CHARM CITY CIRCULATOR

OPERATIONS AND FINANCIAL ANALYSIS

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PREPARED BY:

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EXECUTIVE SUMMARY

Introduction

Louis Berger was tasked by the Baltimore City Department of Transportation (BCDOT) to evaluate the Charm City Circulator (CCC) bus operation and analyze financial performance, and develop route operations alternatives that maximize ridership while minimizing costs.

Objective

The objective is to develop and evaluate alternatives to eliminate the annual deficits while providing maximum service to riders within existing financial resources.

Description of Current System Existing Condition

The CCC consists of four routes, Purple, Orange, Green and Banner providing "Fast. Friendly. Free." service throughout downtown Baltimore 362 days per year, with hours of service varying by day type and by season.

Key characteristics of each route:

Purple Route- runs north - south from Federal Hill to Historic Mount Vernon. Ten (10) minute headways require six (6) buses to operate. Heaviest ridership of all the routes.

Orange Route- runs east – west from Historic Fell's Point and Harbor Point in the east beyond University of Maryland, Baltimore in the west. Ten (10) minute headways require five (5) buses to operate. Ridership is second best in the system.

Green Route- roughly U shaped route serves Johns Hopkins University Hospital East Baltimore Campus (JHUH) connecting south to Harbor Point and Harbor East, then northwest to park and ride lots, looping down near City Center then back around. Ten (10) minute headways require six (6) buses. Longest route, least productive in terms of riders.

Banner Route- angles southeast of the city past Federal Hill to Fort McHenry. Shortest route, reliably operates 20 minute headways with two (2) buses. Absolute ridership lower than the Green Route, ridership per bus, per hour higher. BCDOT was awarded a Federal grant to initiate and support Circulator service from downtown Baltimore to Fort McHenry for the Star Spangled War of 1812 bicentennial and related events; grant funding ended in 2014.

CCC started service in 2010. CCC is funded by a portion of the City parking tax (approximately $6 million per year), advertising and partnership funds (approximately $340,000 per year), and a grant from the Maryland Transit Administration (MTA) Locally Operated Transit Systems (LOTS) at $2 million per year through 2019.

The CCC fleet is comprised of 13 Design Line buses, purchased in 2009, 12 Orion buses, purchased in 2011 and 2012, and five (5) leased VanHool buses. Current operation requires 19 buses plus four (4) spares to run effectively. Design Line buses have had perpetual operating and maintenance problems; the manufacturer declared bankruptcy in 2013 and cannot provide parts. As of July, 2014 only 4 of 13 Design Line buses are in active service (the reason for the VanHool lease.)

Financial Status: The CCC expanded hours of service rapidly, as shown in Table 1 (summarized from BCDOT and BBMR reports). Operating costs fluctuated greatly due to contract provisions and unexpected expenses such as purchasing and leasing additional buses. The 2014 cumulative deficit of $11.63 million will continue to increase unless operating service hours are brought into balance with system revenues. Finding that optimum balance is the purpose of this study.

Table 1. CCC Summary Operating and Financial History

Category/ Year	2010	2011	2012	2013	2014
Annual Hours of Service	34,762	55,620	69,934	98,531	90,000*
Annual Operating Cost ($ in millions)	$3.91	$8.53	$15.16	$9.35	$9.96
Operating Surplus/ Deficit ($ in millions)	$4.99	$1.90	($7.02)	($10.21)	($11.63)

*Projected

Methodology

The travel time, headway and ridership operations analysis is presented in Section I of the report. The financial analysis is in Section 2. The study team worked closely with BCDOT and with Transdev, formerly Veolia, to obtain essential data. The analysis had six (6) major components:

1) Create and calibrate a detailed microsimulation traffic model for downtown Baltimore to test route changes and operational options and suggestions;

2) Investigate four (4) sample service days in-depth, examining riders, bus capacity, bus headways and travel times, and overall route performance;

3) Identify potential route adjustments (headway and route changes and stop consolidations); test the routes on the traffic model to determine travel time by time of day; and evaluate the impacts on buses required, riders and operating costs;

4) Develop packages of options; identify optimal combinations of alternatives that meet the objectives;

5) Conduct ancillary analyses on bus fleet operations (fuel and maintenance costs and fleet history), contract rates (benchmark analysis of comparable systems), bus lease versus bus purchase alternatives, synopsis of best practices for increasing bus advertising revenues, and overview of federal and state transit operating and capital grant programs;

6) Develop recommendations including financial implications of the recommended options.

1) Microsimulation Model

The study relied on a multimodal transportation model to test alternative bus routes, stop locations and consolidation, and bus lane priority enforcement. Louis Berger used the TransModeler™ Multimodal simulation software because it provides the ability to model bus routes based on actual traffic conditions. Louis Berger created the model and calibrated the traffic and transit operations, including more than 400 downtown area intersections. BCDOT will take ownership of the model at

the conclusion of the study, with training and six (6) months use of the software included. BCDOT can test transit and traffic operations options as desired.

2) Sample Service Days Analysis

The study analyzed service in depth for four (4) sample days: a summer weekday with Orioles service, a summer weekday without special events, a fall weekday and a Saturday. The analysis included bus ridership by route and by stop, including bus capacity along the route; bus operations including buses in service, route travel time by time of day and average headways and deviations from averages. Key finding are as follows:

Orange Route:

- Currently operates at approximately 14 minute headways most of the time.
- Buses are well-utilized but not typically overcrowded.

Green Route:

- Has the lowest number of riders per bus, per mile or per hour of any route.
- Western section (to park and rides) is less utilized than eastern section of route.
- Sample day headways averaged almost 19 minutes.

Purple Route:

- Currently operates at close to ten (10) minute headways most of the time; deviations primarily due to bus shortages.
- Capacity analysis demonstrates that ten (10) minute headways are necessary to support current ridership levels.

Banner Route:

- Currently operates at approximately 20 minute headways (on-line schedule states 15 minute headways.)
- Some excess capacity at 20 minute headways, operates reliably with two assigned buses.
- Service was initiated with funding for the Star Spangled Bi-Centennials (2012-2014). Funding now eliminated.

3) Potential Route Adjustments

Table 2 summarizes the adjustments evaluated for each route, including the abbreviations used in the optimization analysis (left hand column of Table 2). Maps of the potential route adjustments are illustrated in Figure E. 1, below, with full descriptions and analysis included in the Operations Analysis section of the report.

Figure E.1. Proposed Orange and Green Routes

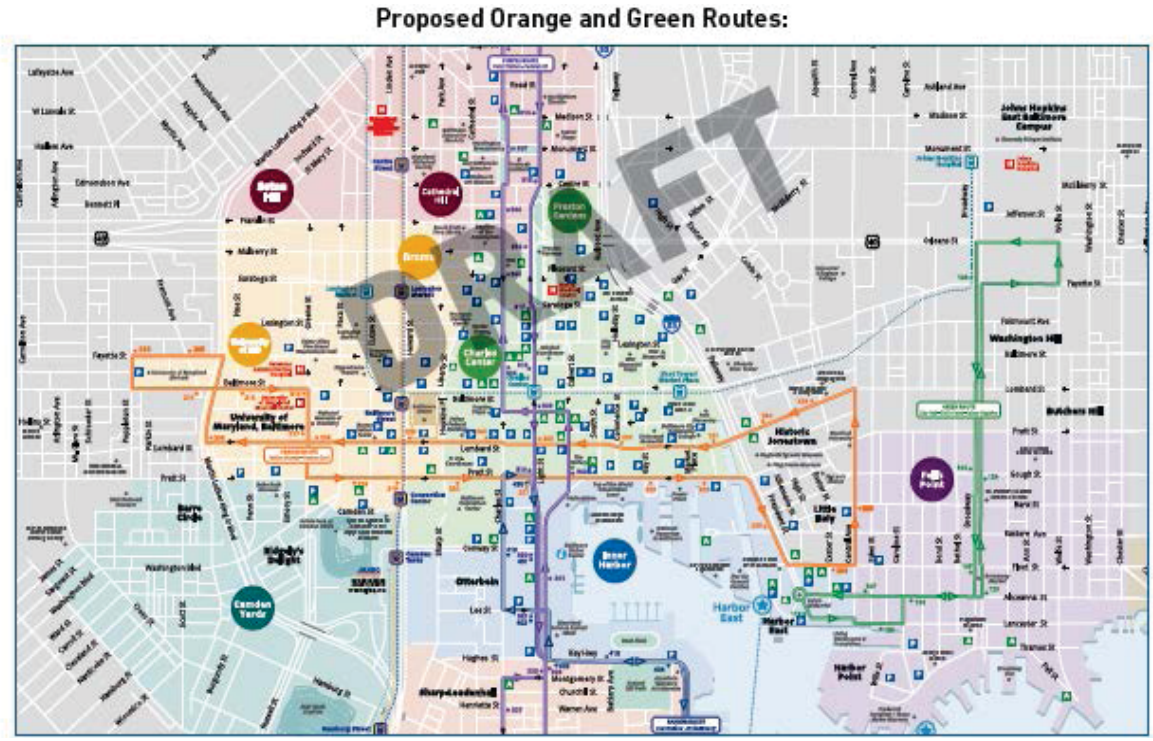

Table 2: Summary of Operating Routes and Service Options Evaluated

Abbreviation	Alternative Comparison		Number of Buses	Headway (minutes)	Annual Miles of Service	Annual Hours of Service	Estimated Annual Riders (in 000s)	Annual Riders per Annual Bus Mile	Annual Riders per Annual Bus Hour	Annual Cost (at projected 10 year average cost per hour including leases- $ in 000s)
										$ 108.670
	Orange Route									
OE	Existing @ 10 m hdwy	Existing	5	10	173,517	23,828	1,324.1	7.6	55.6	$ 2,589.334
O1	Existing @ 15 m hdwy std hrs	Alternative 1	5	15	110,891	22,769	1,287.0	11.6	56.5	$ 2,474.253
O2A	Short opt.1 @ 15 m hdwy	Alternative 2A	4	15	95,386	18,215	1,173.0	12.3	64.4	$ 1,979.402
O2B	Short opt.1 @ 20 m hdwy	Alternative 2B	3	20	71,540	13,661	1,006.9	14.1	73.7	$ 1,484.552
O3	Short opt.1 @ 15, fewer stops	Alternative 3	4	15	95,386	18,215	1,173.0	12.3	64.4	$ 1,979.402
O4	Short opt.1@ 15, enforce bus lanes	Alternative 4	6	15	95,386	27,322	1,173.0	12.3	42.9	$ 2,969.103
O5	Shortest opt.2 @ 15 m hdwy	Alternative 5	4	15	81,844	18,215	1,077.3	13.2	59.1	$ 1,979.402
	Green Route									
GE	Existing @ 10 m hdwy	Existing	6	10	206,071	28,593	789.2	3.8	27.6	$ 3,107.201
G1	Existing @ 20 m hdwy	Alternative 1	5	20	98,772	22,769	537.0	5.4	23.6	$ 2,474.253
G2A	Short opt.1 @ 15 m hdwy	Alternative 2A	4	15	102,648	18,215	545.4	5.3	29.9	$ 1,979.402
G2B	Short opt.1 @ 20 m hdwy	Alternative 2B	3	20	76,986	13,661	490.6	6.4	35.9	$ 1,484.552
G3	Short opt. 2 @ 15 m hdwy	Alternative 3	4	15	93,620	18,215	525.9	5.6	28.9	$ 1,979.402
G4A	Short opt.3 @ 15 m hdwy	Alternative 4A	3	15	76,348	13,661	489.3	6.4	35.8	$ 1,484.552
G4B	Short opt.3 @ 20 m hdwy	Alternative 4B	3	20	57,261	13,661	449.9	7.9	32.9	$ 1,484.552
G5	Short opt.4 @ 20 m hdwy	Alternative 5	2	20	44,160	9,107	423.5	9.6	46.5	$ 989.701
GC	Discontinuation of Green Route		0	0	-	-	-	-	-	$ -
	Purple Route									
PE	Existing @ 10 m hdwy	Existing	6	10	168,911	28,593	1,847.9	10.9	64.6	$ 3,107.201
P1	Existing @ 15 m hdwy	Alternative 1	4	15	107,947	18,215	1,428.4	13.2	78.4	$ 1,979.402
P2A	Extend @ 10 m hdwy	Alternative 2A	7	10	240,232	31,876	2,700.4	11.2	84.7	$ 3,463.954
P2B	Extend @ 15 m hdwy	Alternative 2B	6	15	160,155	27,322	2,131.8	13.3	78.0	$ 2,969.103
P3	No diversion, straight up Charles St. @ 10 m hdwy	Alternative 3	7	10	232,578	31,876	2,643.4	11.4	82.9	$ 3,463.954
P4A	Minor diversion from Charles St. @ 10 m hdwy	Alternative 4A	7	10	238,171	31,876	2,685.0	11.3	84.2	$ 3,463.954
P4B	Minor diversion from Charles St. @ 15 m hdwy	Alternative 4B	5	15	158,781	22,769	2,122.6	13.4	93.2	$ 2,474.253
	Banner Route									
BE	Existing @ 20 m hdwy	Existing	2	20	81,231	9,531	392.6	4.8	41.2	$ 1,035.734
B1	Existing @ 20 m hdwy std hrs	Alternative 1: Standard Hours	2	20	77,869	9,107	381.8	4.9	41.9	$ 989.701
B2	Existing @ 20 m hdwy 7 am- 7 pm	Alternative 2: 7am-7pm	2	20	67,225	8,472	348.7	5.2	41.2	$ 920.652
BC	Discontinuation of Banner Route		0	0	-	-	-	-	-	$ -

Key findings are as follows:

Orange Route:

- Has sufficient capacity to sustain 15 minute headways (essentially formalizing current operations) without undue crowding, saves one (1) bus (OE).
- Option 1 Route (shorter western loop around Biopark) tests include basic route at 15 minute and 20 minute headways (O2A, O2B)[1]; consolidating stops (O3) (minor time savings); and enforcing bus lanes (O4) (no time savings). Twenty (20) minute headways evaluated on this shorter route (O2B) results in some crowding, some loss in riders, saves two (2) buses. Similar results expected to apply to other Orange Route options.
- Option 2 Route tested a shorter route with the western edge at Martin Luther King Jr. Boulevard and the eastern edge at Central Avenue with 15 minute headways (O5). Would save two buses at 20 minute headways, but was not tested, modeled or included in optimization.

Green Route:

- Buses have excess capacity and can sustain 15 minute (G2A, G3, G4A) or 20 minute (G1, G2B, G4B, G5) headways. Twenty minute headway saves one (1) to four (4) buses from current operations, depending on the option.
- Long route, low productivity warrants reconfigured, shorter route. Four options tested: 1) Counterclockwise route between downtown Baltimore, Harbor East, and JHUH (G2A, G2B); 2) Counterclockwise route as in G2A with the Maritime Park loop removed (G3); 3) north/south route along Broadway from JHUH to Aliceanna Street and west to Harbor East (G4A, G4B), and 4) truncated Green Route (requiring only 2 buses with a 20 minute headway) – going northbound on Broadway the route turns east at Orleans Street then south, back to Harbor East (G5).
- Discontinuation of the Green Route considered (GC).

Purple Route:

- A northern extension has been proposed for the Purple Route. Louis Berger was asked to evaluate it. Riders were estimated for each new proposed stop based on similar and nearby stops on the Purple Route, as documented in the Operations Analysis. Based on the evaluation, the northern loop would be well utilized if it were implemented (P2A).
- Travel times for the route (existing and with the extension) including the northern loop were estimated using the calibrated multimodal simulation model. Based on the evaluation, the northern extension can be operated with one additional bus, rather than the two buses that had been identified in proposals (P2A). Evening peak hour buses may experience delay and require monitoring and potential cost-effective interventions.
- Ten (10) minute and 15 minute headways were evaluated. 15 minute headways result in severe overcrowding and people being unable to board the bus (P1, P2B and P4B).

[1] The Orange Route was modeled along Caroline Street rather than Central Avenue. It is anticipated that the time savings and ridership impacts from the proposed change to Central Avenue would be modest.

- Two (2) additional route options were tested – one straight up Charles Street (P3), one diverting from Charles Street only to the Visitor Center for two (2) blocks (P4A, P4B) to avoid congested northbound traffic conditions on Light Street and Calvert Street. Time savings identified can only save a bus with 15 minute headways- not recommended.

Banner Route:

- Tested for standard hours (B1).
- Tested operating from 7 a.m. to 7 p.m. – modest savings, minimal rider impact (B2).
- Discontinuation of the Banner Route considered (BC).

Note: the proposal to operate year-round is included for all recommendations and all routes. The year round service hours are: 7 a.m.-8 p.m. Monday-Thursday; 7am-Midnight, Friday; 9am-12am, Saturday; 9a.m.-8p.m. Sunday.

4) Optimization Assessment

Alternatives within each route were combined into discrete sets and ranked to maximize riders and minimize operating hours and costs. The range of combined hours for a valid option was set at 50,000 hours to 72,000 hours per year to test a range of alternatives balancing long term sustainability with service. The optimization analysis created numerous combinations of route options within the established parameters. They are ranked based on passengers per hour. The full optimization table is included as Attachment 2 to the Executive Summary (will be an Appendix in the full report.) Ridership estimates range from approximately 4.7 million per year to approximately 2.1 million per year. (CCC carried approximately 4.35 million riders in 2014.)

The recommended Alternative combinations provided in Table 3 below were selected by choosing the highest ridership option from among the combinations generated for each set of hours, while presenting distinct options. Annual hours estimates within the threshold ranges occur in unique categories as shown in Table 3. The abbreviations match the descriptions and abbreviations in Table 2.

Overview of Top-Performing Route Alternatives in the Optimization Evaluation

O2B- Shortened Orange Route at 20 minute headways (3 buses)

O2A- Shortened Orange Route at 15 minute headways (4 buses)

P2A- Purple Route 33rd Street extension at 10 minute headways (7 buses)

G5- Shortest Green route alternative (Harbor East to Orleans Street) at 20 minute headways (2 buses). As noted, the Green Route is the currently the poorest-performing route in the system. The restructured alternative G5 route serves core areas and reduces duplication with the Orange Route.

B1- Banner Route at 20 minute headways (2 buses)

Table 3. Alternative Combinations Selected Based on Maximum Ridership for Each Set of Hours

Alternative	Service Description				Annual Hours of Service	Estimated Annual Riders (in 000s)	Annual Riders per Annual Bus Hour	Average Annual CCC Expenditures (including bus leases)
	Orange	Green	Purple	Banner				
1	O2B	G5	P2A	B1	63,752	4,512,600.0	70.8	$ 6,453,163.86
2	O2A	GC	P2A	BC	50,091	3,873,400.0	77.3	$ 4,914,842.22
3	O2B	GC	P2A	B1	54,644	4,089,100.0	74.8	$ 5,402,496.77
4	O2A	G5	P2A	BC	59,198	4,296,900.0	72.6	$ 5,965,509.31
5	O2A	G5	P2A	B1	68,306	4,678,700.0	68.5	$ 6,953,464.83

Comparisons of Alternatives:

Alternative 1 preserves core portions of all four routes, while increasing headways where feasible and reducing or eliminating redundant or less productive segments of specific routes to significantly reduce cost. This option eliminates annual deficits through 2019. This provides a healthy cumulative surplus for the 2016-2024 time periods (approximately $5 million).

