King County Metro RapidRide
Performance Evaluation Report

December 2014

CONTENTS

INTRODUCTION

King County Metro's bus rapid transit (BRT) service, called RapidRide, currently operates along six high-use corridors totaling 62 miles:

- A Line: Implemented in October 2010 and serves Tukwila, Seatac, Des Moines, Kent, and Federal Way on SR 99.
- B Line: Implemented in October 2011 and serves Redmond and Bellevue via Crossroads and Overlake.
- C Line: Implemented in September 2012 and serves downtown Seattle and West Seattle via the Alaska Junction and Fauntleroy neighborhood.
- D Line: Implemented in September 2012 and serves downtown Seattle, Uptown, and Ballard via Belltown and Interbay.
- E Line: Implemented in February 2014 and serves downtown Seattle and Shoreline via Aurora Avenue N.
- F Line: Implemented in June 2014 and serves Burien, Seatac, Tukwila and Renton.

The RapidRide system includes a unique fleet of vehicles, and corridor and system capital investments, such as transit signal priority (TSP) and improved passenger facilities.

King County Metro developed a series of goals to guide the implementation and vision of the RapidRide system:

- Recognized as an enhanced service
- Frequent service
- Faster bus travel times than existing service
- Reliable service
- Comfortable, pleasant, and easy to use
- Designed to be safe and secure on and off the bus
- Easy integration with other King County Metro bus routes
- Supports healthy, car-less travel, reducing pollution, and increasing connections to community
- Improvements minimize negative impacts on the quality of existing service
- Encourage partnerships with local communities
- Encourage private investment and development along corridors
- Increase transit ridership
- RapidRide will have higher numbers of riders per hour than the average number of riders per hour for other King County Metro service

The report is organized into five sections:

- An evaluation of how the RapidRide program is performing based on performance measures directly related to the program goals,
- A comparison to similar BRT systems in the US,
- An assessment of how capital expenditures support the program goals,
- An assessment of how operating costs support the program goals, and
- Identification of parameters for determining future expansion of the RapidRide system.

PERFORMANCE EVALUATION

RapidRide performance was evaluated based on how well the service meets the program goals. Performance measures, summarized in Table 1, directly align with the RapidRide goals identified by Metro.

Methodology
Data used to evaluate RapidRide program performance was collected from a variety of sources including customer surveys, ridership and travel time data, and interviews with Metro staff and developers. Data was a combination of qualitative and quantitative information. RapidRide performance was then rated on a scale of 1 (low performing) to 5 (high performing) for each program goal. Shaded circles identify how the RapidRide program was rated for each goal.

A detailed description of how each goal was evaluated is included in this section

> **RapidRide performance was measured based on how well RapidRide routes fulfilled the RapidRide program goals.**

Table 1. Program Performance Evaluation

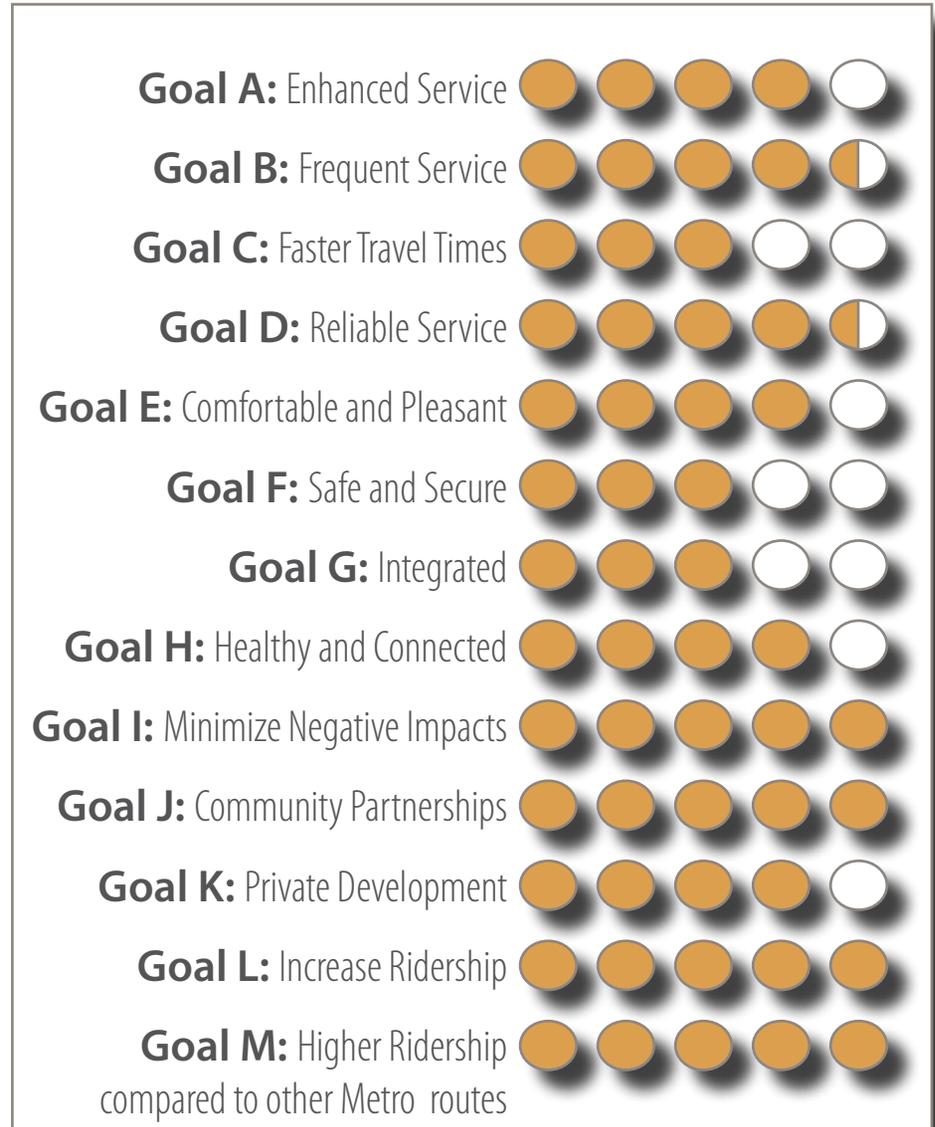| RapidRide Program Goal	Performance Measure
A. Recognized as an enhanced service	– Satisfaction comparison to prior routes
B. Frequent service	– 10 minute headways or less during peak commute periods
C. Faster bus travel times than existing service	– Travel times decrease by 10-30% based on pre-RapidRide routes
D. Reliable service	– Schedule reliability (headway adherence)
E. Comfortable, pleasant, and easy to use	– Overall customer satisfaction
F. Designed to be safe and secure on and off the bus	– Satisfaction with personal safety
G. Easy integration with other King County Metro bus routes	– Satisfaction with transfer system
H. Supports healthy, car-less travel, reducing pollution, and increasing connections to community	– Mode choices if RapidRide not available – Convenience of stops to home/start of trip
I. Improvements minimize negative impacts on the quality of existing service	– Qualitative measures of implementing new service
J. Encourage partnerships with local communities	– Summary of jurisdictions with RapidRide services – Summary of improvements made in RapidRide corridors – Complimentary programs to reduce car travel and encourage transit
K. Encourage private investment and development along corridors	– Amount of private development in RapidRide corridors since implementation
L. Increase transit ridership	– Ridership increase by 50% in corridor within 5 years of implementation
M. RapidRide will have higher numbers of riders per hour than the average number of riders per hour for other King County Metro service	– Comparison of RapidRide ridership to other Metro routes

Performance Evaluation Summary

The RapidRide program is performing well on fulfilling the RapidRide program goals. RapidRide performed best on Goals I, J, L, and M. As measured in Goal I, RapidRide implementation allowed Metro to restructure other Metro service that would have duplicated or competed with RapidRide in host corridors to minimize impacts on existing service. The In Motion program in RapidRide corridors is building relationships with communities and encouraging car-less travel, which allows the program to satisfy Goal J. Ridership on RapidRide, measured in Goal L, has been consistently increasing and two RapidRide lines have exceeded 50 percent ridership growth before five years. Ridership on RapidRide lines also constitute 14 percent of Metro's total weekday ridership. RapidRide also has on average, 50 riders per hour versus 32 riders per hour on non-RapidRide routes, which indicates that RapidRide is meeting Goal M.

The RapidRide program is performing the weakest on Goal F, which is concerned with safety on and off the bus. Based on customer survey results, some riders have concerns about security on and off the bus, particularly on the C Line.

Table 2. Summary Program Performance Rating

Goal A: Enhanced Service
Goal B: Frequent Service
Goal C: Faster Travel Times
Goal D: Reliable Service
Goal E: Comfortable and Pleasant
Goal F: Safe and Secure
Goal G: Integrated
Goal H: Healthy and Connected
Goal I: Minimize Negative Impacts
Goal J: Community Partnerships
Goal K: Private Development
Goal L: Increase Ridership
Goal M: Higher Ridership compared to other Metro routes

# Goal A. Recognized as an enhanced service

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RapidRide Goal A is measured by comparing RapidRide customer satisfaction to Metro transit routes previously serving the same corridor. The King County Metro customer survey asks participants how RapidRide compares overall to pre-RapidRide routes. For all of the RapidRide lines except the D Line, survey participants were more satisfied with RapidRide than compared to their previous route. Survey respondents were most positive about the frequency of service and not having to rely on a predetermined schedule when compared to their previous route.
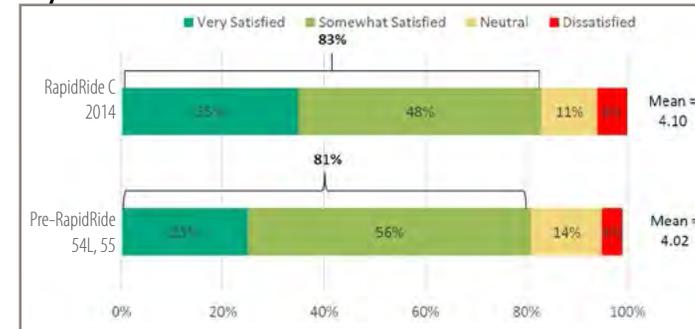
RapidRide A Line

Source: King County Metro RapidRide A Line Customer Satisfaction Survey Results , January 2011; RapidRide A Line Three Year Post-Implementation Survey Results, November 2013
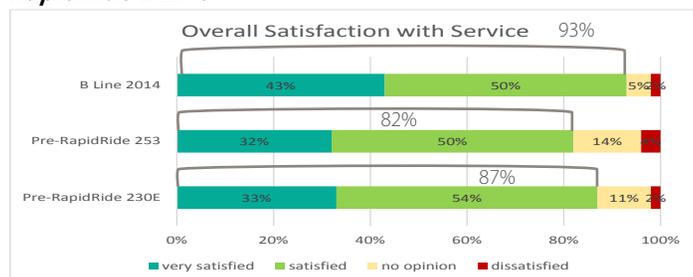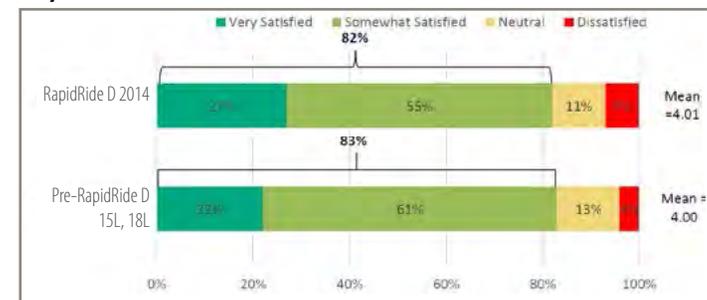
RapidRide B Line

Source: RapidRide B Line Three Year Post-Implementation Survey Results, November 2014,; RapidRide B Line One Year Post-Implementation Survey Results, December 2012

RapidRide C Line

Source: King County Metro RapidRide C and D Lines Customer Surveys Final Report, June 2014

RapidRide D Line

Source: King County Metro RapidRide C and D Lines Customer Surveys Final Report, June 2014

RapidRide E Line

Source: King County Metro RapidRide E Line Customer Satisfaction Survey, June 2014

Goal B. Frequent service

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RapidRide Goal B is measured by verifying that RapidRide peak period service operates on 10 minute headways or less. The peak AM and PM periods vary for each line, with most peak morning service occurring between 6 AM and 9 AM, and most afternoon peak service occurring between 2 PM and 7 PM.

Based on current Metro schedules, all RapidRide routes operate on 10 minute headways during the peak commuter periods. However, during the AM and PM peak periods, the E Line operates on slightly longer headways for the reverse commute direction with 11 to 13 minute headways. This is very close to the desired headways of 10 minutes or less. Outside of the peak periods, RapidRide lines operate on 12 to15 minute headways during the day, which still provides relatively frequent service for riders compared to some Metro conventional service routes.

