

REX Line Service Evaluation

Final Recommendations

April 2016



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1. Introduction

Outlined in this document are the proposed final service and physical improvement recommendations for the REX Line Service Evaluation Study. The source of these recommendations is the Project's "Transit Service Assessment", the project's "Traffic Operations Assessment", ridership and bus stop analyses, driver interviews, public input, and extensive coordination with the project's Project Management Team (PMT).

This document includes recommendations related to the REX Line's service structure, passenger facilities, and corridor running way and traffic signals. The recommendations in this document represent a set of final recommendations developed based on detailed coordination with the project PMT as well as feedback from the passenger survey.

The remainder of this document is focused on a description of the final recommendations. Included as part of the recommendations is backup data to provide an understanding of the estimated cost and ridership impacts associated with each recommendation. In addition, a proposed time frame for implementation is provided, with short-term implementation to occur in 1-2 years, mid-range implementation to occur in 3-4 years, and long range implementation to occur in 5-6 years.

2. Service Recommendations

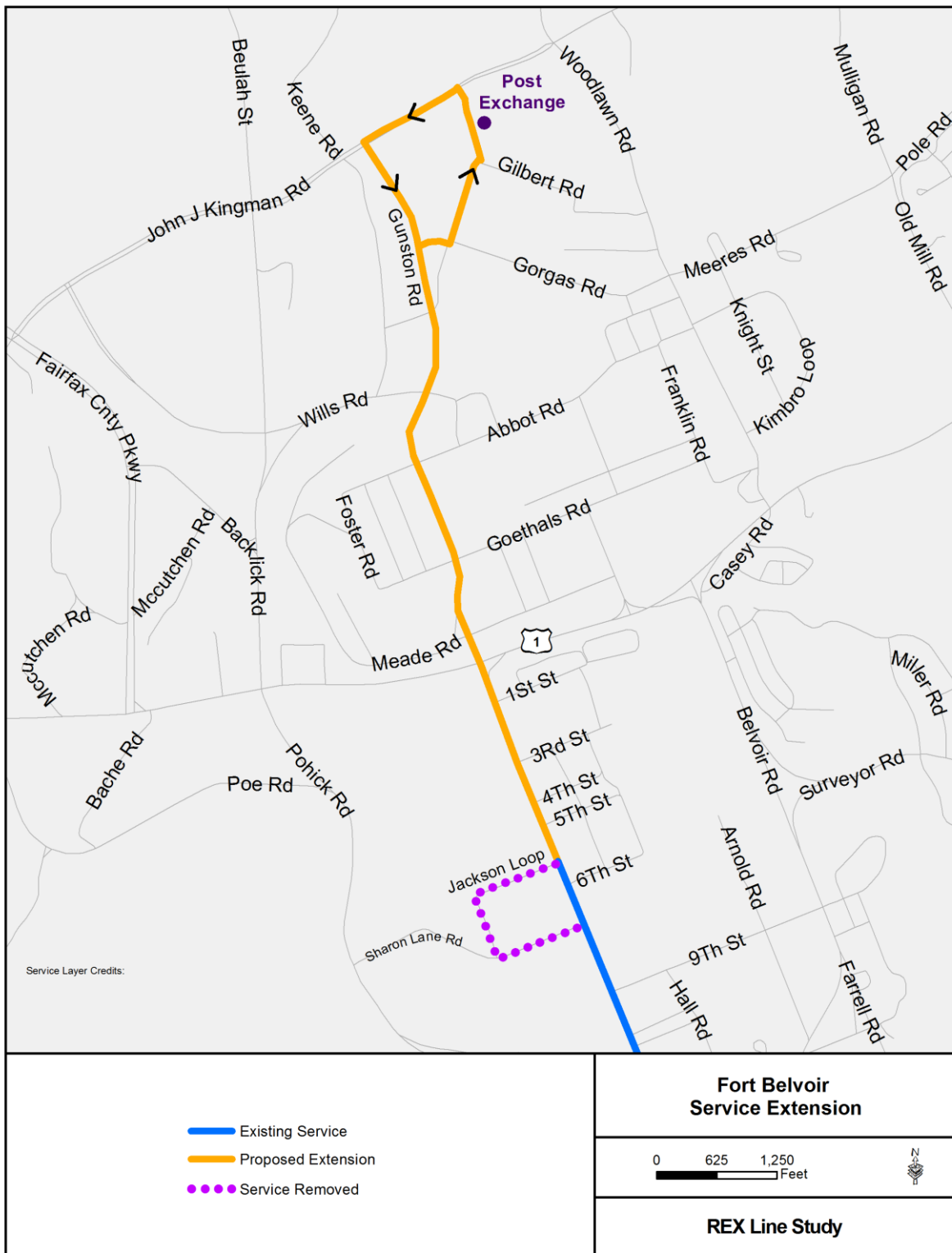
A. Extend Service on Fort Belvoir to New Post Exchange/Commissary Complex (proposed implementation in the short-term time frame)

- 1. Final Recommendation** – This recommendation is to extend the REX line routing beyond its current terminal point at the Jackson Loop on Fort Belvoir to a new terminal at the Fort Belvoir Post Exchange (PX)/Commissary complex located off of John J Kingman Road, east of Gunston Road. The extension is shown in Figure 1. This extension would be approximately 1.7 miles in length and would add approximately 4 minutes to each one-way trip. Three scenarios for accommodating the extra travel time associated with this extension are evaluated below. The scenarios evaluated include:

- a. Accommodate the extension within existing cycle time/recovery time;
- b. Add a bus into service, where required, to cover the additional run time while maintaining current headways;
- c. Widen headways such that the additional run time can be accommodated within the existing operating cost structure.

Metrobus planners, in conjunction with Fairfax County and the City of Alexandria, will make the final decision on how best to implement the extension based on the analysis outlined below, available financial resources, and potential trade-offs between the benefits of the extension compared to the potential need to widen headways.

Figure 1 – Proposed REX Line Extension to the Fort Belvoir Post Exchange



The detailed evaluation of each of these scenarios is outlined below.

- a. **Accommodate Extension within the Existing Cycle Time/Recovery Time** – The evaluation framework for this scenario is an assessment of the percent of total cycle time that is dedicated to layover and recovery time, based on the current schedule and headway sheets. The concept here is that if there is excess recovery time available within the existing total cycle time, some of that excess time can be dedicated to accommodating the added run time resulting from the route extension. Data on recovery time percentages by day of week is presented in Appendix 2. The most relevant column in the Appendix tables is the column labeled “New Layover as % of New Revenue Time” on the right side of the Table.

This column shows the percent of round trip revenue run time that would be available for recovery time after the extension run time is added to the new revenue trip time (4 minutes is added to each one way trip, or 8 minutes for a round trip). The framework for assessing whether there will be sufficient recovery time remaining after the extension run time is added is the rule-of-thumb requirement that a minimum of 10% of revenue run time is required for recovery in order to ensure on-time performance and reliable service. The results by day of week are summarized below.

Weekday – The weekday data in Appendix 2 shows that there are a number of instances throughout the day where the recovery time as a percent of round trip revenue run time falls below the rule-of-thumb required minimum of 10% after the additional extension-related run time is added to the current run time. This means that on weekdays there is not sufficient excess recovery time to accommodate the increase in run time associated with the extension. Therefore, one of the other scenarios noted above, addition of another bus into service, or widening weekday headways, will be necessary in order to accommodate the additional run time associated with a REX Line extension on weekdays.

Saturday – The Saturday data in Appendix 2 shows that in only one instance does the recovery time as a percent of round-trip revenue run time fall below the rule-of-thumb required 10% minimum, after the additional extension-related run time is added to the current run time. This data indicates that the current scheduled recovery time can easily accommodate the additional extension-related run time while continuing to provide adequate recovery time.

Sunday – The Sunday data in Appendix 2 shows that there are two instances where the recovery time as a percent of revenue run times fall below the rule-of-thumb required minimum of 10%, after the additional extension-related run time is added to the current run time (in both instances the percentage is only slightly below 10%). This data indicates that the current scheduled recovery time can easily accommodate the additional extension-related run time while continuing to provide adequate recovery time.

- b. **Add Vehicle to Service in Order to Maintain Current Headways** – Based on the analysis outlined above, this scenario would only be applicable to weekdays, where current recovery time would not be sufficient to accommodate the additional run time

associated with an extension. In this instance, an additional bus would be added into service to accommodate the additional extension-related run time while maintaining the existing headway. The cost of this additional bus is outlined below. The cost estimate assumes that an additional bus in service would be required for the entire length of service on weekdays given the results of the analysis outlined in Appendix 2. The cost estimate is outlined below in Table 1.

The fare recovery portion of the cost estimate in Table 1 is based on an increase in ridership of **176** riders per day due to the extension. This estimate is based on current boardings per trip on Fort Belvoir and an estimated percentage increase of 50% of these boardings per trip due to the extension. This estimate may be conservative given the potential activity at the PX/Commissary but in lieu of detailed activity data at the PX, it was felt this conservative estimate was best suited to the analysis. WMATA will closely monitor boardings on the extension to see if service modifications will be required.

Table 1 - Estimated Cost of Adding a Bus into Service to Maintain Current Headways after Route Extension

	# of Additional Buses Required for Extension	Hours of Weekday Daily Service	Additional Revenue Hours	Platform Hour Factor	Additional Platform Hours	Cost Per Platform Hour	Daily Cost of Extension	Annual Cost of Extension (250 weekdays)
Weekday - All Day	1	19	19	1.1	20.9	\$118.00	\$2,466.20	\$616,550
Total Estimated Cost							\$2,466.20	\$616,550
Estimated Fare Recovery - New Riders							\$228.80	\$57,200
Net Cost after Fare Recovery							\$2,237.40	\$559,350
Cost after Regional Subsidy (assumed regional subsidy covers 20% of net cost)							\$1,789.92	\$447,480

Provided below in Table 2 are a series of evaluation measures that will allow a comparison of this recommendation against other service improvement recommendations contained in this document.

Table 2 - Evaluation Measures – REX Line Extension – Additional Bus In Service

Evaluation Factor	Value
Cost per Existing Impacted Rider	\$7.01
Cost per Existing Impacted Rider - Net Cost after Fare Recovery	\$6.36
Cost per Existing Impacted Rider - Net Cost with Regional Subsidy	\$5.09
Cost per New Rider - Total Cost	\$14.01
Cost per New Rider - Net Cost after Fare Recovery	\$12.71
Cost per New Rider - Net Cost with Regional Subsidy	\$10.17

- c. **Widen Headways and Accommodate Additional Run Time Within the Existing Operating Cost Structure** – Table 3 below shows the number of buses in service during each hour of the day between the start of service at 5:00 AM and the end of the PM peak based on the REX Line Headway sheets. The table also contains information on average headways during each hour and in each direction. This table provides the framework for understanding the number of buses required to meet service during different periods of the day under existing run times. Of specific note is the AM peak pull-out of 10 buses and PM peak pull-out of 12 buses.

Table 3 - REX Line Weekday Bus Requirements by Time of Day

Time Period	#of Buses in Service	Northbound Average Headway	Southbound Average Headway
5 AM – 6 AM	6	12	30
6AM – 7AM	9	12	15
7AM – 8AM	10	12	15
8AM – 9AM	10	15	20
9AM – 10AM	6	20	30
10AM -11AM	6	30	30
11AM – 12PM	4	30	30
12PM – 1PM	5	30	30
1PM – 2PM	7	30	20
2PM – 3PM	7	20	20
3PM – 4PM	8	15	15
4PM – 5PM	10	15	12
5PM – 6PM	12	15	12
6PM – 7PM	12	15	15

The minimum headway that can be achieved while maintaining the existing number of buses in service (and thus also maintaining the existing cost structure) will ultimately depend on how the Metrobus Scheduling Department builds the new REX Line schedules, including how much recovery time is provided (the provision of recovery time in the schedule must also consider the variability of the security procedures for REX Line buses entering Fort Belvoir at the Pence Gate. Based on an assessment of time to get through the gate based on new security procedures, the average time to pass through security is about four minutes but this can be very variable based on unanticipated issues. Schedule adherence and changes in security gate operations will be monitored and if security procedure times increase, or there is greater variability in procedure time, more recovery time to account for this variability and increased procedure times may be required).

Outlined below in Table 4 is an assessment of the potential crowding implications of widening the REX Line headway to accommodate the added service-extension related run time. The data presented in the Table is based on **the most conservative** assumptions regarding the required headway widening associated with the additional run time. Therefore the potential loading impacts shown in the table may not arise if the Schedules Department can maintain current headways during some parts of the day when building a new schedule. It should be noted that the data in the table show that in no instance does widening headways result in excessive

crowding in either direction, even under the most conservative assumptions regarding required headway widening.

Based on the data contained in Appendix 2 it appears that maintaining the same number of buses in service during the AM and PM peak periods would result in a headway widening from the current 12 minutes to no greater than 14 minutes. Further, it appears that required widened headway in the mid-day would be no more than 35 minutes (from the current 30 minutes). Again, the ultimate required headway modifications would depend on the work of the Scheduling Department.

Table 4 - Load and Crowding Impacts of Potential REX Line Headway Widening to Accommodate Service Extension

Southbound Service							
Hour	Hourly On-Board at the Max Load Point	Average Headway Current	Number of Trips per Hour	Average Max Load per trip - Current # of Trips	Potential New Headway After Widening	Number of Trips per Hour - Revised Headway	Average Max Load per Trip - Revised # of Trips
6 AM - 7 AM	74	15	4	19	20	3	25
7 AM - 8 AM	66	15	4	17	20	3	22
8AM - 9AM	48	20	3	16	30	2	24
9 AM - 10 AM	34	30	2	17	40	1.5	23
10 AM - 11 AM	42	30	2	21	40	1.5	28
11 AM - 12 PM	45	30	2	23	40	1.5	30
12 PM - 1 PM	49	30	2	25	40	1.5	33
1 PM - 2 PM	67	20	3	22	30	2	34
2 PM - 3 PM	77	20	3	26	30	2	39
3 PM - 4 PM	113	15	4	28	20	3	38
4 PM - 5 PM	153	12	5	31	15	4	38
5 PM - 6 PM	140	12	5	28	15	4	35
6 PM - 7 PM	105	15	4	26	20	3	35
Northbound Service							
Hour	Hourly On-Board at the Max Load Point	Average Headway Current	Number of Trips	Average Max Load per trip - Current # of Trips	Potential New Headway After Widening	Number of Trips per Hour - Revised Headway	Average Max Load per Trip - Revised # of Trips
6 AM - 7 AM	130	12	5	26	15	4	33
7 AM - 8 AM	129	12	5	26	15	4	32
8AM - 9AM	93	15	4	23	20	3	31
9 AM - 10 AM	75	20	3	25	30	2	38
10 AM - 11 AM	46	30	2	23	40	1.5	31
11 AM - 12 PM	55	30	2	28	40	1.5	37
12 PM - 1 PM	50	30	2	25	40	1.5	33
1 PM - 2 PM	54	30	2	27	40	1.5	36
2 PM - 3 PM	76	20	3	25	30	2	38
3 PM - 4 PM	109	15	4	27	20	3	36
4 PM - 5 PM	97	15	4	24	20	3	32
5 PM - 6 PM	67	15	4	17	20	3	22
6 PM - 7 PM	53	15	4	13	20	3	18

- Reason for Recommendation** – The new Commissary and PX will be one of the largest activity centers on Fort Belvoir. The proposed extension will provide improved access to the

facility for workers on the base on and will also support the overall base redevelopment efforts.