Pros:

- Maximizes savings with minimal service impact.
- Headway adjustments are less complicated and disruptive to the customer: Purple Route- 10 minute headways. All other routes: 20 minute headways.
- Reduces overall annual cost by approximately $3.4 million
- Retains 70% of overall level of service.
- Restructures existing routes to create consistently higher passenger capacity loads and efficiency.

Cons:

- Reduces revenue service hours by thirty percent (30%) and will require additional negotiations with the current operator.
- Route changes and longer headways will potentially cause decreased loss in ridership and travel challenges.
- Does not eliminate the cumulative (pre-2015) deficit.
- Public perception.

Alternative 2 is the preferred alternative. It continues operation of the two best-performing routes, Purple and Orange, at 10 minute and 15 minute headways respectively. To maintain this higher level of service, at the lowest hours of any of the options considered, it eliminates both the Green and Banner Routes. This option eliminates annual deficits and the cumulative deficit by 2024 and generates a financial surplus.

Pros:

- Eliminate redundancy of transit services; Johns Hopkins Hospital shuttle and MTA bus Route 10 & 15 operate along the Broadway corridor (Green Route). Existing MTA bus routes saturate the area, and the subway has stops nearby.
- Harbor East continues to be accessible via the Orange Route and MTA Bus Route 31; there are still viable transit options.
- The Star Spangled celebration is complete; visitors to Fort McHenry have the option of using the Harbor Connector water shuttles and MTA Bus Route 1. The funding to subsidize the Banner Route for the celebration has ended; continuing the service without continued dedicated funding sets a poor precedent for other services.
- MTA Bus Routes 1 and 64 serve the Federal Hill area.
- The loss in ridership is offset by the total operating savings due to the elimination of the routes.

Cons:

- Negative reactions from businesses and residents who rely on the service.
- Increase in vehicular traffic in the Harbor East area as well as Fells Point and Federal Hill.
- Reduced access to transit services. Fewer connections and destinations available from the Orange and Purple Routes.
- Less visibility throughout the city, primarily the Central Business District.
- Ends service to an iconic visitor site in Baltimore- Ft. McHenry- as well as Federal Hill neighborhood.

Alternatives 3 through 5 range from trimming service to cutting service. They provide a clear spectrum of choices and trade-offs between service levels (hours and buses), and riders, which play out in operating costs and long-term annual surpluses or deficits. Alternative 5 is rejected because it presents the highest risk of additional deficits of all the alternatives. It achieves a modest cumulative surplus for the 2016 to 2024 period, but latter year deficits demonstrate that this level of service is not sustainable for the long run, under current funding.

Alternatives 3 and 4 are less desirable than preferred alternative 2 because they operate at higher cost. The shortened Green Route and the Banner Route operate at basically the same cost, at two buses apiece, with comparable numbers of riders, but serving very different areas. The loss of dedicated Banner Route funding makes the Banner Route a reasonable candidate for elimination, since the service would not have been initiated without such funding. Alternatives 3 and 4 are somewhat less desirable to the City than Alternative 5, because, while they reduce the cumulative deficits more than Alternative 1, they do not completely eliminate the cumulative deficit, as does Alternative 5.

Cautionary Note on Ridership Forecasts and Option Rankings

Ridership estimates are based on past route performance. Estimates are particularly challenging when service is increasing or decreasing by adjusting route configuration or headways. A formal ridership study was not part of this study (e.g., no demographic or origin-destination analysis was undertaken.)

The key finding is that annual hours and buses must be limited to the parameters decided and agreed upon, unless additional stable funding is secured. Tradeoffs are required among routes, in order to achieve a sustainable system. The number of riders per hour is a reasonable metric for ranking options, but should not necessarily be the sole decision criteria.

5) Ancillary Analyses

The study team conducted ancillary analyses on bus fleet operations (fuel and maintenance costs and fleet history), contract rates (benchmark analysis of comparable systems), bus lease versus bus purchase alternatives, synopsis of best practices for increasing bus advertising revenues, and overview of federal and state transit operating and capital grant programs, to support the full analyses. The analyses are described in depth in the Operations and Financial analyses, with brief highlights of the most relevant findings reported here.

Bus Fleet Operations Analysis: The Design Line buses are in worse condition than anticipated in the BBMR report. Only four (4) are currently in service, and even those are difficult to keep in service. Louis Berger recommends taking the Design Line buses out of service as quickly as possible and replacing them with additional leased buses for now, up to the number required for service plus 20 percent spare allowance. In the long term, Federal and/or state capital grants may become available; however the financial analysis assumes lease buses through 2024, including for the replacement of the Orion buses when they reach the end of their useful lives in 2023 and 2024.

Benchmark Operating Cost Assessment: Louis Berger evaluated National Transit Database records to identify bus systems comparable to the CCC in terms of size of fleet, physical size of buses, contractual service status, and service characteristics such as operating speed. Of the 11 comparable systems, CCC's operating cost per hour was in the middle of the range. The analysis may prove useful in evaluating the proposed new operating contract.

The other three analyses are primarily intended as technical references for BCDOT staff.

6) Develop recommendations including financial implications of the recommended options.

The financial summary of the five alternatives is provided in Table 4. The abbreviations in the Service Description are the same as those identified in Table 2.

Table 4. Financial Comparison of Operating Alternatives

Alternative	Operational Metrics			Average 2016-2024		Surplus/ Deficit 2024 Status		Service Description			
	Annual Hours	Buses including spares	Est. Annual Riders	Average Annual CCC Expenditures (including bus leases)	Average Annual Surplus/ Defict	Cumulative Surplus/ Deficit 2016-2024	Cumulative Surplus /Deficit 2009-2024	Orange	Green	Purple	Banner
1	63,752	17	4,512,600	$6,453,164	$546,706	$4,920,353	($9,596,799)	O2B	G5	P2A	B1
2	50,091	13	3,873,400	$4,914,842	$2,085,028	$18,765,248	$4,248,096	O2A	GC	P2A	BC
3	54,644	14	4,089,100	$5,402,497	$1,597,373	$14,376,357	($140,795)	O2B	GC	P2A	B1
4	59,198	16	4,296,900	$5,965,509	$1,034,360	$9,309,244	($5,207,908)	O2A	G5	P2A	BC
5	68,306	18	4,678,700	$6,953,465	$46,405	$417,645	($14,099,507)	O2A	G5	P2A	B1

Key assumptions are as follows:

Revenues

- Parking Tax Revenue estimates are consistent with the BBMR Report. Annual increases are reflected at 1.5% per year. The baseline and alternatives considered here do not include a parking tax or any other funding increase.
- Harbor Connector costs are subtracted from the Parking Revenues prior to analyzing CCC operations and fund balances.
- The Local Operated Transit Systems (LOTS) Funding grant from MDOT was established at $2.0 Million annually for 6 years until 2019 and is not assumed to be renewed.
- Minor funding sources (advertising, partnership grants) are consistent with recent experience and the BBMR Report.

Expenditures

- Operator costs per hour are assumed to increase consistent with BBMR forecasts, without adjusting for potential savings in a new contract.
- The alternatives assume that the Design Line buses are retired or scrapped; leases are included in the costs through 2024 to supplement the fleet as needed. [2] When the Orion buses reach their useful lives of 12 years in 2023 and 2024 additional lease costs are included in the analysis for replacement.
- Average annual CCC expenditures in Table 4 are calculated on the hours and lease costs for the CCC alternatives.

[2] The lease option is intended as a conservative placeholder for bus procurement. It is recommended that BCDOT work with MTA and the Federal Transit Administration to establish a regular capital grant funding program and cycle, to fund major refurbishments as well as bus purchases and facilities.

Summary Recommendations

- Preliminary Operating Recommendation (Alternative 2):
    - Shorten Orange Route slightly and choose headway at 15 minutes (O2A).
    - Eliminate Green Route (GC).
    - Extend Purple Route on northern loop with one bus, maintain ten (10) minute headway (P2A).
    - Eliminate Banner Route (BC).
- Prepare to retire or scrap the Design Line buses
- Establish RFP for mid-term lease for buses to meet Alternative 1 fleet requirements
- Establish competitive new RFP for operations- key features
    - Institute NTD reporting
    - Require transparent and accessible monitoring and reporting for bus operations (headways, on-time performance, customer relations) and finances to increase reliability and accountability, and improve the rider experience
    - Expectations for service levels- establish the preferred level of service for long term stability with the flexibility to expand at predictable rates if new partnerships and/or funding sources are established
- Explore long term capital grant funding potential for buses with FTA and MTA; confirm operating eligibility
- Implement 3rd Party Partnerships, with agreements on incremental funding where service is provided.
- Carefully monitor operations, finances and ridership; adjust service if necessary to maintain financial sustainability and customer and partner satisfaction.

Keep the Circulator Fast. Friendly. Free. AND Financially Sound!

CHARM CITY CIRCULATOR

SECTION 1
OPERATIONS ANALYSIS

Louis Berger

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BALTIMORE CITY

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I. INTRODUCTION

Known for its fast, friendly, and free service, the Charm City Circulator (CCC) provides frequent transit service through a network of four (4) routes linking critical parts of Baltimore City. The service is provided by the City of Baltimore Department of Transportation (BCDOT) through a contract with Transdev, formerly Veolia, which operates, maintains, and dispatches the service.

The Charm City Circulator was launched to achieve the following objectives:

1. Encourage those who drive around the downtown area to park once and use the Circulator to move around the CBD, reducing the number of trips taken in single occupant vehicles, thereby reducing automobile congestion and accompanying pollution; hence the fare free aspect of this effort.
2. Encourage residents who live in one area of the city, such as Federal Hill, and work in another, such as Harbor East, to use the Circulator in place of driving.
3. Connect growing neighborhoods, and encourage residents, employees, and visitors to travel to areas they might not otherwise visit.
4. Diversify the existing supply of parking by connecting employees to fringe parking that is often cheaper. Encouraging drivers to park on the fringes of downtown will improve traffic flow on some congested streets.

The service is free, and the funding for this system depends on a number of sources. Costs for the service have outpaced the funding leading to a substantial deficit. Future operation is dependent on the following:

- Reducing the operating costs to manageable level, and
- Selecting a CCC bus operator for the next five (5) to seven (7) years through a competitive request for proposals (RFP) process.

To help BCDOT achieve these goals, Louis Berger was retained to prepare this Charm City Circulator Study. The report contains an overview of the existing operating conditions, develops operational alternatives, provides an operational alternatives analysis, examines existing financial conditions, develops financial alternatives, provides a financial alternatives analysis, and makes recommendations. The existing operational conditions review four (4) sample days covering summer (when most schools are not in session), non-summer (when most schools are in session), weekend and non-weekend, and event and non-event conditions to examine travel time, headway, and boardings and alightings, and to track bus service chronology. The development of operational alternatives explores various route changes, route extensions, new stops, removal of stops, and stop consolidation. The analysis relies on a transportation model covering the CCC bus network to provide the travel time and ridership results.

The existing financial conditions section of the report reviews the overall financial status of the system as documented in the Department of Finance, Bureau of the Budget and Management Research (BBMR) report released by the City November 27, 2014. It then reviews existing fleet characteristics, including maintenance, vehicle availability, and fuel efficiency, as they affect the prior and future financial status of the Circulator service. The report includes a discussion of recommended options related to the bus fleet to increase the reliability of service and reduce the overall cost of future service. It also provides a benchmark analysis of comparable systems in terms of fleet size, vehicle type, "purchased transportation" (contractual) status, and other key parameters, with comparisons of average operating costs per hour. Finally, the report provides a summary of five (5) scenarios implementing varying degrees of service modifications to achieve financial sustainability within existing funding constraints.

The appendices to the Financial Conditions report include recommended resources and templates pertaining to life cycle costs and bus procurement, excerpts from key resources on methods for maximizing bus advertising revenue, and introductory materials on reporting requirements for the National Transit Database (NTD). The draft proposed new Operator RFP is provided under separate cover.

II. EXISTING CONDITIONS

A. Introduction

The Charm City Circulator is a free bus service that provides convenient access to some of the most vibrant areas of Baltimore, Maryland. The circulator connects seven (7) neighborhoods in downtown Baltimore to various landmarks, including the harbor, the University of Maryland – Baltimore, Johns Hopkins, Penn Station, and Oriole Park at Camden Yards. It also connects residents and visitors to subway stations, light rail stops, and commuter rail lines, which in turn connect residents to various employment hubs. There are four (4) main routes currently in operation—the Banner Route, Green Route, Orange Route, and Purple Route. This study looks at all four (4) routes and summarizes the daily operations through a collection of performance measures.

The data used in the study were sourced from NextBus. NextBus is a cloud-based system that provides transit passenger information in real time to more than 135 transit agencies. NextBus tracks the movement of buses and provides the recurring data for use by both transit users and transit agencies.

The data was collected during four (4) full operating days in 2014, with the intention of portraying a diverse array of operating environments. The following days were studied:

- July 16, 2014—a summer weekday with no major events

- August 16, 2014—a summer Saturday with no major events
- September 16, 2014—a fall weekday after schools were in session with a Baltimore Orioles' home game at 7 PM
- September 18, 2014—a fall weekday after schools were in session with no major events

Four (4) main metrics are presented in this study, including *Boardings and Alightings*, *Headways*, *Capacity*, and *Travel Time*.

Boardings and Alightings are a count of riders that enter and exit a bus at each stop. This metric can be used to track how many people are on the bus at any given time. It can also be used to identify which times of the day have the most riders.

Headways are the time between each bus at a given bus stop. The shorter the headway, the more convenient the system is for users. However, shorter headways also mean a greater expense for agencies, due to the additional level of operations required.

Capacity looks at the level of occupancy on a bus during various sections of the route and periods of the day. When a bus reaches capacity, it can no longer pick up new passengers.

Finally, *travel time* is the measure of time between an origin and destination. In this case, the travel time is used to measure how long it takes a bus to complete one rotation of a circulator route. It also looks at how travel times may vary given the circumstances or the time of day.

This information is used to create a snapshot of the existing system. It helps to answer questions such as:

- How long does a rider have to wait between buses?
- How reliable are the expected wait times?
- How long does it take to travel between locations?
- Are the buses being allocated efficiently based on usage?

The answers to these questions allow for informed planning and programming, which leads not only to more efficient transit operations, but also to a transit system that is better able to meet the needs of its users.

B. Fleet Bus Daily Operations

This report begins by a simple analysis of the buses in operation on the four (4) days observed in the analysis. Based on the scheduled headways, 19 buses are required to operate throughout any given day of operations. The distribution of buses results in two (2) buses on the Banner Route, six (6) buses on the Green Route, six (6) buses on the Purple Routes, and five (5) buses on the

Orange Route. Figure 1 illustrates the actual number of buses used on the designated days in the study. It is clear that 19 buses were not being operated on these days. The reason for this deficit is unclear, although it is reasonable to assume that it may be because some buses were undergoing maintenance and were not operational. The Purple and Green Routes are only at the set level of buses on one of the observed days. The Orange Route experiences two (2) days at the set level of buses and two (2) days with one (1) bus not operating, and the Banner Route runs at the set level of two (2) buses for all four (4) days. The effect that these shortages may have on operations is unclear at this point in the analysis.

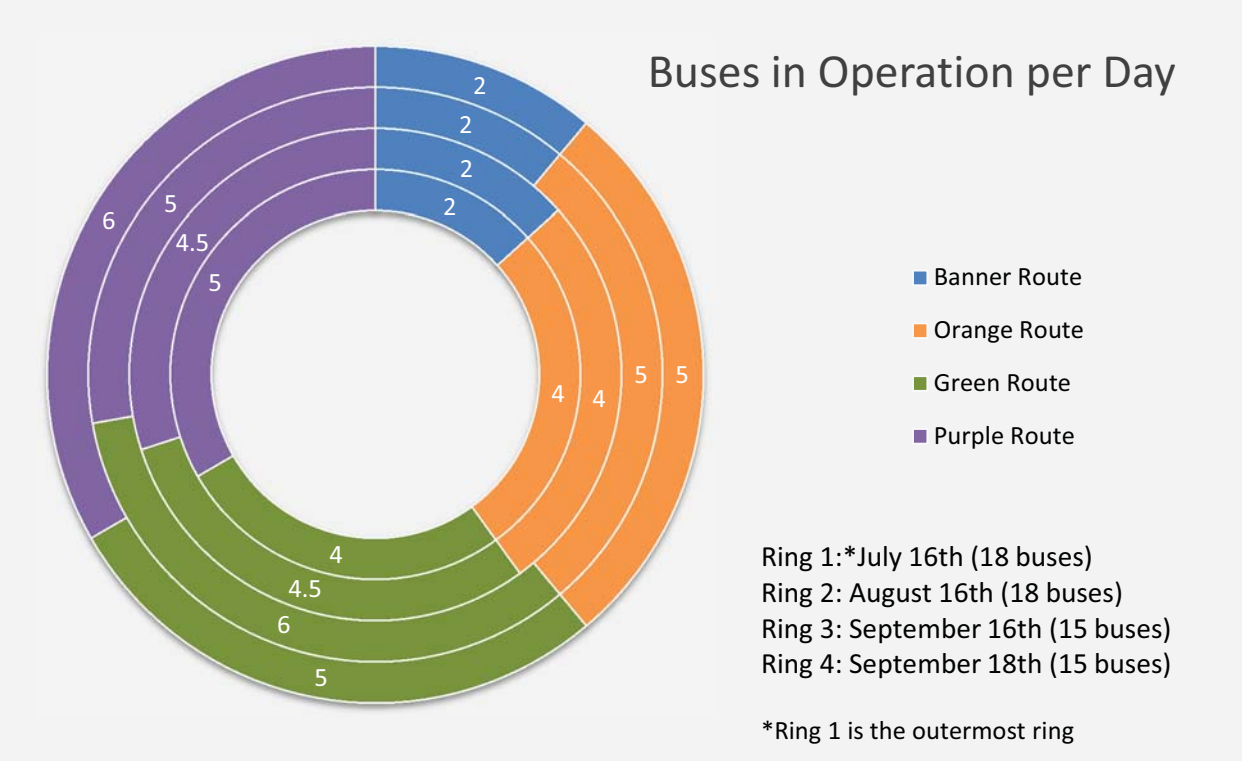

Figure 1. Buses in Operation per Day

DATA AND ANALYSIS

Boardings and Alightings

Hourly

Boardings and alightings, as described in the introduction, are a tally of passengers who enter and exit a bus. Passenger counts were separated by hour from 7:00 AM to 9:00 PM. The weekdays (July 16, September 16, and September 18) are shown in color and the Saturday (August 16) is shown in black. These data identify the peak usage of individual bus lines and help determine the level of activity at individual stops.

