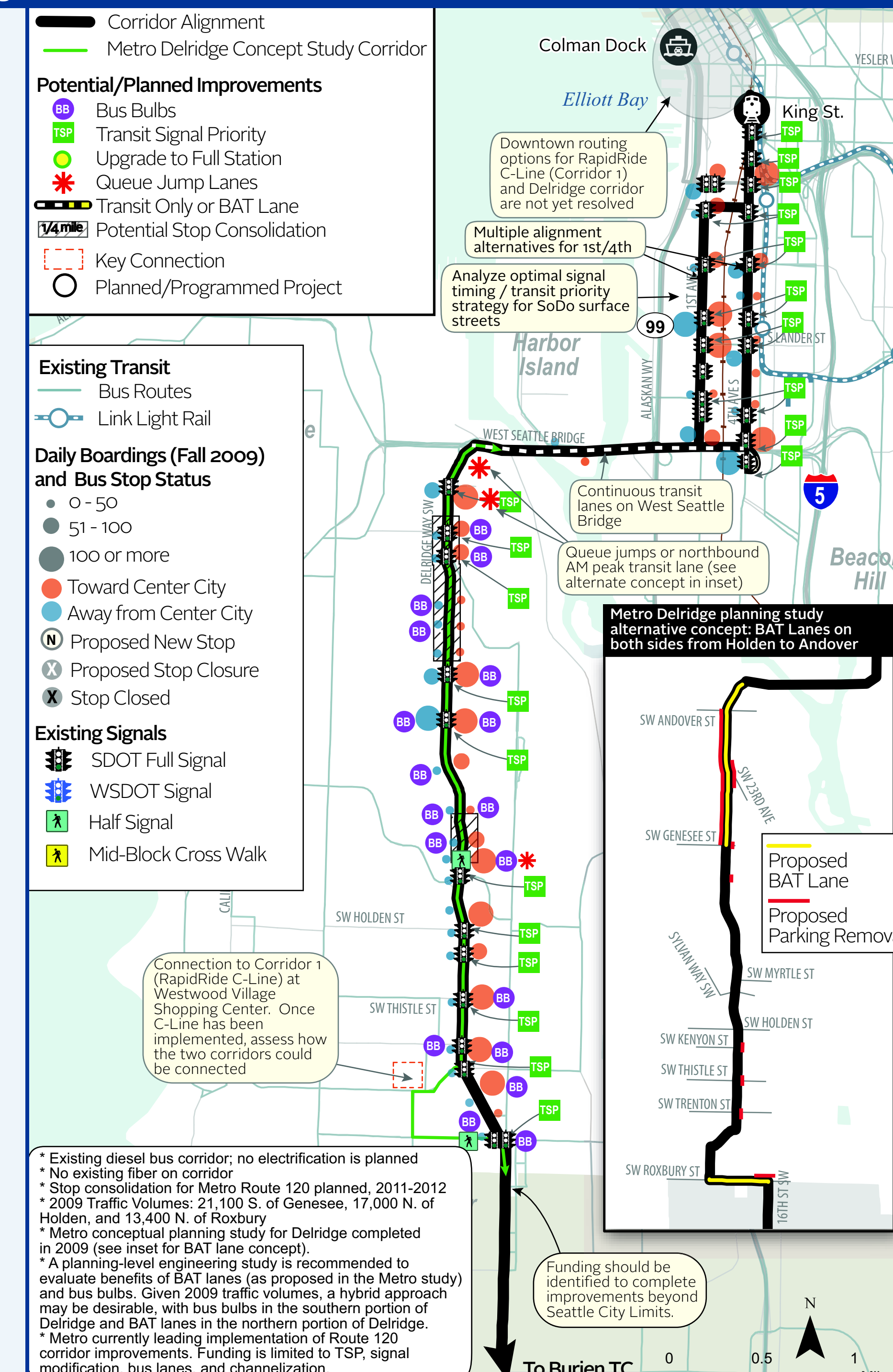
Corridor 2: Burien - White Center - Delridge - Downtown Seattle

Corridor Length: 7.5 miles (within Seattle)

Key Connections:
- King Street Hub
- RapidRide C-Line
- Burien Park & Ride

Neighborhoods Served:
- White Center
- Delridge
- SODO
- Downtown

Key Improvements
- Bus Bulbs
- Transit Lanes
- Station Upgrades



Potential improvements and recommendations are conceptual and will require more detailed evaluation/analysis of current conditions and coordination between SDOT and partner agencies.

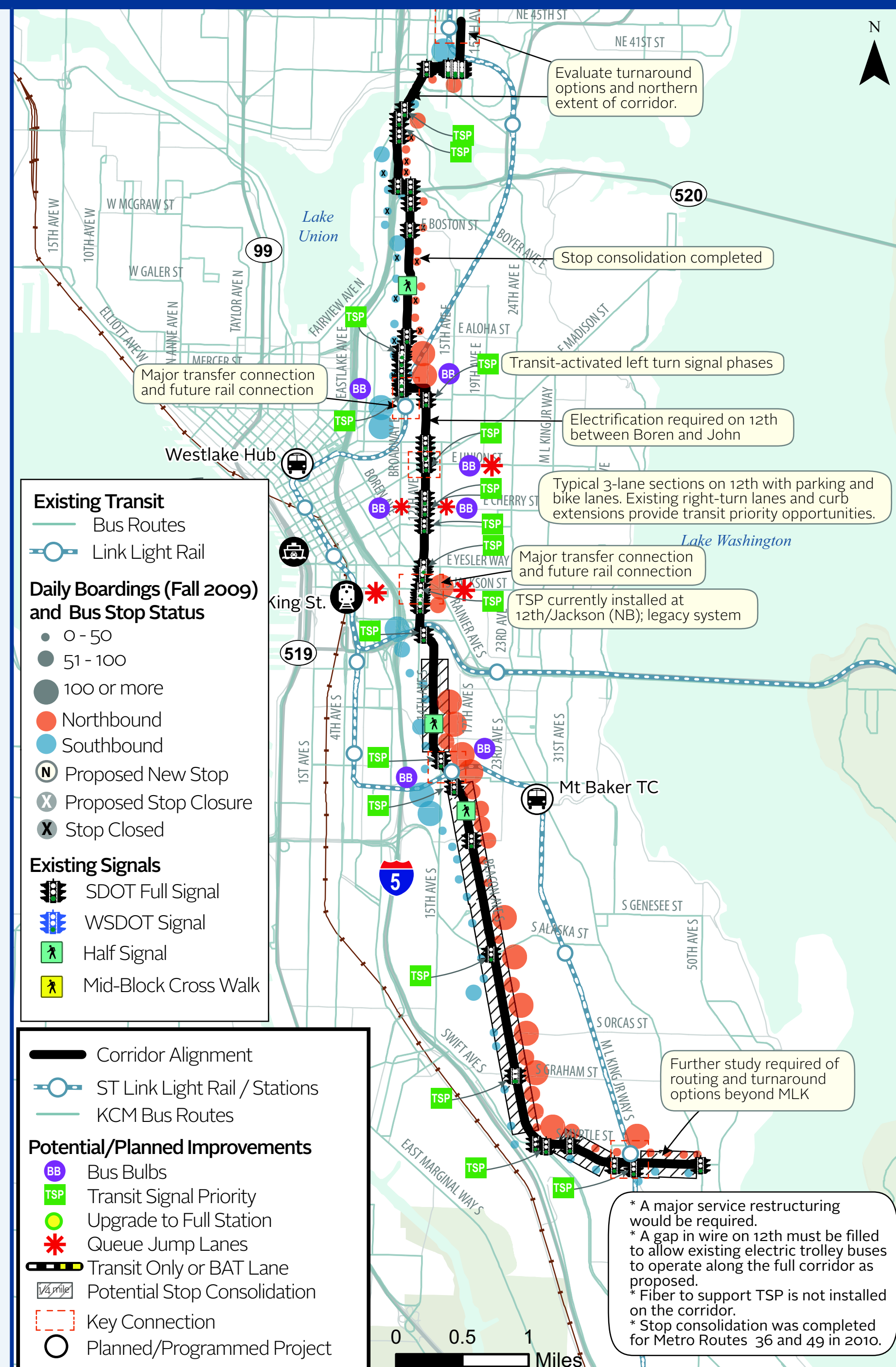
Corridor 3: Othello – U-District via Beacon Ave, 12th Ave, and Broadway

Corridor Length: 10.4 miles

Key Connections:
- University Link station (planned)
- Capitol Hill Link station (planned)
- Jackson Street: connections to Corridor 4 and other bus routes
- Beacon Hill Link station
- Othello Link station

Neighborhoods Served:
- University District
- Capitol Hill
- Central District (West)
- Downtown (East)
- Beacon Hill
- Rainier Beach

Key Improvements
- TSP (requires fiber installation)
- Electrification on 12th Avenue
- Bus Bulbs
- Station Upgrades