B. Improve Service Frequencies on Sunday from Current 60 Minutes to 30 Minutes (proposed implementation in the short-term time frame)

- 1. Final Recommendation** – This recommendation is to improve service frequencies on Sundays from the current 60 minutes to 30 minutes.
- 2. Reasons for Recommendation** – There are two primary reasons for this proposed service improvement. The first is that the current Sunday 60 minute headway does not meet the WMATA service standard for a Priority Corridor Network Line, which is 30 minutes on Sunday. The second is that this service improvement was one of the most requested in the passenger survey completed as part of this study. The estimated daily Sunday ridership increase due to this improvement is 95 riders (more detail on how this was estimated is provided in Appendix 1). It should be noted the primary driver of this recommendation is to improve service to meet Priority Corridor service standards, not to increase ridership.
- 3. Recommendation Cost Estimate** – The estimated cost of this recommendation is outlined below in Table 5. Table 5 includes the additional operating cost of the recommendation, the net cost after fares are accounted for, and the cost after estimated regional subsidies are accounted for. Since this service improvement will occur on Sunday, no additional vehicles in the REX fleet will be required.

Table 5 Estimated Operating Cost – Improved Sunday Service Frequency

Additional Vehicle Requirement Calculations						
	Revenue Round Trip Run Time	Recovery (10% of Revenue Run Time)	Round Trip Cycle Time	Headway	Vehicle Requirement - Calculated	Vehicle Requirement - Rounded
Current Service	94	9	103	60	1.7	2
Future Service	94	9	103	30	3.4	4
Additional Buses in Service						2

Cost Calculation							
Additional Buses in Service	Hours of Service	Total Revenue Hours per Day	Platform Hour Factor	Total Platform Hours	Cost per Platform Hour	Total Daily Cost	Annual Cost (57 Sundays)
2	16	32	1.1	35.2	\$118.89	\$4,185	\$238,541
Estimated Fare Recovery - New Riders*						\$123	\$7,004
Net Cost after Fare Recovery						\$4,062	\$231,536
Cost after Regional Subsidy (assumed regional subsidy covers 20% of net cost)						\$3,250	\$185,229

*Calculated as estimated new riders * average fare of \$1.30

- 4. Cost Effectiveness and Productivity Evaluation Measures** – Provided in this section are a series of evaluation measures (see Table 6) that will allow a comparison of the different recommendations contained in this document. It should also be noted that some of these evaluation factors depend on the calculation of new riders associated with the proposed improvements in service frequencies.

Table 6 - Evaluation Measures – Improved Service Frequency on Sundays

Evaluation Factor	Value
Cost per Existing Impacted Rider	\$4.66
Cost per Existing Impacted Rider - Net Cost after Fare Recovery	\$4.52
Cost per Existing Impacted Rider - Net Cost with Regional Subsidy	\$3.62
Cost per New Rider - Total Cost	\$44.27
Cost per New Rider - Net Cost after Fare Recovery	\$42.97
Cost per New Rider - Net Cost with Regional Subsidy	\$34.38

- 5. Additional Considerations** – Some members of the Project Management Team questioned the need for this recommendation because of quite frequent alternative Sunday service in the Richmond Highway corridor. The Fairfax Connector 171 is a local service that runs between the Lorton VRE Station and the Huntington Metrorail Station. It mirrors the routing of the REX Line between the Pence Gate entrance to Fort Belvoir and the Huntington Metrorail Station and runs every 30 minutes throughout the day on Sunday. The combined

headway of the REX Line and 171 services is 20 minutes along the common portion of the line. In addition, the 171 service does provide access to Metrorail at the Huntington Metrorail Station.

The key questions regarding implementation of this recommendation relate to the portions of the corridor that are not served by the Fairfax Connector 171 and therefore would still be left with 60 minute service frequencies. These areas include Fort Belvoir and the area north of the Huntington Metrorail Station, between the Huntington Station and the King Street/Old Town Metrorail Station.

Outlined in Table 7 are Sunday boardings and alightings north of Huntington Station by time period in order to provide an understanding of the number of riders who would not have access to the Fairfax Connector 171 service as a substitute service.

Table 7 - REX Line Boardings/Alightings North of the Huntington Metrorail Station (would not have access to Fairfax Connector 171 Service as a substitute service)

Time Period	Direction	Boardings/Alightings N/O Huntington Station	Total Time Period Boardings/Alightings	Percent of Total Boardings/Alightings Occurring N/O Huntington Station
Early AM	NB	26	51	50.86%
	SB	n/a	n/a	n/a
AM Peak	NB	84	112	74.72%
	SB	18	57	31.05%
Mid-Day	NB	80	187	43.00%
	SB	74	208	35.51%
PM Peak	NB	39	136	28.66%
	SB	95	162	58.43%
Early Evening	NB	26	69	37.93%
	SB	49	92	52.69%
Total		491	1,074	45.72%

Note: For this analysis, alightings are presented in the table for northbound service (for northbound service the section of the REX Line north of Huntington is comprised of the three stops at the end of the line and therefore boardings in this section are minimal). Likewise, boardings are presented for southbound service (for southbound service the section of the REX Line north of Huntington is comprised of the three stops at the start of the line and therefore alightings are minimal).

The data in Table 7 shows that a large percentage of total Sunday boardings or alightings by time period occur north of the Huntington Metrorail station during certain times of the day. The following instances where boardings or alightings north of Huntington exceed 50% of total boardings or alightings during the time period include:

- Early AM NB (alightings)
- AM Peak NB (alightings)
- PM Peak SB (boardings)
- Early evening SB (boardings)

The data in Table 8 show the number of Sunday passengers transferring to or from Metrorail at the three Metrorail stations served by the REX Line. The data in the table show that a relatively small percentage of the passengers boarding and alighting north of Huntington are transferring to Metrorail at King Street or Eisenhower Avenue, meaning Metrorail transfers are not the predominant market for riders boarding or alighting north of Huntington. This fact means that replacing a Metrorail transfer at King Street or Eisenhower with a transfer at Huntington (utilizing the Fairfax Connector 171) instead would not meet the mobility needs of the large majority of riders boarding or alighting north of Huntington.

Table 8 - Sunday Transfers Between the REX Line and Metrorail

REX Transfers to Rail by Station – September 2015				
Station	Day of Week	Monthly Transfers	Days in Month	Daily Average
Eisenhower Avenue	Sunday	1	4	0
King Street	Sunday	172	4	43
Huntington	Sunday	144	4	36
Rail Transfer to REX				
Eisenhower Avenue	Sunday	1	4	0
King Street	Sunday	160	4	40
Huntington	Sunday	131	4	33

A final set of data related to origins and destinations of passengers boarding or alighting north of Huntington is provided in Table 9. The table provides information on passengers transferring to or from REX to other bus lines that connect with REX north of the Huntington station. The data in the table show that the market for transfers to or from other bus lines north of Huntington actually exceeds the market for transfers to or from Metrorail, further highlighting that a large number of REX Line Sunday passengers would not be able to use the Fairfax Connector 171 as a substitute service. Also of interest is the fact that two of the lines with high transfer activity (the 28A and 29N) serve parts of Fairfax County not served by the REX Line, and therefore connections between the REX Line and these other lines may in fact facilitate movements from one part of Fairfax County to another.

Table 9 - Sunday Transfers from REX to Other Bus Lines and From Other Bus Lines to REX

To REX		Monthly	Days in Month	Average Daily
AT2 - Seminary Plaza – Van Dorn Metro	Sunday	37	4	9
AT5 - Braddock Road Metro – Van Dorn Metro	Sunday	37	4	9
AT8 - Fairfax & Pendelton (Old Town) – Van Dorn Metro	Sunday	88	4	22
AT10 - King Street Metro – Potomac Yard	Sunday	12	4	3
28A - Leesburg Pike	Sunday	170	4	43
29N - Alexandria - Fairfax	Sunday	88	4	22
9A - Huntington - Pentagon	Sunday	23	4	6
Total				114
From REX		Monthly	Days in Month	Average Daily
AT2 - Seminary Plaza – Van Dorn Metro	Sunday	28	4	7
AT5 - Braddock Road Metro – Van Dorn Metro	Sunday	45	4	11
AT8 - Fairfax & Pendelton (Old Town) – Van Dorn Metro	Sunday	84	4	21
AT10 - King Street Metro – Potomac Yard	Sunday	10	4	3
28A - Leesburg Pike	Sunday	168	4	42
29N - Alexandria - Fairfax	Sunday	126	4	32
9A - Huntington - Pentagon	Sunday	132	4	33
Total				149

The final set of data to help identify whether the Fairfax Connector 171 is appropriate as a substitute service for REX Line riders is boardings and alightings on Fort Belvoir, which is not served by the 171 route. This data is outlined below in Table 10. The data in the table show much smaller numbers than boardings and alightings north of Huntington (see Table 7), though during some time periods boardings or alightings on Fort Belvoir exceed 10% of total boardings or alightings for that time period and direction. These passengers would not have access to the Fairfax Connector 171 as a substitute service for the REX Line.

Table 10 - REX Line Boardings/Alightings On Fort Belvoir (Would not Have Access to Fairfax Connector 171 Service as a Substitute Service)

Time Period	Direction	Boardings/Alightings Fort Belvoir	Total Time Period Boardings/Alightings	Percent of Total Boardings/Alightings Fort Belvoir
Early AM	NB	2	51	4.04%
	SB	n/a	n/a	n/a
AM Peak	NB	6	106	5.62%
	SB	8	49	16.85%
Mid-Day	NB	9	182	4.71%
	SB	17	196	8.65%
PM Peak	NB	15	142	10.41%
	SB	8	163	4.81%
Early Evening	NB	7	66	10.57%
	SB	8	92	8.69%
Total		80	1,047	7.64%

Note: For this analysis, boardings are presented in the table for northbound service (for northbound service the section of the REX Line on Fort Belvoir is comprised of the stops at the start of the line and therefore alightings in this section are minimal). Likewise, alightings are presented for southbound service (for southbound service the section of the REX Line on Fort Belvoir is comprised of the stops at the end of the line and therefore boardings are minimal).

Based on the analysis outlined above, it is recommended that WMATA continue with implementation of the improved headways. While the Fairfax Connector 171 does provide duplicate service along much of the corridor, there are large numbers of riders that cannot use the 171 as a substitute service and thus would still benefit from the proposed improved headways.

C. Evaluate Scheduled Run Time - Adjust as Necessary

- 1. Analysis Framework** – As part of each Priority Corridor Study, an analysis of scheduled run times versus actual run times is completed in order to assess whether scheduled run time is adequate and reflects actual operating conditions. The analysis framework for the comparison is the percent difference between scheduled run time and actual run time for each trip, with any trip where actual run time exceeds scheduled run time by 10% identified as a run time issue.

The detailed analysis of scheduled versus actual run times is outlined in Appendix 3. The instances where actual run time exceeds scheduled run time by 10% are highlighted in yellow in the Appendix 3 tables.

For weekdays, the data in Appendix 3 show that there are no run time issues in the northbound direction and a few instances in the southbound direction. In the southbound direction there is one early AM trip that exceeds the 10% difference. This trip occurs just before longer scheduled trip run times begin, indicating that the longer scheduled trip times should potentially start earlier in the AM peak. In the PM peak there are two trips, just after scheduled one-way run time drops from 55 minutes to 53 minutes that exceed the 10%

threshold. In this instance schedulers may wish to extend the 55 minute scheduled run time a little later in the PM peak.

The northbound Saturday data in Appendix 3 show a single trip in the early AM where the actual run time exceeds scheduled run time by 10% as well as four trips in the PM peak. Two of the four PM peak trips occur just after the point when scheduled one-way run times drop from 49 minutes to 45 minutes. As with weekday service, perhaps extending the 49 minute run time later in the day will help address these issues. Southbound Saturday data show two instances where actual run time exceeds scheduled run time by 10%, one in the PM peak and one later in the evening.

Sunday northbound data shows one instance, during the middle of the day, where actual run time exceeds scheduled run time by more than 10%. Sunday southbound data show two instances where actual run time exceeds scheduled run time, both in the early evening and both occurring immediately after scheduled one-way run time drops from 51 minutes to 44 minutes.

2. **Final Recommendation** – The data analysis contained in Appendix 3 does not show wide scale issues with inadequate scheduled run time. Rather the analysis shows issues during specific times of the day, usually right after there is a drop in scheduled one-way run time. The recommendation here is for Metrobus schedulers to evaluate the potential for extending the number of trips that have longer run times (for instance, on Saturday in the northbound direction, rather than ending the 49 minute one-way run time with the 4:30 PM trip, extend the 49 minute run time to 6:00 PM).

D. Add Trips to Meet Hours of Service Criteria (recommended for implementation in the short-term time frame)

1. **Final Recommendation** – This recommendation is to add trips on trips on weekdays and Sundays in order to meet hours-of-service standards for Priority Corridor Network Lines.

The hour-of-service standards by day of week are outlined below in Table 11.

Table11 - Priority Corridor Network Hours-Of-Service Standards

Day of Week	First Trip of Day Starts No Later Than:	Last Trip of Day Starts No Earlier Than:
Weekday	5:45 AM	10:30 PM
Saturday	6:00 AM	10:00 PM
Sunday	6:30 AM	10:00 PM

The specific recommendations are as follows

- a. **Weekday** – add one additional southbound trip in the evening in order to meet hours-of-service standards.
 - i. Currently the last southbound trip leaves King Street at 10:04 PM, falling short of the 10:30 PM standard.

- b. **Sunday** – add two additional southbound trips and two additional northbound trips in the evening in order to meet hour-of-service standards.
- i. Currently the last Sunday trips in the evening in each direction leave at 9:00 PM, short of the 10:00 PM standard. Of note is that the proposal to add two trips in each direction reflects Recommendation B, which proposes improving Sunday service frequency to every 30 minutes from the current 60 minutes.