Goal C. Faster bus travel times than existing service
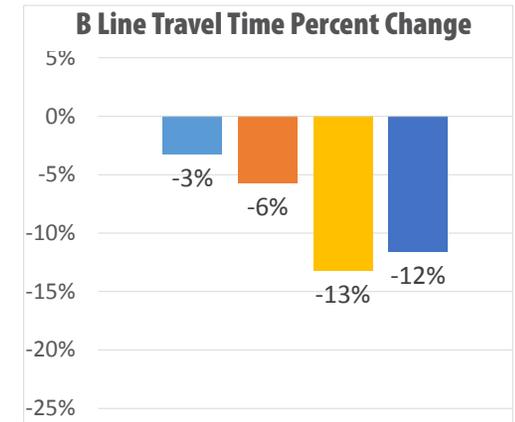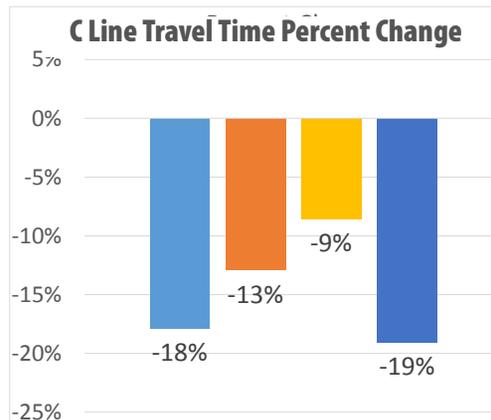
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RapidRide Goal C is measured using travel time comparisons. To satisfy Goal C, RapidRide travel times should be decreasing by 10 to 30 percent compared to pre-RapidRide routes in the same corridor. Travel time percent change was calculated by comparing the average peak period run time from Spring 2014 with the average peak period run time directly before RapidRide implementation. Run time data for RapidRide A-E lines indicates that travel times on RapidRide lines have been decreasing, with the highest decreases occurring on the C Line. The A Line was the only line that had an increase in travel time compared to the pre-RapidRide route in one direction of travel during the PM peak period. For RapidRide lines traveling towards downtown Seattle in the AM (C, D, and E lines), travel times have reduced between 7 and 18 percent compared to the pre-RapidRide routes. When traveling away from downtown in the PM, the travel times on these same lines have reduced between 3 and 19 percent. Although travel times on RapidRide lines are decreasing, all travel times have not yet decreased to the desired level.

Legend:
- 🟦 AM Northbound/ Eastbound
- 🟧 PM Northbound/ Eastbound
- 🟨 AM Southbound/ Westbound
- 🟦 PM Southbound/ Westbound

A Line Travel Time Percent Change

Values: -12%, -11%, -9%, 1%
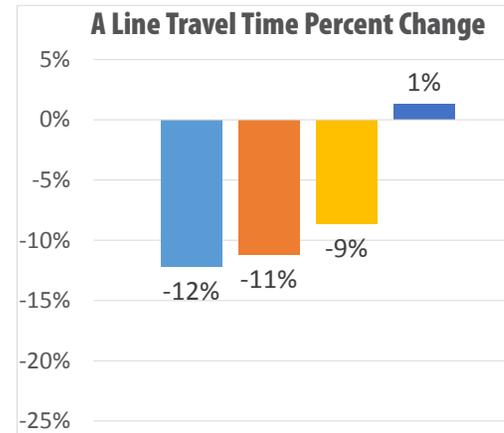
Between International Blvd/160th and 316th/ Pacific Highway

B Line Travel Time Percent Change

Values: -3%, -6%, -13%, -12%

Between NE 8th/116th NE and Overlake P&R

C Line Travel Time Percent Change

Values: -18%, -13%, -9%, -19%

Between 35th/Barton and 35th/Avalon; does not include Viaduct

D Line Travel Time Percent Change

Values: -5%, -12%, -9%, -8%
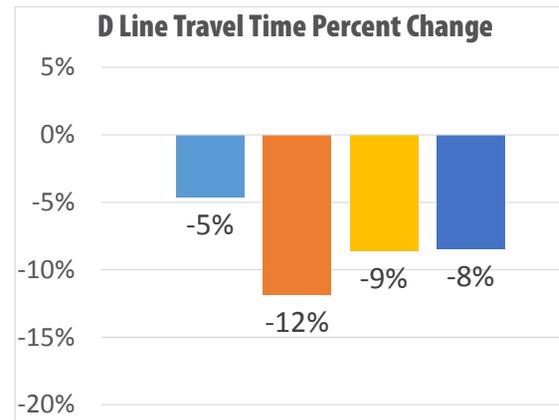
Between 1st/Denny and 15th NW/NW 85th

E Line Travel Time Percent Change

Values: -5%, -3%, -7%, -9%
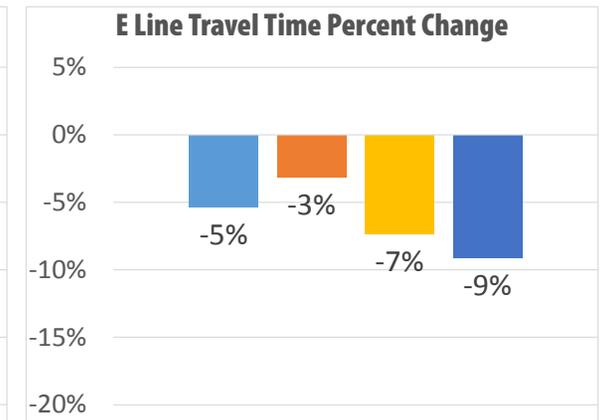
Between Aurora/Denny and Aurora/192nd

Source: RapidRide Corridor Run Time Data, Spring 2007- Spring 2014

Goal D. Reliable service

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RapidRide Goal D is measured by schedule reliability. Goal D is fulfilled if RapidRide lines are adhering to the schedule and determined headways at least 80 percent of the time. Headway adherence data from the past two years indicates that the combined RapidRide lines are adhering to the schedule approximately 84 percent of the time. RapidRide E Line, one of Metro's newest lines, has the lowest headway adherence rate of approximately 78 percent,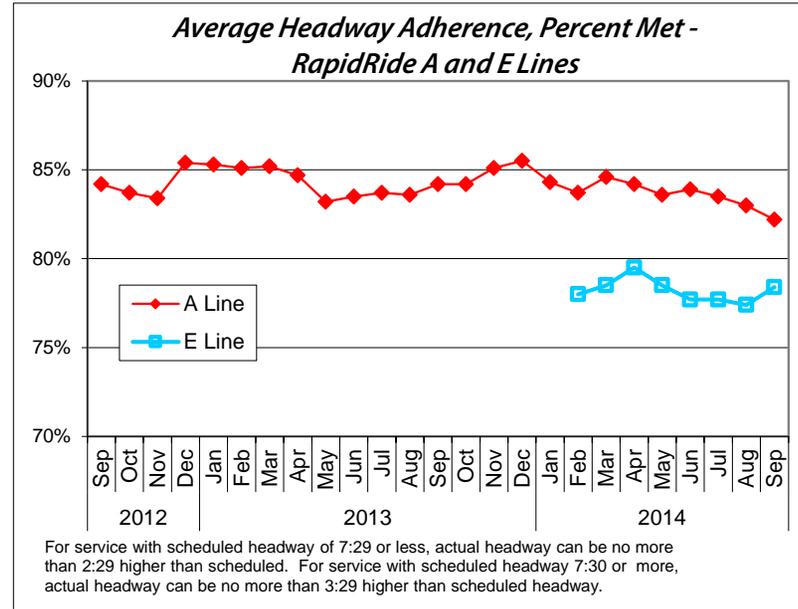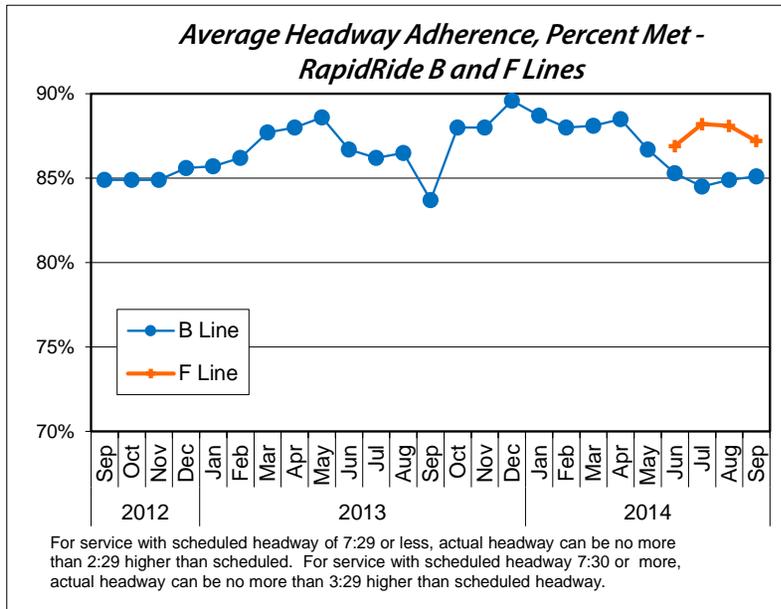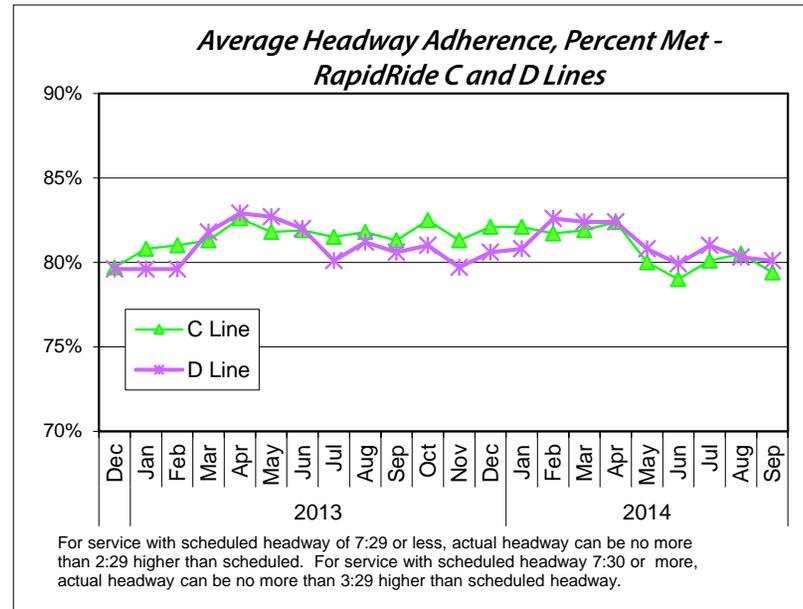 which is just below the target. The RapidRide B Line performs the best on headway adherence with an adherence rate of approximately 87 percent over the past two years.

Average Headway Adherence, Percent Met - RapidRide A and E Lines

For service with scheduled headway of 7:29 or less, actual headway can be no more than 2:29 higher than scheduled. For service with scheduled headway 7:30 or more, actual headway can be no more than 3:29 higher than scheduled headway.

Source: OBS Data, June 2012 - September 2014

Average Headway Adherence, Percent Met - RapidRide B and F Lines

For service with scheduled headway of 7:29 or less, actual headway can be no more than 2:29 higher than scheduled. For service with scheduled headway 7:30 or more, actual headway can be no more than 3:29 higher than scheduled headway.

Source: OBS Data, June 2012 - September 2014

Average Headway Adherence, Percent Met - RapidRide C and D Lines

For service with scheduled headway of 7:29 or less, actual headway can be no more than 2:29 higher than scheduled. For service with scheduled headway 7:30 or more, actual headway can be no more than 3:29 higher than scheduled headway.

*Source: OBS Data, June 2012 - September 2014*

Goal E. Comfortable, pleasant, and easy to use

RapidRide Goal E is measured by overall customer satisfaction with RapidRide over time. This is measured in the King County Metro customer survey. Over 80 percent of survey participants on the B, C, D, and E lines stated that they were satisfied with their RapidRide Line. On the RapidRide A Line, just under 80 percent of riders reported that they were satisfied. The C and D lines improved between approximately 10 to 15 percent compared to the previous year. On the A Line, overall customer satisfaction decreased from two years prior by 6 percent.