Figure 2 shows passenger counts on the Banner Route. There was no consistent AM peak, but there was a PM peak between the hours of 4:00 and 7:00 PM. The route averaged 150 boardings per hour during this peak. Additionally, it had the lowest average weekday volume of

all the routes, at 81 riders per hour.

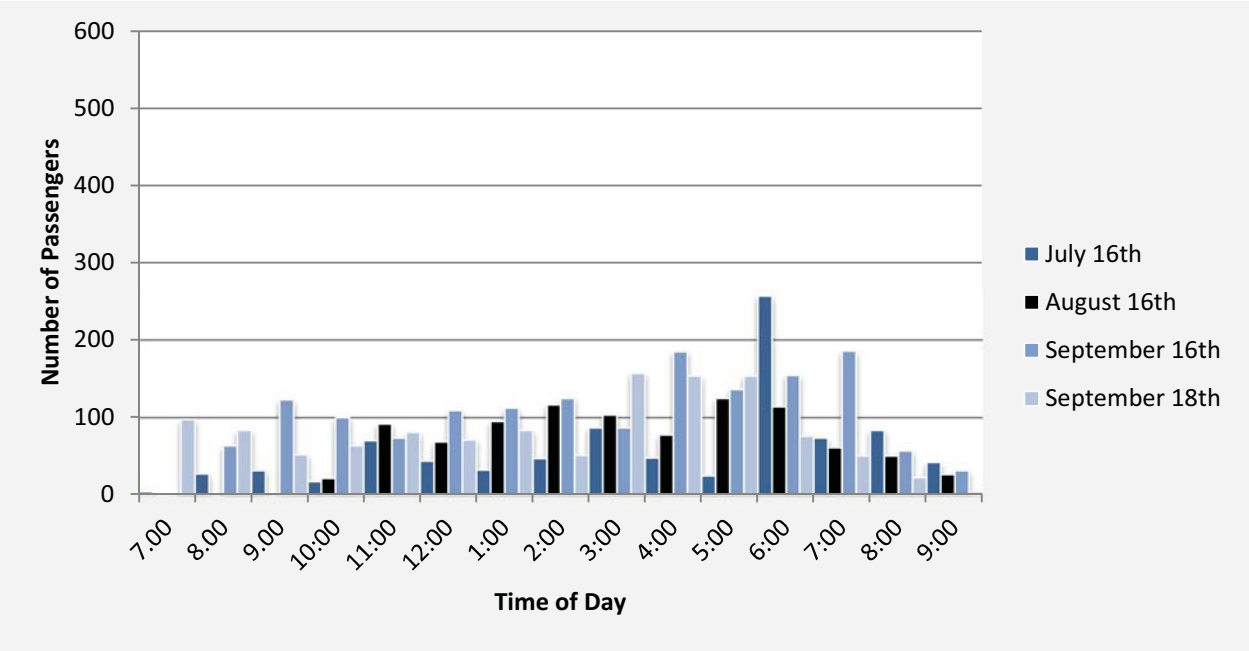

Figure 2. Passengers on the Banner Route by Hour

The Purple Route, shown in Figure 3, had a completely different usage pattern. It had a slight AM peak, with an average of 400 boardings and fairly consistent ridership throughout the day. It also had the highest ridership of all of the routes, with an average weekday volume of 340 riders per hour.

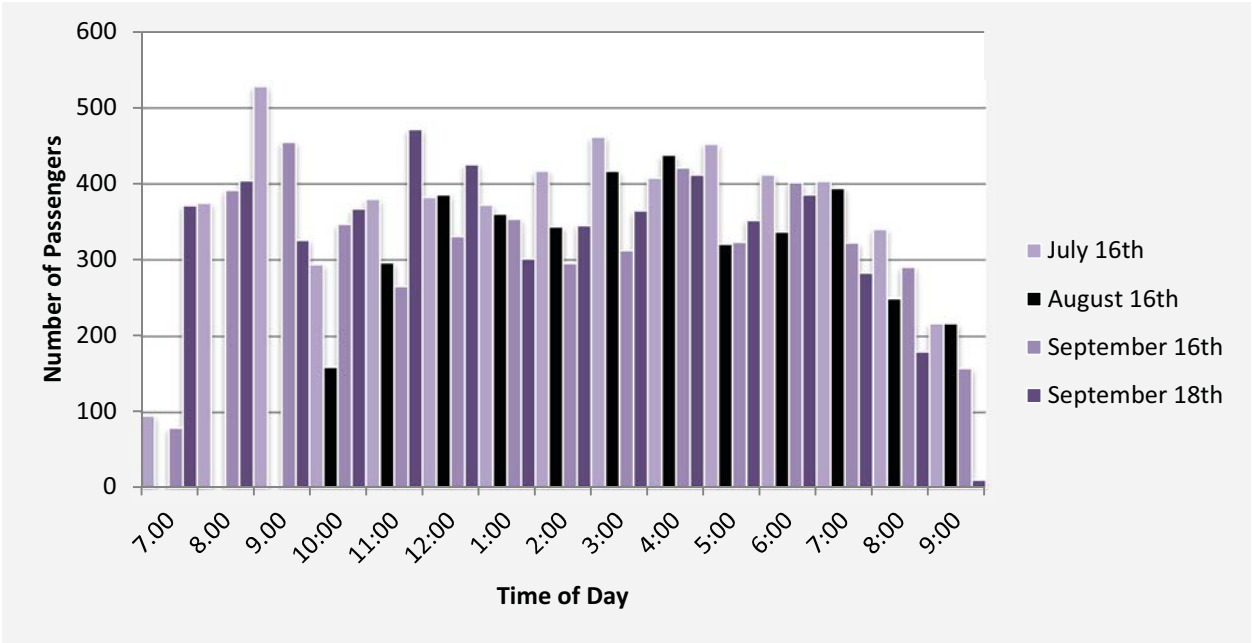

Figure 3. Passengers on the Purple Route by Hour

Figure 4, shown below, displays boardings on the Green Route. There was a short AM peak

for this line, but no PM peak. Overall, the ridership was fairly constant throughout the day, dropping off after 7:00 PM. A spike in boardings occurred during 5:00 and 6:00 PM on September 16. Given the lack of a PM peak on other weekdays, this spike may correlate with the Orioles' baseball game, which started at 7:00 PM. The ridership on this line was similar to the Banner Route with an average weekday volume of 122 riders per hour.

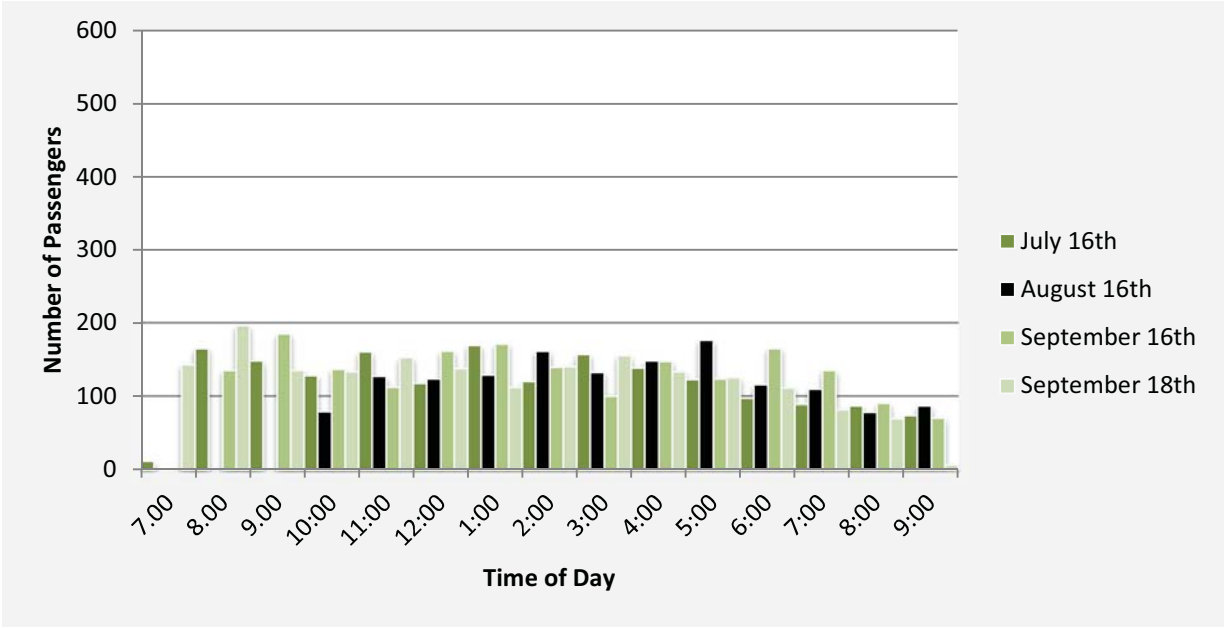

Figure 4. Passengers on the Green Route by Hour

Unlike the other routes, the Orange Route (Figure 5) had a midday peak with ridership hovering right around 350 riders per hour. Additionally, both the afternoon and evening of September 16 saw a marked increase compared to September 18. This spike, similar to the one on the Green Route, correlates with the evening Orioles' game. There was an average weekday volume of 275 riders per hour.

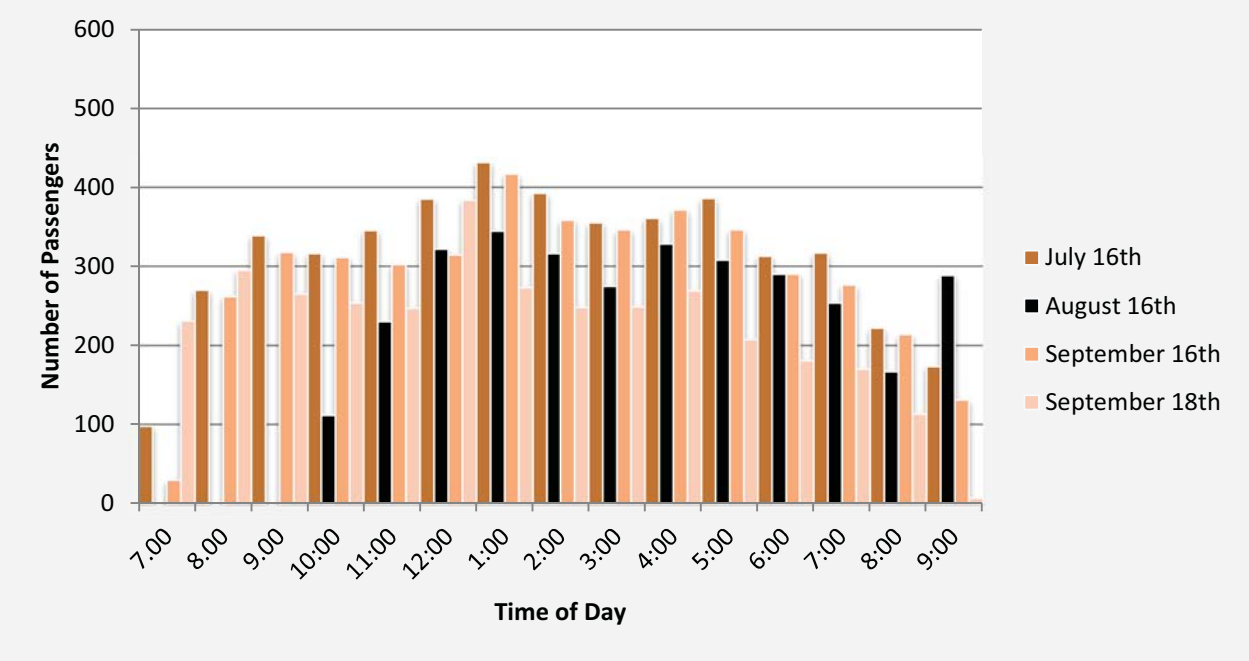

Figure 5. Passengers on the Orange Route by Hour

By Stop

The maps shown below illustrate the average daily boardings and alightings for the three (3) observed weekdays. The volumes are shown based on the size of the circle at each stop. Additionally, the stop number is displayed in the callout next to each symbol.

Along the Banner Route, shown in Figures 6 and 7, the majority of passengers boarded near the north end of the route, at Pratt Street and Light Street (Stop 420) and Conway Street (Stop 401). These stops both experienced 200+ boardings per day. They serve as transfer points for the Orange and Purple Routes, respectively. Close to 100 people a day also boarded along East Fort Avenue at Lawrence Street (Stop 414), Woodall Street (Stop 413), and Towson Street (Stop 412). There were 13 stops along the route that had an average daily volume of fewer than 50 boardings. These same stops experienced fewer than 50 alightings. The majority of alightings took place near the north end, with close to 100 alightings at Otterbein (Stop 419).

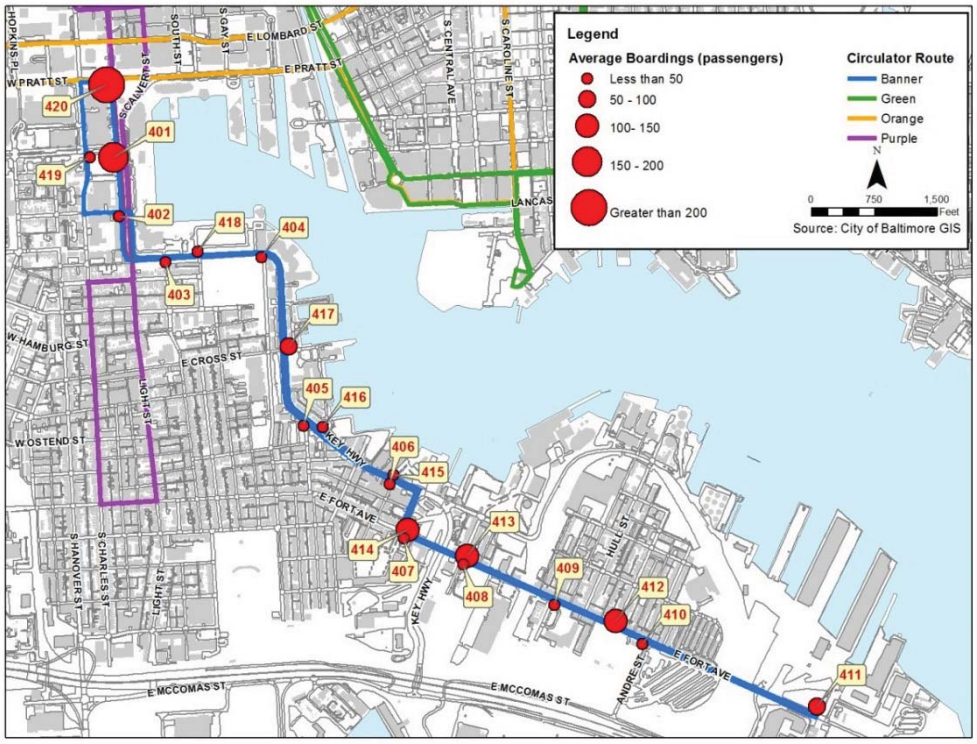

Figure 6. Boardings—Banner Route

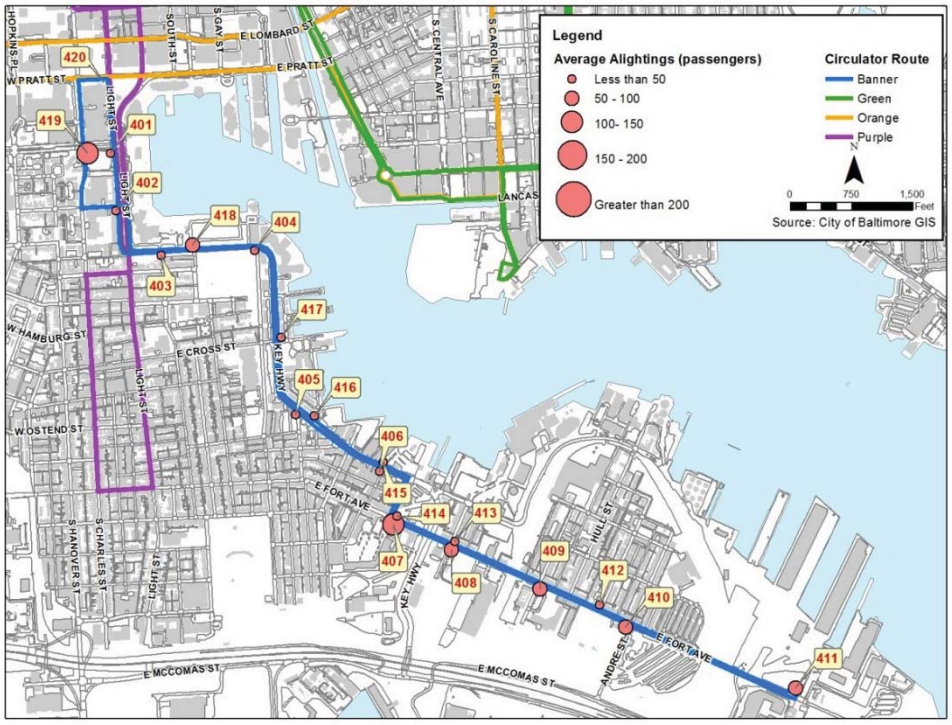

Figure 7. Alightings—Banner Route

Figures 8 and 9 show the boardings and alightings for the Purple Route. It is evident from the maps that this route experienced higher volumes than the Banner Route. Seven (7) stops averaged more than 200 boardings for the weekday counts, and only three (3) stops had a daily volume of fewer than 50 boardings. The three (3) stops that saw a daily volume below 50 were Saratoga Street (Stop 317), Fayette Street (Stop 318), and Light Street (Stop 303). Unlike the Banner Route, which only saw volumes above 200 at the north end of the line, the busiest stops for the Purple Route were distributed throughout. Six (6) stops had fewer than 50 alightings, but the majority of stops experienced between 150 and 200 alightings. Unlike the Banner Route, the stops that experienced fewer than 50 boardings were not the same as the stops that experienced alighting volumes below 50. In fact, all three (3) stops with fewer than 50 boardings saw alighting volumes that were greater than 50, with some closer to 200.

The Green Route (Figures 10 and 11) experienced volumes that were similar to the Banner Route. It had three (3) stations with boarding volumes higher than 200. These stations (Rutland Avenue [Stop 101], Johns Hopkins [Stop 102], and Gough Street [Stop 124]) were all located along the eastern spur of the route, running north and south. Similar to the Banner Route, the Green Route saw correlating stops between boardings and alightings. In other words, stops with a high volume of boardings also had a large daily volume of alightings. Ten (10) stops experienced fewer than 50 boardings on an average weekday and ten (10) stops had fewer than 50 alightings. Five (5) of these stops had low volumes for both counts: Maritime Park – Westbound (Stop 106), Central Avenue (Stop 107), Gay Street (Stop 115), Lancaster Street (Stop 120), and Caroline Street (Stop 122).