Note: Weekday northbound service meets all hours-of-service standards. Saturday service also meets all hours-of-service standards.

2. **Reason for Recommendation** – The Priority Corridor Network (PCN) service span standards are meant to ensure that service in corridors within the PCN is premium, high quality service that meets the needs of the riders within the corridor. Adjusting service to ensure that the hour-of-service standards are met will ensure that riders utilizing REX Line service for non-traditional work hours or for other trip purposes that fall outside traditional commute hours have the option of relying on transit for their trip needs.
3. **Recommendation Cost Estimate** – The estimated operating cost estimate for this recommendation, including accounting for fare recovery and the regional subsidy, is outlined below in Table 12.

Table 12 - Estimated Cost – Add Trips to Meet Hours-of-Service Standards

Day of Week	Additional Trips	Run Time in Hours	Additional Revenue Hours	Platform Hour Factor	Additional Platform Hours	Cost per Platform Hour	Daily Cost	Annual Cost
Weekday	1	0.77	0.77	1.1	0.84	\$115.00	\$96.98	\$24,246
Estimated Fare Recovery							\$43.29	\$10,823
Net Cost after Fare Recovery							\$53.69	\$13,423
Sunday NB	2	0.77	1.53	1.1	1.69	\$115.00	\$193.97	\$11,250
Estimated Fare Recovery							\$15.21	\$882
Net Cost after Fare Recovery							\$178.76	\$10,368
Sunday SB	2	0.73	1.47	1.1	1.61	\$115.00	\$185.53	\$10,761
Estimated Fare Recovery							\$27.50	\$1,595
Net Cost after Fare Recovery							\$158.04	\$9,166
Total Cost Before Fare Recovery							\$476.48	\$46,257
Estimated Total Fare Recovery							\$86.00	\$13,299
Net Cost after Fare Recovery							\$390.49	\$32,957
Cost after regional subsidy (assumed regional subsidy covers 20% of net cost)							\$312.39	\$26,366

- 4. Cost Effectiveness and Productivity Evaluation Measures** – Provided in this section are a series of evaluation measures (see Table 14) that will allow a comparison of the different recommendations contained in this document. It should also be noted that some of these evaluation factors depend on the calculation of new riders associated with the expansion of service hours. Included first in this section in Table 13 is an estimate of ridership on each trip based on existing ridership on the last trips of the day. The assumption used in estimating the ridership on the new trips is that the pattern of the ridership on the last trips would continue to the new trips but would decline by 10% to reflect the fact that the new trips are later in the evening when fewer people are riding.

Table 13 – Estimated Ridership – New Trips (based on ridership patterns on current last trips of the day)

Day of Week	Direction	Trip Time	Total Trip Boardings	Average Boardings	10 % Decrease	Estimated Ridership
Weekday	Southbound	10:00 PM	37	37	4	33
Sunday	Northbound	8:00 PM	12			
		9:00 PM	14	13	1	12
	Southbound	8:00 PM	24			
		9:00 PM	23	24	2	21

Table 14 contains the actual evaluation criteria that will allow for comparison of the different proposed recommendations contained in this document.

Table 14 - Evaluation Measures – Add Trips to Meet Hours of Service Standards

Evaluation Factor	Value
Weekday	
Cost per New Rider - Total Cost	\$2.91
Cost per New Rider - Net Cost after Fare Recovery	\$1.61
Cost per New Rider - Net Cost with Regional Subsidy	\$1.29
Sunday	
Cost per New Rider - Total Cost	\$11.55
Cost per New Rider - Net Cost after Fare Recovery	\$10.25
Cost per New Rider - Net Cost with Regional Subsidy	\$8.20

E. Implement Dedicated Supervision (proposed implementation in the short-term time frame)

- 1. Analysis Framework/Final Recommendation** – A detailed headway separation analysis for each day of the week and by direction is contained in Appendix 4. The analysis framework for this data is that any trip where actual headway separation exceeds scheduled headway separation by more than 15% is identified as a headway-separation issue.

The data in Appendix 4 show consistent headway issues throughout the day in both directions on weekdays and in the mid-day and PM peak on Saturdays. Based on the results of this analysis, it is recommended that dedicated supervision be provided during these time periods in order to proactively manage the REX line and help maintain correct headway separation. Given that the headway separation issues occur in the middle of the line in the vicinity of Ladson Lane, the proposed deployment of the dedicated supervision would be at this location in both directions, as follows:

- Ladson Lane Southbound – weekday – 12 hours (6:00 AM to 6:00 PM)
- Ladson Lane Northbound - weekday – 12 hours (6:00 AM to 6:00 PM)
- Ladson Lane Southbound – Saturday – 8 hours (11:00 AM to 7:00 PM)
- Ladson Lane Northbound – Saturday – 8 hours (11:00 AM to 7:00 PM)

It should be noted that the “Service Operations Managers Assignments – Final Report” dated May 2013 recommended dedicated supervision on the REX Line at King Street and Fort Belvoir. These recommendations were based on the best data available at the time of the completion of the report. The more detailed headway separation analysis developed for this study resulted in the modified recommendation included here.

- 2. Reason for Recommendation** – Congestion on the U.S. 1 corridor results in a lack of reliability and poor headway separation, as shown in the data outlined in Appendix 4. Lack of REX Line reliability was also identified by survey respondents as a key issue. Assigning dedicated supervisors at a key point along the REX Line will ensure buses are correctly separated in the middle of the line, ensuring more reliable service, more even distribution of loads and more productive use of capacity.
- 3. Recommendation Cost Estimate** - The estimated cost of this recommendation is outlined below in Table 14

Table 15 – Dedicated Supervision – Cost Estimate

Time Period	Full Annual Cost per Manager (direct salary and fringe)	Annual Hours	Hourly Cost	Hours of Daily Line Management	Managers Deployed During Hours of Line Management	Total Hours of Daily Line Management	Total Daily Cost	Annual Cost - Assumes Works 250 weekdays per Year, 55 Saturdays
Weekday All Day	\$90,000	2,080	\$43.27	12	2	24	\$1,038	\$259,615
Saturday Mid-day, PM Peak	\$90,000	2,080	\$43.27	8	2	16	\$692	\$40,154
Total								\$299,769

4. **Cost-Effectiveness and Productivity Evaluation Measures** - Provided in this section is the cost per impacted rider evaluation measure for comparison to other recommendations contained in this report.

Weekday

Daily weekday cost	\$1,038
Number of Impacted Daily Riders:	3,332
Daily Cost per Impacted Rider:	\$.31

Saturday

Daily Saturday Cost:	\$692
Number of Impacted Daily Riders:	2,314
Daily Cost per Impacted Rider:	\$.30

F. Additional Areas Evaluated – No Recommendations Made

1. REX Branding

As part of the project planning process, the Project Management Team evaluated whether maintenance of the specific REX Line brand was still warranted, given that the other MetroExtra services throughout the region have a common MetroExtra brand. This question arose predominantly because the REX Line service will be dispatched from the soon-to-be-opened Cinder Bed Road facility. Originally, the Cinder Bed Road facility would be a weekday operation only and therefore weekend REX Line service would have to be provided with MetroExtra branded buses from WMATA's Four Mile facility in Arlington.

Fairfax County has identified a desire to maintain the REX brand. To this end, support of weekend operations at Cinder Bed Road must be planned and implemented. No changes to the REX Line Brand will be made at this point.

Terminate Service at Huntington Metrorail Station

During the early stages of the planning process, Project Management Team members asked that an evaluation of potentially terminating REX Line service at Huntington be completed. The impetus for this request was the delays and impacts to reliability from running on congested streets in Alexandria, especially during peak periods. An evaluation was completed early in the planning process and, based on the results of the evaluation, a decision was made not to pursue this potential service change. The results of the evaluation and the foundation for the decision not to move forward with this potential recommendation are summarized below.

REX Line Boardings and Alightings North of Huntington – The first piece of the evaluation was an assessment of weekday REX Line boardings and alightings north of Huntington. The results are shown below in Table 15. The data in Table 15 show that approximately ¼ of all daily boardings and alightings on the REX Line occur north of Huntington.

Table 16 – REX Line Boardings and Alightings North of Huntington

		On	Off
Direction	Time Period		
SB	AM Early	23	0
	AM Peak	155	54
	Mid-day	200	23
	PM Peak	424	27
	Early Night	171	6
Total		973	110
NB	AM Early	1	72
	AM Peak	3	262
	Mid-day	3	200
	PM Peak	9	166
	Early Night	1	43
Total		17	743
Total - Both Directions		990	853
Percent of Total Daily Boardings		26.36%	23.18%

The second piece of the evaluation assessed transfers to other bus lines that are located north of Huntington. This data is displayed in Table 16. The reason for this assessment is that there was speculation that most riders boarding or alighting north of Huntington were transferring to or from Metrorail at the King Street station and therefore that transfer could now occur at the Huntington Station if the service termination at

Huntington was implemented. The data in Table 16 show that 379 weekday REX Line riders are transferring to another bus line north of Huntington. This is approximately 10% of total daily weekday REX Line boardings.

Table 17 contains comparable data for transfers from other bus routes north of Huntington to the REX Line. The same patterns and general numbers of transfers occur for transfers to the REX Line as transfers from the REX Line.

The final Table in the evaluation is Table 18, which shows the number of transfers to and from Metrorail north of Huntington. The data in the table highlight that the transfers to and from Metrorail at King Street are a relatively small proportion of the total boarding and alighting activity north of Huntington.

Based on the data in Tables 15 through 18, the Project Management Team determined not to recommend the termination of service at Huntington given the potential impact to a large number of riders on the line. Instead, it was determined that the current service and route configuration should be retained.

Table 17 – REX Transfers to Other Bus Routes North of Huntington

REX transfers to Other Routes - N/O Huntington				
September 2015				
REX to:		Monthly	Days in Month	Average Daily
AT2	Weekday	707	22	32
	Saturday	35	4	9
	Sunday	28	4	7
AT2X	Weekday	21	22	1
	Saturday	n/a	4	n/a
	Sunday	n/a	4	n/a
AT5	Weekday	517	22	24
	Saturday	103	4	26
	Sunday	45	4	11
AT6	Weekday	1,505	22	68
	Saturday	n/a	4	n/a
	Sunday	n/a	4	n/a
AT7	Weekday	479	22	22
	Saturday	2	4	1
	Sunday	n/a	4	n/a
AT8	Weekday	1,330	22	60
	Saturday	111	4	28
	Sunday	84	4	21
AT10	Weekday	427	22	19
	Saturday	34	4	9
	Sunday	10	4	3
28A	Weekday	1,930	22	88
	Saturday	264	4	66
	Sunday	168	4	42
29K	Weekday	676	22	31
	Saturday	n/a	4	n/a
	Sunday	n/a	4	n/a
29N	Weekday	752	22	34
	Saturday	167	4	42
	Sunday	126	4	32
Total	Weekday			379
	Saturday			181
	Sunday			116

Table 18– Transfers from Other Bus Routes North of Huntington to the REX Line

Transfers from Other Routes to REX - N/O Huntington				
September 2015				
to Rex:		Monthly	Days in Month	Average Daily
AT2	Weekday	565	22	26
	Saturday	44	4	11
	Sunday	37	4	9
AT2X	Weekday	14	22	1
	Saturday	n/a	4	n/a
	Sunday	n/a	4	n/a
AT5	Weekday	465	22	21
	Saturday	79	4	20
	Sunday	37	4	9
AT6	Weekday	1,206	22	55
	Saturday	n/a	4	n/a
	Sunday	n/a	4	n/a
AT7	Weekday	258	22	12
	Saturday	1	4	0
	Sunday	n/a	4	n/a
AT8	Weekday	957	22	44
	Saturday	101	4	25
	Sunday	88	4	22
AT10	Weekday	295	22	13
	Saturday	31	4	8
	Sunday	12	4	3
28A	Weekday	1,698	22	77
	Saturday	221	4	55
	Sunday	170	4	43
29K	Weekday	674	22	31
	Saturday	n/a	4	n/a
	Sunday	n/a	4	n/a
29N	Weekday	723	22	33
	Saturday	123	4	31
	Sunday	88	4	22
Total	Weekday			313
	Saturday			150
	Sunday			108

Table 19 – REX Transfers to and From Metrorail at Stations North of Huntington

REX Transfer to Rail September 2015				
Station				
	Day of Week	Monthly Transfers	Days in Month	Daily Average
Eisenhower Avenue	Weekday	37	22	2
	Saturday	7	4	2
	Sunday	1	4	0
King Street	Weekday	2,195	22	100
	Saturday	328	4	82
	Sunday	172	4	43
Rail Transfer to REX				
Eisenhower Avenue	Weekday	54	22	2
	Saturday	8	4	2
	Sunday	1	4	0
King Street	Weekday	3,322	22	151
	Saturday	275	4	69
	Sunday	160	4	40

3. Passenger Facility Recommendations

A. Improve Bus Stop Amenities

1. **Final Recommendation** - As part of the study process, a field review of the REX Line was completed to identify stop amenities at each stop along the line. This list of amenities was then compared against the “WMATA Bus Stop Guidelines” to determine where additional amenities are warranted based on the Guidelines. The Guidelines are structured around a bus stop hierarchy wherein every stop should have a basic set of passenger amenities including a bus stop flag, sidewalk access to the stop, and a sidewalk or landing pad at the stop itself. Further up the hierarchy are amenities that should be installed based on the level of passenger boarding activity at a stop. These additional amenities include an information case, a trash receptacle, a shelter and bench, and real time bus arrival information signs. The proposed basic amenities are outlined first, followed by those amenities that are contingent upon boarding activity at a stop.

This recommendation is to begin the process of installing missing amenities based on the WMATA Bus Stop Guidelines. This recommendation is proposed to begin in the short-term time frame (1-2 years) though it is not anticipated that all amenities would be installed in that time frame. The estimated capital cost of installing the proposed amenities is shown in Table 15.

Fairfax County has a comprehensive list of improvements to improve pedestrian and transit access in the Route 1 corridor, including bus stop improvements. Funding is available and bus stop amenity improvements are set to begin in the summer of 2016. It should also be noted that at those stops where the improvements incorporate a new shelter, the branded REX Line shelters that are currently at REX Line stops may be replaced. Finally, amenity improvements will need to be coordinated with plans to widen Route 1 between Fort Belvoir and North/South Kings Highway to accommodate median-running BRT.