RapidRide A Line
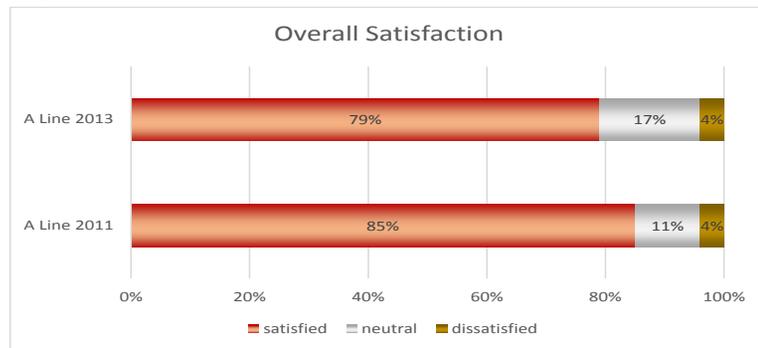
Source: King County Metro RapidRide A Line Customer Satisfaction Survey Results , January 2011; RapidRide A Line Three Year Post-Implementation Survey Results, November 2013
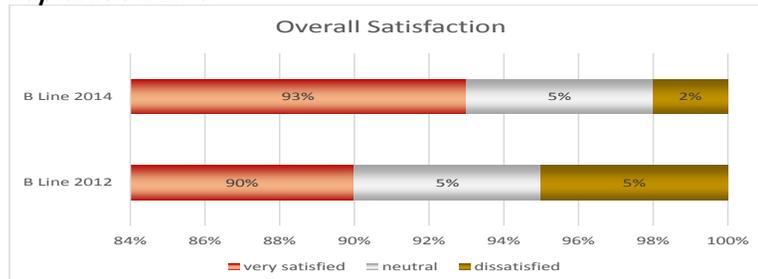
RapidRide B Line

Source: RapidRide B Line Three Year Post-Implementation Survey Results, November 2014 ; RapidRide B Line One Year Post-Implementation Survey Results, December 2012
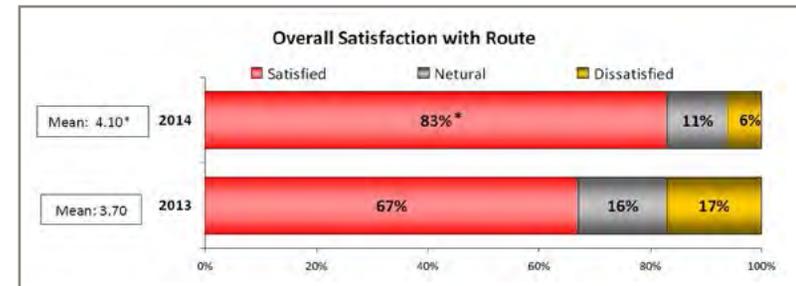
RapidRide C Line

Source: RapidRide C Line Customer Satisfaction Survey Quick Look Eighteen Months Post Implementation, June 2014
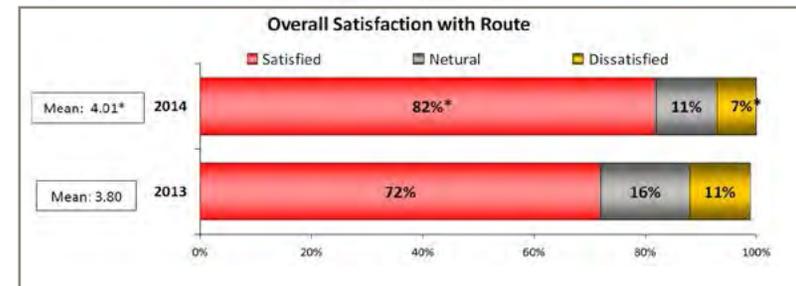
RapidRide D Line

Source: RapidRide D Line Customer Satisfaction Survey Quick Look Eighteen Months Post Implementation, June 2014

RapidRide E Line

Source: RapidRide E Line Customer Satisfaction Survey, June 2014

Goal F. Designed to be safe and secure on and off the bus

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RapidRide Goal F is measured by customer satisfaction with personal safety while at RapidRide stops and on RapidRide buses. The customer surveys asked riders how safe they felt using RapidRide facilities and buses. Customer responses indicated that on all active RapidRide lines, most riders are satisfied with personal safety. Overall satisfaction with personal safety increased on both the A and E lines, and remained about the same on the B Line. However, on RapidRide C and D Lines, overall satisfaction is lower than the pre-RapidRide route. Information included in the Metro customer surveys indicates that the decrease in overall personal safety satisfaction for RapidRide D Line is likely due to lower satisfaction ratings on personal safety on the bus, behavior of other passengers on the bus, and behavior of other people at the stops. For RapidRide C Line, satisfaction with most safety characteristics decreased, including daytime personal safety on the bus, behavior of other passengers on the bus, and behavior of other passengers while waiting.

RapidRide A Line

Overall Satisfaction with Personal Safety

- A Line 2013: 3.57
- Pre-RapidRide A - 174: 3.33

Source: King County Metro RapidRide A Line Customer Satisfaction Survey Results , January 2011; RapidRide A Line Three Year Post-Implementation Survey Results, November 2013

RapidRide B Line

Overall Satisfaction with Personal Safety

- B Line 2014: 4.06
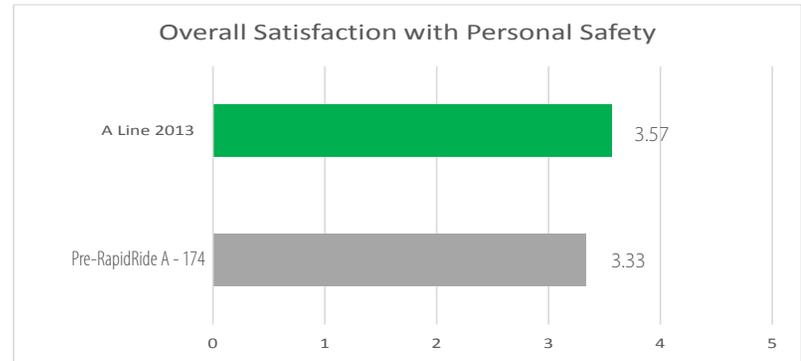- Pre-RapidRide 253: 4.16
- Pre-RapidRide 230E: 4.18

Source: RapidRide B Line Three Year Post-Implementation Survey Results, November 2014; RapidRide B Line One Year Post-Implementation Survey Results, December 2012

RapidRide D Line

Overall Satisfaction with Personal Safety

- RapidRide D Line 2014: 3.66
- Pre-RapidRide D - 15L, 18L: 3.82

Source: RapidRide C and D Lines Customer Surveys Final Report, June 2014

RapidRide C Line

Overall Satisfaction with Personal Safety

- RapidRide C Line 2014: 3.70
- Pre-RapidRide C - 54L, 55: 3.94

Source: RapidRide C and D Lines Customer Surveys Final Report, June 2014

RapidRide E Line

Overall Satisfaction with Personal Safety

- RapidRide E Line 2014: 3.45
- Pre-RapidRide E - 358: 3.28

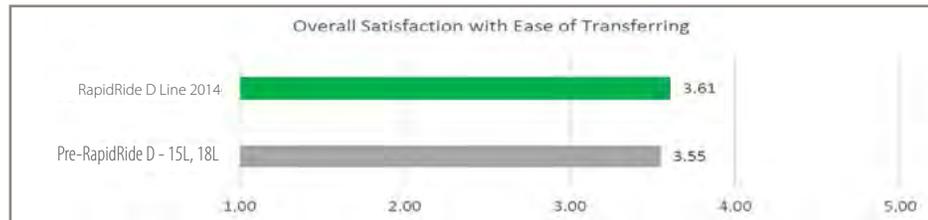*Source: RapidRide E Line Customer Surveys Final Report, July 2014*

Goal G. Easy integration with other KC Metro bus routes

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RapidRide Goal G is measured by customer satisfaction with the RapidRide transfer system. The customer surveys record how satisfied respondents are with various transfer characteristics, such as overall satisfaction, the number of required transfers, and helpfulness of drivers. Overall, most respondents report that they are satisfied with the overall transfer system. Each of the RapidRide lines has improved on overall satisfaction with the transfer system compared to pre-RapidRide routes. For all RapidRide lines, about half of all respondents were satisfied with the way buses are scheduled to make transfers.
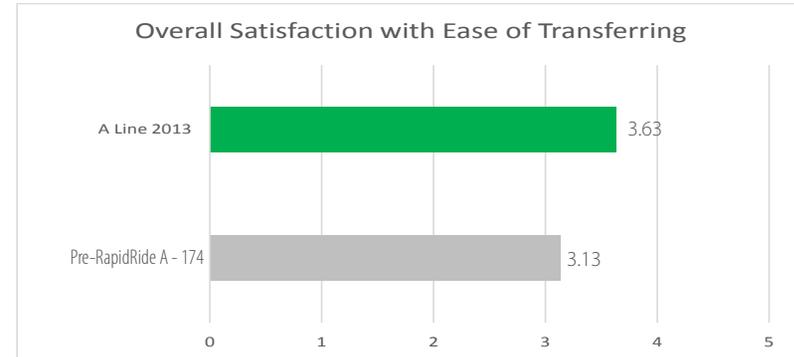
RapidRide A Line

Overall Satisfaction with Ease of Transferring

A Line 2013 — 3.63
Pre-RapidRide A - 174 — 3.13

Source: King County Metro RapidRide A Line Customer Satisfaction Survey Results, January 2011; RapidRide A Line Three Year Post-Implementation Survey Results, November 2013

RapidRide B Line

Overall Satisfaction with Ease of Transferring

B Line 2014 — 3.86
Pre-RapidRide 253 — 3.72
Pre-RapidRide 230E — 3.80

Source: RapidRide B Line Three Year Post-Implementation Survey Results, November 2014 ; RapidRide B Line One Year Post-Implementation Survey Results, December 2012

RapidRide D Line

Overall Satisfaction with Ease of Transferring

RapidRide D Line 2014 — 3.61
Pre-RapidRide D - 15L, 18L — 3.55

Source: RapidRide C and D Lines Customer Surveys Final Report, June 2014

RapidRide E Line

Overall Satisfaction with Ease of Transferring

RapidRide E Line 2014 — 3.66
Pre-RapidRide E - 358 — 3.40

Source: RapidRide E Line Customer Surveys Final Report, July 2014

RapidRide C Line

Overall Satisfaction with Ease of Transferring

RapidRide C Line 2014 — 3.56
Pre-RapidRide C - 54L, 55 — 3.55

Source: RapidRide C and D Lines Customer Surveys Final Report, June 2014

Goal H. Supports healthy, car-less travel, reduces pollution, and increases connections to community

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RapidRide Goal H is measured by how convenient stops are to home/start of the trip for riders. The majority of respondents to the customer surveys reported that they were satisfied with how convenient RapidRide stops were to their home or start of their trip. RapidRide C and D lines improved in customer satisfaction of convenience of stops in the latest survey compared to previous years. However, customer satisfaction for convenience of stops decreased for RapidRide compared to the pre-RapidRide routes. This is a common trade-off of most BRT systems. Fewer stops means faster travel speeds and times. Responses to the customer surveys also indicated that the RapidRide system attracts riders who would have otherwise driven alone to make their trip. RapidRide lines replace drive alone trips for between 15 and 20 percent of riders.

RapidRide A Line
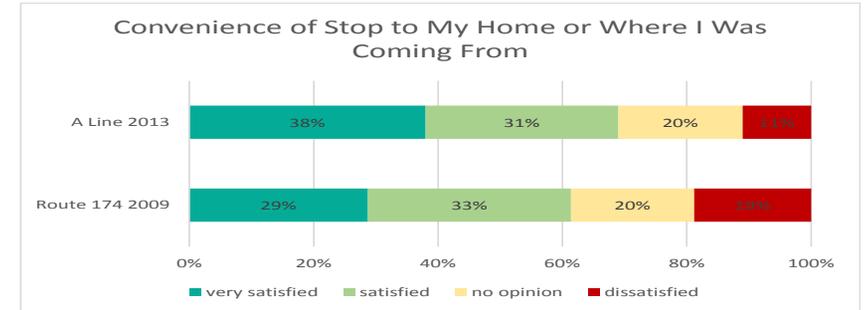
Source: RapidRide A Line Customer Satisfaction Survey Results, January 2011; RapidRide A Line Three Year Post-Implementation Survey Results, November 2013

RapidRide D Line

Source: RapidRide C and D Lines Customer Surveys Final Report, June 2014

RapidRide E Line

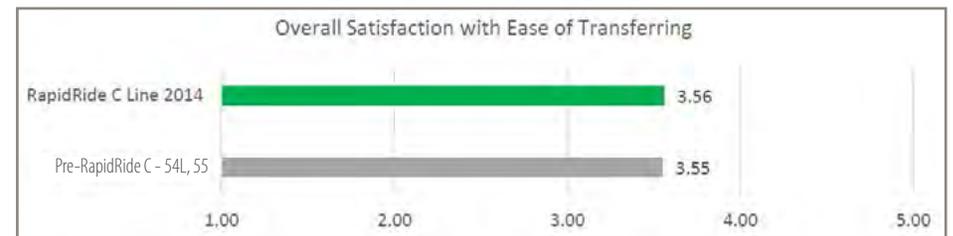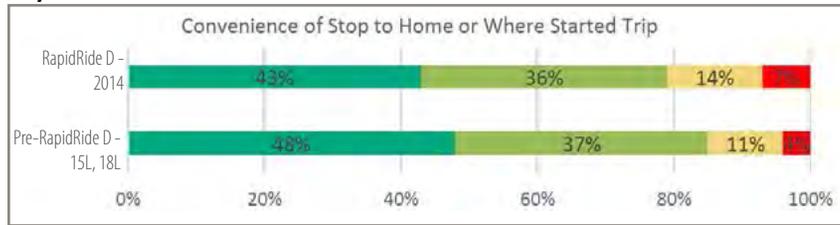Source: RapidRide E Line Customer Surveys Final Report, July 2014