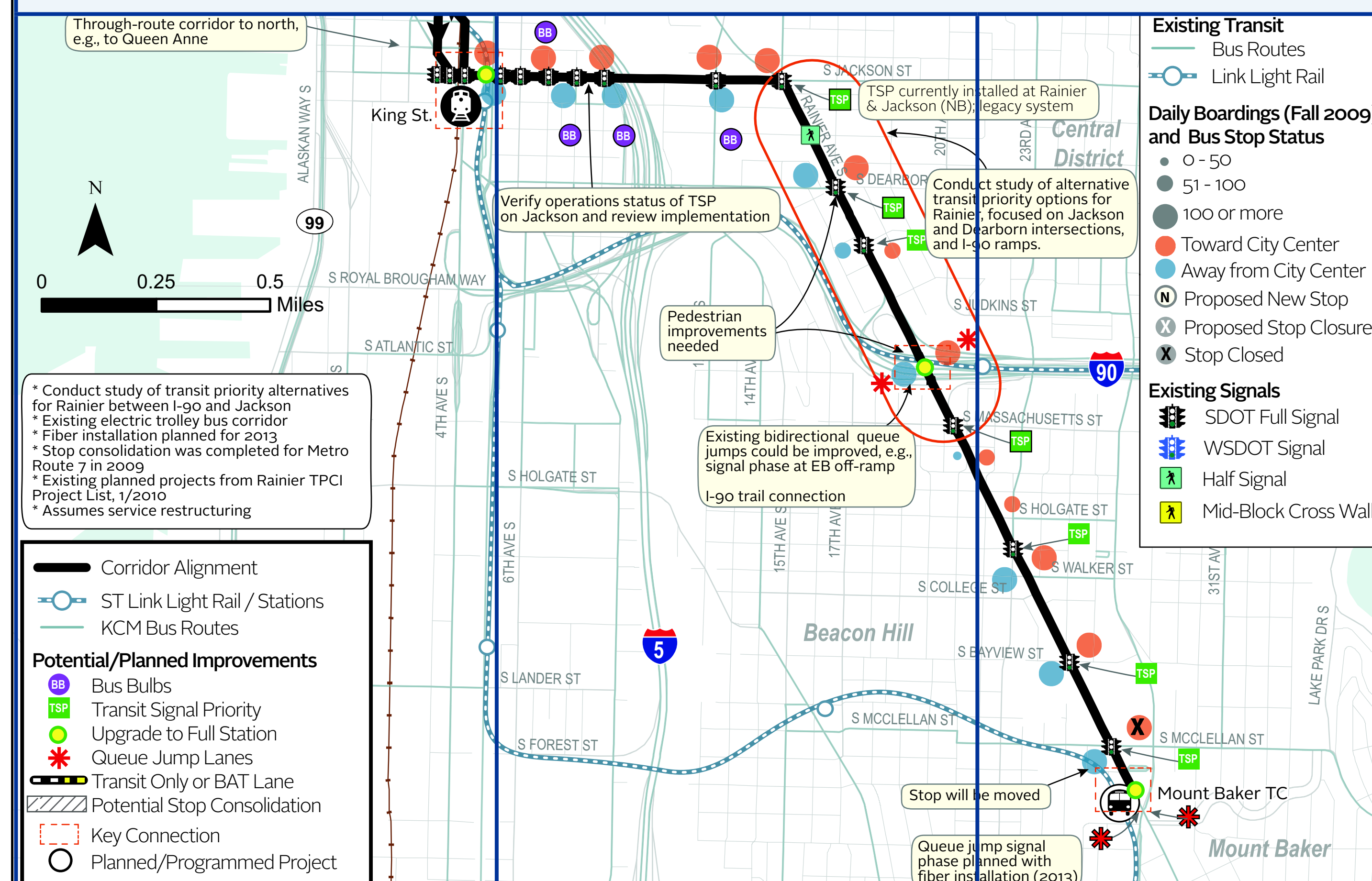
Corridor 4: Mount Baker – Downtown via Rainier Ave

Corridor Length: 2.7 miles

Key Connections:
- King Street Hub
- East Link Rainier station (planned)
- Mount Baker TC / Link station

Neighborhoods Served:
- University District
- Capitol Hill
- Central Area (West)
- Downtown (East)
- Beacon Hill
- Rainier Beach

Key Improvements
- TSP (requires fiber installation)
- Electrification on 12th Avenue
- Bus Bulbs
- Station Upgrades



Potential improvements and recommendations are conceptual and will require more detailed evaluation/analysis of current conditions and coordination between SDOT and partner agencies.

Corridor 5: Rainier Valley – U-District via Rainier Ave and 23rd Ave

Corridor Length: 9.6 miles

Key Connections:

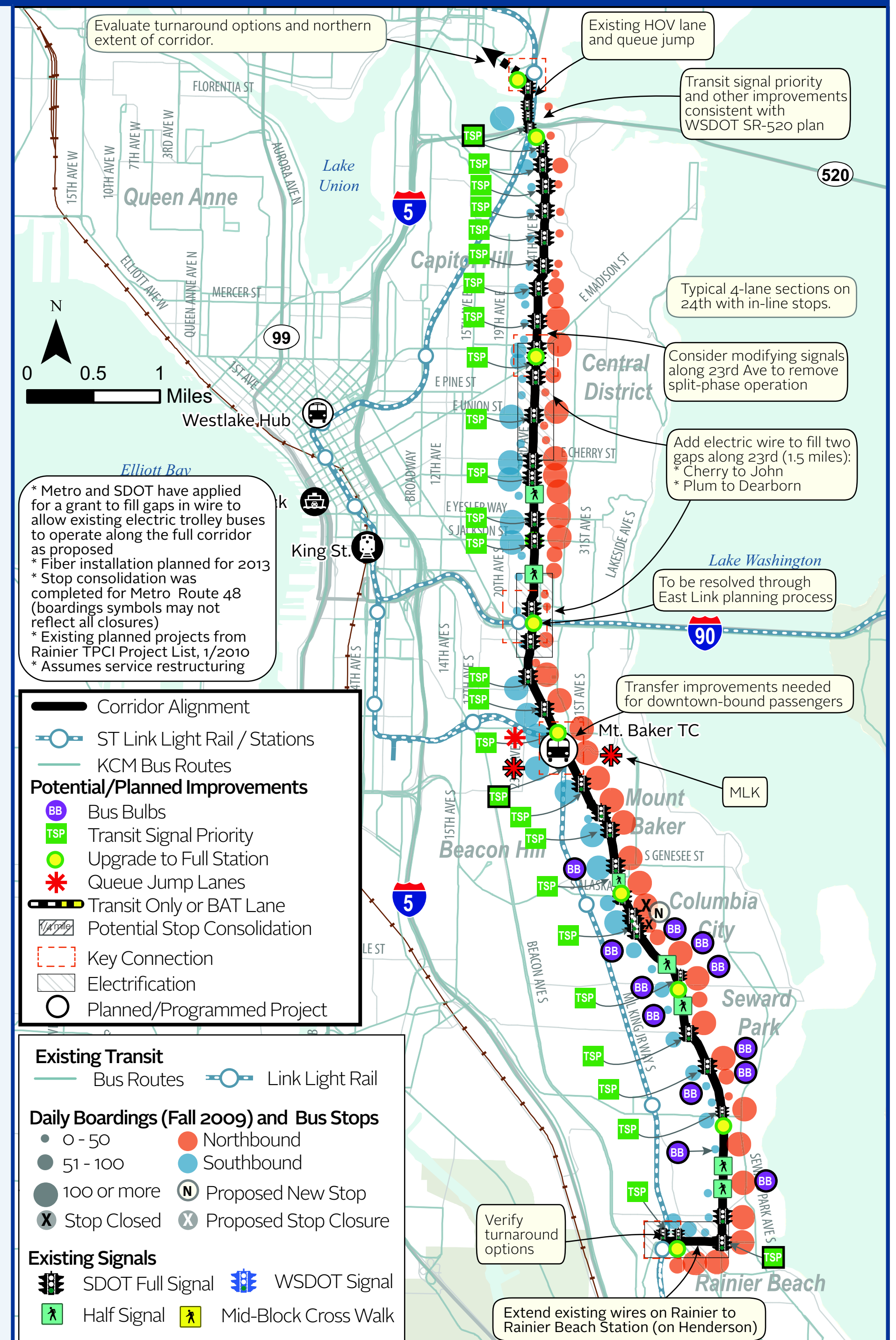
- University Link station (planned)
- Corridor 6 (Madison)
- East Link Rainier station (planned)
- Mount Baker TC/ Link station
- Rainier Beach Link station

Neighborhoods Served:

- University District
- Capitol Hill
- Central District
- Rainier Valley

Key Improvements

- TSP (requires fiber installation)
- Electrification on 23rd Avenue
- Bus bulbs (currently planned for south portion of corridor)
- Station Upgrades



Corridor 7: Queen Anne – South Lake Union – Capitol Hill via Denny

Corridor Length: 5.0 miles

Key Connections:

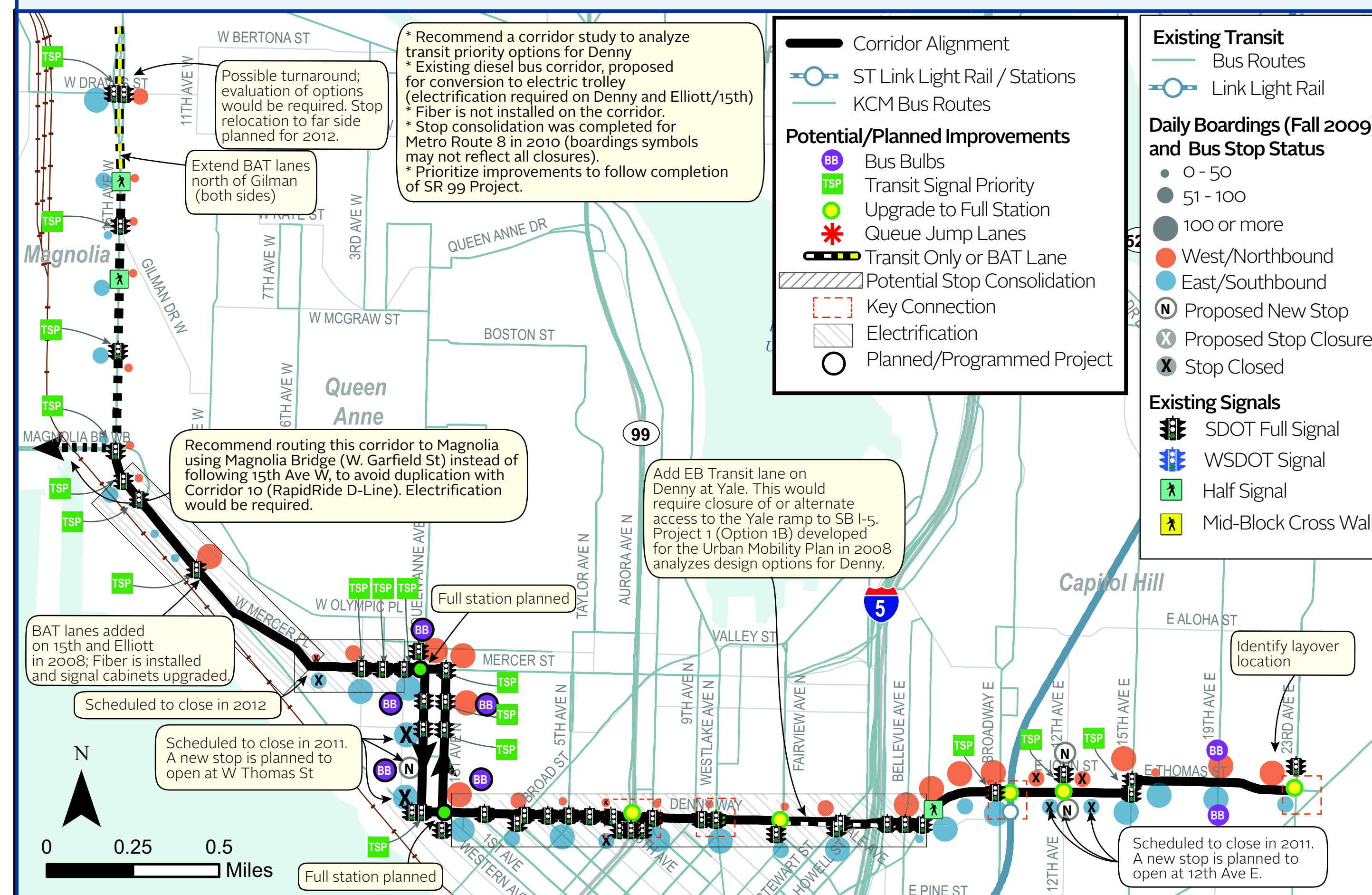
- Direct routing to Magnolia urban village or transfer connections
- North-south transfer opportunities along Denny
- Capitol Hill Link station (planned) and Corridor 3 cross-town line
- Corridors 5 (cross-town) and 6 (Madison) at 23rd Ave