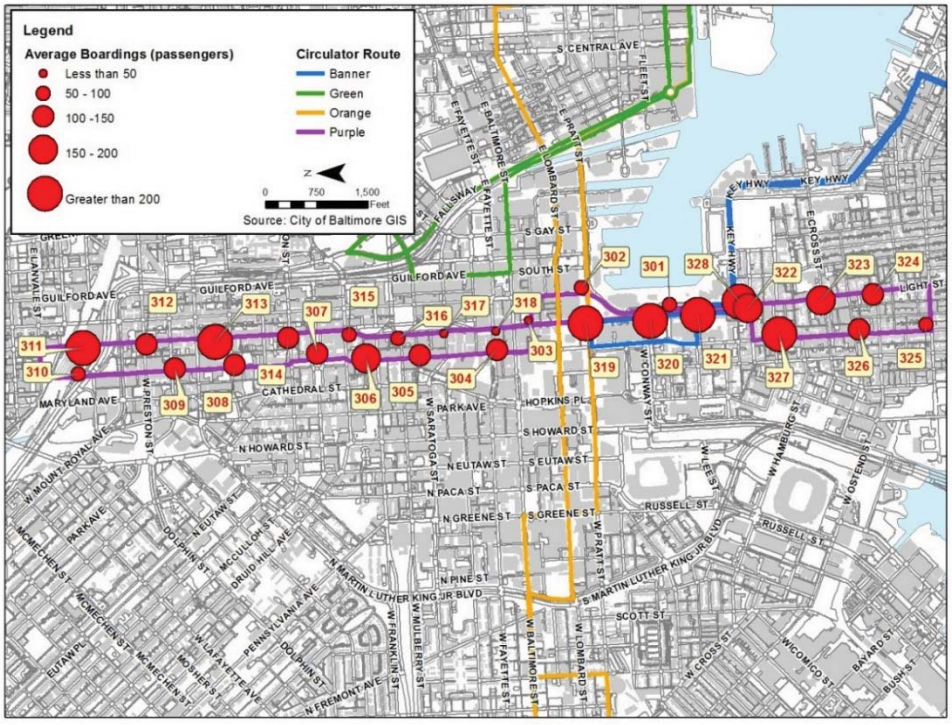

Figure 8. Boardings—Purple Route

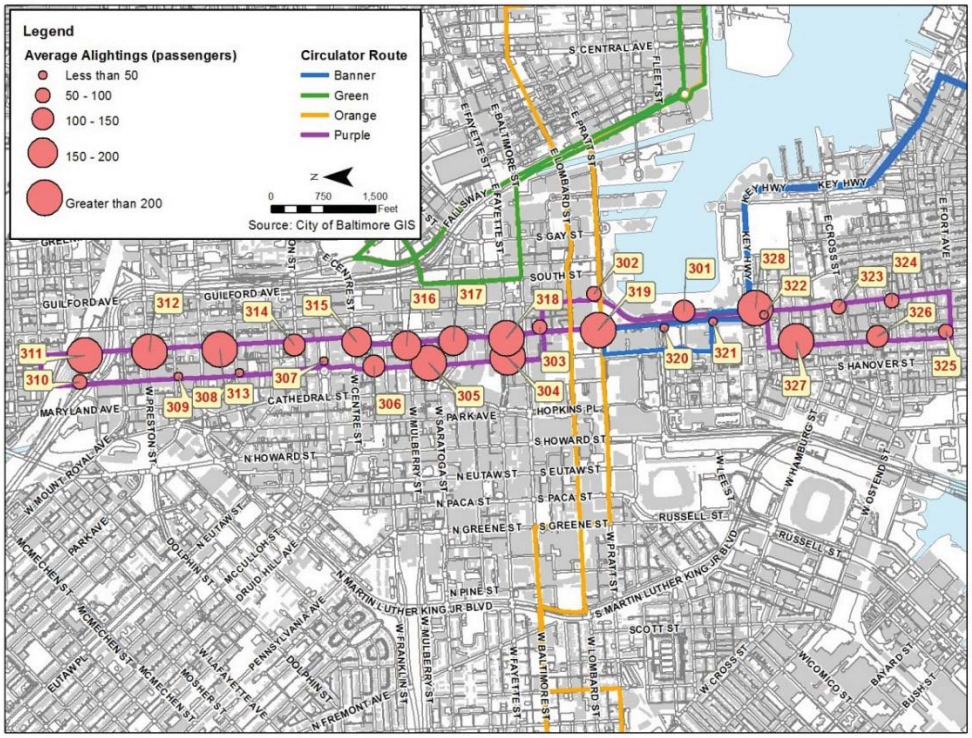

Figure 9. Alightings—Purple Route

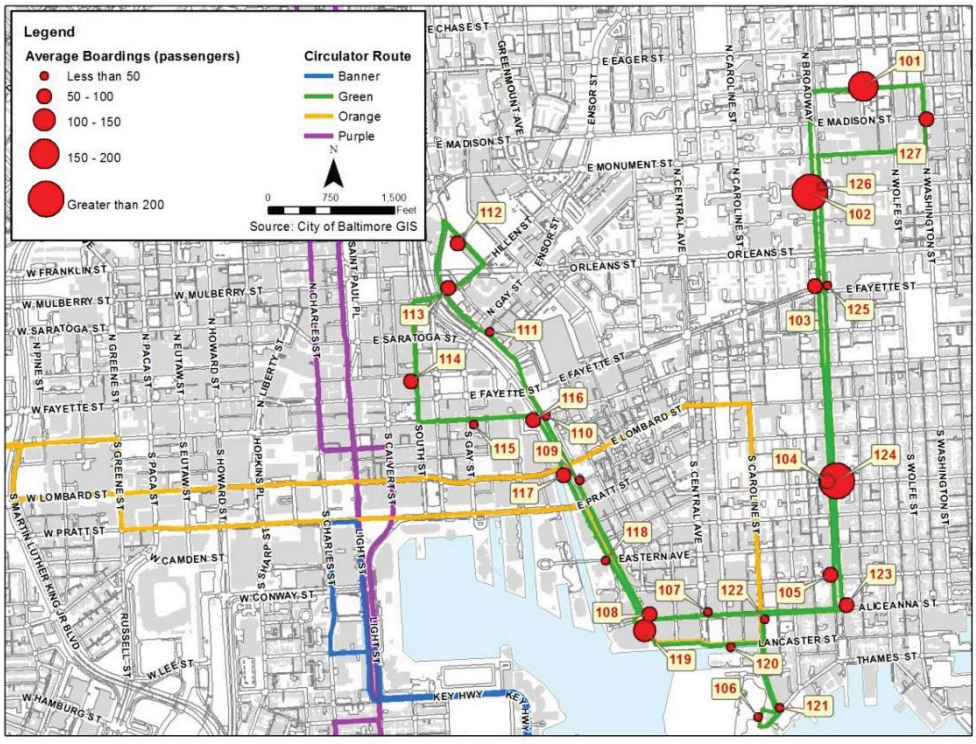

Figure 10. Boardings—Green Route

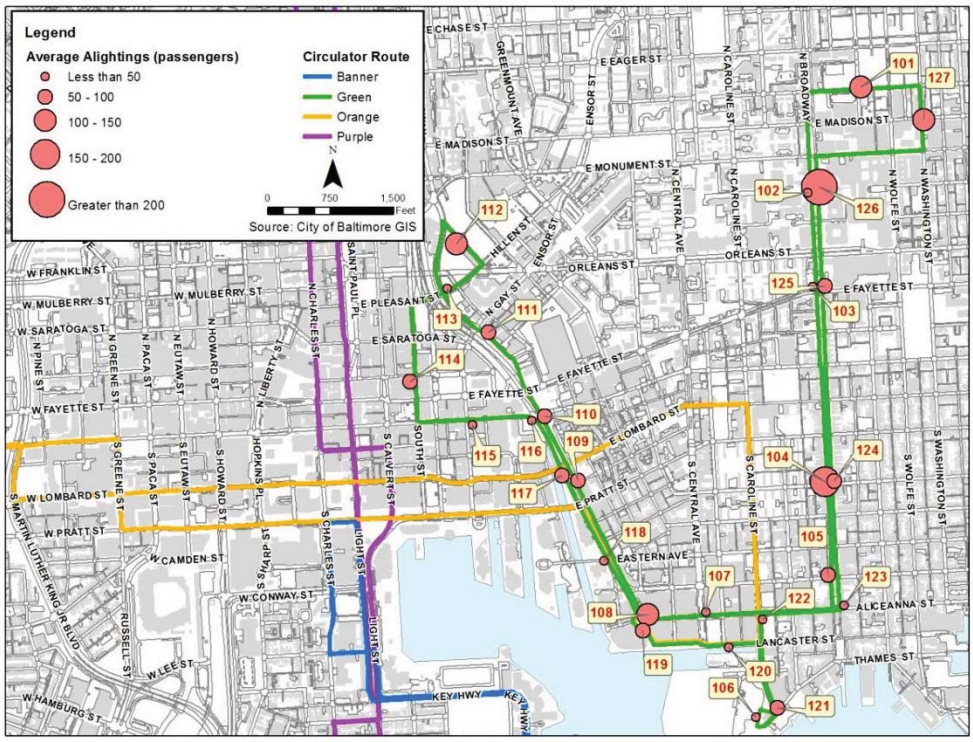

Figure 11. Alightings—Green Route

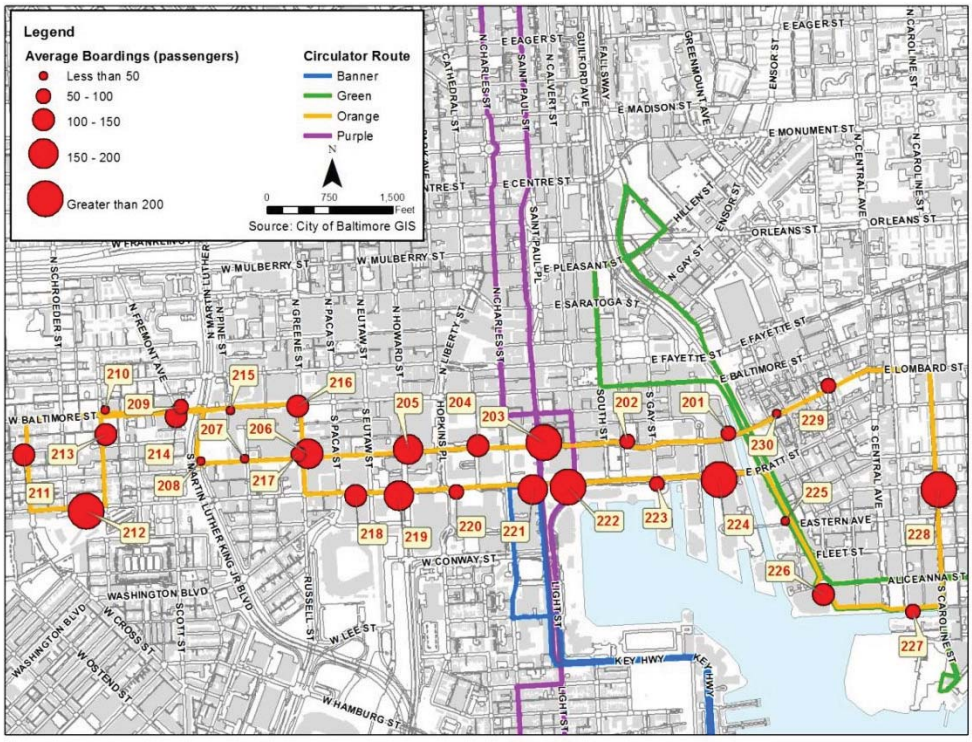

Figure 12. Boardings—Orange Route

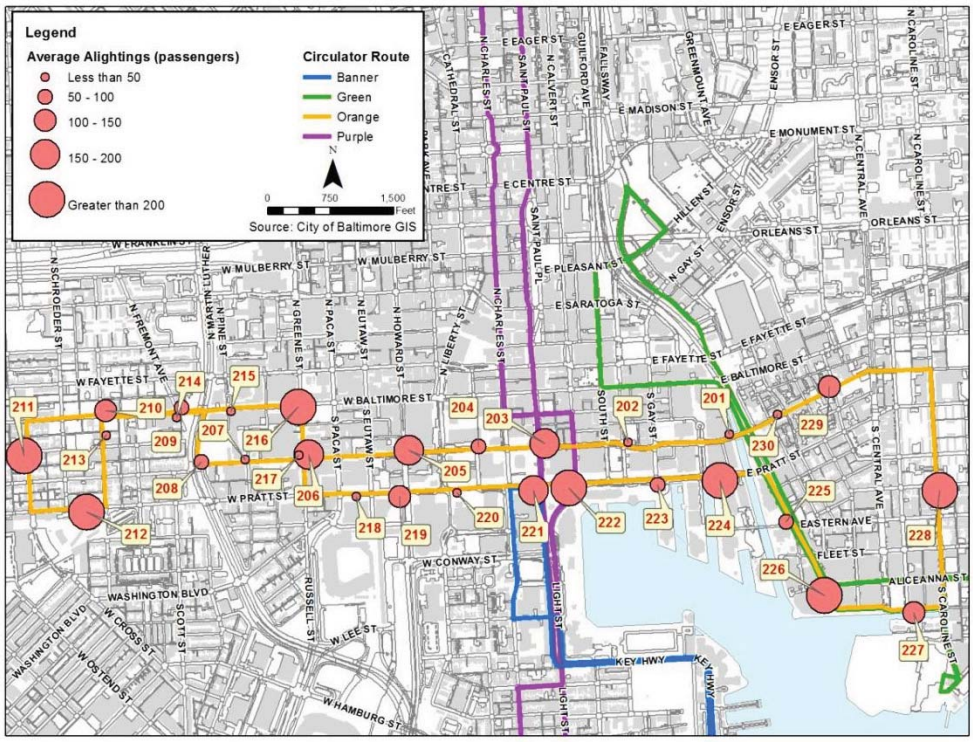

Figure 13. Alightings—Orange Route

The Orange Route, shown in Figures 12 and 13, had volumes similar to the Purple Route. Both of these routes serve as backbones of the system, whereas the Banner and Green Routes act more as spurs, traveling out from the spines. Similar to the Purple Route, the Orange Route saw high daily average volumes. The stops that had both a high volume of boardings and alightings were located near the intersection of the four (4) routes, the outer edges of the route (Historic Fell's Point, on the east, and the University of Maryland – Baltimore, on the west), and along the harbor. Unlike the Purple Route, some stops experienced daily volumes below 50 for both boardings and alightings. These included Penn Street (Stop 207), Pine Street (Stop 215), and Albemarle Square (Stop 230).

Headways

The Headways section of the analysis examines how often buses arrive at each stop, as well as how consistently the timing between each bus is maintained. This is an important metric for determining system reliability from the user's perspective. The figures in this section identify four (4) time periods: AM (open–10:00 AM), midday (10:00 AM–3:00 PM), PM (3:00–7:00 PM), and night (7:00 PM–close). According to the CCC website, the Banner Route has a headway of 15 minutes and the three (3) other routes have headways of 10 minutes.

Figure 14 looks at the headways for the Banner Route. The blue squares represent the average headway for all stops in the given time period. The black line shows one standard deviation from the average headway for that particular time period. The average headway was 18.42 minutes, about 3.5 minutes longer than the intended headway. For the Banner Route, the PM and night periods have greater variation compared to the AM and midday periods. This means that the wait time is more reliable in the morning and midday than it is in the evening. The average deviation, across all four (4) days and all time periods, was 6 minutes. This is the lowest of all the routes. One of the largest deviations took place during the PM period on July 16, which had an average headway of 23 minutes and a deviation of 14 minutes. On September 16 the variation in headways was very small. There was no more than a full minute of difference between headways for every time period on September 16.

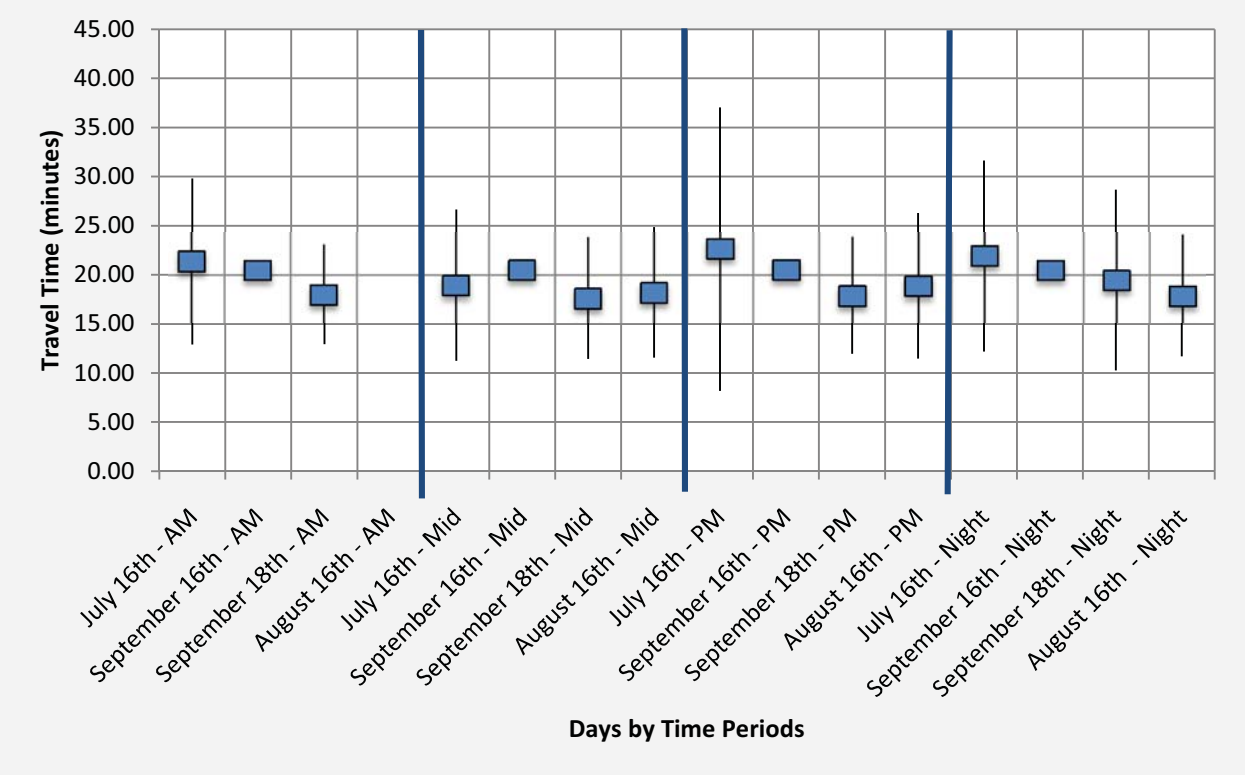

Figure 14. Headways with Deviation—Banner Route

The Purple Route, shown in Figure 15, had an average headway of 11.94 minutes, 2 minutes longer than claimed. The average deviation was 8 minutes. The shortest headway of the four (4) days occurred on July 16 and correlates with the highest number of buses serving the route. As illustrated in Figure 1, there were six (6) buses on the route for July 16, and five (5) or fewer on the other three (3) days. July 16 also had some of the smallest headway deviations for the route. The two (2) largest deviations (at close to 12 minutes) occurred in the PM period on September 16 and September 18.