RapidRide B Line

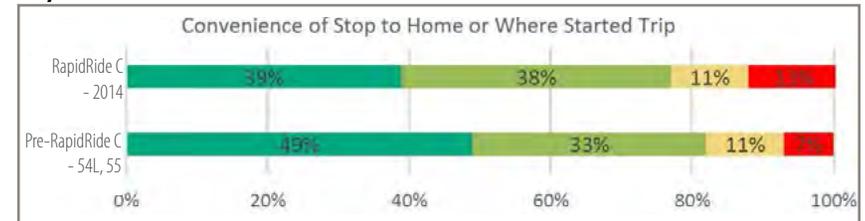Source: RapidRide B Line Three Year Post-Implementation Survey Results, November 2014; RapidRide B Line One Year Post-Implementation Survey Results, December 2012

RapidRide C Line

Source: RapidRide C and D Lines Customer Surveys Final Report, June 2014

Goal 1. Improvements minimize negative impacts on the quality of existing service

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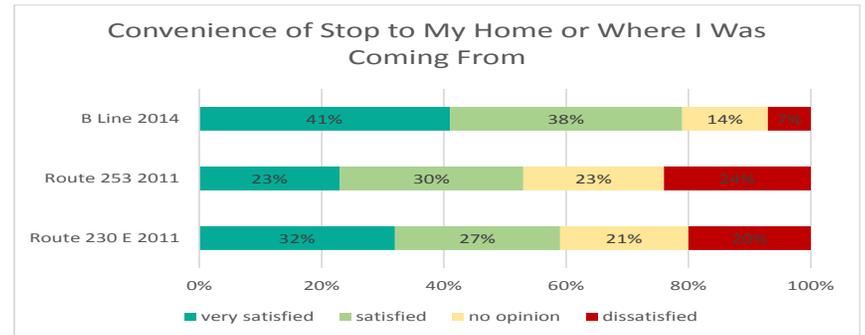
RapidRide Goal 1 is fulfilled if improvements associated with RapidRide implementation and service minimize the negative impacts on the quality of existing service. Information included in the '*RapidRide C and D Line Implementation and Restructures: Ridership Assessment and Guidelines Analysis*' report describes how RapidRide service was implemented and integrated in host corridors. RapidRide implementation allowed Metro to restructure service and change routes that would have duplicated or competed with RapidRide in host corridors. Metro was able to create new connections and improve service frequency to compliment RapidRide, which was made possible by reducing low productivity services and segments and redistributing resources to other routes.

For example, in the RapidRide C Line corridor, existing routes 21, 22, 60, 120, and 156 were restructured and improved to provide better connections and service to shopping, community destinations, and the C Line. Route 50 was also created to improve connections following C Line implementation. In the D Line corridor, existing routes 5 and 75 were improved with additional frequency and more direct connections to major destinations and other transit, and routes 32 and 40 were created. Because of these changes, overall ridership in the D Line corridor improved by 3.6 percent directly after RapidRide implementation and by 14.1 percent in the C Line corridor directly after RapidRide implementation. Similar efforts to minimize impacts to existing service has been done in the other RapidRide corridors.

Connections to RapidRide Service C and D Lines

Thicker lines indicate increased frequency
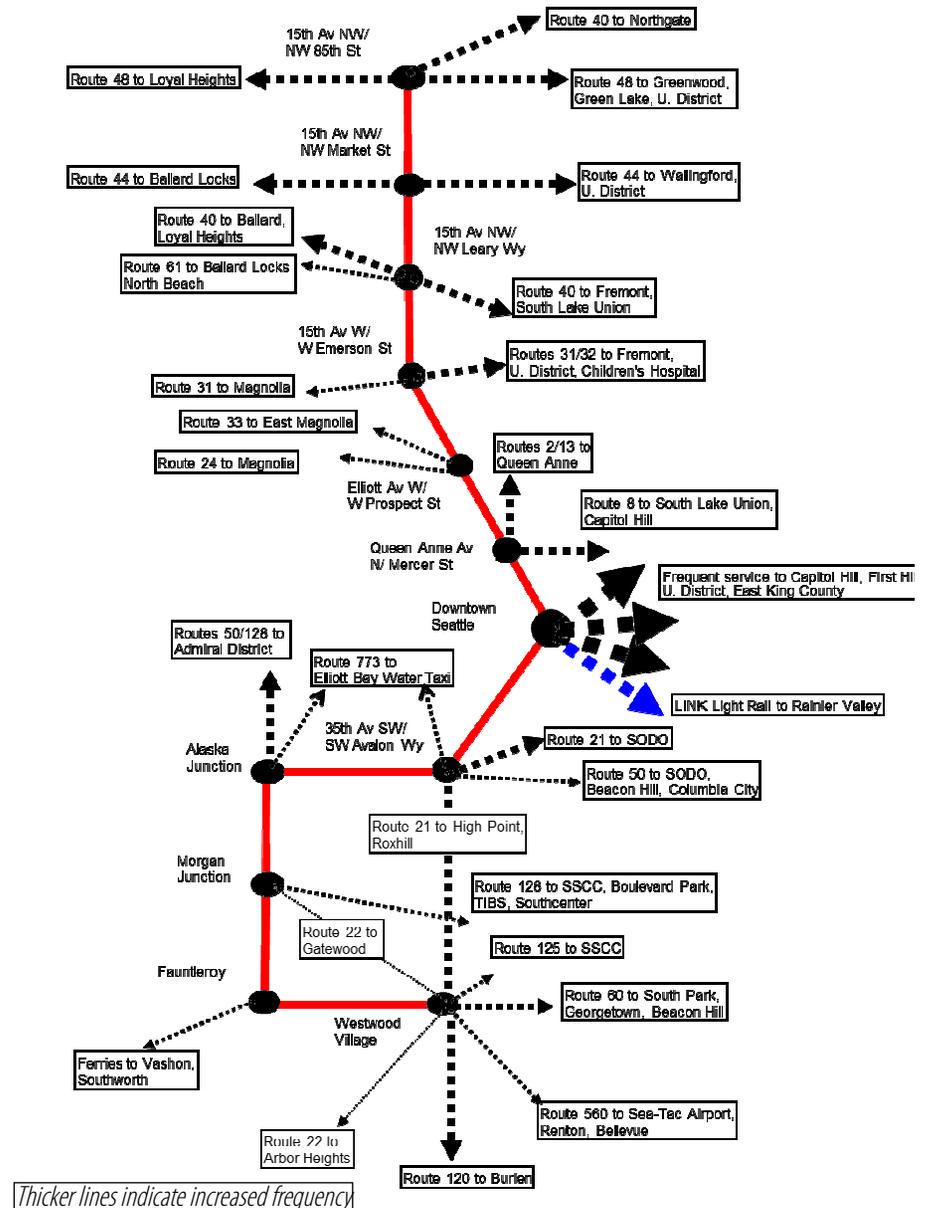
Goal J. Encourage partnerships with local communities

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RapidRide Goal J is satisfied by community partnerships and Metro's In Motion program. The local jurisdictions served by RapidRide as well as Sound Transit and the Washington State Department of Transportation were significant partners in the RapidRide program. The cities and agencies worked closely with Metro to provide various RapidRide elements such as the fiber-optic back bone needed to support the intelligent transportation system elements, pedestrian access improvements, transit signal priority, priority transit lanes, as well as incorporating some station and stop civil work into their existing roadway projects. Private businesses, both large (Boeing and Microsoft) and small, as well as Sound Transit, provided the use of their property for the location of RapidRide stations and stops.

Metro's In Motion program established a partnership with the community by promoting car-less travel. Participants in target neighborhoods take a pledge to drive less, receive travel information to help them get started and are rewarded for driving less. The In Motion program was delivered along the RapidRide A, C, D, E and F corridors as the lines were implemented. Over 7,500 people participated in the In Motion programs.

Goal K. Encourage private investment and development along corridors

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RapidRide Goal K is measured by the amount of private development that occurs in RapidRide corridors. The Urban Land Institute's (ULI) report "*Developing the Next Frontier: Capitalizing on Bus Rapid Transit to Build Community*" indicates that RapidRide station infrastructure, running way improvements, and high ridership have the potential to reinforce land uses in host corridors. Because RapidRide operates in commercial corridors, the service also promotes access to jobs and to workers and supports meeting basic consumer needs without a car. Stop spacing associated with RapidRide service also replaces the station area as a field for development, as described in the ULI report. The Institute for Transportation and Development Policy also states that BRT projects, such as RapidRide, are catalysts for transit oriented development. This is supported by developer perceptions along BRT corridors in Boston and Ottawa as reported in the *TCRP Report 118*. Developers stated that BRT contributed to the station-area development market and improvements associated with BRT projects, such as sidewalks, was also key in influencing developer interest.

Although still early to develop a conclusive measurement for RapidRide, initial interviews with developers along the corridors and land use experts has indicated that RapidRide has had a beneficial impact on private development in host corridors by increasing property values and attracting different types of development that are consistent with transit oriented land uses. In the RapidRide C Line corridor, a West Seattle developer stated that this includes higher density mixed use and micro-housing projects. Developers have indicated that without the RapidRide line and the increased riders that it attracts and moves through the corridor, much of the higher density development activity would not occur.

Goal L. Increase Transit Ridership

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RapidRide Goal L is measured by ridership growth. This goal is fulfilled if ridership on RapidRide lines increases by 50 percent within 5 years of implementation. RapidRide A and C lines have achieved over 70 percent ridership growth, both before 5 years of implementation. RapidRide A Line carries an average of 10,000 weekday riders and RapidRide C Line carries an average of 8,100 weekday riders. RapidRide B, D, and F Lines have not yet reached 50 percent growth in ridership; however, RapidRide F Line was implemented in 2014, and B and D Lines have been operating for only 3 and 2 years, respectively. RapidRide F Line has the lowest average weekday ridership, with approximately 5,000 weekday riders. RapidRide B Line carries on average 6,700 weekday riders and the RapidRide D Line carries an average of 10,800 weekday riders. RapidRide E Line, which has the lowest increase in ridership of 20 percent, was also implemented in 2014. Although the E Line has the lowest increase in ridership, it carries the most average weekday riders, with 14,000 weekday riders. Combined, all of the RapidRide lines have seen a 43 percent increase in ridership since implementation. The combined average weekday ridership on RapidRide lines make up 14 percent of Metro's overall average weekday ridership.

Ridership Growth - YTD through September 2014 against Baseline

	Percent Growth
All Lines	43%
2010 (A Line)	81%
2011 (B Line)	33%
2012 (C Line)	74%
2012 (D Line)	41%
2014 (E Line)	20%
2014 (F Line)	33%