Table 20 – Bus Stop Amenity Capital Cost Requirements

Amenity	Units to be Installed	Cost per Unit	Total Cost
Bus Stop Shelter/Bench	10	\$15,000	\$150,000
Trash Receptacle	6	\$1,000	\$6,000
Information Case (immediate Installation)	3	\$200	\$600
Information Case (installed as resources become available)	7	\$200	\$1,400
Bus Stop Pad	5	\$1,500	\$7,500
Sidewalk	5	\$3,600	\$18,000
Real Time Bus Arrival Sign	13	\$15,000	\$195,000
Total			\$378,500

Unit Cost Source:

- 1) Bus Stop Pad – WMATA Anacostia/Congress Heights Stations Access Study – assumes 10x10 pad - \$15.00 per square foot
- 2) Sidewalk – WMATA Anacostia/Congress Heights Stations Access Study – assumes sidewalk 6' in width and 40' in length - \$15.00 per square foot
- 3) Information Case – WMATA Metrobus 30s Line Study
- 4) Trash Receptacle – composite average costs based on manufacturer price – multiple manufacturers
- 5) Shelter and Bench – cost from District of Columbia for current shelter and bench installation
- 6) Real Time Bus Arrival Information Signs – from WMATA – cost reflects just the cost of the sign. Connectivity costs vary significantly from location to location so these costs are not included here.

Note: Local jurisdictions are responsible for bus shelters and benches, trash receptacles, sidewalks and bus stop pads. Metrobus is responsible for the installation and maintenance of stop information cases.

2. Proposed Passenger Amenities by Stop

ADA Bus Stop Pad – The first bus stop amenity that every stop should be equipped with is an ADA compliant bus stop pad. Outlined below in Table 16 is a list of the five REX Line stops that are missing an ADA compliant bus stop pad.

Table 21 – REX Line Stops Missing an ADA Bus Stop Pad

Stop	Direction	Weekday Average Boardings
Richmond Hwy & Arlington Dr	Southbound	37
Richmond Hwy & Frye Rd	Southbound	20
Fort Belvoir Community Hospital	Southbound/ Northbound	80
Belvoir Rd & Langfit Loop	Southbound	0
Belvoir Rd & 16 th St	Southbound	4

Sidewalk Accessibility - The second basic amenity that should be located at every stop is sidewalk accessibility to the stop. Outlined below in Table 17 is a list of the five REX Line stops that do not have sidewalk accessibility.

Table 22 – Rex Line Stops Missing Sidewalk Accessibility

Stop	Direction	Weekday Average Boardings
Richmond Hwy & Southgate Dr	Southbound	82
Richmond Hwy & Lockheed Blvd	Southbound	66
Richmond Hwy & Arlington Dr	Southbound	37
Richmond Hwy & Belford Dr	Southbound	69
Richmond Hwy & Frye Rd	Southbound	20

Information Cases Tables 18 and 19 summarize bus stops that warrant installation of an information case. The field visit identified the location of all information cases along the REX Line. All stops with more than 50 boardings per day that do not currently have an information case were identified as candidates for immediate (short-term) installation. All stops with more than 20 boardings per day that do not currently have an information case were identified as candidates for future (long-term) installation.

A total of 10 stops are missing bus information cases along the line; three of these stops warrant immediate installation and seven warrant long-term installation.

Table 23 - REX Line Stops Missing Information Cases that Require Immediate (Short-Term) Installation

Stop	Direction	Weekday Average Boardings
Dulany St & Duke St	Southbound	258
Richmond Hwy & Belford Dr	Southbound	69
Fort Belvoir Community Hospital	Southbound/ Northbound	80

Table 24 - REX Line Stops Missing Information Cases that Require Future (Long-term) Installation

Stop	Direction	Weekday Average Boardings
Belvoir Rd & 16 th St	Northbound	21
Belvoir Rd & 16 th St	Southbound	4
Belvoir Rd & Langfit Loop	Southbound	0
Belvoir Rd & Langfit Loop	Northbound	30
Belvoir Rd & Pence Gate	Northbound	43
Richmond Hwy & Frye Rd	Southbound	20
Dulany St & Duke St	Northbound	9

Trash Receptacles – The next step in the amenity hierarchy is trash receptacles, which are proposed based on the level of boardings at a stop. The field visit identified the location of all trash receptacles along the REX Line. All stops with more than 25 boardings per day that do not currently have a trash receptacle were identified as candidates for installation. Since WMATA does not install trash receptacles, WMATA would request Alexandria and Fairfax County to install them.

There are 8 candidates for installation of a trash receptacle. These are listed below in Table 20.

Table 25 - REX Line Candidates for the Installation of a Trash Receptacle

Stop	Direction	Weekday Average Boardings
Dulany St & Duke St	Southbound	258
Eisenhower Ave & Swamp Fox Rd	Southbound	168
Richmond Hwy & Southgate Dr	Southbound	82
Richmond Hwy & Arlington Dr	Southbound	37
Richmond Hwy & Belford Dr	Northbound	69
Richmond Hwy & Ladson Ln	Northbound	152
Fort Belvoir Community Hospital	Southbound/ Northbound	80
Jackson Loop	Southbound/ Northbound	42

Stop and Shelter - The next step in the amenity hierarchy is shelters and benches. The “WMATA Bus Stop Guidelines” indicate that any stop with more than 50 boardings is a candidate for a shelter and bench. Since WMATA does not install benches and shelters, WMATA would request Alexandria and Fairfax County to install them. As shown in Table 21, the REX Line has six stops that are candidates for installation of a shelter and bench.

Table 26 - REX Line Candidates for the Installation of a Bench and Shelter

Stop	Direction	Weekday Average Boardings
Dulany St & Duke St	Southbound	258
Eisenhower Ave & Swamp Fox Rd	Southbound	168
Richmond Hwy & Belford Dr	Northbound	69
Richmond Hwy & Ladson Ln	Northbound	152
Richmond Hwy & Mt Vernon Memorial Hwy	Southbound	64
Fort Belvoir Community Hospital	Southbound/ Northbound	80

Real Time Bus Arrival Information Signs - The final step in the amenity hierarchy is real time bus arrival information signs. Any stop with greater than 100 daily boardings is a candidate for a real time bus arrival information sign. As shown in Table 22, the REX Line has 13 stops that are candidates for installation of a real time bus arrival information sign.

Table 27 - REX Line Candidates for the Installation of a Real Time Bus Arrival Information Sign

Stop	Direction	Weekday Average Boardings
King Street Metrorail Station	Southbound	549
Dulany/Duke Street	Southbound	258
Eisenhower Metrorail Station	Southbound	168
Huntington Metrorail Station	Southbound	435
Richmond Highway/Cooper Road	Northbound	165
Richmond Highway/Frye Road	Northbound	189
Richmond Highway/Mohawk Lane	Northbound	184
Richmond Highway/Ladson Lane	Northbound	152
Richmond Highway/Belford Drive	Northbound	144
Richmond Highway/Dart Drive	Northbound	278
Richmond Highway/Southgate Drive	Northbound	112
Richmond Highway/Kings Highway	Northbound	108
Huntington Metrorail Station	Northbound	144

4. Traffic and Running Way Improvements

A. Proposed Traffic and Running Way Improvements

- 1. Final Recommendation** – A number of traffic and running way issues in the REX Line service area were identified based on the completion of the project “Traffic Operations Assessment”. The next step in implementing improvements to address these issues will be to complete more detailed analysis at the identified intersections and other locations, including traffic counts, intersection capacity analysis, intersection geometry analysis, and signal timing and phase length analysis. This recommendation is to start the work on these next analysis steps as well as coordinate on the work with Alexandria, Fairfax County and

the Virginia Department of Transportation. The specific proposed areas of analysis are outlined below.

Transit Signal Priority

Transit Signal Priority (TSP), which would be designed to improve bus run times in the Route 1 Corridor, will be one of the corridor improvements that are included in the “Embark Richmond Highway” initiative that includes Bus Rapid Transit between Huntington and Fort Belvoir as well as planned increased land use densities and more walkable communities along the corridor. At this point, no TSP has been implemented in the corridor.

Signal Timing and Phasing

Bus delays were observed at several locations along the REX Line. Delays and queues that could be attributed to non-optimal signal timing are summarized below.

Recommendation

The recommendation for each of the intersections described below is to conduct turning movement/pedestrian counts and optimize cycle lengths/splits based on demand for all traffic movements. The results of this analysis may address some bus delay, though traffic volumes on other legs of the intersection may preclude providing additional green time to the bus movement.

- ***Route 1 & Ladson Lane***

A long northbound queue in the AM peak prevents the bus from getting to the near side bus stop. The bus has to wait for the northbound green signal to get to the stop. During our field visit, it took two signal cycles to clear the intersection.

- ***Route 1 & Boswell Ave***

A long northbound queue in the AM peak that is due to a long red phase causes delays to bus operations. During our field visit, the bus cleared the intersection in one light cycle.

- ***Route 1 & Lockheed Boulevard/ Dart Drive***

A long northbound queue in the AM peak prevents the bus from servicing the near-side bus stop, causing delays to bus operations. During our field visit, it took one full cycle for the bus to service all boarding and alighting passengers. The bus traveled through the intersection in the 2nd cycle.

- ***Route 1 & Huntington Avenue***

A long northbound queue in the AM peak stretching back to the Holiday Inn prevented the bus from getting into the left turn pocket. During our field visit, the left turn from Route 1 onto Huntington Avenue took three cycles.

- ***Telegraph Road & Huntington Avenue***

The very long red signal in the northbound AM peak for right turning vehicles causes delays to bus operations (the signal was observed to last over two minutes).

- ***Eisenhower Avenue & Stovall Street***

There is a long right turn queue in the northbound AM and PM peaks due to short right turn green time. Right-turn-on-red (RTOR) is allowed at this intersection but conflicting traffic makes RTOR difficult.

- ***Dulany & Jamieson***

There is a long left turn queue in the northbound AM and PM peak as a result of a short left turn green phase. This queue causes delays to bus operations. Most vehicles at this approach are turning left. During our field visit, the bus took two cycles to clear the intersection in the AM peak and three cycles in the PM peak.

- ***Route 1 & Lockheed Boulevard/ Dart Drive***

A long northbound queue in the PM peak spills back to the upstream intersection at Arlington Drive. During our field visit, the bus required two light cycles to pick up passengers, drop off passengers, and travel through the Arlington Boulevard intersection. The bus also needed two light cycles to pick up passengers, drop off passengers, and clear the Lockheed Boulevard/ Dart Drive intersection.

- ***Route 1 & South King Highway***

A long northbound queue in the PM peak causes delays to bus operations. During our field visit, the bus needed one light cycle to clear the intersection and get to the far-side bus stop.

- ***Stovall St & Mill Road***

The long red signal at this intersection in the southbound AM peak causes delays to bus operations.

- ***Huntington Ave & Metroview Parkway***

A long queue resulting from insufficient green time causes delays to the buses trying to turn right into the Huntington Metro Station in the southbound AM and PM peak. During our field visit the bus cleared the intersection in one cycle.

- ***Route 1 & Beacon Hill***

A long AM peak southbound through queue spills back to the upstream intersection at South Gate Drive due to high peak hour volumes and insufficient green time.

- ***Route 1 & Arlington Drive***

Long AM and PM peak southbound through queues causes delays to bus operations. During our field visit, the bus required two cycles to clear the intersection in the AM peak and one cycle in the PM peak.

- ***Route 1 & Buckman Road/ Mt Vernon Highway***

A long AM peak southbound queue causes delays to bus operations.

- ***Route 1 & Mohawk Lane***

A long AM peak southbound queue causes delays to bus operations.

- **Route 1 & Jeff Todd Way/ Mt. Vernon Memorial Hwy**

A long AM peak southbound queue causes delays to bus operations. During our field visit the bus traveled in the right turn lane and merged in the middle of the intersection to travel southbound through the intersection.

Stop Access

A number of stop access issues were identified as part of the operational analysis. Specific instances are outlined below.

- **Route 1 & South King Highway**

Long AM and PM peak southbound through queues as a result of long cycle length delay buses trying to access the South King Highway far-side bus stop.

- **Route 1 & South Gate Drive**

A long southbound AM peak queue spills back past the bus stop and prevents the bus from accessing the near-side stop. During our field visit, the bus had difficulty merging back into the travel lane. The queue's origin is at the downstream intersection at Beacon Hill.

- **Route 1 & Mohawk Lane**

A long northbound AM peak queue makes it difficult to merge back into the travel lane after serving the stop located in the right turn lane.

- **Route 1 & Arlington Drive**

A long AM peak northbound queue can grow to prevent the bus from accessing the bus stop. During our field visit, the queue cleared the intersection in one light cycle.

- **Route 1 & Sacramento Drive**

A long PM peak northbound queue at Sacramento delays the bus from accessing the Cooper Road stop.

- **Route 1 & Sherwood Hall**

A long PM peak northbound queue causes delays for the bus trying to pick up and drop off passengers at the Belford Drive stop.

- **Route 1 & Belford Drive**

There are merging issues in the northbound PM peak for the bus after picking up and dropping off passengers at the Belford Drive bus stop.

Recommendation

Evaluate the location of impacted stops to determine if there would be potential benefit from a stop-relocation. This would include an evaluation of the availability of space for a relocated stop as well as the impacts of relocation on riders. Any stop relocation recommendations will be coordinated with the stop amenity improvements scheduled to start in the summer of 2016 as well as the plans to widen Route 1 to accommodate BRT.

Safety/Operational Issues

- ***Mill Road & Telegraph Road***

Based on feedback from drivers, it is very difficult for buses to turn right onto Telegraph Road in the southbound direction because of poor sight lines and the inability of drivers to see very fast oncoming traffic coming over a rise on southbound Telegraph Road.

Recommendation

Drivers recommended consideration of running service directly from the King Street Metro to Telegraph Road via Duke Street in order to avoid this turn. This re-route would bypass the Eisenhower Metrorail Station stop on the REX Line. No recommendation regarding this re-route is provided at this time. Monitoring of ridership at the Eisenhower Metrorail station in light of increased development in the station area will continue in order to determine the impact to riders of a potential re-route. No changes are proposed at this time.

Appendix 1
New Rider Calculations – Sunday Headway Improvement

Recommendation B (improved Sunday headways) proposed will involve an improvement in Sunday service levels. In order to assess the ridership impacts associated with this service improvement, an elasticity factor was utilized. The source of the equation used to calculate ridership impacts from the service change is “Patronage Impact of Changes in Transit Fares and Services, US Department of Transportation Urban Mass Transportation Administration, 1980”. The elasticity value (e in the equation below) comes from AECOM and WMATA staff work on the PCN networks and observations on riders response to these changes.

The actual equation and elasticity value (the percentage change in ridership associated with each percentage improvement in travel time associated, either through an improvement in service frequencies or an improvement in actual travel times, or both) is outlined below. The actual changes in ridership associated with the Sunday service improvement is provided after the explanation.