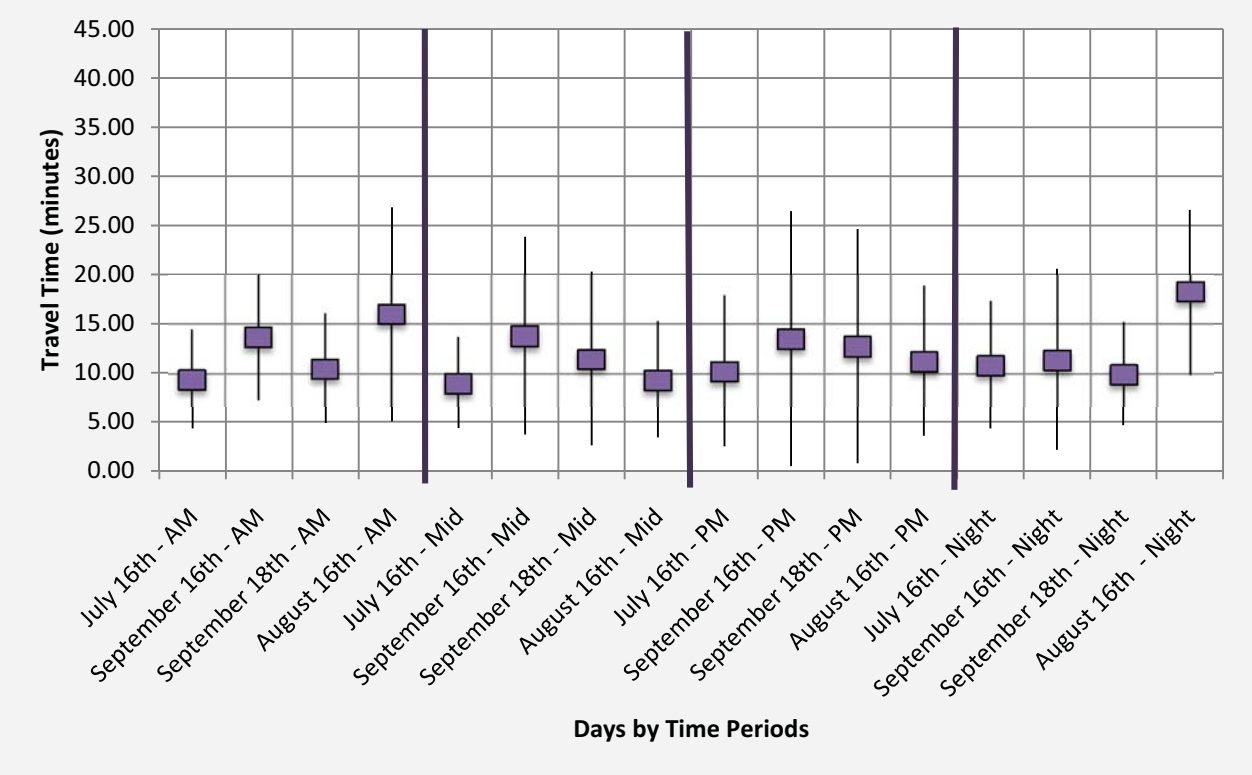

Figure 15. Headways with Deviation—Purple Route

Figure 16 shows the headway times and deviations for the Green Route during the four (4) observed days. This route had some of the largest and most consistent variations. This suggests that the Green Route has some of the most unreliable headways. The day with the greatest number of buses (August 16) also had the shortest headways. The fact that it also had similar volumes suggests that more buses correlate with shorter headways. The average deviation for this route was close to 12 minutes, and the largest deviation was 17 minutes. This route averaged 18.7 minutes for headways.

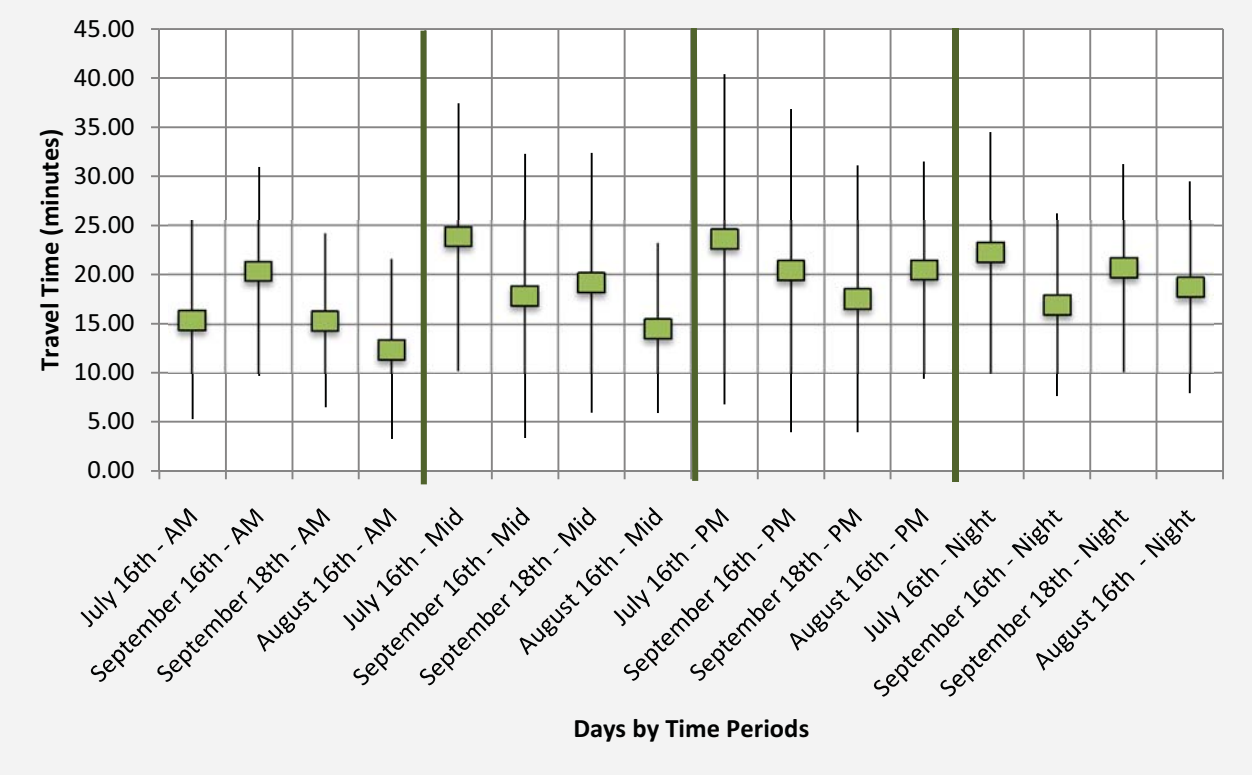

Figure 16. Headways with Deviation—Green Route

The Orange Route (Figure 17) experienced an average 14.5 minute headway. The average deviation was the same as the Purple Route (8 minutes). The longest headways occurred during the PM period on September 18 with an average of 22 minutes between buses. Only four (4) buses ran on this day, and volumes were high in the evening and at night.

Overall, the Banner Route had the most consistent headways and the Green Route had the least consistent. The Purple Route had headway times just over 10 minutes. The Green and Orange Routes both had headway times between 10 and 20 minutes, and the Banner Route had headway times around 15 minutes.

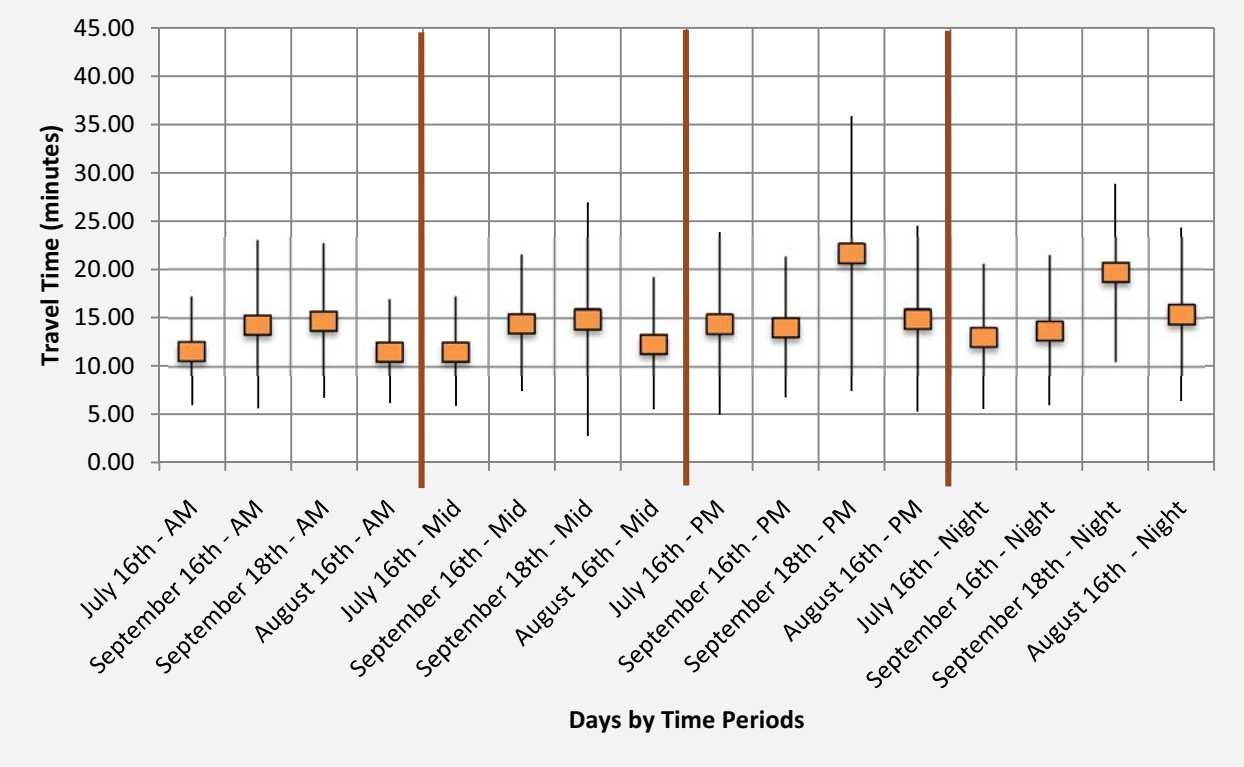

Figure 17. Headways with Deviation—Orange Route

C. Passenger Capacity

Passenger capacity analyzes the volume of people using the bus service, compared to the total number of people that the buses can hold. The buses are equipped with 42 seats and are designed to hold an additional 30 standing passengers, bringing the total possible number of passengers to
72. Most of the buses remained far below capacity for the majority of the operating day. The maps in this section show the number of seats taken on a bus during a specific operating period.

Figure 18 shows the Banner Route on September 18, between 4:45 and 5:30 PM. From the figure, the Banner Route remained under capacity. In fact, at no point along the line were all of the seats occupied. The bus reached its highest level of passengers at two (2) stops, Federal Hill Park (Stop 403) and the American Visionary Art Museum (Stop 404), when 27 seats were occupied. This means that even at the highest volume for this time period, there were 20 seats still available on the bus. The bus was at its lowest volume at Fort McHenry (Stop 411) with 10 passengers.

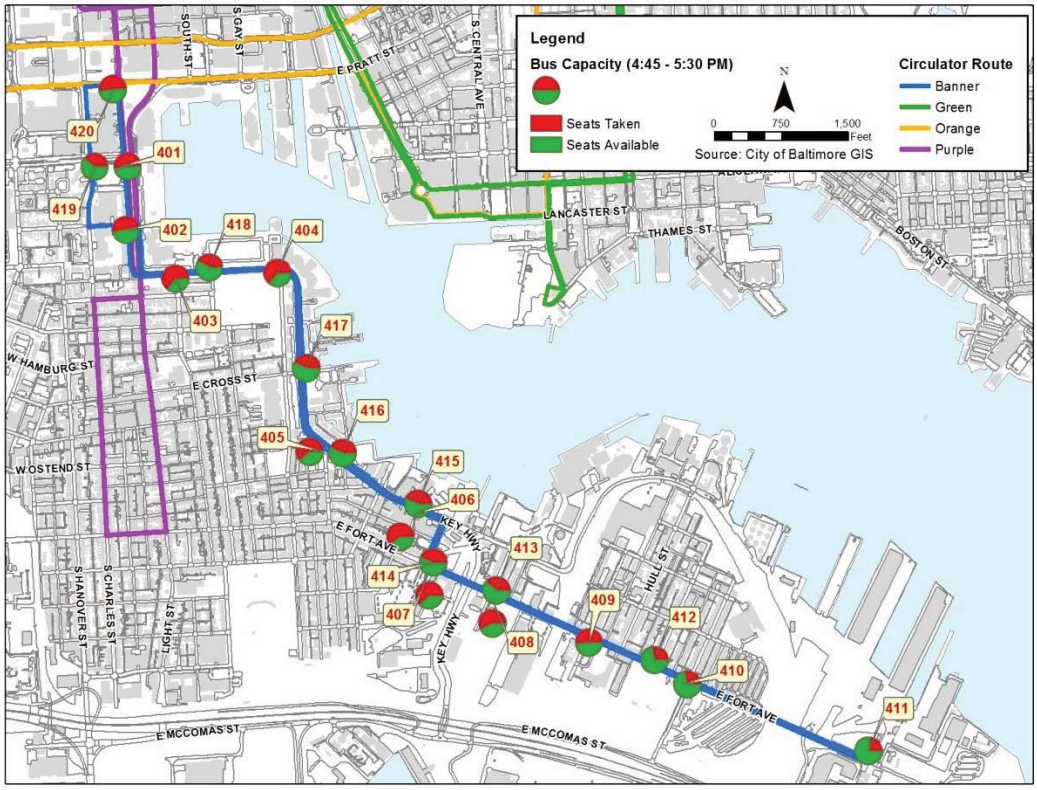

Figure 18. Capacity—Banner Route

The Purple Route, shown in Figure 19, carries a much higher volume of passengers than the Banner Route. The map shows four (4) stops where the seats on the bus were either full or almost full. This occurs at Fayette Street (Stop 318), Pratt Street – Inner Harbor (Stop 319), Conway Street (Stop 320), and Lee Street (Stop 321). The number of passengers at these stops ranged between 40 and 47. At 40 passengers, two (2) seats were available and at 47 no seats were available. However, even at this level of passengers, the bus still had 25 standing spaces available. The high volume of passengers, where the bus intersects the Orange and Banner Routes, correlates with the large number of boardings, illustrated in Figure 8.

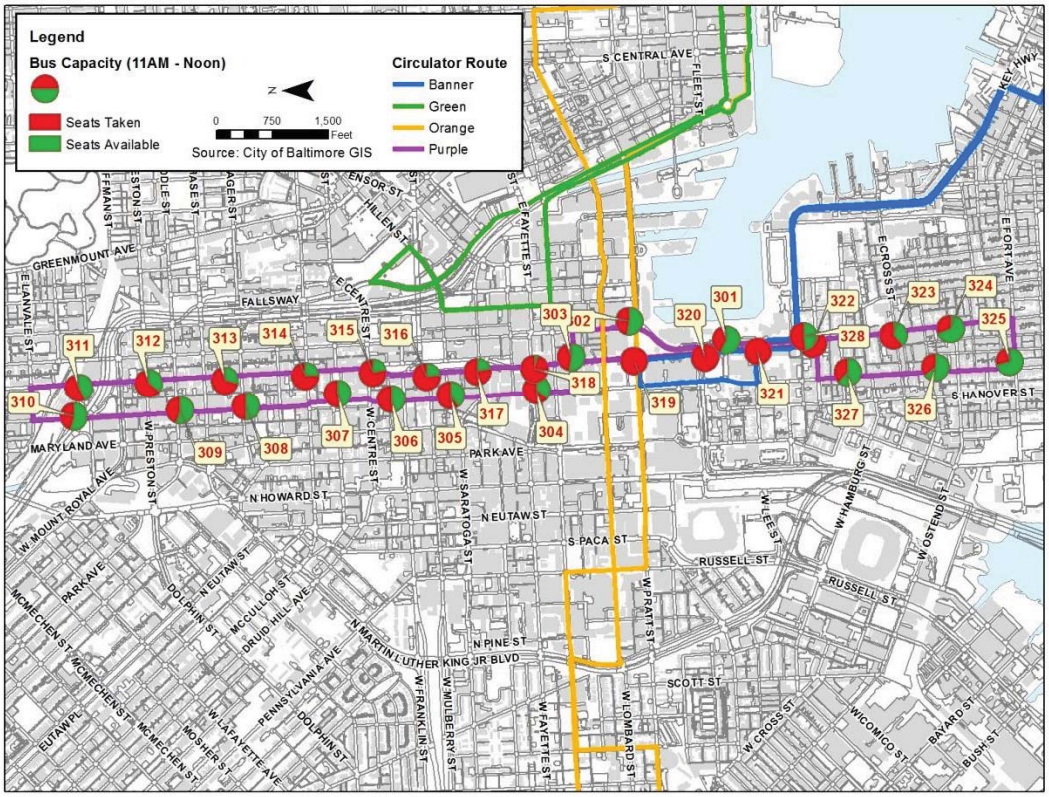

Figure 19. Capacity—Purple Route

The level of capacity on the Green Route also correlated with the boardings and alightings analysis. As illustrated in Figure 20, the Green Route had passenger volumes that were more comparable with the Banner Route. The route experienced its highest volumes around Washington Hill and Johns Hopkins. This location is adjacent to a subway stop, which may also account for the higher volumes. The Green Route reached its peak at 40 passengers, leaving two (2) seats and 32 standing spaces available.