Neighborhoods Served:

- Queen Anne
- South Lake Union
- Capitol Hill

Key Improvements

- TSP (requires fiber installation)
- Electrification



A corridor profile for Corridor 6 can be found in the HCT section

Potential improvements and recommendations are conceptual and will require more detailed evaluation/analysis of current conditions and coordination between SDOT and partner agencies.

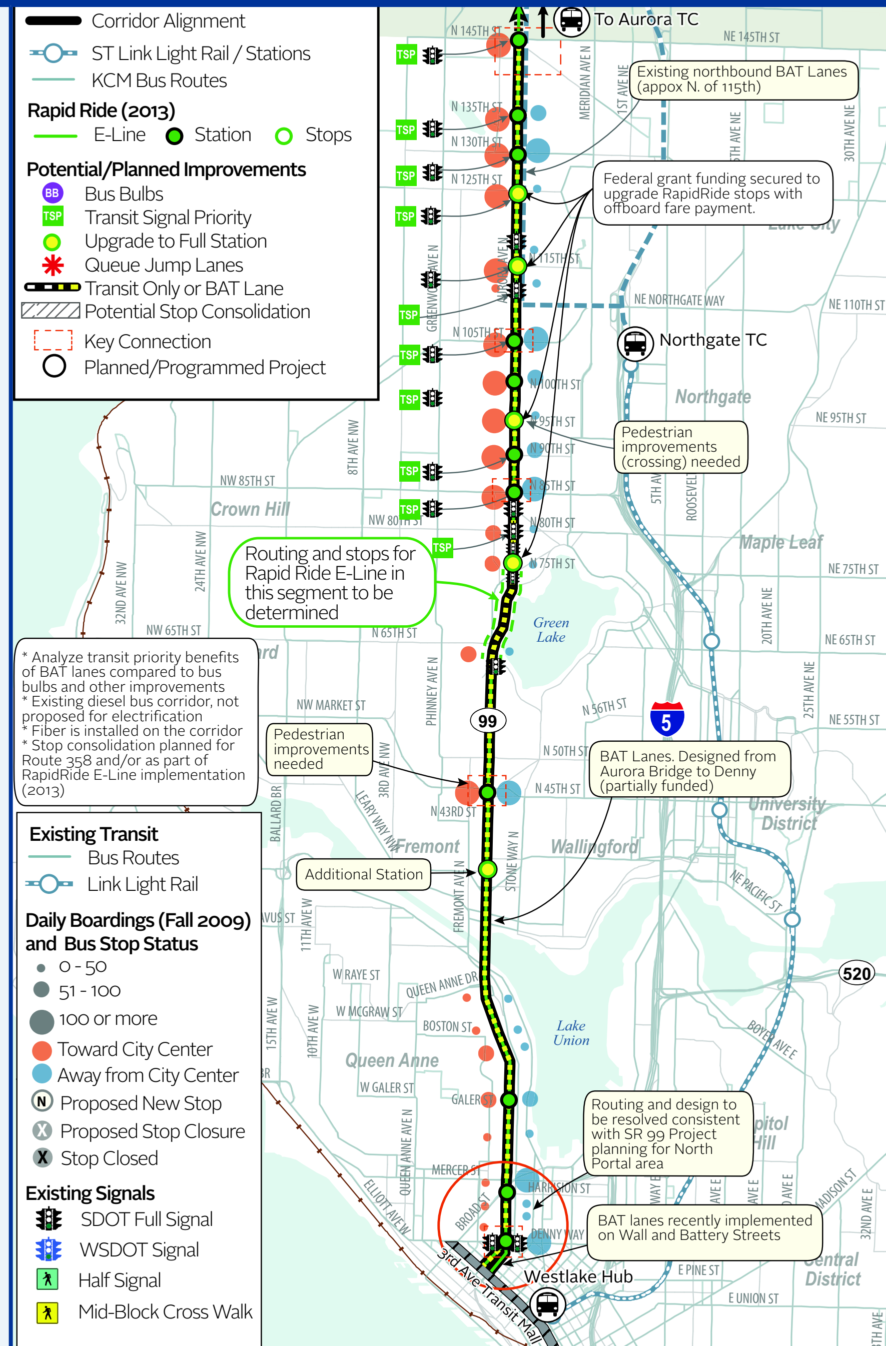
Corridor 9: Aurora Village - Downtown via Aurora Avenue

Corridor Length: 8.2 miles (within Seattle)

Key Connections:
- Aurora Village TC (outside of Seattle)
- Corridor 10 at 105th Street
- Corridor 14 at 85th Street
- Corridor 13 at 45th Street
- Westlake Hub

Neighborhoods Served:
- Bitter Lake and Greenwood (west) and Northgate (east)
- Phinney Ridge and Fremont (west) and Green Lake and Wallingford (east)
- Queen Anne
- South Lake Union
- Downtown

Key Improvements
- TSP (fiber is already installed)
- BAT lanes
- RapidRide station upgrades



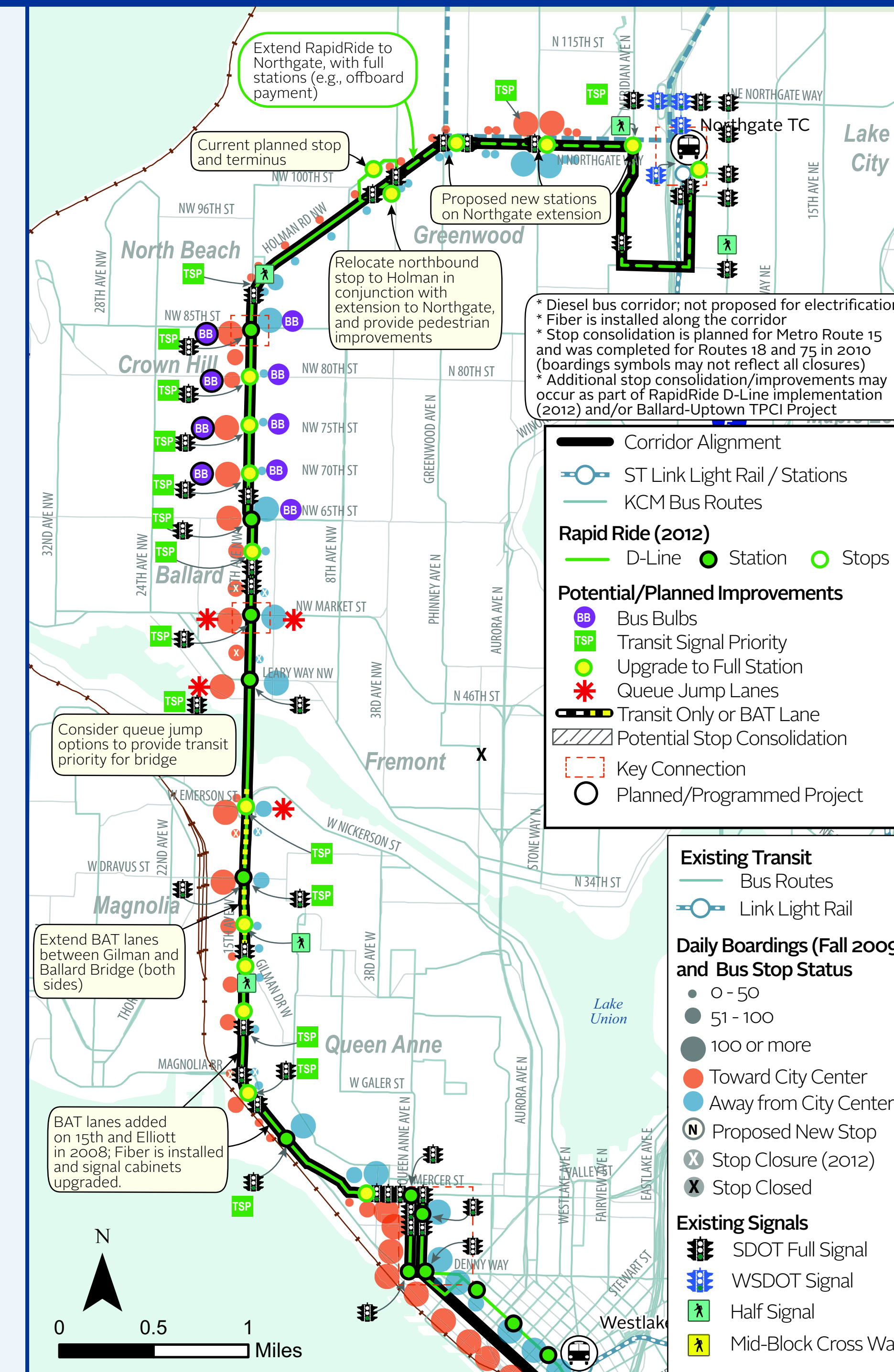
Corridor 10: Northgate - Ballard – Downtown via Northgate Way, Holman Road, and 15th Avenue

Corridor Length: 9.1 miles

Key Connections:
- Northgate TC
- Corridor 14 at 85th Street
- Corridor 13 at 45th Street
- Corridor 7 at Denny Way
- Westlake Hub

Neighborhoods Served:
- Northgate
- Bitter Lake/Greenwood/Crown Hill
- Ballard
- Queen Anne/Interbay
- Downtown

Key Improvements
- TSP (fiber is already installed)
- Bus bulbs
- BAT lanes (extend existing) and queue jumps
- Rapid Ride station upgrades



Corridor profiles for Corridors 8 and 11 can be found in the HCT section

Potential improvements and recommendations are conceptual and will require more detailed evaluation/analysis of current conditions and coordination between SDOT and partner agencies.