Formula:

$$r2=r1*(((f1+f2)+-e*(f2-f1))/((f1+f2)-e*(f2-f1)))$$

r2 = projected ridership

r1 = current ridership

f1 = current frequency

f2 = planned frequency

e= .15

New Rider Calculations – Sunday Headway Change

Improved Headway - Sunday	
Total Ridership Affected (Sunday Boardings)	898
Saturday 6:00 AM to 7:00 PM	
Current Frequency (F1)	60
Planned Frequency (F2)	30
e	-0.15
New Daily Riders	95
New Projected Total Boardings (R2)	993
All Service	

Appendix 2
Calculation of Layover as Percentage of Total Revenue Run Time

Weekday Layover Percentages – With and Without REX Line Extension

Block	Start Terminal	Trip Start Time	Trip End Time	End Terminal	Revenue Run Time	Layover Time	Current Round Trip Revenue Time (Minutes)	Layover Time	Current Layover Time as % of Revenue Time	Current Cycle time	Additional Revenue Time From Extension	New Revenue Time - Extension	Remaining Layover With No Schedule Change	New Layover as % of New Revenue Time	Round Trip Time Period
SR-05	King Street	5:35 AM	6:21 AM	Fort Belvoir	0:46	0:08	96	24	25.00%	120	8	104	16	15.38%	AM Peak
	Fort Belvoir	6:29 AM	7:19 AM	King Street	0:50	0:16									
	King Street	7:35 AM													
	King Street	10:00 AM	10:51 AM	Fort Belvoir	0:51	0:09	103	17	16.50%	120	8	111	9	8.11%	Mid-Day
	Fort Belvoir	11:00 AM	11:52 AM	King Street	0:52	0:08									
	King Street	12:00 PM													
SR-01	Fort Belvoir	5:00 AM	5:44 AM	King Street	0:44	0:06	90	19	21.11%	109	8	98	11	11.22%	AM Peak
	King Street	5:50 AM	6:36 AM	Fort Belvoir	0:46	0:13									
	Fort Belvoir	6:49 AM													
	Fort Belvoir	9:20 AM	10:09 AM	King Street	0:49	0:21	100	30	30.00%	130	8	108	22	20.37%	Mid-Day
	King Street	10:30 AM	11:21 AM	Fort Belvoir	0:51	0:09									
	Fort Belvoir	11:30 AM													
SR-09	King Street	6:05 AM	6:51 AM	Fort Belvoir	0:46	0:09	99	21	21.21%	120	8	107	13	12.15%	AM Peak
	Fort Belvoir	7:00 AM	7:53 AM	King Street	0:53	0:12									
	King Street	8:05 AM													
SR-03	Fort Belvoir	5:30 AM	6:14 AM	King Street	0:44	0:06	90	12	13.33%	102	8	98	4	4.08%	AM Peak
	King Street	6:20 AM	7:06 AM	Fort Belvoir	0:46	0:06									
	Fort Belvoir	7:12 AM													
SR04	Fort Belvoir	5:45 AM	6:29 AM	King Street	0:44	0:06	95	16	16.84%	111	8	103	8	7.77%	AM Peak
	King Street	6:35 AM	7:26 AM	Fort Belvoir	0:51	0:10									
	Fort Belvoir	7:36 AM													
	Fort Belvoir	10:00 AM	10:49 AM	King Street	0:49	0:11	100	20	20.00%	120	8	108	12	11.11%	Mid-Day
	King Street	11:00 AM	11:51 AM	Fort Belvoir	0:51	0:09									
	Fort Belvoir	12:00 PM													

Block	Start Terminal	Trip Start Time	Trip End Time	End Terminal	Revenue Run Time	Layover Time	Current Round Trip Revenue Time (Minutes)	Layover Time	Current Layover Time as % of Revenue Time	Current Cycle time	Additional Revenue Time From Extension	New Revenue Time - Extension	Remaining Layover With No Schedule Change	New Layover as % of New Revenue Time	Round Trip Time Period
SR06	Fort Belvoir	5:57 AM	6:41 AM	King Street	0:44	0:09	95	16	16.84%	111	8	103	8	7.77%	AM Peak
	King Street	6:50 AM	7:41 AM	Fort Belvoir	0:51	0:07									
	Fort Belvoir	7:48 AM													
SR07	Fort Belvoir	6:09 AM	6:59 AM	King Street	0:50	0:06	101	10	9.90%	111	8	109	2	1.83%	AM Peak
	King Street	7:05 AM	7:56 AM	Fort Belvoir	0:51	0:04									
	Fort Belvoir	8:00 AM													
SR07	Fort Belvoir	10:30 AM	11:19 AM	King Street	0:49	0:11	100	20	20.00%	120	8	108	12	11.11%	Mid-Day
	King Street	11:30 AM	12:21 PM	Fort Belvoir	0:51	0:09									
	Fort Belvoir	12:30 PM													
SR08	Fort Belvoir	6:19 AM	7:09 AM	King Street	0:50	0:11	101	15	14.85%	116	8	109	7	6.42%	AM Peak
	King Street	7:20 AM	8:11 AM	Fort Belvoir	0:51	0:04									
	Fort Belvoir	8:15 AM													
SR10	Fort Belvoir	7:24 AM	8:17 AM	King Street	0:53	0:23	105	31	29.52%	136	8	113	23	20.35%	AM peak
	King Street	8:40 AM	9:32 AM	Fort Belvoir	0:52	0:08									
	Fort Belvoir	9:40 AM													
SR15	King Street	12:30 PM	1:21 PM	Fort Belvoir	0:51	0:09	103	27	26.21%	130	8	111	19	17.12%	Mid-Day
	Fort Belvoir	1:30 PM	2:22 PM	King Street	0:52	0:18									
	King Street	2:40 PM													
	King Street	5:12 PM	6:05 PM	Fort Belvoir	0:53	0:10	108	15	13.89%	123	8	116	7	6.03%	PM Peak
	Fort Belvoir	6:15 PM	7:10 PM	King Street	0:55	0:05									
	King Street	7:15 PM													

Block	Start Terminal	Trip Start Time	Trip End Time	End Terminal	Revenue Run Time	Layover Time	Current Round Trip Revenue Time (Minutes)	Layover Time	Current Layover Time as % of Revenue Time	Current Cycle time	Additional Revenue Time From Extension	New Revenue Time - Extension	Remaining Layover With No Schedule Change	New Layover as % of New Revenue Time	Round Trip Time Period
SR20	King Street	1:00 PM	1:51 PM	Fort Belvoir	0:51	0:09	103	17	16.50%	120	8	111	9	8.11%	Mid-Day
	Fort Belvoir	2:00 PM	2:52 PM	King Street	0:52	0:08									
	King Street	3:00 PM													
	Fort Belvoir	2:00 PM	2:52 PM	King Street	0:52	0:08	107	13	12.15%	120	8	115	5	4.35%	Mid-Day/PM Peak
	King Street	3:00 PM	3:55 PM	Fort Belvoir	0:55	0:05									
	Fort Belvoir	4:00 PM													
	King Street	5:24 PM	6:17 PM	Fort Belvoir	0:53	0:13	108	33	30.56%	141	8	116	25	21.55%	PM Peak
	Fort Belvoir	6:30 PM	7:25 PM	King Street	0:55	0:20									
	King Street	7:45 PM													
SR21	King Street	1:20 PM	2:11 PM	Fort Belvoir	0:51	0:09	103	27	26.21%	130	8	111	19	17.12%	Mid-Day/PM Peak
	Fort Belvoir	2:20 PM	3:12 PM	King Street	0:52	0:18									
	King Street	3:30 PM													
	Fort Belvoir	2:20 PM	3:12 PM	King Street	0:52	0:18	107	23	21.50%	130	8	115	15	13.04%	Mid-Day/PM Peak
	King Street	3:30 PM	4:25 PM	Fort Belvoir	0:55	0:05									
SR22	King Street	1:40 PM	2:35 PM	Fort Belvoir	0:55	0:05	107	18	16.82%	125	8	115	10	8.70%	Mid-Day/PM Peak
	Fort Belvoir	2:40 PM	3:32 PM	King Street	0:52	0:13									
	King Street	3:45 PM													

Block	Start Terminal	Trip Start Time	Trip End Time	End Terminal	Revenue Run Time	Layover Time	Current Round Trip Revenue Time (Minutes)	Layover Time	Current Layover Time as % of Revenue Time	Current Cycle time	Additional Revenue Time From Extension	New Revenue Time - Extension	Remaining Layover With No Schedule Change	New Layover as % of New Revenue Time	Round Trip Time Period
SR22	Fort Belvoir	2:40 PM	3:32 PM	King Street	0:52	0:13	107	18	16.82%	125	8	115	10	8.70%	Mid-Day/PM Peak
	King Street	3:45 PM	4:40 PM	Fort Belvoir	0:55	0:05									
	Fort Belvoir	4:45 PM													
	King Street	6:30 PM	7:23 PM	Fort Belvoir	0:53	0:17	107	25	23.36%	132	8	115	17	14.78%	PM Peak/Evening
	Fort Belvoir	7:40 PM	8:32 PM	King Street	0:52	0:08									
	King Street	8:40 PM													
SR 23	King Street	2:00 PM	2:55 PM	Fort Belvoir	0:55	0:05	114	18	15.79%	132	8	122	10	8.20%	Mid-Day/PM Peak
	Fort Belvoir	3:00 PM	3:59 PM	King Street	0:59	0:13									
	King Street	4:12 PM													
SR 23	Fort Belvoir	3:00 PM	3:59 PM	King Street	0:59	0:13	114	21	18.42%	135	8	122	13	10.66%	PM Peak
	King Street	4:12 PM	5:07 PM	Fort Belvoir	0:55	0:08									
	Fort Belvoir	5:15 PM													
SR24	King Street	2:20 PM	3:15 PM	Fort Belvoir	0:55	0:15	114	34	29.82%	148	8	122	26	21.31%	Mid-Day/PM Peak
	Fort Belvoir	3:30 PM	4:29 PM	King Street	0:59	0:19									
	King Street	4:48 PM													
SR26	King Street	3:15 PM	4:10 PM	Fort Belvoir	0:55	0:05	117	24	20.51%	141	8	125	16	12.80%	PM Peak
	Fort Belvoir	4:15 PM	5:17 PM	King Street	1:02	0:19									
	King Street	5:36 PM													
	Fort Belvoir	4:15 PM	5:17 PM	King Street	1:02	0:19	115	35	30.43%	150	8	123	27	21.95%	Mid-Day/PM Peak
	King Street	5:36 PM	6:29 PM	Fort Belvoir	0:53	0:16									
	Fort Belvoir	6:45 PM													
	King Street	8:00 PM	8:47 PM	Fort Belvoir	0:47	0:13	99	21	21.21%	120	8	107	13	12.15%	Evening
	Fort Belvoir	9:00 PM	9:52 PM	King Street	0:52	0:08									
	King Street	10:00 PM													

Block	Start Terminal	Trip Start Time	Trip End Time	End Terminal	Revenue Run Time	Layover Time	Current Round Trip Revenue Time (Minutes)	Layover Time	Current Layover Time as % of Revenue Time	Current Cycle time	Additional Revenue Time From Extension	New Revenue Time - Extension	Remaining Layover With No Schedule Change	New Layover as % of New Revenue Time	Round Trip Time Period
SR 26	Fort Belvoir	9:00 PM	9:52 PM	King Street	0:52	0:08	99	15	15.15%	114	8	107	7	6.54%	Evening
	King Street	10:00 PM	10:47 PM	Fort Belvoir	0:47	0:07									
	Fort Belvoir	10:54 PM													
SR27	King Street	4:00 PM	4:55 PM	Fort Belvoir	0:55	0:05	117	18	15.38%	135	8	125	10	8.00%	PM Peak
	Fort Belvoir	5:00 PM	6:02 PM	King Street	1:02	0:13									
	King Street	6:15 PM													
	Fort Belvoir	5:00 PM	6:02 PM	King Street	1:02	0:13	115	25	21.74%	140	8	123	17	13.82%	PM Peak/Evening
	King Street	6:15 PM	7:08 PM	Fort Belvoir	0:53	0:12									
	Fort Belvoir	7:20 PM													
SR28	King Street	4:36 PM	5:31 PM	Fort Belvoir	0:55	0:14	110	19	17.27%	129	8	118	11	9.32%	PM Peak
	Fort Belvoir	5:45 PM	6:40 PM	King Street	0:55	0:05									
	King Street	6:45 PM													
SR29	King Street	7:30 PM	8:23 PM	Fort Belvoir	0:53	0:07	105	15	14.29%	120	8	113	7	6.19%	Evening
	Fort Belvoir	8:30 PM	9:22 PM	King Street	0:52	0:08									
	King Street	9:30 PM													
	Fort Belvoir	8:30 PM	9:22 PM	King Street	0:52	0:08	99	21	21.21%	120	8	107	13	12.15%	Evening
	King Street	9:30 PM	10:17 PM	Fort Belvoir	0:47	0:13									
	Fort Belvoir	10:30 PM													
SR25	Fort Belvoir	3:15 PM	4:14 PM	King Street	0:59	0:10	114	21	18.42%	135	8	122	13	10.66%	PM Peak
	King Street	4:24 PM	5:19 PM	Fort Belvoir	0:55	0:11									
	Fort Belvoir	5:30 PM													
	King Street	7:00 PM	7:53 PM	Fort Belvoir	0:53	0:07	105	15	14.29%	120	8	113	7	6.19%	Evening
	Fort Belvoir	8:00 PM	8:52 PM	King Street	0:52	0:08									
	King Street	9:00 PM	9:47 PM	Fort Belvoir											
	Fort Belvoir	8:00 PM	8:52 PM	King Street	0:52	0:08	99	21	21.21%	120	8	107	13	12.15%	Evening
	King Street	9:00 PM	9:47 PM	Fort Belvoir	0:47	0:13									
	Fort Belvoir	10:00 PM	10:46 PM	King Street											