Legend: ■ All Lines ■ A Line ■ B Line ■ C Line ■ D Line ■ E Line ■ F Line
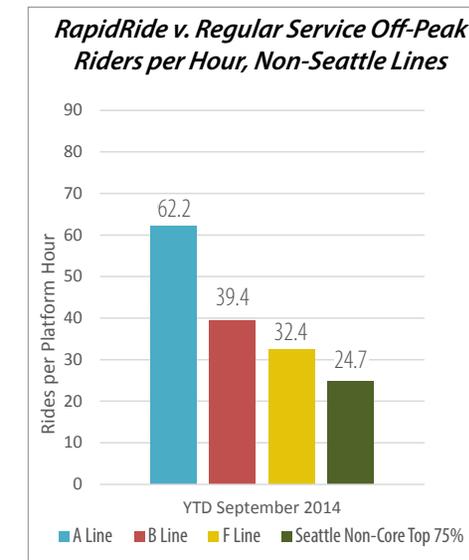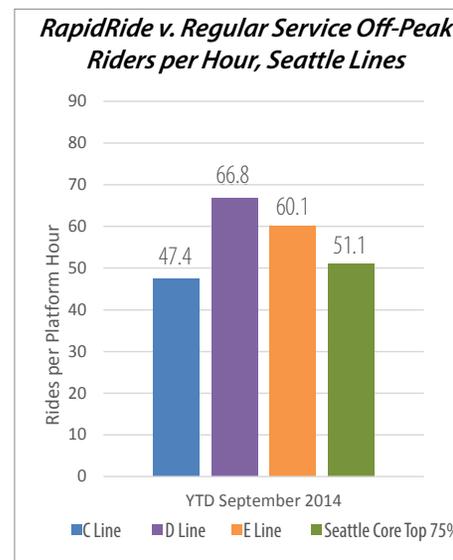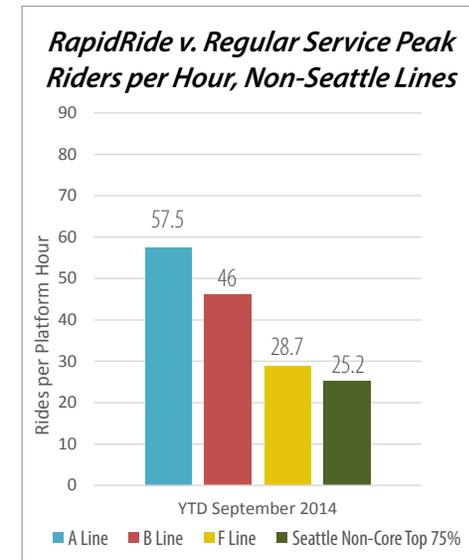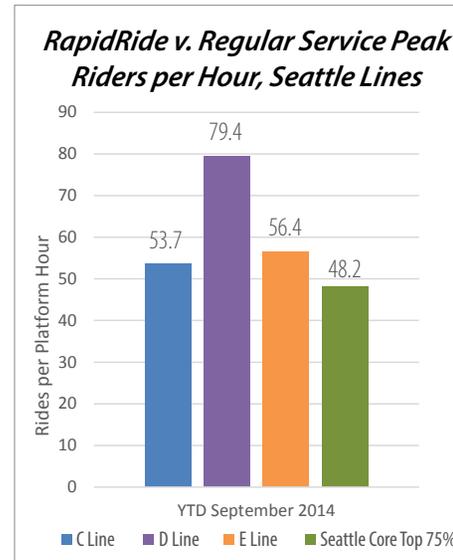
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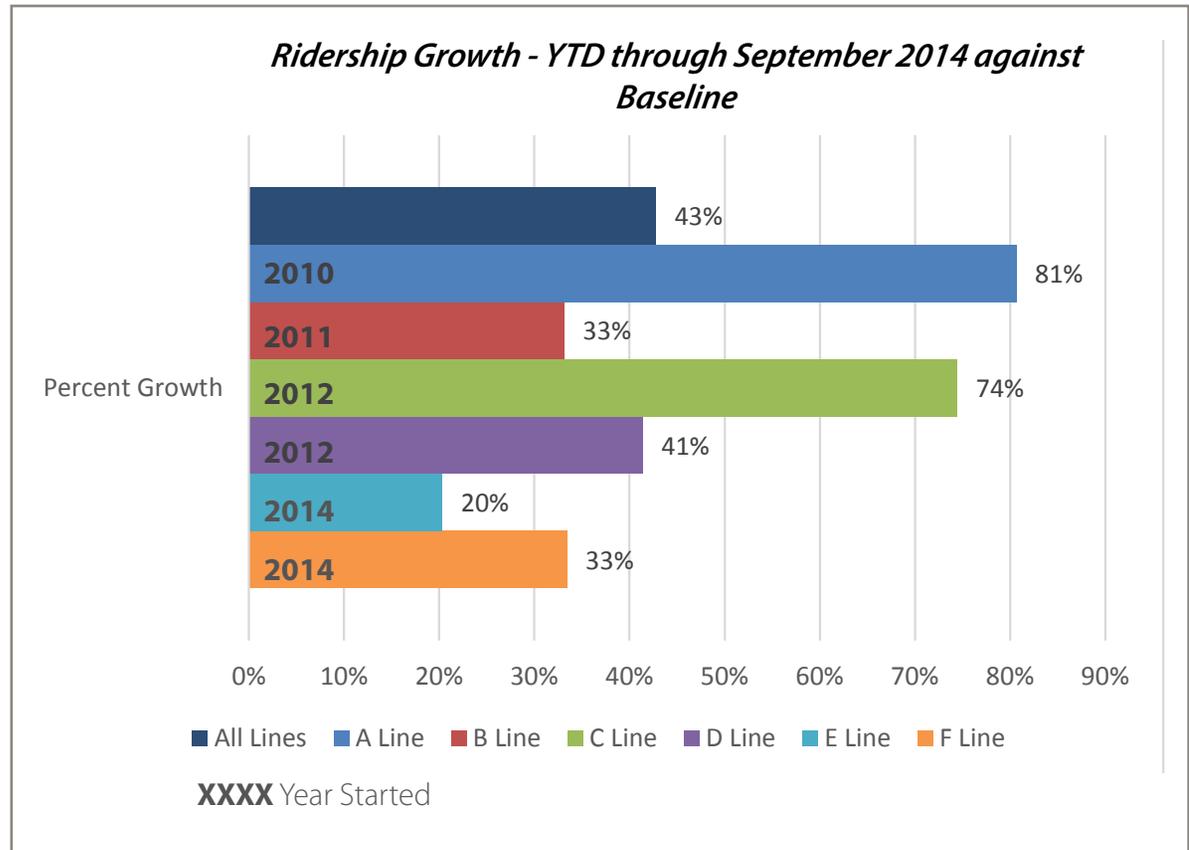
Source: Ridership Data, YTD through September 2014

Goal M. RapidRide will have higher number of riders per hour than the average number of riders per hour for other KC Metro service

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RapidRide Goal M is fulfilled if the number of riders per hour on RapidRide lines is higher than the number of riders per hour on regular Metro service. Regular Metro service data used for this performance metric includes the average riders per hour for the whole system, excluding RapidRide. Ridership data shows that there are between 53 and 80 riders per hour on RapidRide C, D, and E lines versus 48 riders per hour on similar non-RapidRide routes during peak service periods. On the non-Seattle RapidRide A, B, and F lines during peak service periods, there were between 28 and 58 riders per hour compared to 25 riders per hour on similar non-RapidRide routes. During off-peak period, there are between 47 and 67 riders per hour on the A, D, and E lines. On similar non-RapidRide routes, there are 51 riders per hour during the off-peak period. On the non-Seattle RapidRide A, B, and F lines during the off-peak service period, there were between 32 and 62 riders per hour compared to 25 riders per hour on similar non-RapidRide routes. During both the peak and off-peak periods, RapidRide serves more riders per hour on all lines, with the exception of the C Line during only the off-peak.

RapidRide v. Regular Service Peak Riders per Hour, Seattle Lines

C Line: 53.7	D Line: 79.4	E Line: 56.4	Seattle Core Top 75%: 48.2

YTD September 2014

RapidRide v. Regular Service Peak Riders per Hour, Non-Seattle Lines

A Line: 57.5	B Line: 46	F Line: 28.7	Seattle Non-Core Top 75%: 25.2

YTD September 2014

RapidRide v. Regular Service Off-Peak Riders per Hour, Seattle Lines

C Line: 47.4	D Line: 66.8	E Line: 60.1	Seattle Core Top 75%: 51.1

YTD September 2014

RapidRide v. Regular Service Off-Peak Riders per Hour, Non-Seattle Lines

A Line: 62.2	B Line: 39.4	F Line: 32.4	Seattle Non-Core Top 75%: 24.7

YTD September 2014

Source: APC Data YTD September 2014

COMPARISON TO OTHER NATIONAL BRT SERVICE

RapidRide is compared to the performance of other BRT systems in the US to provide an additional measure of RapidRide's performance. The BRT systems in Salt Lake City, Oakland, and Boston, known as MAX, Rapid, and the Silver Line, were chosen for this analysis. These systems were chosen for comparison because they have similar operating characteristics as RapidRide; each of the systems operates primarily in mixed use traffic on arterials with some dedicated lanes, have similar amounts of service, and use unique branding.

MAX

The Utah Transit Authority's (UTA) BRT service, called MAX, provides a connection between South Salt Lake, the 3300 South TRAX Station, and Magna. The MAX service runs for 3.5 miles in a dedicated guideway with stops approximately every half-mile on the 10.1 mile route. Buses operate in mixed traffic for the remaining portion of the route. Service is provided between 5:30 a.m. and 12:00 a.m. with 15 minute headways. MAX buses are specially branded and provide low-floor boarding through three doors. Riders can pay at stations before boarding the bus. According to a study done by the University of Utah, MAX service was valued higher by riders than other regular UTA bus service.

The Rapid

AC Transit's BRT service called Rapid operates between San Pablo and Oakland with stops in Richmond, El Cerrito, Albany, Berkeley, and Emeryville. The service operates daily between 6:00 a.m. and 7:00 p.m. on 12 minute headways. End to end travel time is between 50 and 67 minutes. The route is 14 miles long with 26 stops located at major intersections. Rapid buses are specially branded and provide low-floor boarding through three or four doors. Riders can pay at stations prior to boarding. Rapid operates in mixed traffic with stops every half mile. Surveys of Rapid users indicates that the BRT service is perceived to be better than other bus service provided by AC Transit.

Silver Line

The Boston Silver Line is a BRT service operated by the Massachusetts Bay Transportation Authority (MBTA), serving downtown Boston, Dudley Station, and the Logan Airport. The Silver Line has two phases of operations: Phase 1, which is a 2.2 mile route between Dudley Square and the Downtown Crossing, and Phase 2, which provides 12.9 miles of service in three different corridors for a total of 14.1 miles of BRT service with 29 stops. Phase 2 provides connections to Logan International Airport, the Boston Marine Industrial Park, and City Point. The Silver Line runs partially in mixed traffic, and partially in a dedicated lane and in a transit tunnel. Service is provided between 6:00 a.m. and 12:00 a.m. Monday through Saturday and 7:00 a.m. and 12:00 a.m. on Sundays. The Silver Line operates on 10 minute headways during peak travel periods and 15 minute headways during the off-peak. A customer survey concluded that 80 to 90 percent of riders were satisfied with Silver Line service.

Performance Summary

These systems have similar operating characteristics as RapidRide in terms of amount of service, mixed-use arterial operations, capital investments, and branding. The following service characteristics were compared between RapidRide and the other BRT services to measure performance:
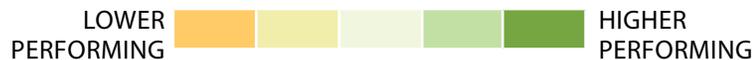
- Weekday Ridership
- Ridership Increase
- Peak Period Headways
- Travel Time Reduction
- Real Time Information
- Vehicle Propulsion

RapidRide, when compared to similar national BRT systems, performs well. RapidRide had higher increases in ridership than comparable BRT systems, with between 20 and 81 percent ridership growth for the six RapidRide lines. Weekday ridership on RapidRide lines was higher when compared to MAX and the Rapid. RapidRide also had some of the most frequent service with 10 minute headways during peak ridership periods. Rapid and MAX both had higher travel time reductions than RapidRide with reductions between 15 and 21 percent. All of the BRT systems, including RapidRide used special branding and a new fleet of vehicles with low floor, multiple door loading. This helps to attract riders and promote BRT as an enhanced service.

Table 3. Comparison of RapidRide to other BRT Systems

	Ridership	Ridership Increase	Peak Headways (minutes)	Travel Time Reduction	Real Time Information	Vehicle Propulsion
RapidRide A	10,000	81%	10	12% - +1%	Yes	Hybrid Diesel Electric
RapidRide B	6,750	33%	10	3% - 13%	Yes	Hybrid Diesel Electric
RapidRide C	8,100	74%	10	9% - 19%	Yes	Hybrid Diesel Electric
RapidRide D	10,800	41%	10	5% - 12%	Yes	Hybrid Diesel Electric
RapidRide E	14,100	20%	10	3% - 9%	Yes	Hybrid Diesel Electric
RapidRide F	5,000	33%	10	NA	Yes	Hybrid Diesel Electric
MAX	4,400	33%	15	15%	No	Diesel
Rapid	6,050	8.5%	12	17% - 21%	Yes	Hybrid Fuel Cell
Silver Line	29,000	24-98%	10	0%	Yes	Hybrid Diesel Electric

KEY TO RANKING

LOWER PERFORMING ▢▢▢▢▢ HIGHER PERFORMING

COST EFFECTIVENESS OF CAPITAL EXPENDITURES

Metro has made several capital investments in infrastructure and technology that are unique to the RapidRide system. These investments allow RapidRide to achieve various program goals, such as recognition as an enhanced service, faster travel times, reliable service, and better comfort and ease of use.

> *RapidRide capital expenditures help achieve the program goals.*

Methodology

The cost effectiveness of capital expenditures was evaluated based on how well they allow RapidRide to achieve the program goals. Capital expenditure data was collected from King County Metro and then compared against program goal performance to evaluate cost effectiveness. Cost effectiveness performance was then rated on a scale of 1 (low performing) to 5 (high performing). Shaded circles identify how each capital expenditure was rated for cost effectiveness.

A description of how each capital expenditure was evaluated is included in this section.

Cost Effectiveness Performance Summary

The various capital investments included in the RapidRide program are performing well on cost effectiveness. The investment in off-board fare payment equipment is performing the best on cost effectiveness. This is primarily because the total investment in off-board fare equipment is low while the impact of this element in achieving the RapidRide program goals is high. With the off-board fare payment equipment, RapidRide travel times

and service reliability are improved. This capital expenditure also allows RapidRide to be recognized as an enhanced service and to be comfortable, pleasant, and easy to use.

Table 4. Cost Effectiveness Summary

1. Transit Signal Priority, Signal Timing, ITS Infrastructure	●●●●○
2. Real Time Infrastructure	●●●●○
3. Off-Board Fare Payment Equipment	●●●●◐
4. Passenger Facilities	●●●◐○
5. Unique Fleet of Coaches	●●●●○
6. Roadway Improvements	●●●●○

Expenditures in passenger facilities were rated the lowest compared to the other capital investments, but are still performing adequately on cost effectiveness. Passenger facilities had lower satisfaction ratings for nighttime safety, weather protection and seating. RapidRide facilities were designed to be more open and bright to increase visibility within and around the shelter, which required a trade-off with protection from the weather for increased safety. Because there are still concerns with nighttime safety, passenger facilities were rated lower in cost effectiveness.

A full cost-benefit analysis of RapidRide capital expenditures is a complex process. The primary goal of the program capital expenditures is to improve speed and reliability and to allow RapidRide to stand out as an enhanced service. The cost effectiveness evaluation included in this report indicates that the speed and reliability improvements on the A through D lines have been successful and that RapidRide stands out as an enhanced service.