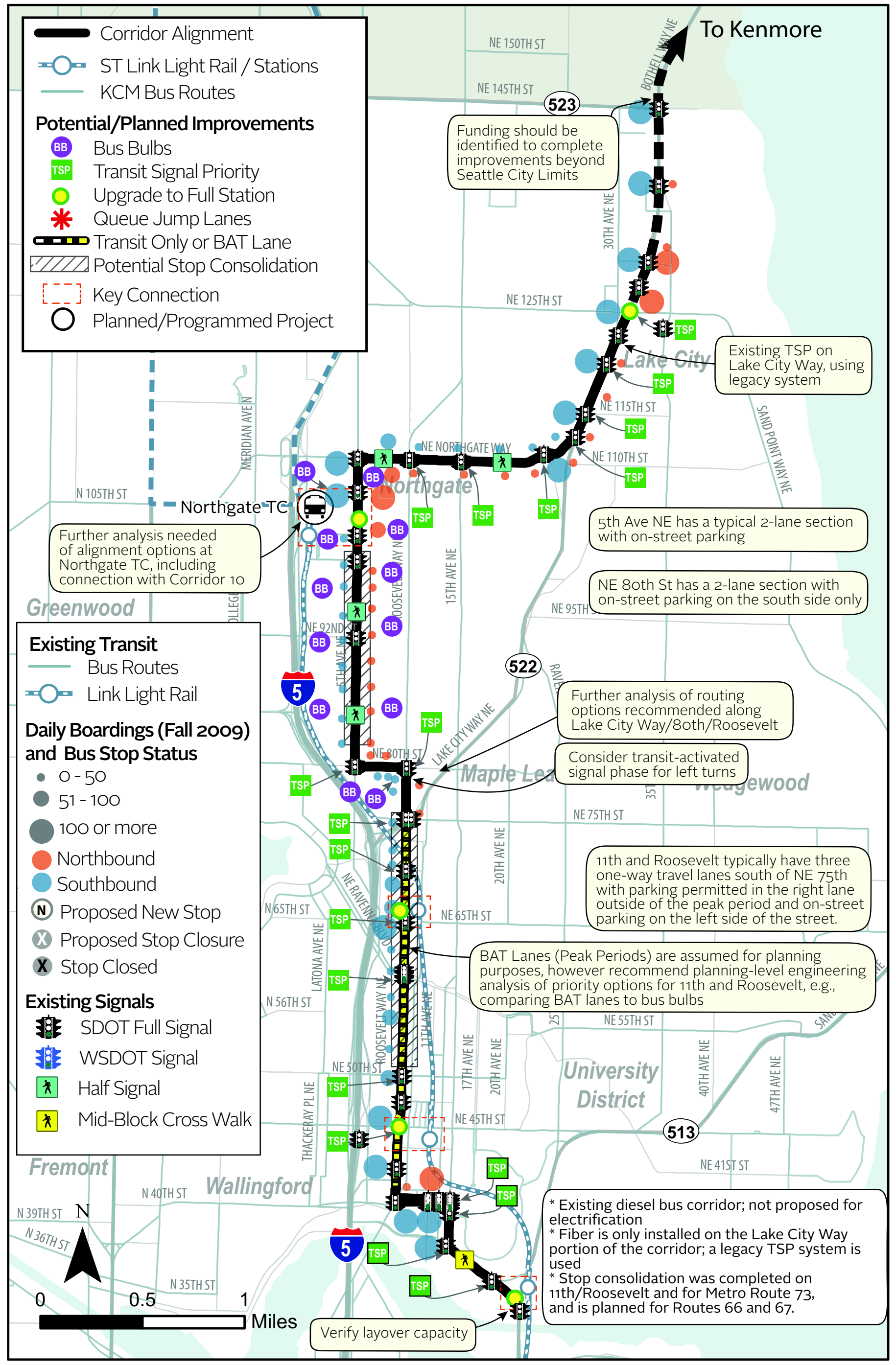
Corridor 12: Lake City – Northgate – U District via Northgate Way and 5th Avenue

Corridor Length: 7.7 miles

Key Connections:
- Northgate Transit Center (future Link station)
- Roosevelt Link Station (future) and bus Corridor 14 at NE 65th Street
- Brooklyn Link Station (future) and bus Corridor 13 at NE 45th Street
- HCT Corridor 8 (Downtown via Eastlake) along 11th/Roosevelt
- Bus Corridors 3 and 5 in University District

Neighborhoods Served:
- Lake City
- Northgate
- Roosevelt
- University District

Key Improvements
- TSP (fiber is only installed along Lake City Way)
- Bus bulbs
- Stop consolidation



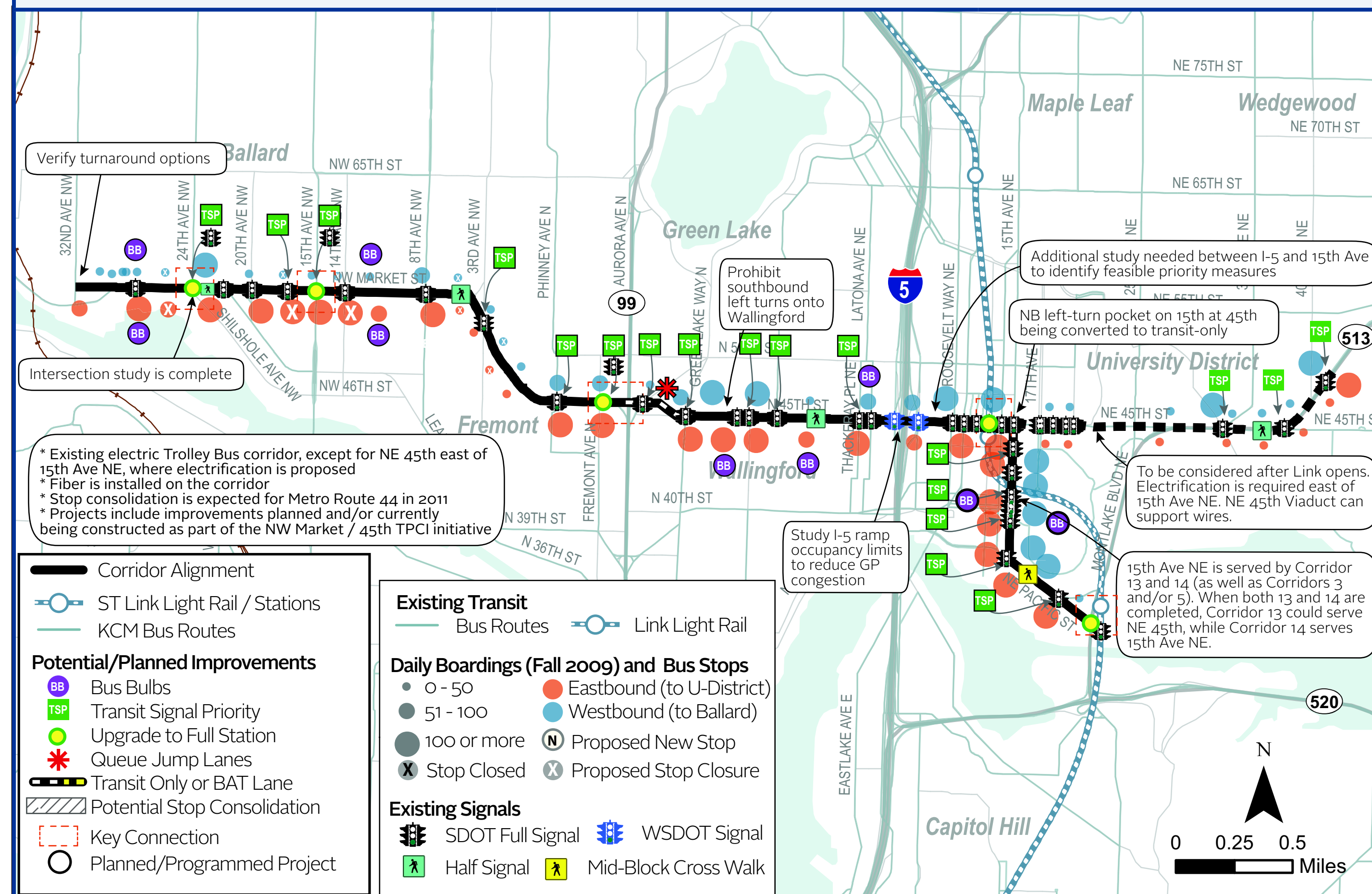
Corridor 13: Ballard – U-District – Laurelhurst via Market and 45th Streets

Corridor Length: 5.4 miles

Key Connections:
- HCT Corridor 11 at 24th Ave NW
- Bus Corridor 10 at 15th Ave NW
- Bus Corridors 15 at Phinney
- Bus Corridor 9 at Aurora
- HCT Corridor 8 and Bus Corridors 3, 5, 12, and 14 in the U-District

Neighborhoods Served:
- Ballard
- Phinney Ridge, Fremont, Wallingford
- University District

Key Improvements
- TSP (fiber is installed)
- Bus bulbs
- Station upgrades



A corridor profile for Corridor 11 can be found in the HCT section

Potential improvements and recommendations are conceptual and will require more detailed evaluation/analysis of current conditions and coordination between SDOT and partner agencies.