Saturday Layover Percentages – With and Without REX Line Extension

Block	Start Terminal	Trip Start Time	Trip End Time	End Terminal	Revenue Run Time	Layover Time	Current Round Trip Revenue Time (Minutes)	Layover Time	Current Layover Time as % of Revenue Time	Current Cycle time	Additional Revenue Time From Extension	New Revenue Time - Extension	Remaining Layover With No Schedule Change	New Layover as % of New Revenue Time
SR04	King Street	5:30 AM	6:14 AM	Fort Belvoir	0:44	0:16	82	38	46.34%	120	8	90	30	33.33%
	Fort Belvoir	6:30 AM	7:08 AM	King Street	0:38	0:22								
	King Street	7:30 AM												
	Fort Belvoir	6:30 AM	7:08 AM	King Street	0:38	0:22	84	36	42.86%	120	8	92	28	30.43%
	King Street	7:30 AM	8:16 AM	Fort Belvoir	0:46	0:14								
	Fort Belvoir	8:30 AM												
	King Street	10:00 AM	10:51 AM	Fort Belvoir	0:51	0:09	104	16	15.38%	120	8	112	8	7.14%
	Fort Belvoir	11:00 AM	11:53 AM	King Street	0:53	0:07								
	King Street	12:00 PM												
SR01	Fort Belvoir	5:00 AM	5:38 AM	King Street	0:38	0:22	82	38	46.34%	120	8	90	30	33.33%
	King Street	6:00 AM	6:44 AM	Fort Belvoir	0:44	0:16								
	Fort Belvoir	7:00 AM												
	King Street	6:00 AM	6:44 AM	Fort Belvoir	0:44	0:16	92	28	30.43%	120	8	100	20	20.00%
	Fort Belvoir	7:00 AM	7:48 AM	King Street	0:48	0:12								
	King Street	8:00 AM												
	Fort Belvoir	7:00 AM	7:48 AM	King Street	0:48	0:12	94	26	27.66%	120	8	102	18	17.65%
	King Street	8:00 AM	8:46 AM	Fort Belvoir	0:46	0:14								
	Fort Belvoir	9:00 AM												

Block	Start Terminal	Trip Start Time	Trip End Time	End Terminal	Revenue Run Time	Layover Time	Current Round Trip Revenue Time (Minutes)	Layover Time	Current Layover Time as % of Revenue Time	Current Cycle time	Additional Revenue Time From Extension	New Revenue Time - Extension	Remaining Layover With No Schedule Change	New Layover as % of New Revenue Time
SR02	Fort Belvoir	5:30 AM	6:08 AM	King Street	0:38	0:22	82	38	46.34%	120	8	90	30	33.33%
	King Street	6:30 AM	7:14 AM	Fort Belvoir	0:44	0:16								
	Fort Belvoir	7:30 AM												
	King Street	6:30 AM	7:14 AM	Fort Belvoir	0:44	0:16	92	28	30.43%	120	8	100	20	20.00%
	Fort Belvoir	7:30 AM	8:18 AM	King Street	0:48	0:12								
	King Street	8:30 AM												
	Fort Belvoir	7:30 AM	8:18 AM	King Street	0:48	0:12	94	26	27.66%	120	8	102	18	17.65%
	King Street	8:30 AM	9:16 AM	Fort Belvoir	0:46	0:14								
	Fort Belvoir	9:30 AM												
SR03	Fort Belvoir	6:00 AM	6:38 AM	King Street	0:38	0:22	82	38	46.34%	120	8	90	30	33.33%
	King Street	7:00 AM	7:44 AM	Fort Belvoir	0:44	0:16								
	Fort Belvoir	8:00 AM												
	King Street	7:00 AM	7:44 AM	Fort Belvoir	0:44	0:16	92	28	30.43%	120	8	100	20	20.00%
	Fort Belvoir	8:00 AM	8:48 AM	King Street	0:48	0:12								
	King Street	9:00 AM												
	Fort Belvoir	8:00 AM	8:48 AM	King Street	0:48	0:12	99	21	21.21%	120	8	107	13	12.15%
	King Street	9:00 AM	9:51 AM	Fort Belvoir	0:51	0:09								
	Fort Belvoir	10:00 AM												
SR10	King Street	3:30 PM	4:21 PM	Fort Belvoir	0:51	0:09	100	50	50.00%	150	8	108	42	38.89%
	Fort Belvoir	4:30 PM	5:19 PM	King Street	0:49	0:41								
	King Street	6:00 PM												
	Fort Belvoir	4:30 PM	5:19 PM	King Street	0:49	0:41	100	50	50.00%	150	8	108	42	38.89%
	King Street	6:00 PM	6:51 PM	Fort Belvoir	0:51	0:09								
	Fort Belvoir	7:00 PM												
SR11	King Street	1:30 PM	2:27 PM	Fort Belvoir	0:57	0:03	113	37	32.74%	150	8	121	29	23.97%
	Fort Belvoir	2:30 PM	3:26 PM	King Street	0:56	0:34								
	King Street	4:00 PM												

Block	Start Terminal	Trip Start Time	Trip End Time	End Terminal	Revenue Run Time	Layover Time	Current Round Trip Revenue Time (Minutes)	Layover Time	Current Layover Time as % of Revenue Time	Current Cycle time	Additional Revenue Time From Extension	New Revenue Time - Extension	Remaining Layover With No Schedule Change	New Layover as % of New Revenue Time
SR11	Fort Belvoir	2:30 PM	3:26 PM	King Street	0:56	0:34	107	43	40.19%	150	8	115	35	30.43%
	King Street	4:00 PM	4:51 PM	Fort Belvoir	0:51	0:09								
	Fort Belvoir	5:00 PM												
	King Street	4:00 PM	4:51 PM	Fort Belvoir	0:51	0:09	96	54	56.25%	150	8	104	46	44.23%
	Fort Belvoir	5:00 PM	5:45 PM	King Street	0:45	0:45								
	King Street	6:30 PM												
	Fort Belvoir	7:30 PM	8:15 PM	King Street	0:45	0:15	91	29	31.87%	120	8	99	21	21.21%
	King Street	8:30 PM	9:16 PM	Fort Belvoir	0:46	0:14								
	Fort Belvoir	9:30 PM												
SR12	King Street	2:00 PM	2:57 PM	Fort Belvoir	0:57	0:03	113	37	32.74%	150	8	121	29	23.97%
	Fort Belvoir	3:00 PM	3:56 PM	King Street	0:56	0:34								
	King Street	4:30 PM												
	Fort Belvoir	3:00 PM	3:56 PM	King Street	0:56	0:34	107	43	40.19%	150	8	115	35	30.43%
	King Street	4:30 PM	5:21 PM	Fort Belvoir	0:51	0:09								
	Fort Belvoir	5:30 PM												
	King Street	7:00 PM	7:46 PM	Fort Belvoir	0:46	0:14	91	29	31.87%	120	8	99	21	21.21%
	Fort Belvoir	8:00 PM	8:45 PM	King Street	0:45	0:15								
	King Street	9:00 PM												
SR13	King Street	2:30 PM	3:27 PM	Fort Belvoir	0:57	0:03	106	44	41.51%	150	8	114	36	31.58%
	Fort Belvoir	3:30 PM	4:19 PM	King Street	0:49	0:41								
	King Street	5:00 PM												
	Fort Belvoir	3:30 PM	4:19 PM	King Street	0:49	0:41	100	50	50.00%	150	8	108	42	38.89%
	King Street	5:00 PM	5:51 PM	Fort Belvoir	0:51	0:09								
	Fort Belvoir	6:00 PM												

Block	Start Terminal	Trip Start Time	Trip End Time	End Terminal	Revenue Run Time	Layover Time	Current Round Trip Revenue Time (Minutes)	Layover Time	Current Layover Time as % of Revenue Time	Current Cycle time	Additional Revenue Time From Extension	New Revenue Time - Extension	Remaining Layover With No Schedule Change	New Layover as % of New Revenue Time
SR13	King Street	7:30 PM	8:16 PM	Fort Belvoir	0:46	0:14	91	29	31.87%	120	8	99	21	21.21%
	Fort Belvoir	8:30 PM	9:15 PM	King Street	0:45	0:15								
	King Street	9:30 PM												
SR14	King Street	3:00 PM	3:57 PM	Fort Belvoir	0:57	0:03	106	44	41.51%	150	8	114	36	31.58%
	Fort Belvoir	4:00 PM	4:49 PM	King Street	0:49	0:41								
	King Street	5:30 PM												
	Fort Belvoir	4:00 PM	4:49 PM	King Street	0:49	0:41	100	50	50.00%	150	8	108	42	38.89%
	King Street	5:30 PM	6:21 PM	Fort Belvoir	0:51	0:09								
	Fort Belvoir	6:30 PM												
	King Street	8:00 PM	8:46 PM	Fort Belvoir	0:46	0:14	91	29	31.87%	120	8	99	21	21.21%
	Fort Belvoir	9:00 PM	9:45 PM	King Street	0:45	0:15								
	King Street	10:00 PM												

Sunday Layover Percentages – With and Without REX Line Extension

Block	Start Terminal	Trip Start Time	Trip End Time	End Terminal	Revenue Run Time	Layover Time	Current Round Trip Revenue Time (Minutes)	Layover Time	Current Layover Time as % of Revenue Time	Current Cycle time	Additional Revenue Time From Extension	New Revenue Time - Extension	Remaining Layover With No Schedule Change	New Layover as % of New Revenue Time
SR01	Fort Belvoir	5:00 AM	5:40 AM	King Street	0:40	0:20	80	40	50.00%	120	8	88	32	36.36%
	King Street	6:00 AM	6:40 AM	Fort Belvoir	0:40	0:20								
	Fort Belvoir	7:00 AM												
	King Street	6:00 AM	6:40 AM	Fort Belvoir	0:40	0:20	80	40	50.00%	120	8	88	32	36.36%
	Fort Belvoir	7:00 AM	7:40 AM	King Street	0:40	0:20								
	King Street	8:00 AM												
	Fort Belvoir	7:00 AM	7:40 AM	King Street	0:40	0:20	80	40	50.00%	120	8	88	32	36.36%
	King Street	8:00 AM	8:40 AM	Fort Belvoir	0:40	0:20								
	Fort Belvoir	9:00 AM												
	King Street	8:00 AM	8:40 AM	Fort Belvoir	0:40	0:20	85	35	41.18%	120	8	93	27	29.03%
	Fort Belvoir	9:00 AM	9:45 AM	King Street	0:45	0:15								
	King Street	10:00 AM	10:48 AM	Fort Belvoir										
	Fort Belvoir	9:00 AM	9:45 AM	King Street	0:45	0:15	93	27	29.03%	120	8	101	19	18.81%
	King Street	10:00 AM	10:48 AM	Fort Belvoir	0:48	0:12								
	Fort Belvoir	11:00 AM												
	Fort Belvoir	6:00 AM	6:40 AM	King Street	0:40	0:20	80	40	50.00%	120	8	88	32	36.36%
	King Street	7:00 AM	7:40 AM	Fort Belvoir	0:40	0:20								
	Fort Belvoir	8:00 AM												
SRO2	King Street	7:00 AM	7:40 AM	Fort Belvoir	0:40	0:20	80	40	50.00%	120	8	88	32	36.36%
	Fort Belvoir	8:00 AM	8:40 AM	King Street	0:40	0:20								
	King Street	9:00 AM												
	Fort Belvoir	8:00 AM	8:40 AM	King Street	0:40	0:20	80	40	50.00%	120	8	88	32	36.36%
	King Street	9:00 AM	9:40 AM	Fort Belvoir	0:40	0:20								
	Fort Belvoir	10:00 AM												
	Fort Belvoir	10:00 AM												

Block	Start Terminal	Trip Start Time	Trip End Time	End Terminal	Revenue Run Time	Layover Time	Current Round Trip Revenue Time (Minutes)	Layover Time	Current Layover Time as % of Revenue Time	Current Cycle time	Additional Revenue Time From Extension	New Revenue Time - Extension	Remaining Layover With No Schedule Change	New Layover as % of New Revenue Time
SR02	King Street	9:00 AM	9:40 AM	Fort Belvoir	0:40	0:20	85	35	41.18%	120	8	93	27	29.03%
	Fort Belvoir	10:00 AM	10:45 AM	King Street	0:45	0:15								
	King Street	11:00 AM												
	Fort Belvoir	10:00 AM	10:45 AM	King Street	0:45	0:15	93	27	29.03%	120	8	101	19	18.81%
	King Street	11:00 AM	11:48 AM	Fort Belvoir	0:48	0:12								
	Fort Belvoir	12:00 PM												
SR10	King Street	12:00 PM	12:48 PM	Fort Belvoir	0:48	0:12	101	22	21.78%	123	8	109	14	12.84%
	Fort Belvoir	1:00 PM	1:50 PM	King Street	0:50	0:10								
	King Street	2:00 PM												
	Fort Belvoir	1:00 PM	1:50 PM	King Street	0:50	0:10	102	18	17.65%	120	8	110	10	9.09%
	King Street	2:00 PM	2:52 PM	Fort Belvoir	0:52	0:08								
	Fort Belvoir	3:00 PM												
SR11	King Street	1:00 PM	1:52 PM	Fort Belvoir	0:52	0:08	102	18	17.65%	120	8	110	10	9.09%
	Fort Belvoir	2:00 PM	2:50 PM	King Street	0:50	0:10								
	King Street	3:00 PM												
	Fort Belvoir	2:00 PM	2:50 PM	King Street	0:50	0:10	102	18	17.65%	120	8	110	10	9.09%
	King Street	3:00 PM	3:52 PM	Fort Belvoir	0:52	0:08								
	Fort Belvoir	4:00 PM												
SR12	King Street	4:00 PM	4:51 PM	Fort Belvoir	0:51	0:09	97	23	23.71%	120	8	105	15	14.29%
	Fort Belvoir	5:00 PM	5:46 PM	King Street	0:46	0:14								
	King Street	6:00 PM												
	Fort Belvoir	5:00 PM	5:46 PM	King Street	0:46	0:14	97	23	23.71%	120	8	105	15	14.29%
	King Street	6:00 PM	6:51 PM	Fort Belvoir	0:51	0:09								
	Fort Belvoir	7:00 PM												
SR14	King Street	7:00 PM	7:44 PM	Fort Belvoir	0:44	0:16	90	30	33.33%	120	8	98	22	22.45%
	Fort Belvoir	8:00 PM	8:46 PM	King Street	0:46	0:14								