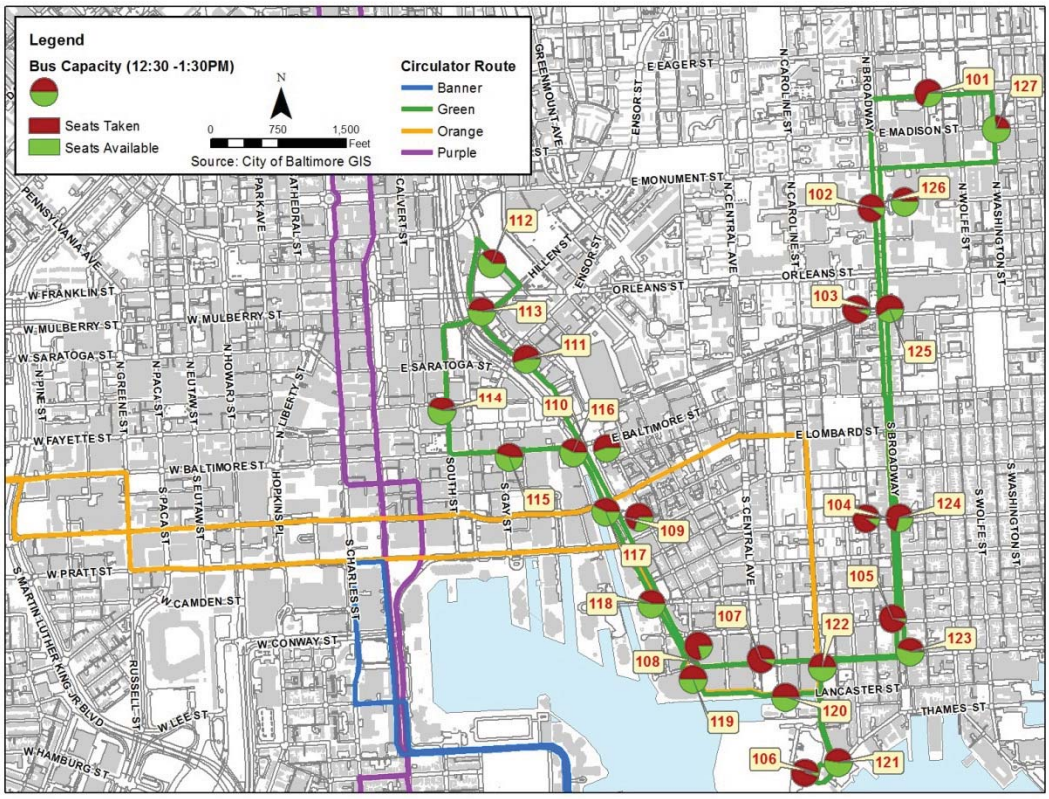

Figure 20. Capacity—Green Route

The Orange Route rarely experienced capacity issues during the time when the count was taken (midday peak). Ridership on the Orange Route is similar in magnitude to the Purple Route; there were several stops where the seats were completely filled. As shown in Figures 12 and 13, the distribution of boardings and alightings appears to be the reason for the capacity constraints. The Purple Route (Figures 8 and 9) had three (3) stops in a row that experienced a high volume of boardings and a low volume of alightings. The Orange Route (Figure 21), on the other hand, saw a high volume of both boardings and alightings at its busiest stops.

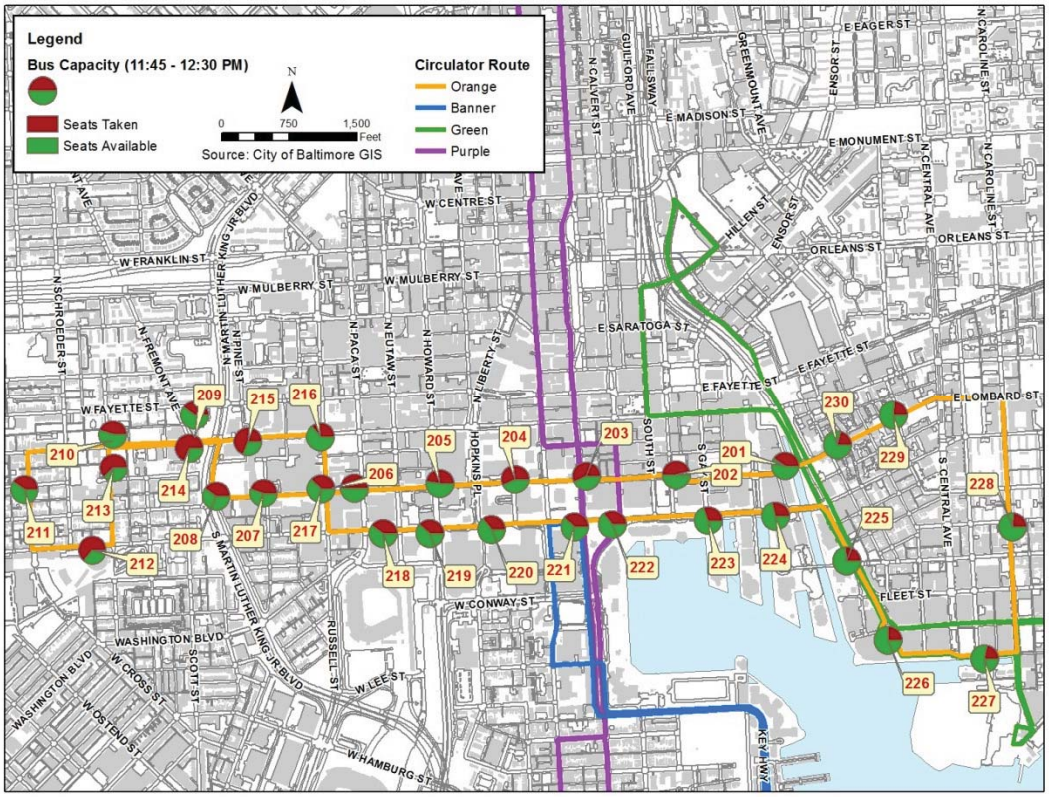

Figure 21. Capacity—Orange Route

Travel Time

Travel time, similar to headway analysis, is discussed in this section. However, instead of comparing the average time between stops, travel time measures the time it takes to complete one (1) full rotation of the loop. The times are then compared across four (4) periods. The four (4) periods used are also the same as the headway analysis; AM, midday, PM, and night.

The Banner Route, shown in Figure 22, had an average travel time of 30 minutes. Given that the headway averaged 15 minutes, and that two (2) buses ran on the route, it would appear that the Banner Route bus ran on time. The longest travel time was in the PM period of July 16, at 35 minutes. This same period had the largest deviation, at 9 minutes. It also saw a peak in boardings. The average deviation for the route was four (4) minutes.

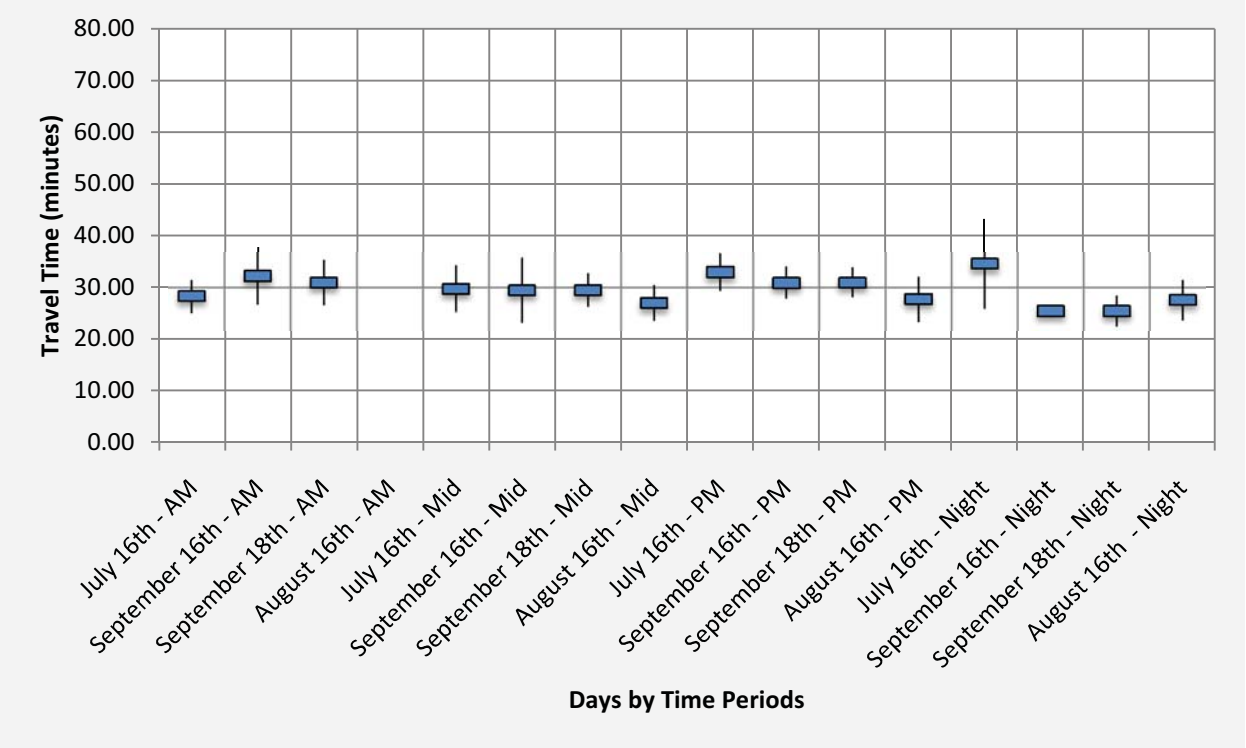

Figure 22. Travel Time—Banner Route

The Purple Route (Figure 23) had an average travel time of 48 minutes. It had a range of 12 minutes, compared to the Banner Route's range of 9 minutes. However, proportionally, the Purple Route was actually more consistent than the Banner Route. The deviation correlates, for the most part, with the number of buses assigned to the route. The lowest average deviation, 4.88 minutes, took place on July 16. This means the travel times were the most consistent on a day with six (6) (the highest number of the four [4] days) buses assigned to the route. Additionally, the only day with 4.5 (the lowest amount of the four [4] days) buses saw the highest average deviation of 6.39 minutes.

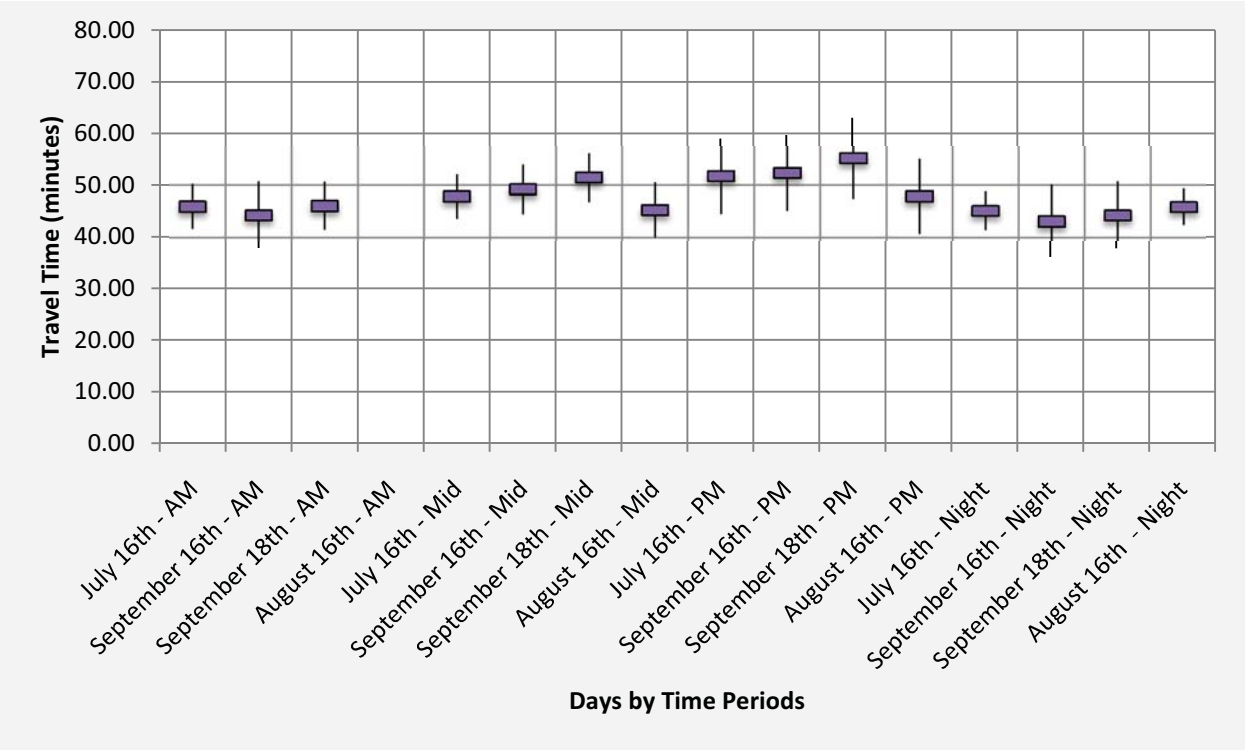

Figure 23. Travel Time—Purple Route

With 11 minutes of difference between the samples, the Green Route (Figure 24) had the most consistent travel times. The average travel time for the route was 59 minutes. The Green Route does not display the same correlation between the number of buses assigned to the route and the average deviation in travel time. However, given that the ridership is one-third the number of the Purple Route, the change in the number of buses serving the line may have less of an effect on the travel time.

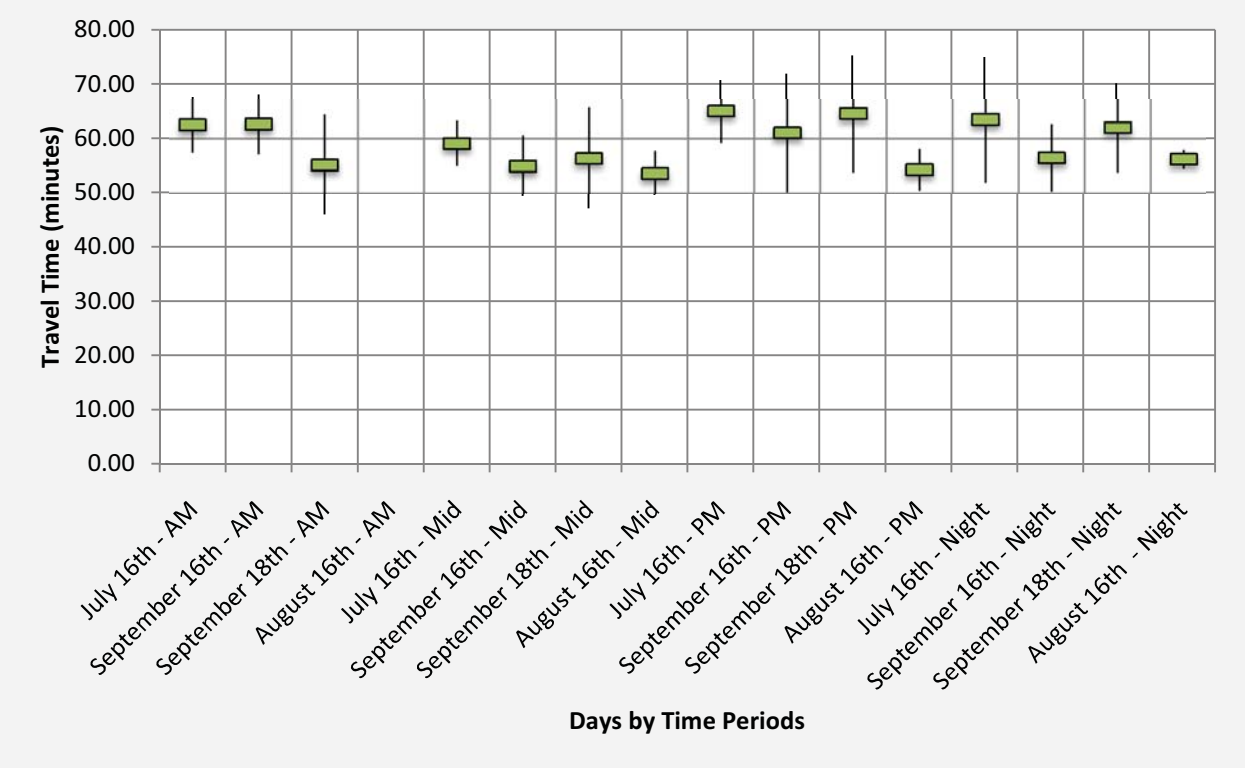

Figure 24. Travel Time—Green Route

The Orange Route is shown in Figure 25. This route was similar in volume to the Purple Route, and it also showed a slight correlation between the number of buses assigned to the route and the average deviation. There were two (2) days with five (5) buses and two days (2) with four (4) buses on this route. The average deviation on the days with five (5) buses was 4.7 minutes, while the average deviation on the days with four (4) buses was 5.9 minutes.

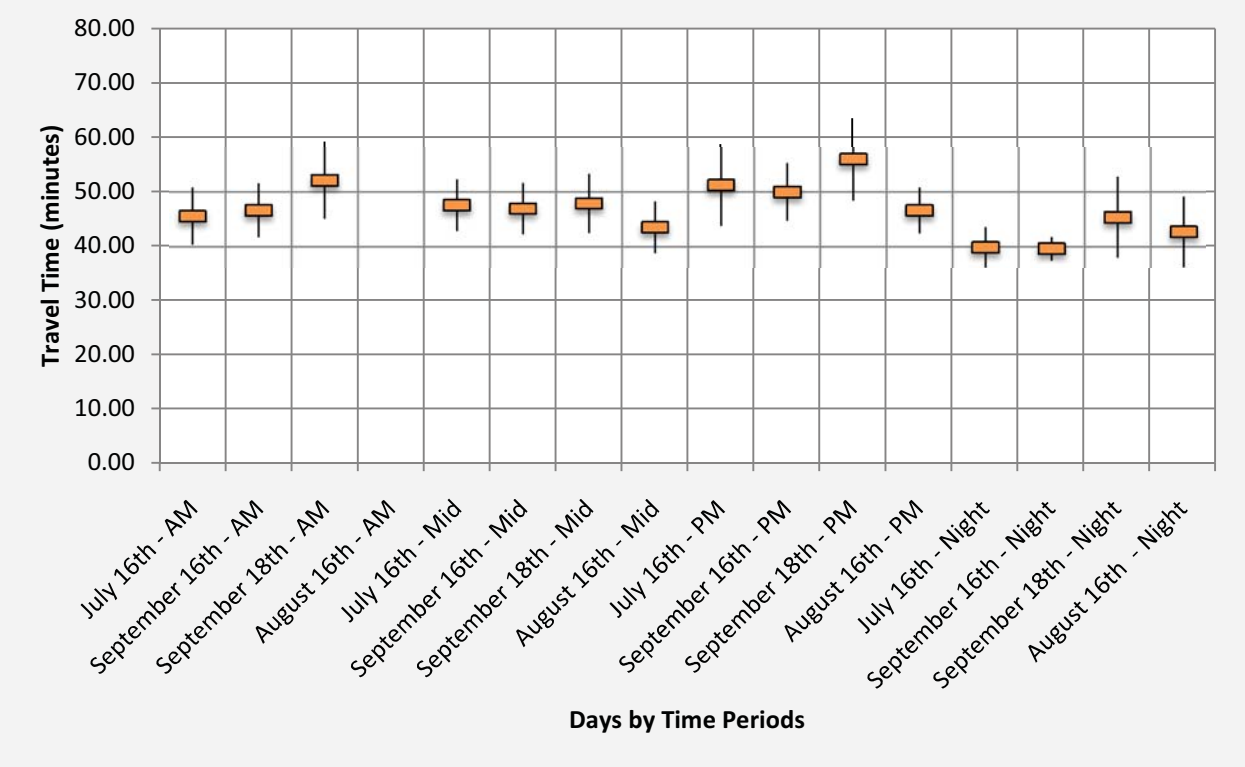

Figure 25. Travel Time—Orange Route

Vehicle Chronology

The diagrams below illustrate consistency in route execution. They track the movements of each bus that ran on September 18 and follow the length of the operating day. The closer the line gets to a 45 degree angle, the closer the bus was to being at its intended location along the route. The diagrams also show how the headways were maintained between buses.