Corridor 14: Crown Hill – Greenlake – U District via NE 85th Street and 15th Avenue NW

Corridor Length: 6.6 miles

Key Connections:

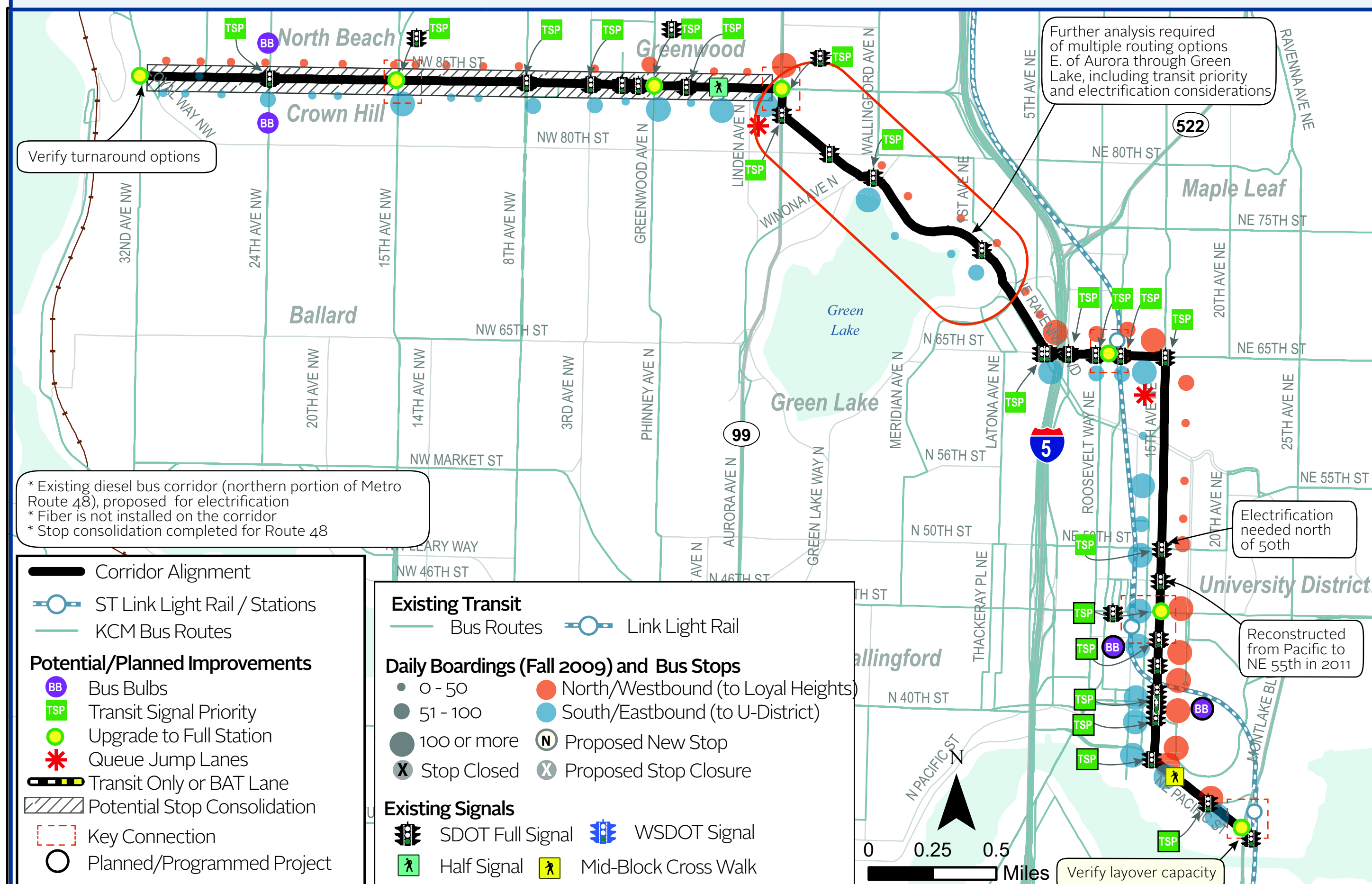
- Corridor 11 (15th Ave NW)
- Corridor 15 (Greenwood)
- Corridor 9 (Aurora)
- Corridosr 3, 5, 8, and 12 (University District)

Neighborhoods Served:

- Crown Hill / North Beach
- Greenwood
- Green Lake
- University District

Key Improvements

- TSP (fiber is not installed)
- Bub Bulbs
- Electrification



Corridor 15: Phinney Ridge – Greenwood – Broadview

Corridor Length: 9.1 miles (within Seattle)

Key Connections:

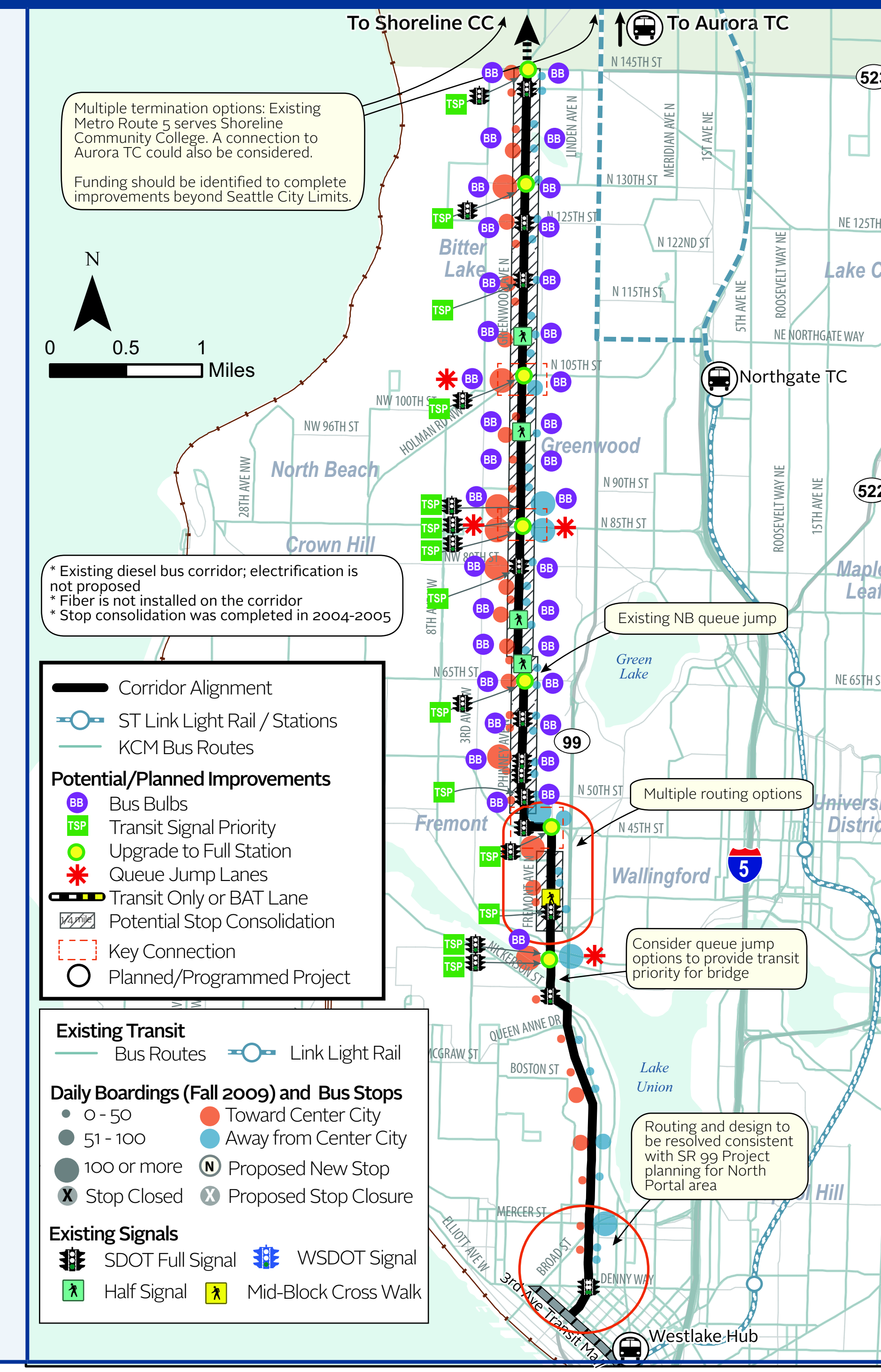
- Shoreline Community College and/or Aurora Village TC
- Corridor 10 at 105th Street
- Corridor 14 at 85th Street
- Corridor 13 at 45th Street
- Westlake Hub

Neighborhoods Served:

- Broadview, Bitter Lake, and Greenwood
- Phinney Ridge and Fremont
- Queen Anne and Westlake
- South Lake Union
- Downtown

Key Improvements

- Bus Bulbs
- TSP (fiber installation required)
- Station Upgrades



Potential improvements and recommendations are conceptual and will require more detailed evaluation/analysis of current conditions and coordination between SDOT and partner agencies.

PRIORITY BUS CORRIDOR EVALUATION RESULTS

Figure 3-13 summarizes the evaluation results for the priority bus corridors.