# 1. Transit Signal Priority, Signal Timing, and ITS Infrastructure

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Transit Signal Priority (TSP), signal timing and Intelligent Transportation System (ITS) infrastructure help the RapidRide system achieve faster bus travel times compared to pre-RapidRide routes (Goal C) as well as more reliable service (Goal D). Cost data for TSP, signal timing, and ITS infrastructure was provided for the A, B, C, and D lines.

TSP reduces the amount of delay buses experience at intersections by giving RapidRide buses priority at signals. Along RapidRide corridors, TSP provides green light extensions and early green lights for buses. On the A, B, C, and D lines, Metro invested between $180,000 to $890,000 per line to install TSP on a total of 157 intersections.

Signal timing investments along RapidRide corridors included implementation of a traffic-responsive signal timing system, which selects different coordinated timing plans depending on traffic conditions. This system improves travel times by providing better coordination of traffic signals and signal timing that is compatible with current traffic conditions to allow RapidRide buses to travel more efficiently through corridors. Metro invested between $63,000 to $340,000 per line on signal timing along the A, B, C, and D line corridors.

ITS infrastructure includes the fiber optic network that is used to operate TSP, ORCA readers and real time signage. The cost per line to install TSP infrastructure on the A, B, C, and D lines was between $700,000 and $2.3 million.

On the A, B, C, and D lines, travel time reductions of up to 19 percent have been achieved when compared to the pre-RapidRide routes. A travel time reduction of between 10 to 30 percent is desired to fulfill Goal C of the RapidRide program. As shown on page 9, the A, B, C and D lines have
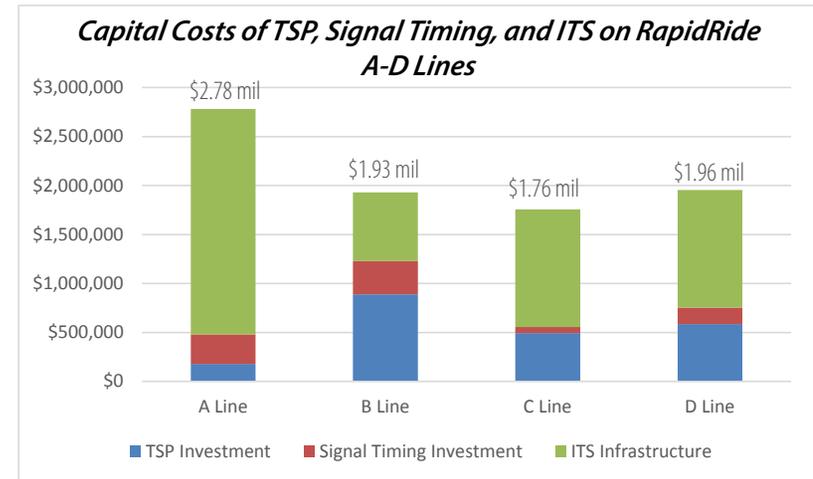
Capital Costs of TSP, Signal Timing, and ITS on RapidRide A-D Lines

met or nearly met the desired travel time reductions in many of the peak directions measured. The C Line experienced the highest reductions in travel time.

Capital expenditures in TSP, ITS infrastructure, and signal timing are also allowing RapidRide to achieve satisfactory average headway adherence rates. The A, B, C, and D lines have average headway adherence rates of between 81 and 87 percent over the past two years. The RapidRide program goal for headway adherence is met if RapidRide lines are adhering to the schedule at least 80 percent of the time. Each of the A, B, C and D lines are currently achieving Goal D.

The existing investments in TSP, ITS infrastructure, and signal timing have allowed RapidRide to achieve Goal D and partially achieve Goal C. ITS infrastructure, TSP, and signal timing make up approximately 9 percent of the total capital expenditure budget on the A though D lines.
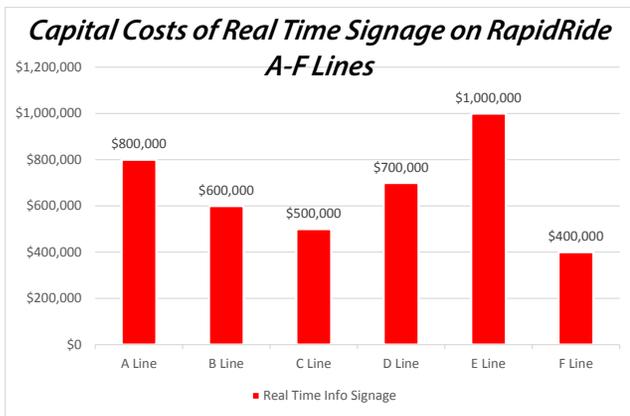
2. Real Time Infrastructure

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Real time infrastructure provides riders with information on when the next bus will be arriving at a station. This infrastructure includes real time signage that is installed at RapidRide stations, or just under 50 percent of all stops. Real time infrastructure allows RapidRide to achieve recognition as an enhanced service (Goal A); to be comfortable, pleasant, and easy to use (Goal E); and to integrate with other Metro bus routes (Goal G).

The capital expenditure for real time infrastructure on the A through F lines is between $400,000 and $1 million per line. System-wide, there are 133 real time signs at a total cost of $4 million.

The real time signage also helps the RapidRide system to integrate with other Metro bus routes. The real time signage installed provides arrival information on other Metro routes that serve the same station. The customer surveys indicate that between 60 and 66 percent of riders use the real time information signs at stations for trip information. Use of real time information signs for trip information is used more heavily than other trip information resources, such as the OneBusAway app, the Metro Transit web page, and the printed timetables.

The investments in real time infrastructure have helped the RapidRide system to be recognized as an enhanced service, and to be comfortable, pleasant, and easy to use. The real time infrastructure also helps RapidRide to fulfill Goal G of integrating with other Metro bus routes. The total cost for real time infrastructure is approximately 2 percent of the total capital expenditure budget.

Capital Costs of Real Time Signage on RapidRide A-F Lines

Real time signage is implemented as part of the system at RapidRide stations. The real time signage allows RapidRide to stand out as an enhanced service. As reported in the *BRT Standard,* passenger satisfaction is linked to knowing when the next bus will arrive. Data included in the Metro Customer Surveys indicated that 69 to 82 percent of riders were satisfied with the information provided on the real time signage. Real time signage also improves the ease of use of the RapidRide system by providing riders with more information. Responses to the surveys indicate that riders are satisfied with the comfort and ease of use of the RapidRide system.
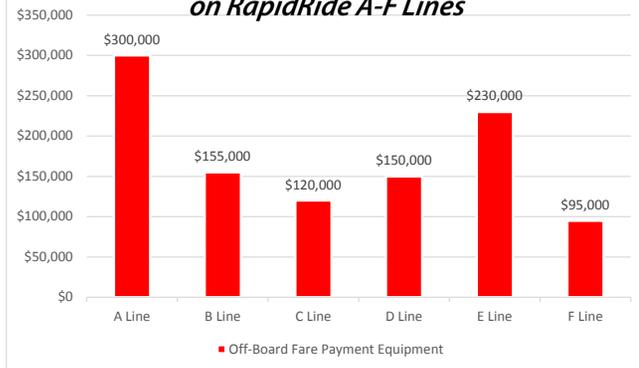
3. Off-Board Fare Payment Equipment

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Off-board fare payment equipment installed at RapidRide stations helps the RapidRide system achieve faster bus travel times (Goal C), provide reliable service (Goal D), be recognized as an enhanced service (Goal A), and be comfortable, pleasant, and easy to use (Goal E).

Metro invested between $95,000 and $300,000 on the six different RapidRide lines in off-board fare payment equipment, or ORCA readers. These readers allow customers using smart card payment forms, or ORCA cards, to pay before entering the bus. There are 131 ORCA readers system-wide at a total cost of $1.05 million.

Capital Costs of Off-Board Fare Payment Equipment on RapidRide A-F Lines

A bar chart showing capital costs: A Line $300,000; B Line $155,000; C Line $120,000; D Line $150,000; E Line $230,000; F Line $95,000. Y-axis ranges from $0 to $350,000. Legend: Off-Board Fare Payment Equipment.

Off-board fare payment equipment helps achieve faster bus travel times by decreasing the dwell time at stations. Buses are able to load more quickly because riders have paid prior to the bus arriving and can also enter through any door. A study of the impacts of installing ORCA readers at stations in downtown Seattle concluded that between 8 to 25 percent of riders board through the middle door and between 10 and 50 percent of riders board through the back door, depending on the number of passengers boarding. The rates for passengers boarding through the middle and back doors were 5 to 25 percent higher at stations with ORCA readers than for stations without them. It is likely that as riders become more comfortable with off-board fare payment, the percentage of passengers that board via the middle and back doors will increase, which will further decrease dwell times. Off-board fare payment is estimated to decrease dwell times by approximately 1 to 4 seconds per boarding as reported in the TCRP Report 100.

RapidRide service reliability is also improved by investing in off-board fare payment equipment. Similarly to faster bus travel times, schedule reliability is improved by decreasing stop dwell time.

Off-board fare payment equipment is another element unique to RapidRide service that allows it to be recognized as an enhanced service, and to be comfortable, pleasant, and easy to use. Off-board fare payment equipment allows RapidRide service to be viewed similarly to rail service in the region, such as Link light rail, which also provides off-board fare payment. All door loading also makes riding RapidRide easier.

The investments in off-board fare payment equipment have allowed RapidRide to achieve Goal D and Goal A, and to partially achieve Goal C. Off-board fare payment equipment make up less than 1 percent of the total capital expenditure budget for RapidRide, making it an effective investment because of the benefits associated with the costs.

4. Passenger Facilities

The passenger facilities unique to the RapidRide system include branded shelters with additional seating and lighting compared to standard Metro passenger facilities. The investment in RapidRide passenger facilities helps the service be recognized as an enhanced service (Goal A), be pleasant, comfortable, and easy to use (Goal E), and to be safe and secure on and off the bus (Goal F).

Capital Costs of Passenger Facilities on RapidRide A-F Lines

Metro invested between $3.2 and $7.6 million per line on the A through F lines for passenger facilities. System-wide development of facilities cost $2.6 million. In total, Metro invested $35 million for RapidRide passenger facilities for the entire system.

The unique passenger facilities allow RapidRide to stand out from other Metro service. The RapidRide passenger facilities carry the unique branding throughout the corridor and establish a presence during the day and night. These characteristics make RapidRide more appealing to riders. The unique branding also allows riders to easily locate where RapidRide serves.

The unique passenger facilities allow the RapidRide system to be comfortable and easy to use by providing shelter from the weather, seating, and lighting for riders who are waiting for the bus. RapidRide facilities were designed to be more open and bright to increase visibility within and around the shelter. This required a trade-off with protection from the weather for increased safety. Between 61 and 74 percent of riders were satisfied with the amount of lighting provided, and 50 to 63 percent of riders were satisfied with the amount of seating at RapidRide stops. Responses to the customer surveys indicated that between 46 and 55 percent of riders were satisfied with the protection from weather provided at RapidRide A through E line stops. The lower satisfaction rating is consistent with the trade-off required for safety enhancements at stops. However, responses to the customer surveys indicate that more than 70 percent of riders felt that RapidRide stops were better than their previous route. This indicates that although riders still want more weather protection, they recognize RapidRide passenger facilities as an improvement over other Metro passenger facilities.

Passenger facilities should also be safe and secure for riders. On the A through E lines, between 70 and 88 percent of riders who responded to the customer surveys stated that they were satisfied with how safe they felt while waiting at bus stops during the day. The satisfaction of riders waiting for the bus during the night dropped from the daytime satisfaction rate to between 42 and 64 percent satisfaction with safety.

The capital expenditure for passenger facilities made up approximately 18 percent of the total RapidRide capital budget. Satisfaction rates with weather protection and seating at RapidRide stops was lower compared to other passenger facility elements, indicating that the investment in passenger facilities could be more effective in making the service more pleasant, comfortable and easy to use. Satisfaction with the perception of daytime safety at stops was good; however, satisfaction with safety while waiting at stops dropped during the evening.

Standard RapidRide Stop
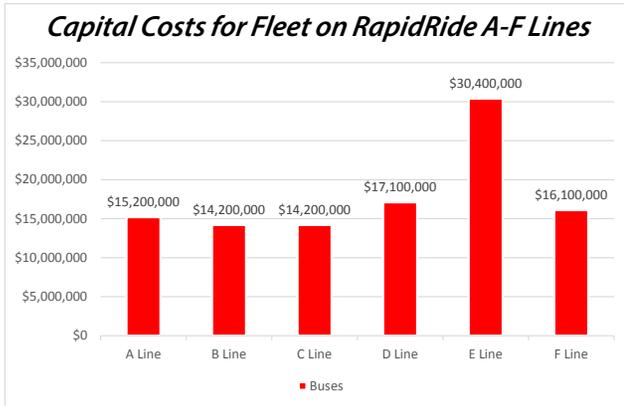
RapidRide Station

Enhanced RapidRide Stop

RapidRide Station at Night

5. Unique Fleet of Coaches

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A unique fleet of coaches helps RapidRide be recognized as an enhanced service (Goal A) and be comfortable, pleasant, and easy to use (Goal E). RapidRide buses are branded with a unique red, black and yellow livery, a modified interior seating arrangement to enable easy loading and unloading and more comfortable standing capacity, and have three doors with low floor boarding. RapidRide buses also provide free Wi-Fi, audible stop announcements and security cameras.