The majority of the buses stayed on schedule for all of the routes, with very few inconsistencies. The Banner Route (Figure 26) in particular showed very consistent arrival times throughout the day and the buses rarely "bunched." The Purple Route showed breaks in the lines. These occurred when the intervals between the buses became too frequent. According to the Charm City Circulator website, the bus driver will stop a bus to create a layover and prevent "bunching" at the stops. These sections of delay can also be seen on the Green and Orange Routes (Figure 27). For the Green Route, very little "bunching" occurred throughout the day. It appears that only two (2) buses run in the midday on this route, while four (4) buses run during the rest of the time. For the Orange Route, only three (3) buses were operating in the afternoon. It can also be observed that "bunching" occurred for all four (4) lines on the Orange Route between 10:00 and 11:30 AM. Buses 1102 and 1104 experienced the same "bunching" around 4:00 and 5:00 PM.

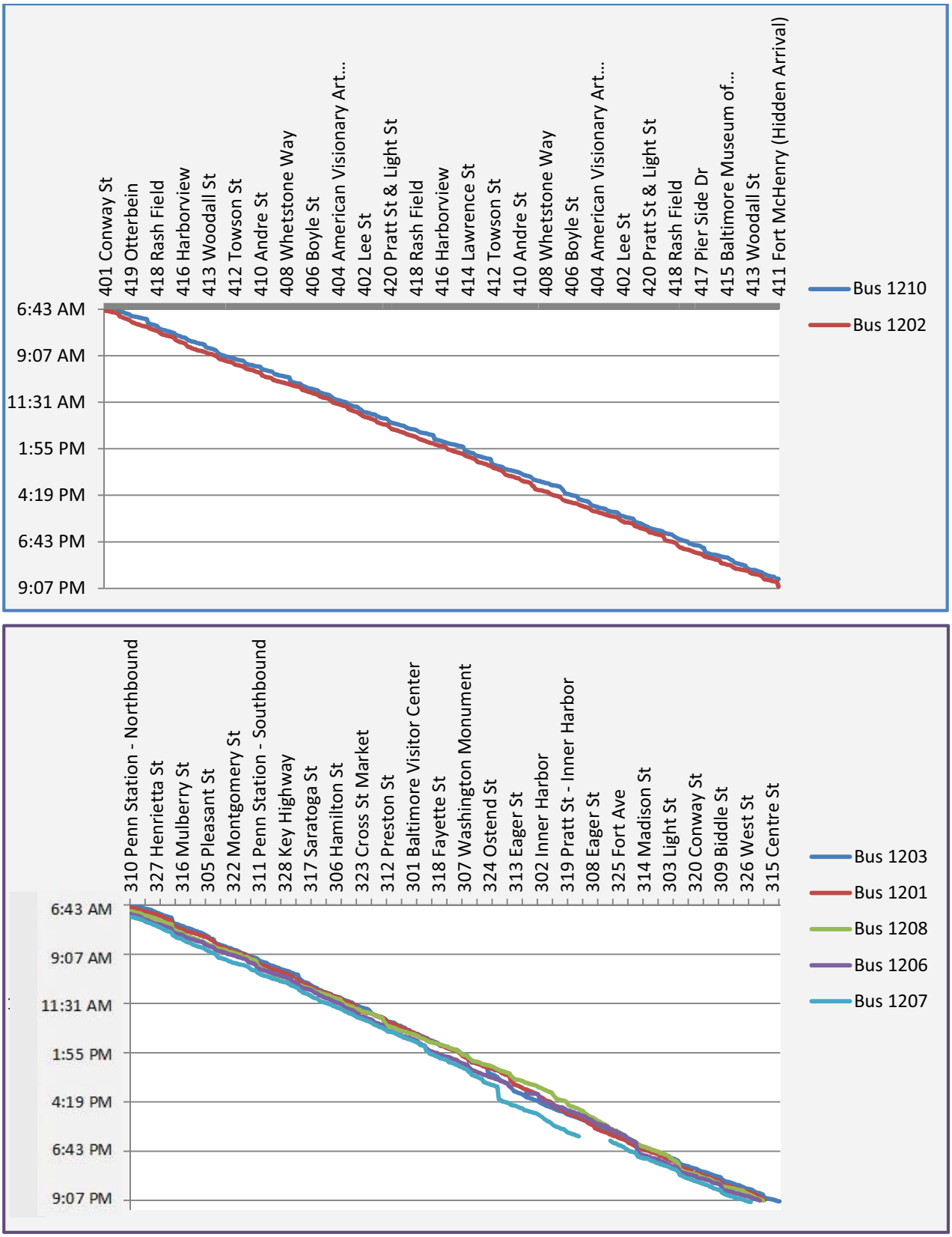

Figure 26. Vehicle Chronology—Banner Route and Purple Route

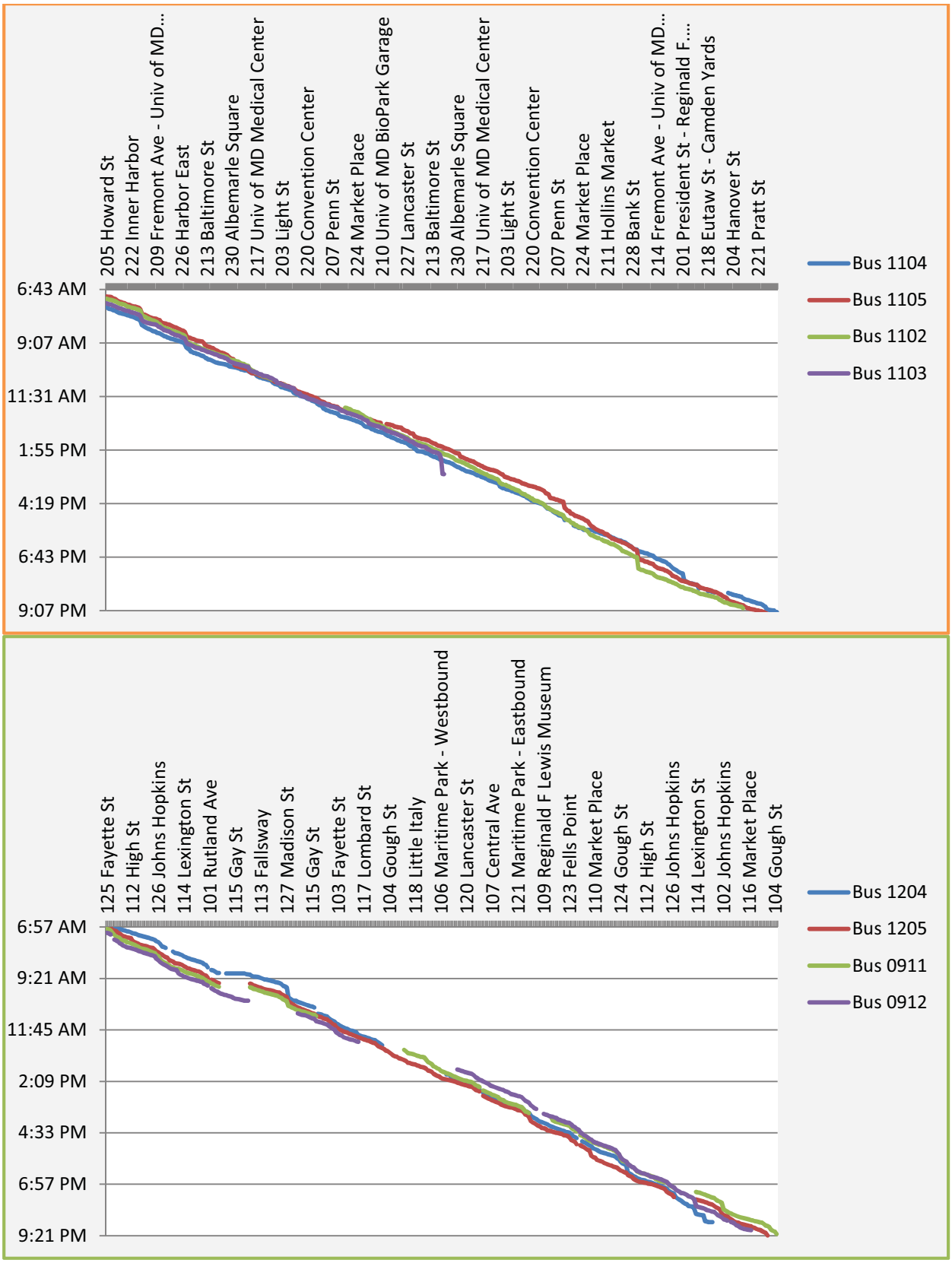

Figure 27. Vehicle—Green Route and Orange Route

IV. EXISTING TRANSPORTATION MODEL CALIBRATION

A. Introduction

The study relied on a multimodal transportation model to test various alternative bus routes, stop locations, and bus lane priority enforcement. Louis Berger used the TransModeler™ Multimodal simulation software developed by the Caliper Corporation because it provides the ability to model bus routes based on the actual traffic conditions. To achieve a ready-to-use model to test alternatives, Louis Berger created the model and calibrated the traffic. Once this step was completed, the transit operation was calibrated. Appendix A contains the steps taken to create the model and calibrate it to existing traffic conditions.

B. Transit System Creation

The transit calibration relied on creating the transit network (bus routes and stops), assigning boarding and alightings per stop, and defining the lost time at each bus stop. Each bus route was created forming a loop network. The study relied on the travel time for one (1) complete bus loop; therefore, the routing was assigned one (1) loop rather than a continual loop. Each stop was added and assigned to the proper bus route or routes because some bus stops service more than one (1) CCC route. Figure 28 shows the resulting network.

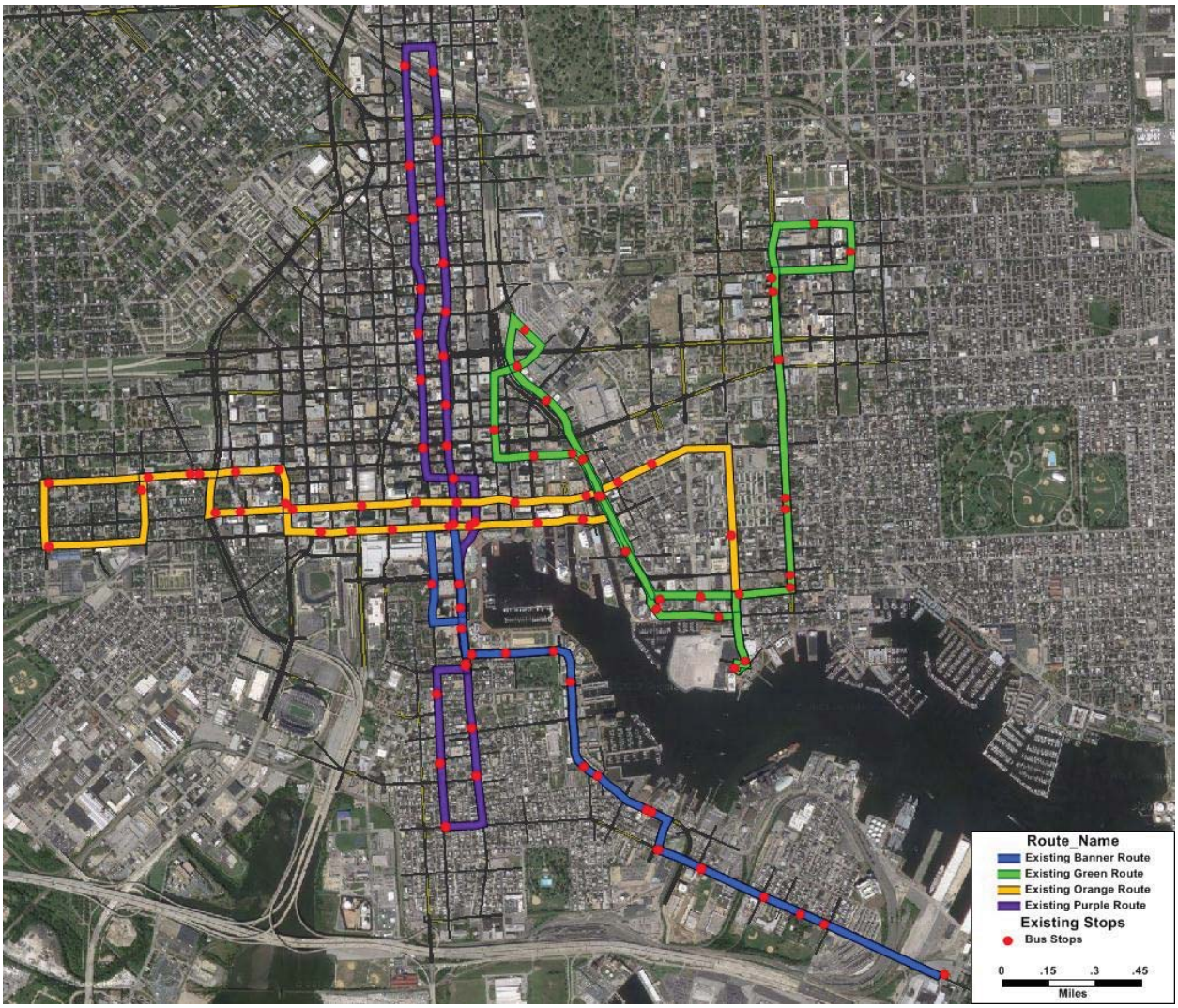

Figure 28. Existing Modeled Bus Route Network

Louis Berger obtained boarding and alighting data covering four (4) days, three (3) of which represented typical weekday patterns. Each bus stop was assigned the average boarding and alighting AM and PM peak hour volumes based on an average of the three (3) weekdays sampled to represent patterns. The AM peak hour was 8:00 AM, and PM peak hour was 4:00 PM. These volumes represented stop delays, during which time passengers entered or exited each bus, and created a cumulative record of bus capacity. The alightings were further broken down by bus, based on the existing headway assigned to each route. TransModeler™ relies on hourly boardings or passenger arrivals and passenger alightings by bus. Appendix B contains the existing boarding and alighting volumes for each CCC stop.

TransModeler™ provides the ability to set the time lost in seconds that can occur at each bus stop. This includes the time for each passenger to board, exit the vehicle, and the time for the doors to open and close. Samples of all three (3) of these delays were recorded in the field to

determine if the times varied from the researched times in the Transit Cooperative Research Program (TCRP) 165 – Transit Capacity and Quality of Service Manual, 3rd Edition. The samples times were observed to be in the range of the TCRP 165 report; therefore, the TCRP values were used because they were based on many more samples than those obtained on the CCC routes (TCQSM, 2013). According to Exhibit 6-4 in TCRP 164, the range of delay or service times was as follows:

- No fare payment boarding 1.75–2.5 seconds
- Front door alighting 1.4–3.6 seconds
- Rear door alighting 1.2–2.2 seconds

Based on observation, use of the rear or front door for exiting tended to rely on the volume exiting the rear door and proximity to the front door. Passengers seated in the first few seats tended to use the front door to exit. A precise breakdown of door use was difficult to determine without substantial observation; therefore, the TCRP 165 recommended 75 percent rear door and 25 percent front door split was used (TCQSM, 2013). To be conservative, the study relied on the highest delay or service time values, resulting in 2.5 seconds per boarding passenger and a weighted average between the rear and front door values or 2.55 seconds per alighting passenger.

Headways were assigned to each route based on the existing schedule resulting in the Purple, Orange, and Green Routes assigned a 10-minute headway and Banner Route assigned a 20-minute headway. Beginning at the start point of the route, TransModeler™ releases a bus based on the headway assigned within the first few minutes from the start of the simulation. Given a two-hour simulation for both the AM and PM peak, a 10 minute headway results in up to 12 buses simulated per route and a 20 minute headway results in up to 6 buses simulated.

C. Transit System Calibration

Once the initial model was created, Louis Berger ran a micro simulation model to test the buses and compare their round trip travel times to existing conditions. For a model result to be statistically accurate, a number of runs are required to account for numerous input values that fluctuate between runs, including vehicle behavior, vehicle route assignments, and bus boarding and alighting patterns. Based on the size of the model, it would require more than 600 model runs to obtain output that would be accurate to a level of plus or minus 10 vehicle hours traveled. Given a time sensitivity, 20 simulation runs were selected to provide a number of runs that could be completed within a reasonable amount of time and still result in a statistical accuracy of plus or minus 60 vehicle hours traveled. Table 1 contains the CCC model simulation run comparison to 95 percent confidence statistical accuracy.

Table 1. CCC Model Simulation Run Comparison to 95 Percent Confidence Statistical Accuracy

Simulations	95 percent Confidence Interval
Approximately 630	plus or minus 10 vehicle hours traveled
Approximately 280	plus or minus 15 vehicles hours traveled
Approximately 160	plus or minus 20 vehicle hours
Approximately 70	plus or minus 30 vehicle hours
Approximately 40	plus or minus 40 vehicle hours
Approximately 30	plus or minus 50 vehicle hours
Approximately 20	***plus or minus 60 vehicle hours***
Approximately 10	plus or minus 100 vehicle hours
Approximately 2	plus or minus 2000 vehicle hours

After 20 simulations were completed, Louis Berger evaluated the results to compare them to an average of the three (3) weekday existing bus travel times (July 16, September 16, and September 18). The simulated travel times ranged from a high of 23 percent to a low of 10 percent lower than the existing averaged travel times. Because the transportation model does not account for active construction zones, vehicles attempting to parallel-park, or other delays that could occur along a bus route, Louis Berger calculated adjustment values that were used to adjust the results from the alternatives. Table 2 contains the comparison between the actual and modeled travel times.

Table 2. Comparison between Actual and Modeled Travel Times

	Orange Route		Green Route		Purple Route		Banner Route	
	AM	PM	AM	PM	AM	PM	AM	PM
Averaged actual travel times (seconds)	48.12	52.40	60.08	63.52	45.43	53.12	30.48	31.62
Modeled travel times (seconds)	40.34	43.87	46.02	55.36	40.97	43.27	26.49	34.81
Adjustment	7.78	8.53	14.06	8.15	4.46	9.84	3.99	-3.19
Percent difference	16.2%	16.3%	23.4%	12.8%	9.8%	18.5%	13.2%	10.1%

Once both the model and CCC system were was successfully created and calibrated, the model was ready for use in testing various alternative routing and stop locations.