FIGURE 3-13 PRIORITY BUS CORRIDOR EVALUATION RESULTS AND KEY IMPROVEMENTS/ACTIONS

Corridor	Description	2030 Weekday Riders	Net New Riders[1]	Productivity (2030 Riders per Hour)[2]	Capital Costs[3]	Capital Costs per Mile	Travel Time Improvement[4]	Net GhG Reduction[5]	Key Capital Improvements and/or Implementation Actions
1	West Seattle - Downtown via Fauntleroy/California	up to 6,600	up to 1,900	up to 40	$3.6 million	$0.3 million	5.7 minutes	400 MtCO2e	• Transit lanes on West Seattle Bridge (not included in cost or travel time improvement) and Alaskan Way limited access roadway and SoDo surface streets • BAT lanes • Upgrade RapidRide stops to full stations, e.g, with offboard payment
2	Burien TC - Downtown via Delridge	up to 7,900	up to 2,300	up to 70	$5.2 million	$0.7 million	4.6 minutes	340 MT CO2e	• Transit lanes on West Seattle Bridge (not included in cost or travel time improvement) and Alaskan Way limited access roadway and SoDo surface streets • Stop consolidation for Metro Route 120 (planned for 2011-2012) • Further evaluation of BAT lanes vs. bus bulbs, or a hybrid approach
3	Othello – U-District via Beacon Ave and Broadway	up to 11,100	up to 3,900	up to 60	$20.0 million	$1.9 million	4.4 minutes	820 MtCO2e	• Evaluation of turnaround options at north and south ends of the corridor • Electrification needed on 12th Ave and NE 11th/Roosevelt N. of Campus Pkwy • TSP and bus bulbs (some existing) on 12th, a new transit street • Key connections at several Link stations
4	Mount Baker – Downtown via Rainier Ave	up to 11,000	up to 5,700	up to 100	$0.7 million	$0.3 million	1.2 minutes	310 MtCO2e	• Through-route corridor to north, e.g. to Queen Anne • Existing planned improvements on Rainier and Jackson • Conduct study of priority options for Rainier south of Jackson
5	Rainier Valley – U-District via Rainier Ave and 23rd Ave	up to 17,200	up to 3,600	up to 70	$24.8 million	$2.6 million	4.5 minutes	700 MtCO2e	• Electrification needed to fill two gaps on 23rd and to connect Rainier to Rainier Beach Link station • Existing planned improvements on Rainier • TSP on 24th Ave
7	Queen Anne/Magnolia – South Lake Union – Capitol Hill via Denny	up to 14,700	up to 4,200	up to 80	$38.6 million	$7.7 million	3.0 minutes	1,710 MtCO2e	• Consider through-routing to Magnolia using Magnolia Bridge, to avoid duplication with Corridor 10 (RapidRide D-Line) • Recommend corridor study to analyze transit priority options for Denny • Electrification on Denny and Elliott/15th
9	Aurora Village to Downtown via SR 99	up to 12,400	up to 3,900	up to 80	$1.0 million	$0.1 million	4.7 minutes	650 MtCO2e	• Upgrade RapidRide stops to full stations (grant funding already secured) • BAT lanes, already designed from Aurora Bridge to Denny; evaluate priority benefits relative to bus bulbs and other improvements • Routing/design of southern extent consistent with SR 99 Project for North Portal
10	Northgate – Ballard – Downtown	up to 16,900	up to 4,400	up to 70	$4.2 million	$0.5 million	4.7 minutes	810 MtCO2e	• Extend RapidRide to Northgate with full stations • TSP with queue jumps at key congested intersections • Consider queue jump options for Ballard Bridge
12	Lake City – Northgate – U District	up to 4,600	up to 1,300	up to 40	$5.1 million	$0.7 million	4.4 minutes	200 MtCO2e	• Peak period BAT lanes on 11th/Roosevelt couplet, bus bulbs on 5th Ave, and TSP on Northgate Way/Lake City Way • Further analysis of alignment options at Northgate TC • Identify funding to complete improvements outside of Seattle city limits
13	Ballard – U District - Laurelhurst via Market St and 45th St	up to 8,900	up to 1,400	up to 80	$15.1 million	$2.8 million	3.3 minutes	150 MtCO2e	• Existing planned improvements on Market/45th and Roosevelt/11th couplet (bus bulbs, TSP, bus lane, etc.) • Verify turnaround options on west end and alignment options on east end, including after Link opens and to avoid duplication with Corridor 14
14	Crown Hill – Greenlake – U District	up to 7,400	up to 1,100	up to 60	$57.0 million	$8.6 million	3.3 minutes	1,150 MtCO2e	• Electrification needed north of 50th St • TSP with queue jumps as key congested intersectons • Existing planned improvements south of 50th
15	Phinney Ridge – Greenwood – Broadview	up to 9,600	up to 2,300	up to 60	$9.3 million	$1.0 million	5.0 minutes	420 MtCO2e	• Multiple termination options on north end • Identify funding to complete improvements outside of Seattle city limits • TSP and Bus Bulbs on Greenwood • Routing/design of southern extent consistent with SR 99 Project for North Portal

Notes: All metrics are for corridor extent within Seattle city limits. [1] Relative to current ridership levels. [2] Productivity is 2030 Weekday Riders per Revenue Hour, [3] Does not include planned/programmed improvements or vehicle costs. [4] Estimated end-to-end travel time savings from capital improvements per direction (including planned/programmed, such as RapidRide), relative to existing bus service. [5] GhG emissions savings from reduced VMT ( ) and from transit (; e.g., electric trolley buses replacing diesel buses).

Bus Corridor Metrics and Methodology Notes

The following metrics were evaluated for each of the priority bus corridors.

- 2030 Weekday Ridership: Estimated from Fall 2009 stop/route-level boardings assigned to each corridor.
- Net New Riders:
  - 2030 estimate of potential ridership - current (2009) ridership estimate for the corridor.
- Productivity: Efficiency with which provided transit capacity is utilized.
  - Productivity = weekday ridership / weekday revenue hours.
  - Weekday hours of revenue service calculated through development of corridor specific operating plan.
- Capital Costs: Cost to implement transit priority improvements, based on typical costs, including allowances for engineering and contingency costs. Does not include vehicle costs.
  - Capital Costs per Mile = total capital costs / corridor miles
- Travel Time Improvement: estimated end-to-end time savings per identified capital or other efficiency improvement (including both potential and currently planned and funded improvements). Unit travel times savings was based on local SDOT or King County Metro experience. If local estimates were not available, industry-standard estimates were applied.
- Greenhouse Gas Reduction: Annual reduction in GhG equivalents from reduced VMT and net change in transit emissions (see HCT results for methodology details)

The conceptual operating plans developed to calculate these metrics assumed the following minimum headways over a service span of 5 a.m. to 1 a.m. (20 hours), which approximately correspond to RapidRide service levels. The operating plans were limited to the corridor as evaluated in the TMP and to service within Seattle.

Period	Weekday	Weekend
Peak	10	15
Off-Peak	15	15
Late Evening	30	30

CENTER CITY PRIORITY CORRIDORS

CENTER CITY CONDITIONS AND CHALLENGES

Eight years ago, when the City developed the Center City Circulation Report, the Center City area was growing despite a recession. The City was faced with challenges of accommodating many more jobs and residents with the existing and constrained set of transportation facilities. Much of the growth predicted has occurred, yet transit service levels are generally unimproved (with the exception of Central Link). In particular, areas such as South Lake Union have seen tremendous growth, but few improvements in regional transit connectivity. One local success is rapidly increasing ridership on the South Lake Union Streetcar (see sidebar). The Denny Triangle, Downtown Commercial Core, South Downtown, and South Lake Union are targeted for continued high levels of employment growth. Significant residential growth is expected in Belltown, Denny Triangle, First Hill, and South Lake Union. Now in another recession period, these neighborhoods are seeing strong growth, reflecting the fact that even in a recession, downtown Seattle is a great place to live and do business.

To allow the City to grow, fast, frequent, and reliable transit must connect the Center City and its neighborhoods. The City must lead hard tradeoff decisions that prioritize high-capacity, low-impact modes such as transit and bicycles. Physically, the City can only accommodate its planned growth through a highly efficient transportation system with transit as its backbone.

Meeting the expanded travel demand that will accompany growth planned in downtown is accompanied by many mobility and access challenges:

- **Land use:** The Center City is expected to take on roughly 50% of the city's total population and job growth over the next 20 years. This is both a challenge and an opportunity for transit development, since the level of growth demands a shift away from auto-oriented mobility. This is a fact of simple reality driven by geometric constraint.
- **Geography:** Seattle's center resembles an hourglass where both people and goods funnel through heavily-trafficked north-south corridors into a narrow downtown core bounded by Puget Sound, Lake Washington, and I-5. Buses, trucks, ferry passengers, automobiles, bicyclists, and pedestrians must cross and enter the Center City at limited bridge and ferry terminal access points. Steep hills limit transit mode and vehicle options in the east-west direction.
- **Right-of-way constraints:** Approximately 700 local and regional buses travel in the north-south direction through downtown during a single commuter peak hour. Bus operations in Downtown Seattle Transit Tunnel will be increasingly constrained as tunnel capacity is given over to rail operations. Dedicating surface right-of-way to transit requires trade-offs with needs of other modes, including motor vehicles and bicycles.
- **Transit service quality:** Buses are overloaded on a number of transit corridors despite frequent peak service. Travel times on cross-town bus routes and connections from inner-city neighborhoods are among those most impacted by congestion.
- **Electric trolley bus network efficiency:** The existing infrastructure investment in a quiet, low-emission transit mode is a significant asset; however, expanding the system will require adding wire and restructuring service (including changes to route interlining).
- **Wayfinding:** The Center City transit network consists of a wide variety of transit modes, providers, and facilities. Rail modes include Link and the Seattle Streetcar. Diesel and trolley buses are operated by Metro, Sound Transit, and service providers from surrounding counties. Rail and bus modes are vertically separated between surface streets and the Transit Tunnel. Transit legibility is challenging and must be addressed at a system level to optimize service investments in the Center City.