The unique fleet also improves ease of use of the system. The unique branding allows riders to easily locate information about RapidRide, such as routing and the location of served stops. Responses to the customer surveys state that between 74 and 85 percent of riders feel that RapidRide is better than other Metro service in terms of the overall transit experience.

Riders also indicated that they were satisfied with other elements of the fleet. The mean score for overall satisfaction with things about the bus was between 3.7 and 4.2 out of 5. Between all of the RapidRide lines, riders were most satisfied with having enough bars/straps to hang onto while standing. Although the cost per bus for RapidRide is more expensive than for buses used for regular Metro service, the benefits achieved by this investment make it a cost effective expenditure.

Capital Costs for Fleet on RapidRide A-F Lines

Line	Buses
A Line	$15,200,000
B Line	$14,200,000
C Line	$14,200,000
D Line	$17,100,000
E Line	$30,400,000
F Line	$16,100,000

Metro invested between $14.2 million to $30.4 million on the A through F lines for the fleet of coaches. In total, Metro invested $107.2 million for the entire RapidRide fleet of 113 buses. RapidRide coaches cost between $25,000 to $47,000 more per bus than the comparable 60 foot coaches used for regular Metro service. This is approximately $3.3 million in additional capital costs for fleet elements that are unique to RapidRide coaches.

A fleet of coaches unique to RapidRide allows the system to stand out from the rest of the Metro routes. The RapidRide buses are easier to board, attractive and environmentally friendly. These characteristics make RapidRide more appealing to riders. Buses are a key element in allowing RapidRide to stand out because they are one of the higher visibility elements of the system.

The existing investments in a unique fleet have helped RapidRide to achieve Goal A and Goal E. However, many riders indicated that they were not as satisfied with being able to find a seat on the bus. The RapidRide buses provide less seats than other Metro buses to accommodate additional doors and to make loading and unloading easier. This is a common trade-off associated with buses used for BRT service. Trends in satisfaction with being able to find a seat have decreased over time as RapidRide ridership is increasing. This indicates that the service is increasing in productivity even though satisfaction with seating may be going down. The unique fleet of vehicles makes up 56 percent of the total capital expenditure budget for RapidRide.

Exterior of RapidRide Bus

Interior of RapidRide Bus

6. Roadway Improvements

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Roadway improvements are an important element of RapidRide service that allow travel times to be faster (Goal C), service to be reliable (Goal D), and for RapidRide to be recognizable as an enhanced service (Goal A). Roadway improvements along the RapidRide corridors include BAT lanes, curb bulbs and roadway channelization.

Metro invested between $56,000 and $2.1 million between the A and D lines on BAT lanes, curb bulbs and roadway channelization for a total capital expenditure of $2.68 million.

BAT lanes improve RapidRide travel times and schedule reliability by allowing buses to be separated from general purpose traffic. During periods of congestion, this can have a substantial impact on bus travel times and headway adherence by allowing them to avoid stop-and-go traffic. Bus travel times in the A through D line corridors have been reduced by up to 19 percent when compared to the pre-RapidRide routes. The A, B, C and D lines have met or nearly met the desired travel time reductions in many of the peak directions measured, as shown on page 9. The C Line experienced the highest reductions in travel time. This corridor also had the highest capital expenditure for roadway improvements of $2.1 million. BAT lanes also improve schedule reliability by reducing the unpredictability of travel during congested times. Schedule adherence on each of the RapidRide lines is good, with an average adherence rate of between 81 and 87 percent on the A through D corridors.

Curb bulbs improve travel times and schedule reliability by allowing buses to serve stops without leaving the traffic lane. This reduces the amount of delay a bus experiences when trying to pull back into traffic after serving a stop.

Separated travel lanes, including BAT lanes, are also a key element of BRT service that allows it to be different from other regular bus transit service. Separated travel lanes, especially in congested areas, are vital in ensuring fast operations for BRT services, which allows RapidRide to stand out compared to other Metro service.

Metro's investments in roadway improvements, which made up 3 percent of the total capital budget on the A through D lines, have helped RapidRide to achieve Goal A and Goal D, and to partially achieve Goal C. The roadway improvements allow RapidRide to stand out as an enhanced service and to be reliable. There have been reductions in travel times on the A through D lines where speed and reliability improvements such as BAT lanes and curb bulbs have been implemented, but reductions on all of the lines in all of the peak directions have not been to the desired level.

Capital Costs of Roadway Improvements on RapidRide A-D Lines
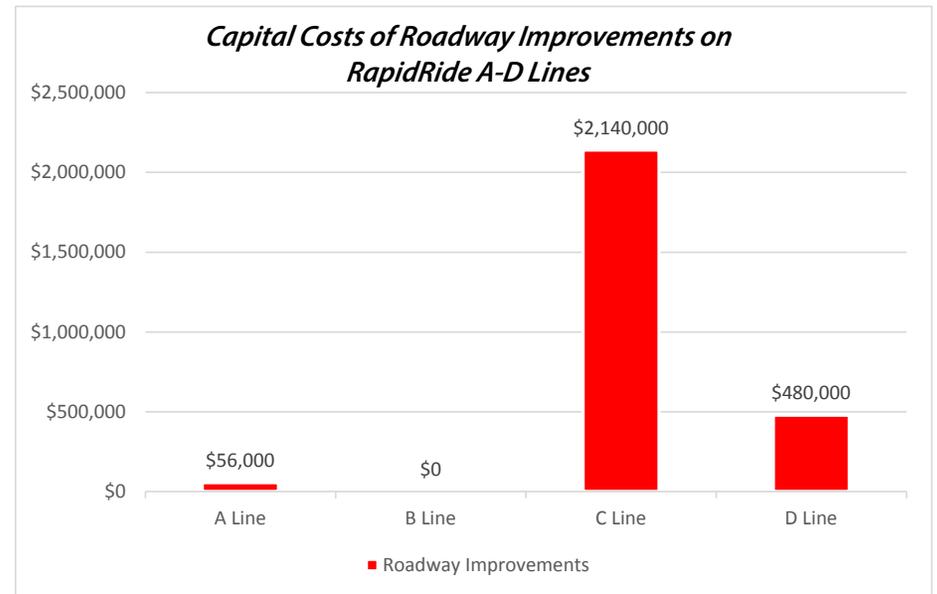
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COST EFFECTIVENESS OF OPERATING COSTS

The cost effectiveness of operating costs for RapidRide was evaluated by comparing the operational costs of the RapidRide A through D lines in 2013 to the 2013 operational costs of the overall Metro system.

Methodology

Data for operational costs was collected from King County Metro. The data included operational costs for the total Metro system and operational costs for RapidRide A through D line service only for 2013. Cost effectiveness performance was then rated on a scale of 1 (low performing) to 5 (high performing). Shaded circles identify how each capital expenditure was rated for cost effectiveness.
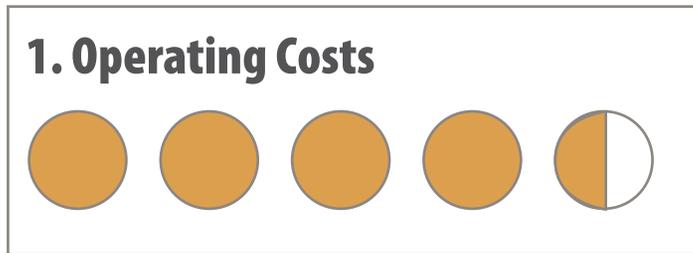

Cost Effectiveness Summary

The operating cost for the RapidRide program performs well on cost effectiveness. The total cost to operate the RapidRide A through D lines was 7 percent of the total Metro system-wide operating budget. In 2013, the RapidRide A through D lines accommodated 9 percent of total Metro ridership at 21 percent less operating cost per rider compared to regular Metro service.

In 2013, the RapidRide A-D lines accommodated 9 percent of total Metro ridership at 21 percent less operating cost per rider compared to regular Metro service.

Table 5. Cost Effectiveness Summary

1. Operating Costs

1. Operating Costs

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The 2013 annual operating cost for the total Metro system, including the RapidRide A through D lines, was $501.7 million. This included a total of 3.6 million service hours and 117.9 million riders. The cost per rider system-wide was $4.26.

On the RapidRide A through D lines, the 2013 annual operating cost was $33.9 million, which was approximately 7 percent of the system-wide operating cost. The cost per rider in 2013 on RapidRide A through D lines was $3.37.

There were a number of RapidRide-exclusive operating costs for service elements that totaled $927,485 in 2013:

- Fare Enforcement: $806,735

- RapidRide Coordinator in Control Center: $111,100

- Miscellaneous facility maintenance: $6,850

- Wi-Fi: $2,800

The cost for RapidRide extras was equal to 3 percent of the total RapidRide operating costs. Even with the additional RapidRide operating costs, the increase in ridership attracted by the system has lowered the cost per rider to less than the system average.

The RapidRide cost per rider of $3.37 was 21 percent less than for the cost per rider for regular Metro service of $4.26. In 2013, there were 10.06 million annual riders on the RapidRide A through D lines, which was 9 percent of the total Metro system riders.

RapidRide is performing well on cost effectiveness for operational costs because RapidRide ridership makes up almost ten percent of the overall system ridership while being 21 percent cheaper to operate per rider.

2013 Cost Per Rider

### 2013 Annual Operating Costs

Total: $501.7
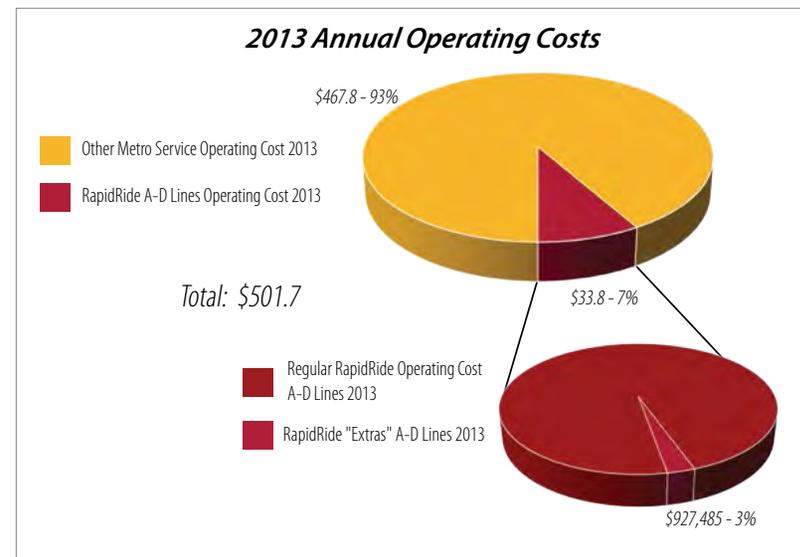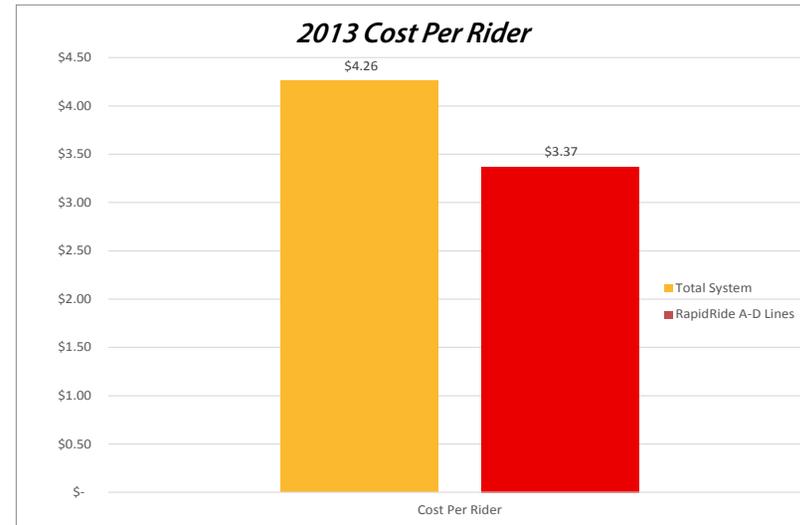
PARAMETERS FOR FUTURE EXPANSION

This section of the report describes the critical BRT system elements and the recommended approach for selecting and prioritizing corridors for future expansion of RapidRide. Metro should use the following set of parameters and guidelines in implementing future RapidRide lines.

BRT System Elements

There are several critical elements needed for a successful BRT system. BRT is intended to provide high passenger capacity and faster operations than traditional bus routes. BRT systems include a unique fleet of vehicles, and corridor and system capital investments, such as TSP and improved passenger facilities, to provide transit service that is more similar to rail transit. The following system elements are critical for BRT service in King County:

– **Frequent Service:** During the AM and PM peak periods, service should operate on 10 minute headways or less. During the midday, headways of 15 minutes or less should be maintained. Frequent service will enhance convenience by allowing passengers to use the service without needing a schedule.