Appendix 3
Actual vs. Scheduled Run Time Comparison

Weekday Northbound Actual vs. Scheduled Run Time Comparison

Weekday Northbound Actual Run Time vs. Scheduled Run Time				
Trip Start	Scheduled Run Time	Actual Run Time	Difference	% Difference
5:00 AM	44	47.6	3.6	8.18%
5:15 AM	44	43.6	-0.4	-0.91%
5:30 AM	44	44.4	0.4	0.91%
5:45 AM	44	45.2	1.2	2.73%
5:57 AM	44	44.9	0.9	2.05%
6:09 AM	50	46.7	-3.3	-6.60%
6:19 AM	50	48.1	-1.9	-3.80%
6:29 AM	50	47.5	-2.5	-5.00%
6:39 AM	50	48.3	-1.7	-3.40%
6:49 AM	50	54.3	4.3	8.60%
7:00 AM	53	50.7	-2.3	-4.34%
7:12 AM	53	49.1	-3.9	-7.36%
7:24 AM	53	52.7	-0.3	-0.57%
7:36 AM	53	52.5	-0.5	-0.94%
7:48 AM	53	48.6	-4.4	-8.30%
8:00 AM	53	49.1	-3.9	-7.36%
8:15 AM	53	50.6	-2.4	-4.53%
8:30 AM	53	49	-4	-7.55%
8:45 AM	49	47.1	-1.9	-3.88%
9:00 AM	49	46.2	-2.8	-5.71%
9:20 AM	49	51.4	2.4	4.90%
9:40 AM	49	48.3	-0.7	-1.43%
10:00 AM	49	48.6	-0.4	-0.82%
10:30 AM	49	45.3	-3.7	-7.55%
11:00 AM	52	51.3	-0.7	-1.35%
11:30 AM	52	55.9	3.9	7.50%
12:00 PM	52	48.2	-3.8	-7.31%
12:30 PM	52	53.6	1.6	3.08%
1:00 PM	52	50.8	-1.2	-2.31%
2:00 PM	52	49.4	-2.6	-5.00%
2:20 PM	52	53	1	1.92%
2:40 PM	52	51.2	-0.8	-1.54%
3:00 PM	59	53.1	-5.9	-10.00%
3:15 PM	59	58.3	-0.7	-1.19%

Trip Start	Scheduled Run Time	Actual Run Time	Difference	% Difference
3:30 PM	59	58.2	-0.8	-1.36%
3:45 PM	59	55.9	-3.1	-5.25%
4:00 PM	62	62.9	0.9	1.45%
4:15 PM	62	60	-2	-3.23%
4:30 PM	62	60.6	-1.4	-2.26%
4:45 PM	62	59.5	-2.5	-4.03%
5:00 PM	55	58.3	3.3	6.00%
5:15 PM	55	56.1	1.1	2.00%
5:30 PM	55	54.7	-0.3	-0.55%
5:45 PM	55	55.2	0.2	0.36%
6:00 PM	55	51.4	-3.6	-6.55%
6:15 PM	55	55	0	0.00%
6:30 PM	55	50	-5	-9.09%
6:45 PM	52	48.1	-3.9	-7.50%
7:00 PM	52	46.8	-5.2	-10.00%

Weekday Southbound Actual vs. Scheduled Run Time Comparison

Weekday Southbound Actual Run Time vs. Scheduled Run Time				
Trip Start	Schedule	Actual	Difference	% Difference
5:35 AM	46	44	-2	-4.35%
5:50 AM	46	50.1	4.1	8.91%
6:05 AM	46	49.1	3.1	6.74%
6:20 AM	46	53.5	7.5	16.30%
6:35 AM	51	52.8	1.8	3.53%
6:50 AM	51	53.9	2.9	5.69%
7:05 AM	51	50.8	-0.2	-0.39%
7:20 AM	51	55.5	4.5	8.82%
7:35 AM	51	50.1	-0.9	-1.76%
7:50 AM	51	50.2	-0.8	-1.57%
8:05 AM	52	51.2	-0.8	-1.54%
8:20 AM	52	56.9	4.9	9.42%
8:40 AM	52	51.3	-0.7	-1.35%
9:00 AM	52	52	0	0.00%
9:30 AM	51	50.4	-0.6	-1.18%
10:00 AM	51	52.9	1.9	3.73%
10:30 AM	51	54.5	3.5	6.86%
11:00 AM	51	52.4	1.4	2.75%
11:30 AM	51	51.8	0.8	1.57%
12:00 PM	51	52.7	1.7	3.33%
12:30 PM	51	54.2	3.2	6.27%
1:00 PM	51	55.8	4.8	9.41%
1:20 PM	51	54.1	3.1	6.08%
1:40 PM	55	53.4	-1.6	-2.91%
2:00 PM	55	54.1	-0.9	-1.64%
2:20 PM	55	59.7	4.7	8.55%
2:40 PM	55	55.5	0.5	0.91%
3:00 PM	55	55.8	0.8	1.45%
3:15 PM	55	55.2	0.2	0.36%
3:30 PM	55	56	1	1.82%
3:45 PM	55	53.1	-1.9	-3.45%
4:00 PM	55	54.5	-0.5	-0.91%
4:12 PM	55	54.1	-0.9	-1.64%
4:24 PM	55	57.5	2.5	4.55%
4:36 PM	55	58.3	3.3	6.00%

Trip Start	Schedule	Actual	Difference	% Difference
4:48 PM	53	61.8	8.8	16.60%
5:00 PM	53	54.5	1.5	2.83%
5:12 PM	53	55.5	2.5	4.72%
5:24 PM	53	59	6	11.32%
5:36 PM	53	55.1	2.1	3.96%
5:48 PM	53	54.9	1.9	3.58%
6:00 PM	53	55.2	2.2	4.15%
6:15 PM	53	54.9	1.9	3.58%
6:30 PM	53	54.8	1.8	3.40%
6:45 PM	53	53.7	0.7	1.32%
7:00 PM	53	50.8	-2.2	-4.15%

Saturday Northbound Actual vs. Scheduled Run Time Comparison

Saturday Northbound Actual Run Time vs. Scheduled Run Time				
Trip Start	Scheduled Run Time	Actual Run Time	Difference	% Difference
5:00	38	37.9	-0.1	-0.26%
5:30	38	42.4	4.4	11.58%
6:00	38	41.1	3.1	8.16%
6:30	38	40.7	2.7	7.11%
7:00	48	46	-2	-4.17%
7:30	48	46.3	-1.7	-3.54%
8:00	48	46.1	-1.9	-3.96%
8:30	48	42.9	-5.1	-10.63%
9:00	48	48	0	0.00%
9:30	53	51.2	-1.8	-3.40%
10:00	53	51.9	-1.1	-2.08%
10:30	53	53.9	0.9	1.70%
11:00	53	48.6	-4.4	-8.30%
11:30	53	52.5	-0.5	-0.94%
12:00	53	55.1	2.1	3.96%
12:30	56	53.3	-2.7	-4.82%
13:00	56	51	-5	-8.93%
13:30	56	47.7	-8.3	-14.82%
14:00	56	54.3	-1.7	-3.04%
14:30	56	53.8	-2.2	-3.93%
15:00	56	53.5	-2.5	-4.46%
15:30	49	55.9	6.9	14.08%
16:00	49	54.9	5.9	12.04%
16:30	49	49.8	0.8	1.63%
17:00	45	48.4	3.4	7.56%
17:30	45	49.7	4.7	10.44%
18:00	45	56.4	11.4	25.33%
18:30	45	49.4	4.4	9.78%
19:00	45	45.7	0.7	1.56%
19:30	45	44.9	-0.1	-0.22%
20:00	45	47.1	2.1	4.67%

Saturday Southbound Actual vs. Scheduled Run Time Comparison

Saturday Southbound Actual Run Time vs. Scheduled Run Time				
Trip Start	Scheduled Run Time	Actual Run Time	Difference	% Difference
5:30 AM	44	41.6	-2.4	-5.45%
6:00 AM	44	42.3	-1.7	-3.86%
6:30 AM	44	43.4	-0.6	-1.36%
7:00 AM	44	40.4	-3.6	-8.18%
7:30 AM	46	49.3	3.3	7.17%
8:00 AM	46	43.5	-2.5	-5.43%
8:30 AM	46	48.9	2.9	6.30%
9:00 AM	51	45.6	-5.4	-10.59%
9:30 AM	51	52	1	1.96%
10:00 AM	51	50.9	-0.1	-0.20%
10:30 AM	51	51.1	0.1	0.20%
11:00 AM	51	54.2	3.2	6.27%
11:30 AM	57	55.5	-1.5	-2.63%
12:00 PM	57	53.3	-3.7	-6.49%
12:30 PM	57	55.2	-1.8	-3.16%
1:00 PM	57	52.3	-4.7	-8.25%
1:30 PM	57	59.3	2.3	4.04%
2:00 PM	57	54.2	-2.8	-4.91%
2:30 PM	57	57.2	0.2	0.35%
3:00 PM	57	54.6	-2.4	-4.21%
3:30 PM	51	51.2	0.2	0.39%
4:00 PM	51	52.9	1.9	3.73%
4:30 PM	51	51.5	0.5	0.98%
5:00 PM	51	57.8	6.8	13.33%
5:30 PM	51	54.9	3.9	7.65%
6:00 PM	51	50.2	-0.8	-1.57%
6:30 PM	46	48.8	2.8	6.09%
7:00 PM	46	45.3	-0.7	-1.52%
7:30 PM	46	54.4	8.4	18.26%
8:00 PM	46	47.1	1.1	2.39%

Sunday Northbound Actual vs. Scheduled Run Time Comparison

Sunday Northbound Actual Run Time vs. Scheduled Run Time				
Trip Start	Scheduled Run Time	Actual Run Time	Difference	% Difference
5:00 AM	40	38.6	-1.4	-3.50%
6:00 AM	40	40.3	0.3	0.75%
7:00 AM	40	42.6	2.6	6.50%
8:00 AM	40	43.7	3.7	9.25%
9:00 AM	45	42.8	-2.2	-4.89%
10:00 AM	45	45.3	0.3	0.67%
11:00 AM	45	46.2	1.2	2.67%
12:00 PM	50	46.2	-3.8	-7.60%
1:00 PM	50	53.3	3.3	6.60%
2:00 PM	50	55.1	5.1	10.20%
3:00 PM	50	48.3	-1.7	-3.40%
4:00 PM	50	50.4	0.4	0.80%
5:00 PM	46	48.5	2.5	5.43%
6:00 PM	46	46.5	0.5	1.09%
7:00 PM	46	44.3	-1.7	-3.70%
8:00 PM	46	42	-4	-8.70%
9:00 PM	46	48.9	2.9	6.30%

Sunday Southbound Actual vs. Scheduled Run Time Comparison

Sunday Southbound Actual Run Time vs. Scheduled Run Time				
Trip Start	Scheduled Run Time	Actual Run Time	Difference	% Difference
6:00 AM	40	42	2	5.00%
7:00 AM	40	38.9	-1.1	-2.75%
8:00 AM	40	41.3	1.3	3.25%
9:00 AM	40	42.1	2.1	5.25%
10:00 AM	48	46.2	-1.8	-3.75%
11:00 AM	48	45	-3	-6.25%
12:00 PM	48	50.3	2.3	4.79%
1:00 PM	52	54.1	2.1	4.04%
2:00 PM	52	51.6	-0.4	-0.77%
3:00 PM	52	52.1	0.1	0.19%
4:00 PM	51	52.9	1.9	3.73%
5:00 PM	51	50.7	-0.3	-0.59%
6:00 PM	51	53	2	3.92%
7:00 PM	44	52.4	8.4	19.09%
8:00 PM	44	50.2	6.2	14.09%
9:00 PM	44	42.4	-1.6	-3.64%

Appendix 4

Headway Separation Analysis

Weekday Northbound Headway Separation Analysis – Headway Separation at U.S. 1 and Ladson Lane

REX Line Weekday Northbound Service Headway Separation at U.S. 1 and Ladson Lane					
Trip Start	Trip Departure @ Ladson Lane	Scheduled Headway Separation	Actual Headway Separation from Previous Trip	Headway Separation Difference	Percent Difference from Scheduled Headway
5:00 AM	5:20:32 AM				
5:15 AM	5:35:37 AM	15:00	15:05	00:05	0.56%
5:30 AM	5:50:24 AM	15:00	14:47	00:13	1.44%
5:45 AM	6:05:51 AM	15:00	15:27	00:27	3.00%
5:57 AM	6:18:29 AM	12:00	12:38	00:38	5.28%
6:09 AM	6:31:07 AM	12:00	12:38	00:38	5.28%
6:19 AM	6:41:13 AM	10:00	10:06	00:06	1.00%
6:29 AM	6:50:22 AM	10:00	09:09	00:51	8.50%
6:39 AM	7:03:40 AM	10:00	13:18	03:18	33.00%
6:49 AM	7:13:45 AM	10:00	10:05	00:05	0.83%
7:00 AM	7:24:03 AM	11:00	10:18	00:42	6.36%
7:12 AM	7:36:10 AM	12:00	12:07	00:07	0.97%
7:24 AM	7:46:16 AM	12:00	10:06	01:54	15.83%
7:36 AM	7:58:12 AM	12:00	11:56	00:04	0.56%
7:48 AM	8:11:45 AM	12:00	13:33	01:33	12.92%
8:00 AM	8:22:02 AM	12:00	10:17	01:43	14.31%
8:15 AM	8:38:45 AM	15:00	16:43	01:43	11.44%
8:30 AM	8:52:13 AM	15:00	13:28	01:32	10.22%
8:45 AM	9:07:14 AM	15:00	15:01	00:01	0.11%
9:00 AM	9:25:14 AM	15:00	18:00	03:00	20.00%
9:20 AM	9:46:28 AM	20:00	21:14	01:14	6.17%
9:40 AM	10:03:20 AM	20:00	16:52	03:08	15.67%
10:00 AM	10:23:23 AM	20:00	20:03	00:03	0.25%
10:30 AM	10:51:01 AM	30:00	27:38	02:22	7.89%
11:00 AM	11:25:22 AM	30:00	34:21	04:21	14.50%
11:30 AM	11:56:35 AM	30:00	31:13	01:13	4.06%
12:00 PM	12:24:09 PM	30:00	27:34	02:26	8.11%

Trip Start	Trip Departure @ Ladson Lane	Scheduled Headway Separation	Actual Headway Separation from Previous Trip	Headway Separation Difference	Percent Difference from Scheduled Headway
12:30 PM	12:53:53 PM	30:00	29:44	00:16	0.89%
1:00 PM	1:24:48 PM	30:00	30:55	00:55	3.06%
1:30 PM	1:55:02 PM	30:00	30:14	00:14	0.78%
2:00 PM	2:28:30 PM	30:00	33:28	03:28	11.56%
2:20 PM	2:44:33 PM	20:00	16:03	03:57	19.75%
2:40 PM	3:06:12 PM	20:00	21:39	01:39	8.25%
3:00 PM	3:27:00 PM	20:00	20:48	00:48	4.00%
3:15 PM	3:43:21 PM	15:00	16:21	01:21	9.00%
3:30 PM	3:54:46 PM	15:00	11:25	03:35	23.89%
3:45 PM	4:09:55 PM	15:00	15:09	00:09	1.00%
4:00 PM	4:29:27 PM	15:00	19:32	04:32	30.22%
4:15 PM	4:42:37 PM	15:00	13:10	01:50	12.22%
4:30 PM	4:57:10 PM	15:00	14:33	00:27	3.00%
4:45 PM	5:11:39 PM	15:00	14:29	00:31	3.44%
5:00 PM	5:26:35 PM	15:00	14:56	00:04	0.44%
5:15 PM	5:39:42 PM	15:00	13:07	01:53	12.56%
5:30 PM	5:54:18 PM	15:00	14:36	00:24	2.67%
5:45 PM	6:09:10 PM	15:00	14:52	00:08	0.89%
6:00 PM	6:25:04 PM	15:00	15:54	00:54	6.00%
6:15 PM	6:39:06 PM	15:00	14:02	00:58	6.44%
6:30 PM	6:57:00 PM	15:00	17:54	02:54	19.33%
6:45 PM	7:09:10 PM	15:00	12:10	02:50	18.89%
7:00 PM	7:22:40 PM	15:00	13:30	01:30	10.00%
7:20 PM	7:43:06 PM	20:00	20:26	00:26	2.17%
7:40 PM	8:05:57 PM	20:00	22:51	02:51	14.25%

Note: Framework for identifying potential headway separation issues is if the difference between actual headway separation and scheduled headway separation is greater than 15%, this is tagged as a potential issue. These instances are highlighted in orange. Instances where actual headway separation is less than scheduled headway separation are highlighted in red.