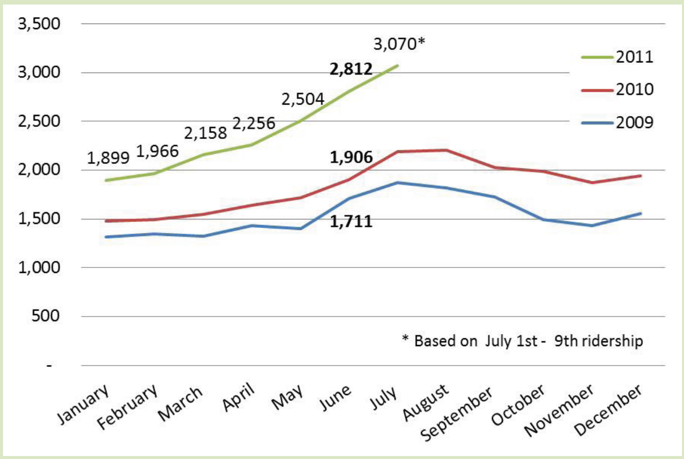
CENTER CITY SERVICE DESIGN PRINCIPLES

TMP recommendations for Center City transit investments are based on analysis and principles that make downtown transit easy to understand and use for both infrequent and regular riders, including:

- Operate routes on the same street in both directions. If this is not possible, operate service in a limited set of linear corridors. Limit turning movements from linear corridors to make transit service more predictable
- Avoid running service more than one block apart
- Operate common service types and destinations on the same streets and/or at common stops. For example, regional service on 2nd and 4th Avenues, service to common sectors of the City (e.g., NW Seattle) stop on the same block, etc.
- Develop a strong, high-capacity Center City circulation system that connects all major multimodal hubs (Westlake, Colman Dock, and King Street/International District) to limit the need for regional bus throughput and increase the usability of regional high capacity transit

SOUTH LAKE UNION STREETCAR RIDERSHIP GROWTH

Ridership on the South Lake Union Streetcar grew in 2010. There were over half a million riders in 2010, a 15% increase over 2009, and 25% greater than ridership in 2008, the first full year of operation. The gains were driven largely by increased weekday trips. Average weekday ridership was over 1,800, peaking at over 2,200 in August 2010. The month with the highest increase over 2009 was November with an increase of 128%. Significant job gains in the district caused by Amazon expansion have fueled these increases. South Lake Union businesses have responded by providing private funding to add peak period runs on the streetcar.



Source: Seattle Transit Blog

IMPLEMENTATION STRATEGIES

STRATEGY AREA: IMPLEMENTING THE CENTER CITY CONNECTOR

- **Strategy CC1.1:** Submit application for Federal Transit Administration support to compete an Alternatives Analysis of Center City Connector alignment options (submitted in July 2011).
- **Strategy CC1.2:** Fund and conduct alternatives analysis study to confirm streetcar as preferred mode and to develop preferred alignment option for connecting South Downtown (and the First Hill Streetcar) with South Lake Union and or Lower Queen Anne (and the South Lake Union Streetcar).
- **Strategy CC1.3:** Ensure that study and consideration of alternatives clearly distinguishes the travel market needs for Center City circulation and inter-neighborhood travel and Center City access.
- **Strategy CC1.4:** Optimize opportunity to connect Center City Multimodal Hubs, including Westlake, Colman Dock, and King Street/International District.
- **Strategy CC1.5:** Ensure Center City Connector and other Center City transit projects consider and address circulation and mobility needs of the Central Waterfront.
- **Strategy CC1.6:** Develop a business plan using the assumption that locally generated funds will be needed to support both capital development (expect 50% match requirement on possible federal funding) and ongoing operating funds. The business plan should include consideration of the private sector role in project development.
- **Strategy HCT CC1.7:** Begin outreach to Center City neighborhoods and business community.

STRATEGY AREA: ENHANCE CENTER CITY TRANSIT SERVICE AND USABILITY

- **Strategy CC2.1:** Conduct an integrated streetscape and operations study for the 3rd Avenue Transit Mall (Denny to Jackson). Study outcomes would include a 3rd Avenue transit mall that operates more effectively as a linear circulator in downtown, serves key city transit routes, and is reconstructed as a centerpiece of Seattle's downtown pedestrian environment.
- **Strategy CC2.3:** Further restrict auto traffic on the 3rd Avenue Transit Mall during midday times and north of Stewart as required by increasing bus volumes.
- **Strategy CC2.3:** Implement strategic electric trolley wire projects to improve trolley bus routing and reduce turn movements on the 3rd Avenue Transit Mall in downtown Seattle.
- **Strategy CC2.4:** Implement speed and reliability projects to enhance operations on four priority center city bus corridors: Pike/Pine, Yesler/James/Jefferson, Jackson, and Queen Anne/SPU.
- **Strategy CC2.5:** Work with transit provides to implement off-board fare payment in conjunction with elimination of the Ride Free Area and Rapid Ride implementation.
- **Strategy CC2.6:** Work with Metro and Sound Transit to improve passenger wayfinding and information on all major transit streets in the Center City.
- **Strategy CC2.7:** Work with Metro, Sound Transit, and Community Transit to reroute regional bus services with high volumes of passengers bound for South Lake Union or north Downtown through South Lake Union via Mercer and Fairview (following completion of Mercer project).
- **Strategy CC2.8:** Upgrade downtown traffic signal systems to increase transit throughput on downtown streets.

OPTIMIZING KEY CENTER CITY TRANSIT CORRIDORS

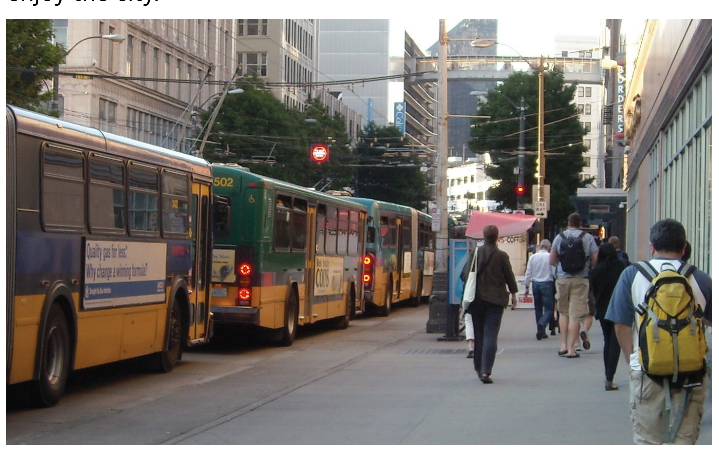
Specific Center City transit enhancements to make transit more user-friendly and improve operational efficiency are discussed in several categories and illustrated in Figure 3-14.

3rd Avenue Transit Mall

The following steps would help simplify transit routing through downtown and would facilitate (though not ensure) the shift of bus volumes from the Downtown Transit Tunnel to 3rd Avenue. They would need to be accompanied by strong branding and clear customer information and signage.

- Eliminate turns where feasible (between Stewart and Yesler) to create a linear transit mall. This configuration would:
  - Allow downtown passengers to board with certainty that buses would not turn off of 3rd Avenue
  - Eliminate conflicts with pedestrians at the city's highest-volume pedestrian intersections
- Route all north-south running rapid, frequent, and local buses serving Seattle on the Transit Mall to the extent possible; regional services would use 2nd and 4th Avenues as a north-south transit corridor.

Throughout much of the day, passenger queues to board buses on 3rd Avenue in the vicinity of Pike and Pine Streets are overwhelming to through pedestrians. To maintain a vital business environment and function effectively for transit passengers, the 3rd Avenue Transit Mall requires significant investment. Streetscape studies have been undertaken to revitalize the corridor, but a more complete, transit-focused study is needed to develop a coordinated set of improvements that elevate 3rd Avenue as a centerpiece of Seattle's public space, an effective circulation corridor for downtown transit passengers, a hub for city and regional transit customers, and a great place to work, shop, and enjoy the city.



Third Avenue Transit Mall

Image from Nelson\Nygaard

Trolley Bus Improvements

Figure 3-14 illustrates proposed Center City improvements to the Trolley Bus network. These include:

- **Denny:** Electrify this corridor to provide quiet, zero emissions transit service on one of Metro's busiest diesel bus routes. The new wire between 1st and 3rd Avenues would also have the benefit of allowing more efficient routing of southbound trolley routes from Queen Anne to downtown via the 3rd Avenue Transit Mall.
- **Madison:** Extend wire from 1st Avenue to the Waterfront to enhance connections to Colman Dock from First Hill/ Capitol Hill.
- **Yesler:** Add wire on Yesler between 2nd Avenue and 9th Avenue E., and on 9th Avenue from Yesler to Jefferson to reduce turning movements off of 3rd Avenue and improve connections to Harborview Medical Center.

These improvements are discussed as part of the comprehensive network of existing and planned trolley bus corridors in the next chapter.

Center City Connector (CC1 and CC2) Alternatives

The Center City Connector corridors shown in Figure 3-15 would operate through the heart of downtown Seattle, connecting Lower Queen Anne, Uptown, and South Lake Union neighborhoods to the north with the King Street Station and International District Multimodal Hub on the south end of downtown. Figure 3-16 and accompanying tables on the following page illustrate the two alternatives in more detail, including various alignment options.

- **CC1:** Queen Anne to King Street Station via 1st Avenue
- **CC2:** Westlake Center to King Street Station, an extension of the existing South Lake Union Streetcar, along 4th and 5th Avenues or using Pike/Pine to 1st Avenue

> The City has applied for federal funding to conduct an Alternatives Analysis (AA) of the proposed Center City Connector corridors to determine, in detail, the benefits, costs, and impacts of each alignment.

Although the Center City Connector corridors can be considered as standalone corridors, their full benefits would be realized as the unifying connections of an integrated streetcar circulator system connecting with the planned and funded First Hill streetcar line at King Street Station and potentially connecting all three of Seattle's multimodal transportation hubs: King Street and International District Stations, Colman Dock, and Westlake Center.

FIGURE 3-14 CENTER CITY TRANSIT CORRIDORS

ACCOMMODATING TRANSIT OPERATIONAL NEEDS IN THE CENTER CITY

Layover

Layover is the uncomely truth about bus operations. No matter the degree to which layover operations are made, more efficient, high-frequency services depend heavily on a ready supply of idle buses/operators to ensure reliable operations. Buses standing still are not all that attractive, nor are they human-scale, but they are a very necessary part of transit operations. The conundrum is how to accommodate bus layover in a way that meets urban design goals without locating them so far away from passenger activity areas that it increases operating costs or decreases reliability.

Layover locations should be at logical anchor points. For the Center City these anchor points will tend to be at the north and south fringes:

- North of downtown, in particular, special care must be given to ensure that the location of layover does not work to isolate South Lake Union from downtown, but instead to help transit integrate the two areas.
- In the south end of downtown, the best layover locations offer greater efficiency and connectivity by serving the King Street/International District multimodal hub rather than stopping just short of it in the northern parts of Pioneer Square.

Off-street layover can often be provided with creative design in mixed-use facilities. Potentially higher costs for developing such facilities are often worth the trade-off in terms of urban design benefits.