– **Longer Stop Distance:** The average distance between BRT stops should be longer than for regular Metro service. The exact stop spacing will vary depending on demand unique to each corridor but 1/2-mile spacing is recommended. Longer stop spacing will allow service to be faster and more reliable.

– **Distinctive Branding:** Future RapidRide lines and facilities should also have the same distinctive branding used on existing lines. This allows the service to be identifiable and to stand out from other Metro service.

BRT SYSTEM ELEMENTS
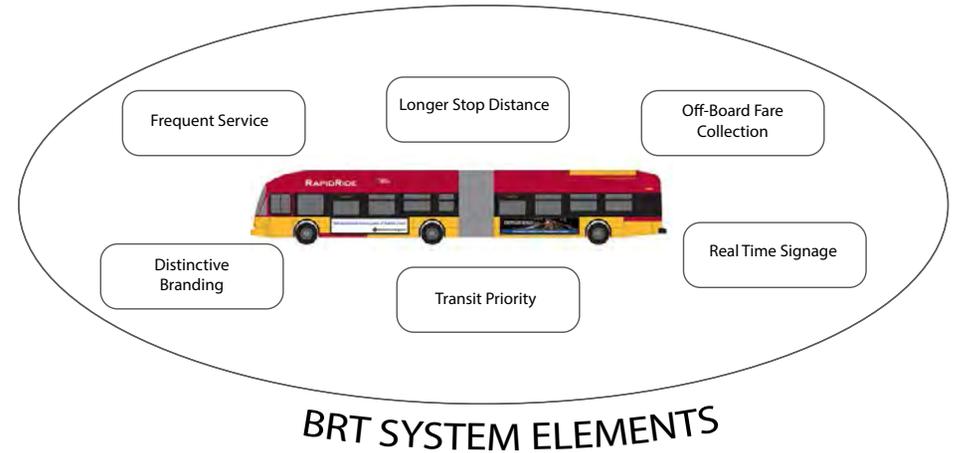
– **Transit Priority:** BRT service should include physical improvements to host corridors and operational elements to allow buses to run more quickly and reliably than existing service. This should include a combination of transit signal priority at intersections, optimized signal timing, BAT lanes, and parking removal.

– **Off-board Fare Collection:** BRT service should include off-board fare payment, or ORCA readers, at most stops and stations to allow faster travel times and more reliable service by reducing boarding and alighting times.

– **Real Time Signage:** Real time signage should be provided at most RapidRide stops and stations to provide passengers with improved route information and to make the service identifiable and easy to use.

Corridor Evaluation Parameters

The parameters summarized in this section should be used as a framework for evaluating and prioritizing corridors for future RapidRide expansion.

Existing Ridership

Corridors with an existing minimum ridership of 3,000-5,000 average weekday riders will likely be able to support BRT service.

Existing Population Density

Corridors with high population density, or more than 1,500-3,000 households, within a half mile have the potential to provide high-ridership demand.

Existing Employment Density

High employment density within a half mile of a corridor, 50-75 employees per acre or more, is another indicator of the potential for a BRT-supportive demand market.

Urban Centers and Transfer Points Served

Corridors with urban centers, activity centers and transit hubs can provide increased connections for riders and can be strong producers/attractors of ridership.

Existing Transit Improvements

Corridors with existing or planned transit improvements such as BAT lanes and TSP have the ability to support faster bus operations and can lower the cost for implementing BRT service (15-30 percent of corridor or more).

Table 6. Corridor Evaluation Parameters

Parameter	Measurement
Ridership Potential	
Existing Ridership	Most Current Weekday Boardings on Existing Routes
Existing Population Density	Households within a 1/2 mile
Existing Employment Density	Jobs within a 1/2 mile
Connectivity	
Urban Centers Served	PSRC urban centers and King County activity centers within 1/2 mile
Transfer points served	Major transfer points and hubs within 1/2 mile
Bus Speed and Reliability	
Existing Transit Improvements	Miles of BAT lanes in corridor; Intersections with TSP in corridor
ROW Capacity	Miles of corridor where a lane could be converted to BAT lane
Compatibility with Higher Speeds	Miles of corridor on arterials or freeways
Financial	
Farebox Recovery	Existing farebox recovery in corridor
Integration	
Integration with other HCT service	Presence of current or planned regional bus, commuter rail or light rail services

ROW Capacity

Corridors with narrow ROW on 30-50 percent or more of the corridor have a lowered capacity to accommodate speed and reliability improvement such as transit only lanes.

Compatibility with Higher Speeds

Corridors that are primarily (40-50 percent of corridor or more) arterials or freeways are better suited for faster bus operations.

Farebox Recovery

Corridors that currently have good farebox recovery (20-25 percent or better) indicate cost effective corridors that have the potential to support BRT.

Integration with other HCT service

Corridors that have current or planned regional high capacity transit, such as express bus, commuter rail, or light rail, can be integrated with BRT service to develop and support a larger ridership market.

Cost Benefit of Expanding RapidRide

The increased frequency and reduced travel times associated with BRT systems such as RapidRide make it similar to light rail transit service. This type of service operation allows BRT to attract additional riders to the system compared to other bus transit service while allowing lower operating costs when certain ridership levels are present. However, implementing a new service can be more expensive in the short term than adding frequency to existing routes. This section includes a description of the benefits and costs associated with implementing new BRT service and a framework for deciding when new service is more cost effective to implement than adding frequency to the existing network.

BRT System Benefits

Case studies included in the *TCRP Report 118* identified a series of trends associated with BRT that make it a cost effective and attractive transit option:

– As BRT development costs increase, there is a consistent reduction in travel times and a growth in BRT ridership.

– Faster travel times reduce operating costs for any given bus volume.

– BRT systems with exclusive right-of-way and wider station spacing have the greatest gains in speeds and ridership, but also the greatest investment costs.

– BRT systems with lower-cost investments (i.e., mixed-traffic bus lanes and/or TSP) have the smallest time savings and ridership gains.

– Travel time savings appear to be the greatest contributor to BRT ridership gains, followed by the provision of special BRT features.

There are clear benefits for providing BRT compared to simply adding frequency to existing routes. BRT has a greater ability to attract new riders, as has been evidenced on RapidRide. Survey respondents indicated that 15 to 20 percent of riders would have otherwise driven alone to make their trip if RapidRide was not available. Trends on the customer surveys have also shown that the drive alone conversion rate has been increasing over time, indicating that the impact of RapidRide on mode shift will likely continue to increase. The high ridership increase of between 20 and 81 percent that has been experienced on RapidRide, as shown in Table 3, is partly due to the ability for the system to convert drive alone trips to transit trips as well as the service restructuring that occurred when lines were implemented.

The system elements of RapidRide discussed earlier in this section allow RapidRide to attract more riders to the system. As evidenced in the responses to the customer surveys, riders were more satisfied with RapidRide when compared to their previous routes. Riders were more satisfied with essential BRT elements of RapidRide when compared to other Metro service, including service frequency, schedule reliability, and

RapidRide passenger facilities. Over 70 percent of riders also reported that the overall transit experience on RapidRide is better than other Metro service. This indicates that the additional costs associated with RapidRide are an effective investment to provide a better transit experience and attract additional riders to the system when compared to other Metro service.

BRT service can also have an impact on land development in a corridor. Case studies have shown that over several decades, BRT service can have the following positive effects on development:

– Increase property values along BRT corridors;

– Generate new investment within proximity to BRT corridors;

Growth in investment along a corridor can have a positive influence on ridership markets and can encourage increased population densities along the corridor. Over longer periods of time, this can help make the service more cost effective by increasing ridership demand within the corridor.
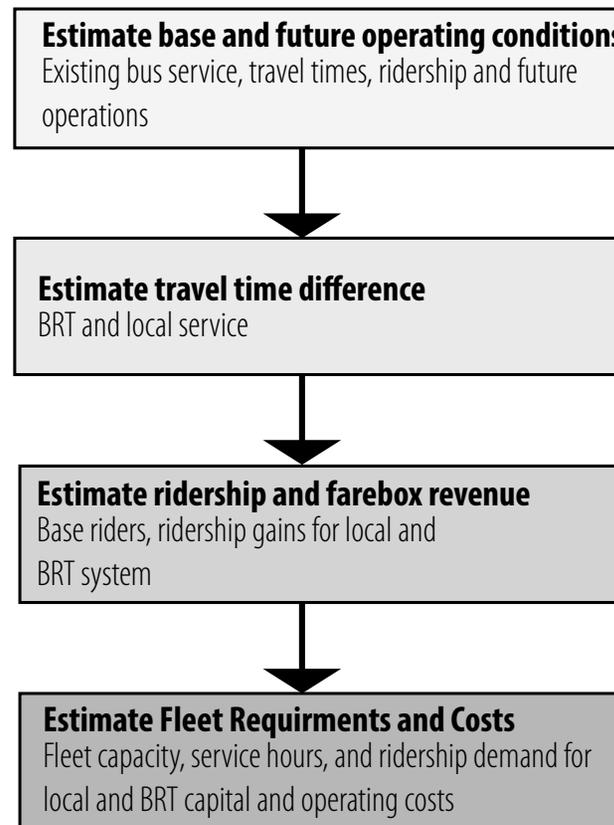
Comparative Cost Benefit Evaluation

The various costs and benefits (i.e. ridership and increased farebox revenue) of a proposed BRT line and local bus route in the same corridor can be analyzed using the flow chart shown in Figure A. For this illustration, benefits are assumed to primarily be from increased ridership and farebox revenue. There are other benefits of BRT, such as:

– Improved public perception and support of the transit agency;

– Overall better transit experience for customers;

– Increased investment and land development in BRT corridors; and
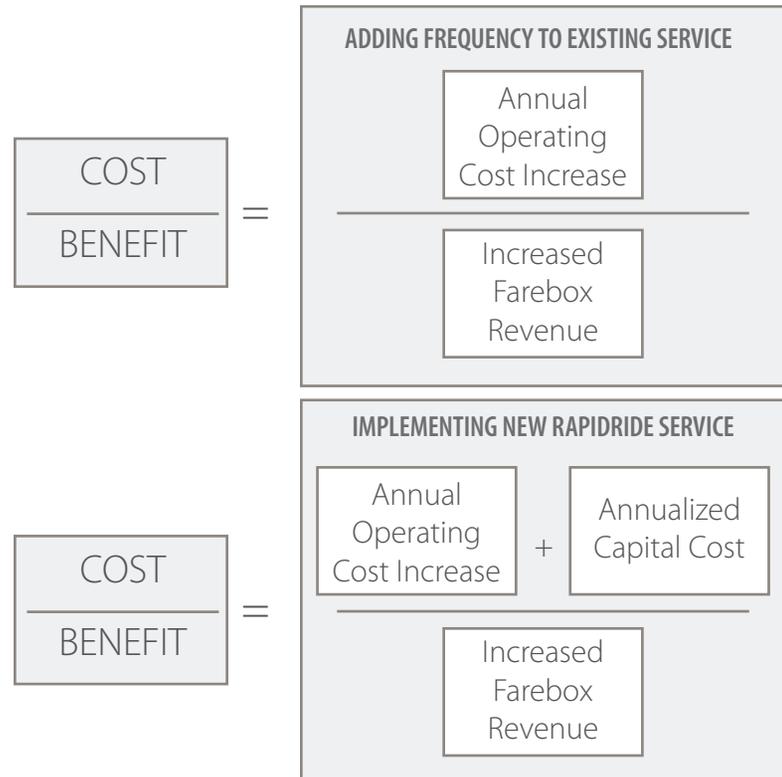
– Lower environmental footprint

The costs associated with BRT are typically greater than adding frequency to existing routes, but the benefits that can be achieved are much greater. After ridership, farebox revenue, and costs have been estimated, a comparison between expanded versus new service can be completed using the framework shown in Figure B on the following page.

Figure A. Cost Benefit Analysis Steps

Estimate base and future operating conditions
Existing bus service, travel times, ridership and future operations

↓

Estimate travel time difference
BRT and local service

↓

Estimate ridership and farebox revenue
Base riders, ridership gains for local and BRT system

↓

Estimate Fleet Requirments and Costs
Fleet capacity, service hours, and ridership demand for local and BRT capital and operating costs

Because there is a large capital facility cost associated with implementing a new RapidRide line, the amount of ridership that can be achieved is the primary factor an agency should take into account when deciding whether to add frequency to existing routes or to implement new BRT service. The large capital investment is typically more cost effective than adding frequency to existing service when the ridership that can be achieved on a new BRT line is 50 percent greater than the ridership that can be achieved by adding frequency to an existing route. This results in higher farebox revenue recovery needed to outweigh the capital cost associated with introducing new RapidRide service.

Figure B. Cost/Benefit Comparison of Expanded Local Service vs New BRT Service

ADDING FREQUENCY TO EXISTING SERVICE

$$\frac{COST}{BENEFIT} = \frac{\text{Annual Operating Cost Increase}}{\text{Increased Farebox Revenue}}$$

IMPLEMENTING NEW RAPIDRIDE SERVICE

$$\frac{COST}{BENEFIT} = \frac{\text{Annual Operating Cost Increase} + \text{Annualized Capital Cost}}{\text{Increased Farebox Revenue}}$$

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