This applies to all tables in Appendix 4.

Weekday Southbound Headway Separation Analysis – Headway Separation at U.S. 1 and Ladson Lane

REX Line Weekday Southbound Service Headway Separation at U.S. 1 and Ladson Lane					
Trip Start	Trip Departure @ Ladson Lane	Scheduled Headway Separation	Actual Headway Separation from Previous Trip	Headway Separation Difference	Percent Difference from Scheduled Headway
5:35 AM	5:59:40 AM				
5:50 AM	6:14:47 AM	15:00	15:07	00:07	0.78%
6:05 AM	6:28:47 AM	15:00	14:00	01:00	6.67%
6:20 AM	6:45:49 AM	15:00	17:02	02:02	13.56%
6:35 AM	6:59:32 AM	15:00	13:43	01:17	8.56%
6:50 AM	7:15:26 AM	15:00	15:54	00:54	6.00%
7:05 AM	7:28:37 AM	15:00	13:11	01:49	12.11%
7:20 AM	7:44:27 AM	15:00	15:50	00:50	5.56%
7:35 AM	7:59:26 AM	15:00	14:59	00:01	0.11%
7:50 AM	8:18:26 AM	15:00	19:00	04:00	26.67%
8:05 AM	8:30:57 AM	15:00	12:31	02:29	16.56%
8:20 AM	8:47:58 AM	15:00	17:01	02:01	13.44%
8:40 AM	9:04:32 AM	20:00	16:34	03:26	17.17%
9:00 AM	9:25:12 AM	20:00	20:40	00:40	3.33%
9:30 AM	9:53:40 AM	30:00	28:28	01:32	5.11%
10:00 AM	10:25:59 AM	30:00	32:19	02:19	7.72%
10:30 AM	10:56:13 AM	30:00	30:14	00:14	0.78%
11:00 AM	11:25:06 AM	30:00	28:53	01:07	3.72%
11:30 AM	11:54:57 AM	30:00	29:51	00:09	0.50%
12:00 PM	12:25:56 PM	30:00	30:59	00:59	3.28%
12:30 PM	12:56:58 PM	30:00	31:02	01:02	3.44%
1:00 PM	1:29:31 PM	30:00	32:33	02:33	8.50%
1:20 PM	1:52:51 PM	20:00	23:20	03:20	16.67%
1:40 PM	2:06:28 PM	20:00	13:37	06:23	31.92%
2:00 PM	2:27:59 PM	20:00	21:31	01:31	7.58%
2:20 PM	2:47:08 PM	20:00	19:09	00:51	4.25%
2:40 PM	3:06:17 PM	20:00	19:09	00:51	4.25%
3:00 PM	3:29:57 PM	20:00	23:40	03:40	18.33%
3:15 PM	3:41:54 PM	15:00	11:57	03:03	20.33%
3:30 PM	3:58:12 PM	15:00	16:18	01:18	8.67%
3:45 PM	4:12:13 PM	15:00	14:01	00:59	6.56%

Trip Start	Trip Departure @ Ladson Lane	Scheduled Headway Separation	Actual Headway Separation from Previous Trip	Headway Separation Difference	Percent Difference from Scheduled Headway
4:00 PM	4:27:44 PM	15:00	15:31	00:31	3.44%
4:12 PM	4:40:39 PM	12:00	12:55	00:55	7.64%
4:24 PM	4:53:06 PM	12:00	12:27	00:27	3.75%
4:36 PM	5:05:08 PM	12:00	12:02	00:02	0.28%
4:48 PM	5:17:20 PM	12:00	12:12	00:12	1.67%
5:00 PM	5:28:21 PM	12:00	11:01	00:59	8.19%
5:12 PM	5:41:32 PM	12:00	13:11	01:11	9.86%
5:24 PM	5:56:30 PM	12:00	14:58	02:58	24.72%
5:48 PM	6:16:12 PM	24:00	19:42	04:18	17.92%
6:00 PM	6:28:39 PM	12:00	12:27	00:27	3.75%
6:15 PM	6:44:06 PM	15:00	15:27	00:27	3.00%
6:30 PM	6:58:34 PM	15:00	14:28	00:32	3.56%
6:45 PM	7:12:45 PM	15:00	14:11	00:49	5.44%
7:00 PM	7:26:13 PM	15:00	13:28	01:32	10.22%
7:15 PM	7:40:50 PM	15:00	14:37	00:23	2.56%
7:30 PM	7:55:52 PM	15:00	15:02	00:02	0.22%
7:45 PM	20:12:47	15:00	16:55	01:55	12.78%

Saturday Northbound Headway Separation Analysis – Headway Separation at U.S. 1 and Ladson Lane

REX Line Weekday Northbound Service Headway Separation at U.S. 1 and Ladson Lane					
Trip Start	Trip Departure @ Ladson Lane	Scheduled Headway Separation	Actual Headway Separation from Previous Trip	Headway Separation Difference	Percent Difference from Scheduled Headway
5:00 AM	5:18:21 AM				
5:30 AM	5:51:01 AM	30:00	32:40	02:40	8.89%
6:00 AM	6:20:16 AM	30:00	29:15	00:45	2.50%
6:30 AM	6:53:09 AM	30:00	32:53	02:53	9.61%
7:00 AM	7:19:45 AM	30:00	26:36	03:24	11.33%
7:30 AM	7:51:50 AM	30:00	32:05	02:05	6.94%
8:00 AM	8:21:21 AM	30:00	29:31	00:29	1.61%
8:30 AM	8:52:50 AM	30:00	31:29	01:29	4.94%
9:00 AM	9:20:31 AM	30:00	27:41	02:19	7.72%
9:30 AM	9:51:43 AM	30:00	31:12	01:12	4.00%
10:00 AM	10:21:18 AM	30:00	29:35	00:25	1.39%
10:30 AM	10:55:08 AM	30:00	33:50	03:50	12.78%
11:00 AM	11:28:53 AM	30:00	33:45	03:45	12.50%
11:30 AM	11:52:20 AM	30:00	23:27	06:33	21.83%
12:00 PM	12:25:03 PM	30:00	32:43	02:43	9.06%
12:30 PM	12:52:28 PM	30:00	27:25	02:35	8.61%
1:00 PM	1:26:11 PM	30:00	33:43	03:43	12.39%
1:30 PM	2:00:26 PM	30:00	34:15	04:15	14.17%
2:00 PM	2:24:09 PM	30:00	23:43	06:17	20.94%
2:30 PM	2:54:55 PM	30:00	30:46	00:46	2.56%
3:00 PM	3:26:54 PM	30:00	31:59	01:59	6.61%
3:30 PM	3:56:19 PM	30:00	29:25	00:35	1.94%
4:00 PM	4:26:49 PM	30:00	30:30	00:30	1.67%
4:30 PM	4:51:56 PM	30:00	25:07	04:53	16.28%
5:00 PM	5:23:09 PM	30:00	31:13	01:13	4.06%
5:30 PM	5:53:04 PM	30:00	29:55	00:05	0.28%
6:00 PM	6:25:51 PM	30:00	32:47	02:47	9.28%
6:30 PM	6:55:17 PM	30:00	29:26	00:34	1.89%
7:00 PM	7:21:13 PM	30:00	25:56	04:04	13.56%
7:30 PM	7:50:28 PM	30:00	29:15	00:45	2.50%
8:00 PM	8:23:08 PM	30:00	32:40	02:40	8.89%

Saturday Southbound Headway Separation Analysis – Headway Separation at U.S. 1 and Ladson Lane

REX Line Weekday Southbound Service Headway Separation at U.S. 1 and Ladson Lane					
Trip Start	Trip Departure @ Ladson Lane	Scheduled Headway Separation	Actual Headway Separation from Previous Trip	Headway Separation Difference	Percent Difference from Scheduled Headway
5:30 AM	5:51:38 AM				
6:00 AM	6:23:52 AM	30:00	32:14	02:14	7.44%
6:30 AM	6:50:53 AM	30:00	27:01	02:59	9.94%
7:00 AM	7:20:19 AM	30:00	29:26	00:34	1.89%
7:30 AM	7:52:17 AM	30:00	31:58	01:58	6.56%
8:00 AM	8:21:26 AM	30:00	29:09	00:51	2.83%
8:30 AM	8:54:49 AM	30:00	33:23	03:23	11.28%
9:00 AM	9:22:24 AM	30:00	27:35	02:25	8.06%
9:30 AM	9:55:25 AM	30:00	33:01	03:01	10.06%
10:00 AM	10:26:27 AM	30:00	31:02	01:02	3.44%
10:30 AM	10:55:45 AM	30:00	29:18	00:42	2.33%
11:00 AM	11:25:57 AM	30:00	30:12	00:12	0.67%
11:30 AM	11:57:25	30:00	31:28	01:28	4.89%
12:00 PM	12:29:41 PM	30:00	32:16	02:16	7.56%
12:30 PM	12:58:50 PM	30:00	29:09	00:51	2.83%
1:00 PM	1:29:46 PM	30:00	30:56	00:56	3.11%
1:30 PM	1:58:25 PM	30:00	28:39	01:21	4.50%
2:00 PM	2:29:16 PM	30:00	30:51	00:51	2.83%
2:30 PM	2:59:54 PM	30:00	30:38	00:38	2.11%
3:00 PM	3:28:53 PM	30:00	28:59	01:01	3.39%
3:30 PM	3:57:57 PM	30:00	29:04	00:56	3.11%
4:00 PM	4:29:49 PM	30:00	31:52	01:52	6.22%
4:30 PM	4:55:12 PM	30:00	25:23	04:37	15.39%
5:00 PM	5:30:05 PM	30:00	34:53	04:53	16.28%
5:30 PM	6:01:02 PM	30:00	30:57	00:57	3.17%
6:00 PM	6:27:02 PM	30:00	26:00	04:00	13.33%
6:30 PM	7:02:15 PM	30:00	35:13	05:13	17.39%
7:00 PM	7:24:17 PM	30:00	22:02	07:58	26.56%
7:30 PM	7:57:48 PM	30:00	33:31	03:31	11.72%
8:00 PM	8:24:58 PM	30:00	27:10	02:50	9.44%
8:30 PM	8:53:24 PM	30:00	28:26	01:34	5.22%

Sunday Northbound Headway Separation Analysis – Headway Separation at U.S. 1 and Ladson Lane

REX Line Sunday Northbound Service Headway Separation at U.S. 1 and Ladson Lane					
Trip Start	Trip Departure @ Ladson Lane	Scheduled Headway Separation	Actual Headway Separation from Previous Trip	Headway Separation Difference	Percent Difference from Scheduled Headway
5:00 AM	5:18:16 AM				
6:00 AM	6:19:20 AM	1:00:00	1:01:04	01:04	1.78%
7:00 AM	7:20:03 AM	1:00:00	1:00:43	00:43	1.19%
8:00 AM	8:20:13 AM	1:00:00	1:00:10	00:10	0.28%
9:00 AM	9:19:47 AM	1:00:00	0:59:34	00:26	0.72%
10:00 AM	10:20:46 AM	1:00:00	1:00:59	00:59	1.64%
11:00 AM	11:20:57 AM	1:00:00	1:00:11	00:11	0.31%
12:00 PM	12:20:53 PM	1:00:00	0:59:56	00:04	0.11%
1:00 PM	1:22:05 PM	1:00:00	1:01:12	01:12	2.00%
2:00 PM	2:28:00 PM	1:00:00	1:05:55	05:55	9.86%
3:00 PM	3:20:18 PM	1:00:00	0:52:18	07:42	12.83%
4:00 PM	4:25:09 PM	1:00:00	1:04:51	04:51	8.08%
5:00 PM	5:24:09 PM	1:00:00	0:59:00	01:00	1.67%
6:00 PM	6:20:38 PM	1:00:00	0:56:29	03:31	5.86%
7:00 PM	7:21:50 PM	1:00:00	1:01:12	01:12	2.00%
8:00 PM	8:17:26 PM	1:00:00	0:55:36	04:24	7.33%

Sunday Southbound Headway Separation Analysis – Headway Separation at U.S. 1 and Ladson Lane

REX Line Sunday Southbound Service Headway Separation at U.S. 1 and Ladson Lane					
Trip Start	Trip Departure @ Ladson Lane	Scheduled Headway Separation	Actual Headway Separation from Previous Trip	Headway Separation Difference	Percent Difference from Scheduled Headway
6:00 AM	6:21:03 AM				
7:00 AM	7:19:54 AM	1:00	0:58:51	01:09	1.92%
8:00 AM	8:22:27 AM	1:00	1:02:33	02:33	4.25%
9:00 AM	9:21:42 AM	1:00	0:59:15	00:45	1.25%
10:00 AM	10:23:26 AM	1:00	1:01:44	01:44	2.89%
11:00 AM	11:21:51 AM	1:00	0:58:25	01:35	2.64%
12:00 PM	12:25:12 PM	1:00	1:03:21	03:21	5.58%
1:00 PM	1:25:30 PM	1:00	1:00:18	00:18	0.50%
2:00 PM	2:26:03 PM	1:00	1:00:33	00:33	0.92%
3:00 PM	3:27:00 PM	1:00	1:00:57	00:57	1.58%
4:00 PM	4:27:06 PM	1:00	1:00:06	00:06	0.17%
5:00 PM	5:29:42 PM	1:00	1:02:36	02:36	4.33%
6:00 PM	18:26:56	1:00	0:57:14	02:46	4.61%
7:00 PM	7:24:06 PM	1:00	0:57:10	02:50	4.72%
8:00 PM	8:26:18 PM	1:00	1:02:12	02:12	3.67%