On-street layover opportunities should be accommodated, but only where appropriate, such as through use of peak hour parking restrictions. The City should coordinate with Metro to identify and support low-impact opportunities for on-street layover. Usually this means no more than two buses at any one location. From an urban design perspective, a string of buses along a curb is like a giant fence or barrier to the urban form and pedestrian environment and should be avoided.

Signal Systems

In the development of corridors for the Frequent Transit Network (discussed in Chapter 4), extensive focus has been given to implementation of aggressive transit signal priority. Along a corridor this strategy is relatively straightforward. In the Center City, a number of factors make the addition of transit signal priority a far more complex undertaking, including:

- The presence of very high pedestrian volumes
- A grid of one way streets
- High peak hour turning volumes to access the freeway system
- The Third Avenue Transit Mall
- Regular major special events at the north and south edges of the Center City
- Uncertain traffic re-distribution patterns brought about by access points for SR 99

A signal system designed to offer transit priority in this environment needs to offer the ability to adapt to current traffic conditions, including high pedestrian volumes. Adaptive traffic control systems require extensive communication networks, centralized computing and communications resources, and staffing to watch the system. As a result, such a system to serve downtown will have a very high capital cost in the range of $10 million.

To date, adaptive systems have been considered for downtown, but not acted upon based on the relatively high cost and the concern of creating a less friendly pedestrian environment. Even so, the current system operates on a fixed-time basis and it may be possible to optimize signal timing for certain times of the day without increasing pedestrian delay, e.g., in the early hours of the AM peak. The potential benefits that might be derived from applying an adaptive signal system are not fully known, but it merits further consideration as a potential tool to improve transit performance in the margins—if it appears the benefits can outweigh the costs and the potential to increase pedestrian delay.

Signal system improvements that move buses more efficiently along the 3rd Avenue Transit Mall would benefit many passengers and could adjust to various traffic patterns at different times of day.

Image from Nelson\Nygaard

A string of buses parked along a curb is like a giant fence and acts as a barrier to street fronting building uses.

Image from Nelson\Nygaard

STRATEGY AREA: ACCOMMODATING TRANSIT OPERATIONS IN THE CENTER CITY

TOCC-1: The City and Metro should jointly identify areas (not specific sites) where development of off-street layover facilities is needed, keeping in mind the balance between serving areas and operational efficiency.

TOCC-2: The City should aggressively seek joint development opportunities to establish off-street layover.

TOCC-3: The City and Metro should continue to work together to maintain an inventory of appropriate on-street layover locations.

TOCC-4: The City should undertake a detailed study to evaluate the costs, benefits to transit, and potential to pedestrian delay through implementation of adaptive signal technology on the downtown signal system.

CONVENTIONAL VS. ADAPTIVE SIGNAL SYSTEMS

Conventional Signal Timing

- **Actuated-Uncoordinated “Free” Signal Timing:** Each intersection in a corridor responds to its own need with no regard to traffic operations at adjacent intersections. The traffic signal controller adjusts the amount of time served to each phase of the intersection based on the number of vehicles detected by detector loops or video detection at that intersection.
- **Coordinated Signal Timing with Time-of-Day Plans:** Signal timing along a corridor or within a network is coordinated between controlled base upon static signal timing plans that are developed based on a sample of the average traffic volumes for the times of the week when the plans will be developed. The time-of-day plans result in a cycle length common to the group of coordinated signals, and offset in the cycle starting points between adjacent signals, a sequence of phases, and an allocation of cycle time (splits) for each phase at each signal.

Adaptive Signal Timing

- **Adaptive Signal Timing:** Adaptive signal control systems continually refine the timings at every intersection within a corridor or network, cycle-by-cycle, as traffic conditions change. Adaptive systems monitor traffic conditions using vehicle detectors for all approaches, and often for all movements, of the intersections within the corridor. These systems adjust the signal timing based on the real-time traffic flow in the corridor.

CC1 Alternative: Lower Queen Anne to Downtown

Corridor Overview

Length: 2.3 miles

New Track Miles: 4.5 single-track miles (rail)

Major Stations: King Street Hub, S Jackson St - 2nd Ave S, 1st Ave - Yesler Way, Madison/Marison St, Seneca St, Pike St, Virginia St, Bell St, Queen Anne Ave N / 1st Ave N - Denny Way, Harrision St (or Mercer/Roy St)

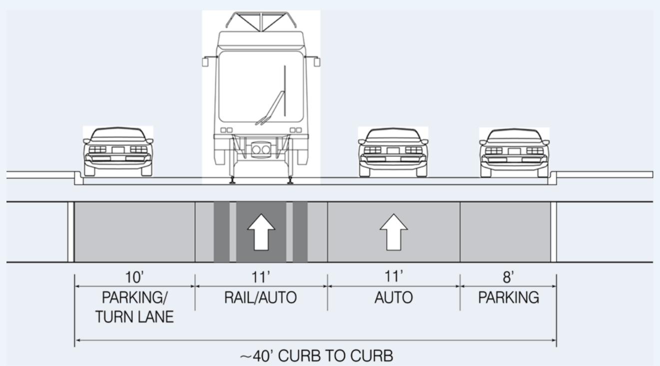
Average Stop Spacing: 1,900 feet

Key Connections:

- King Street Hub
- Financial District Station
- Pioneer Square Station
- Colman Dock
- RapidRide C (future)

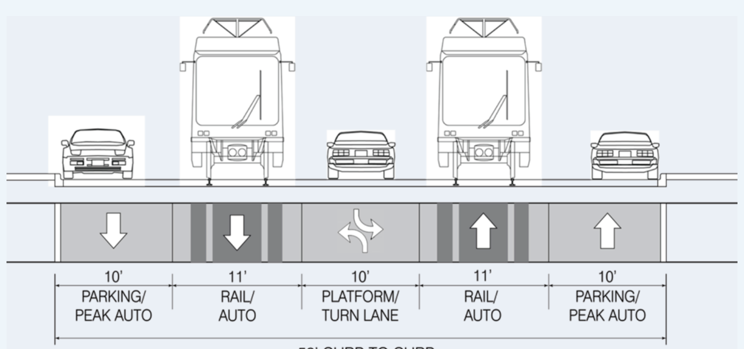
Sample Cross-Sections

Rail



Lower Queen Anne Couplet : North of Denny, rail would operate in a couplet formation and could operate in mixed traffic or dedicated lanes. Multiple options are available for a turnaround/terminus.

Rail



1st Avenue: 1st Avenue has sufficient curb-to-curb width to accommodate 5 lanes. This would allow a center median dedicated or shared lane operation. Center-running rail and center platform stations would benefit traffic circulation on the downtown 1-way street grid all the way from Cherry to Denny. Stations are proposed at somewhat frequent intervals in the downtown core because this portion of the transit line could double as a 'waterfront circulator' in addition to being a high-capacity connection between Lower Queen Anne and Pioneer Square. Interlining/connecting the 1st Avenue line with the First Hill line at Jackson/Occidental would provide expanded circulation options.

FIGURE 3-15 CENTER CITY CONNECTOR ALTERNATIVES AND CORRIDOR ALIGNMENT OPTIONS

Note: All cross sections are representative of a possible design option for a corridor segment. Right-of-way widths, utility constraints, and competing street use needs vary in each of the representative segments.

CC2 Alternative: Lower Queen Anne to Downtown

Corridor Overview

Length: 1.1 miles (new segment only)

New Track Length: 2.4 signal-track miles (rail)

Stations: King St Hub, 4th/5th Ave - James St, Madison St, University St, Union St, Westlake Hub, Westlake Ave - Virginia St, Blanchard St, Denny Way, Thomas/Harrision St, Republican St, Mercer St, Valley St - Terry Ave/Boren Ave, Fairview Ave N - Aloha St

Average Stop Spacing: 1,100 feet

Key Connections:

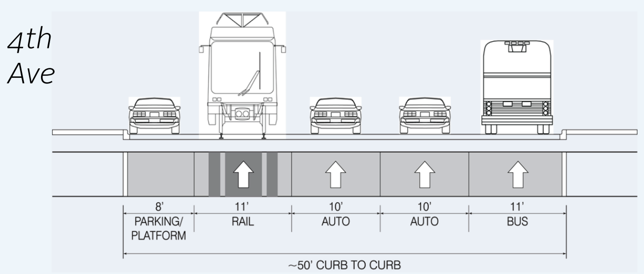
- King Street Hub
- Financial District Station
- Pioneer Square Station
- Westlake Hub

Service Restructuring

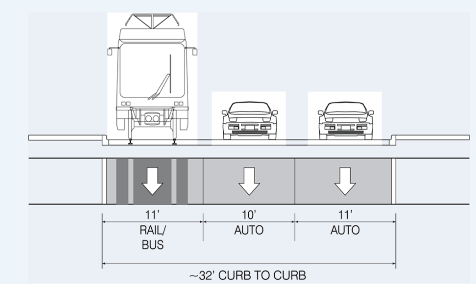
- Rail placement on 4th and 5th would be designed to limit impact on regional bus service.

Sample Cross-Sections

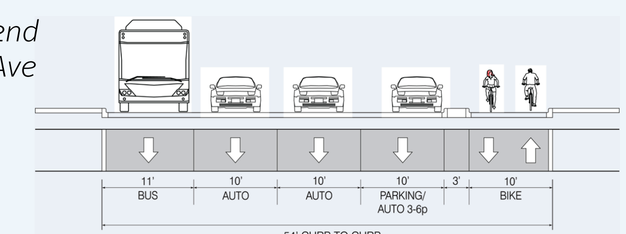
4th Ave



5th Ave



2nd Ave



4th/5th Couplet: 4th will remain an important regional bus corridor; it has significant turning volumes at some cross-streets. Placing a rail circulator/streetcar line on the west side of 4th replaces conflicts with regional buses and I-5-bound turning traffic. An option to mitigate impacts to the 4th Ave bicycle lane is to construct a two-way 'cycle track' on 2nd Ave. Northbound rail would return to the existing SLU alignment via Virginia.

5th Avenue is only 3 lanes wide in the northern part of downtown; rail is proposed for the west curb lane (right turning vehicles could delay rail vehicles at some locations)