Alternative Development

Alternative development focused on testing changes to the CCC system that would provide the following:

- Reduce the number of buses required to operate the system;
- Reduce the travel times to complete one (1) loop during the peak time period;

- Expand service where practical; and
- Consolidate bus stop locations.

In addition to revising the bus route and the stops, the study adjusted the passenger boarding and alightings to account for the changes in route. In some cases, new passengers would be attracted or the existing passengers would switch to another nearby stop or no longer use the bus. This section describes the ridership change assumptions used in the model to accurately account for bus delays or service time. ***It should be noted that a ridership study was not undertaken as part of this study; therefore, the study adjusted the ridership based on existing passenger trends. It was assumed that passengers from stops removed would use the next closest bus stop given the walking distance was not more than approximately 1/3 of mile.***

Orange Route Alternative 1

The headway was changed to 15 minutes and followed the existing route and stopped at the existing bus stops.

Orange Route Alternative 2A and 2B

This route reduces the travel distance by over ¾ of a mile and reroutes the bus to directly serve the University of Maryland BioPark Campus and removes service to Hollins Market. The route continues to serve the existing Pratt and Lombard Streets stops through Camden Yards and Inner Harbor. The route would contain 26 stops, seven (7) stops removed and three (3) stops added. This alternative may lose a small amount of ridership (12 percent) mainly from the Mt. Claire stop. Alternative 2A would operate at 15-minute headways and Alternative 2B would operate at 20-minute headways. Table 3 summarizes Orange Route Alternative 1 and Figure 29 shows the route.

Table 3. Orange Route Alternative 2A and 2B Summary

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
Fremont Avenue/Fayette Street	☑				☑	Other removed nearby stop
Poppleton/ Fayette Streets	☑				☑	Other removed nearby stops
Exeter/Fleet Streets	☑				☑	Other removed nearby stops
Fremont Avenue (Stop 209)		☑			☑	Shifted to Fremont Avenue/Fayette Street (new stop)
University of Maryland BioPark Garage (Stop 210)		☑			☑	Shifted to Poppleton/ Fayette Streets (new stop)
Hollins Market (Stop 211)		☑			☑	Shifted to Poppleton/ Fayette Streets (new stop)
Mt. Claire Street (Stop 212)		☑		☑		More than 1/3 mile to closest bus stop
Baltimore Street (Stop 213)		☑			☑	Shifted to Poppleton/ Fayette Streets (new stop)
Harbor East (Stop 226)		☑			☑	Shifted to Exeter/ Fleet Streets (new stop)
Lancaster Street (Stop 227)		☑			☑	Shifted to Exeter/Fleet Streets (new stop)

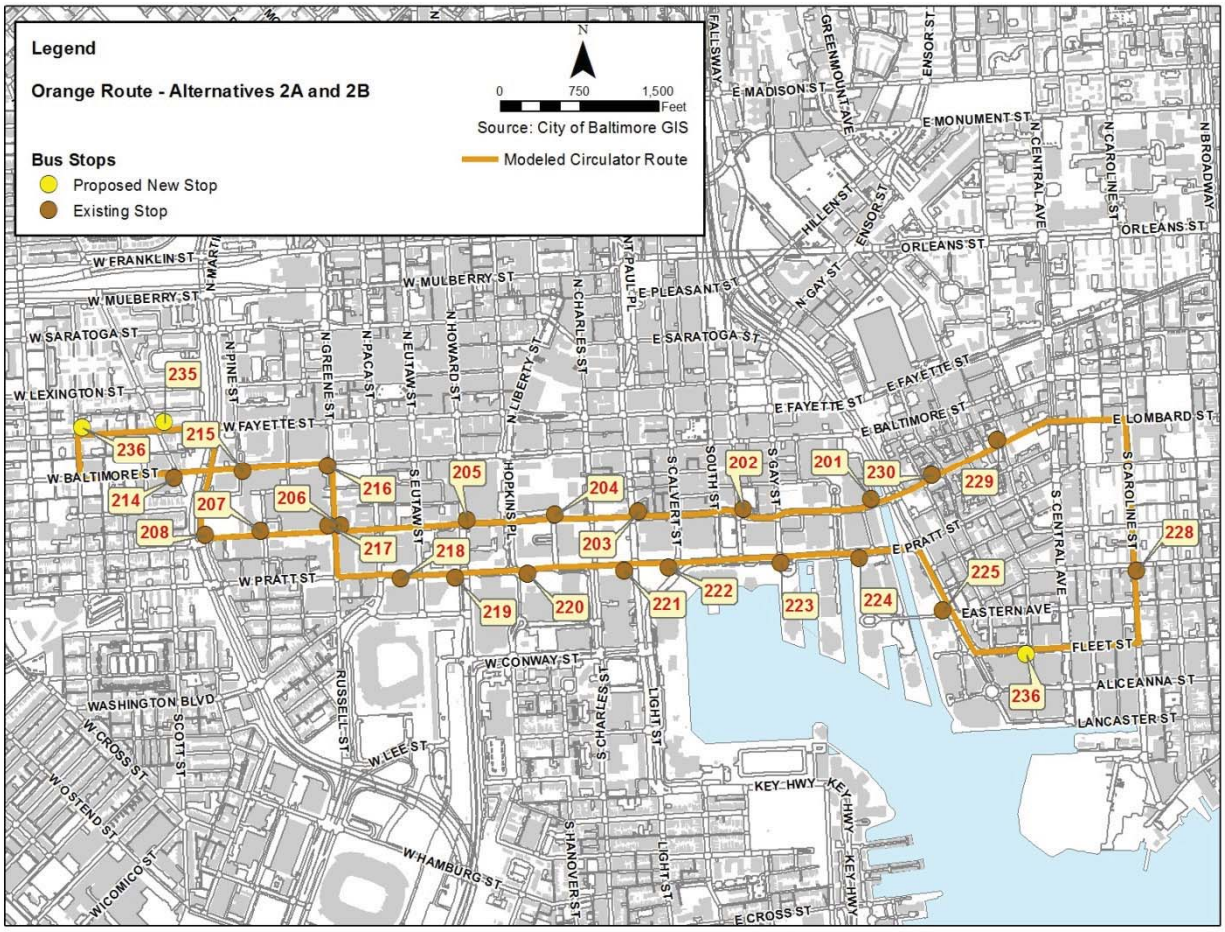

Figure 29. Orange Route Alternatives 2A and 2B

Orange Route Alternative 3

This route follows the same route as Alternative 2; however, stops were consolidated through Camden Yards and Inner Harbor. The route would contain 23 stops, ten (10) stops removed and three (3) stops added. This alternative may lose a small amount of ridership (12 percent) mainly from the Mt. Claire stop. This alternative would operate at 15-minute headways. Table 4 summarizes Orange Route Alternative 3 and Figure 30 shows the route.

Table 4. Orange Route Alternative 3 (Package 2) Summary

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
Fremont Avenue/Fayette Street	☑				☑	Other removed nearby stop
Poppleton/ Fayette Streets	☑				☑	Other removed nearby stops
Exeter/ Fleet Streets	☑				☑	Other removed nearby stops
Penn Street (Stop 207)		☑			☑	Shifted to MLK Jr. Blvd (Stop 208)
Fremont Avenue (Stop 209)		☑			☑	Shifted to Fremont Avenue/Fayette Street (new stop)
University of Maryland BioPark Garage (Stop 210)		☑			☑	Shifted to Poppleton/ Fayette Streets (new stop)
Hollins Market (Stop 211)		☑			☑	Shifted to Poppleton/ Fayette Streets (new stop)
Mt. Claire Street (Stop 212)		☑		☑		More than 1/3 mile to closest bus stop
Baltimore Street (Stop 213)		☑			☑	Shifted to Poppleton/ Fayette Streets (new stop)
Convention Center (Stop 220)		☑			☑	50 percent shifted to Stop 219 and 50 percent shifted to Pratt Street (Stop 221)
Inner Harbor (Stop 222)		☑			☑	Shifted to Pratt Street (Stop 221)
Harbor East (Stop 226)		☑			☑	Shifted to Exeter/Fleet Streets (new stop)
Lancaster Street (Stop 227)		☑			☑	Shifted to Exeter/Fleet Streets (new stop)

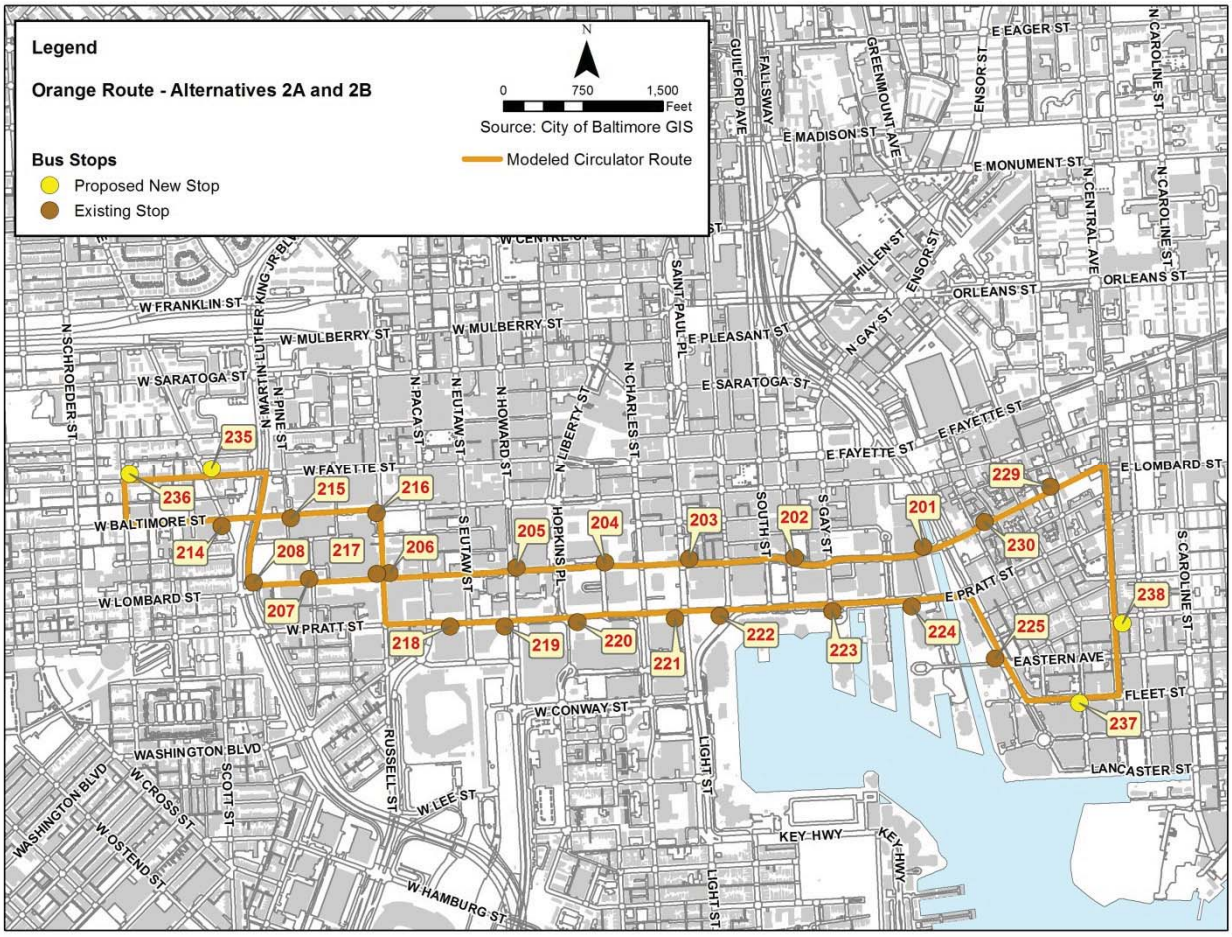

Figure 30. Orange Route Alternative 3

Orange Route Alternative 4

This route follows the same route as Alternative 2; however, the existing bus lanes along Pratt and Lombard Streets would be enforced. This allows the bus lanes to only carry passenger vehicles that were turning right at the next intersection and buses. The route would contain 26 stops, seven (7) stops removed and three (3) stops added. The alternative may lose a small amount of ridership (12 percent) mainly from the Mt. Claire stop. This alternative would operate at 15-minute headways. Table 5 summarizes Orange Route Alternative 4 and Figure 31 shows the route.

Table 5. Orange Route Alternative 4 Summary

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
Fremont Avenue/Fayette Street	☑				☑	Other removed nearby stop
Poppleton/ Fayette Streets	☑				☑	Other removed nearby stops
Exeter/Fleet Streets	☑				☑	Other removed nearby stops
Fremont Avenue (Stop 209)		☑			☑	Shifted to Fremont Avenue/Fayette Street (new stop)
University of Maryland BioPark Garage (Stop 210)		☑			☑	Shifted to Poppleton/ Fayette Streets (new stop)
Hollins Market (Stop 211)		☑			☑	Shifted to Poppleton/ Fayette Streets (new stop)
Mt. Claire Street (Stop 212)		☑		☑		More than 1/3 mile to closest bus stop
Baltimore Street (Stop 213)		☑			☑	Shifted to Poppleton/ Fayette Streets (new stop)
Harbor East (Stop 226)		☑			☑	Shifted to Exeter/ Fleet Streets (new stop)
Lancaster Street (Stop 227)		☑			☑	Shifted to Exeter/Fleet Streets (new stop)

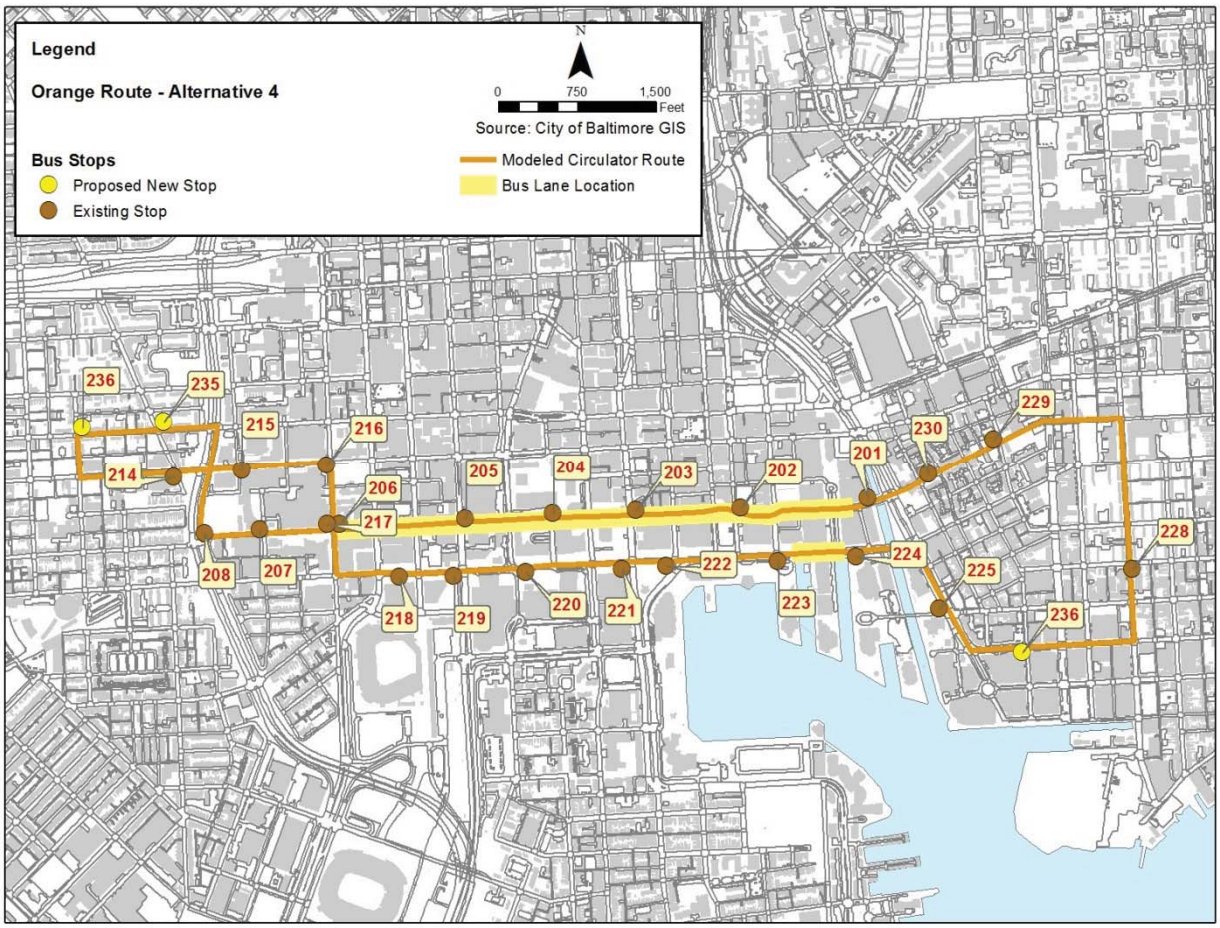

Figure 31. Orange Route Alternative 4

Orange Route Alternative 5

This route shortens the route by 1.5 miles by limiting the western edge to Martin Luther King Jr. Boulevard and limiting the eastern edge to Central Avenue. This route also includes some stop consolidation to help quicken the pace of the bus. This allows the bus route to focus on the Camden Yards, Inner Harbor, and Harbor East neighborhoods. The route would contain 21 stops, ten (10) stops removed and one (1) stop added. The alternative may lose up to 20 percent from the shortened route. This alternative would operate at 15-minute headways. Table 6 summarizes Orange Route Alternative 5 and Figure 32 shows the Alternative 5 route.

Table 6. Orange Route Alternative 5 Summary

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
Bank Street/Central Avenue	☑				☑	Other removed nearby stop
Penn Street (Stop 207)		☑			☑	Shifted to Martin Luther King Jr. Blvd (Stop 208)
Fremont Avenue (Stop 209)		☑			☑	Shifted to Pine Street (Stop 215)
University of Maryland BioPark Garage (Stop 210)		☑			☑	Shifted to Pine Street (Stop 215)
Hollins Market (Stop 211)		☑		☑		More than 1/3 mile to closest bus stop
Mt. Claire Street (Stop 212)		☑		☑		More than 1/3 mile to closest bus stop
Baltimore Street (Stop 213)		☑			☑	Shifted to Pine Street (Stop 215)
Fremont Street (Stop 214)		☑			☑	Shifted to Pine Street (Stop 215)
Inner Harbor (Stop 222)		☑			☑	Shifted to Pratt Street (Stop 221)
Lancaster Street (Stop 227)		☑			☑	Shifted to Exeter/Fleet Streets (new stop)
Bank Street (Stop 228)		☑			☑	Shifted to new stop at Central Avenue/Bank Street

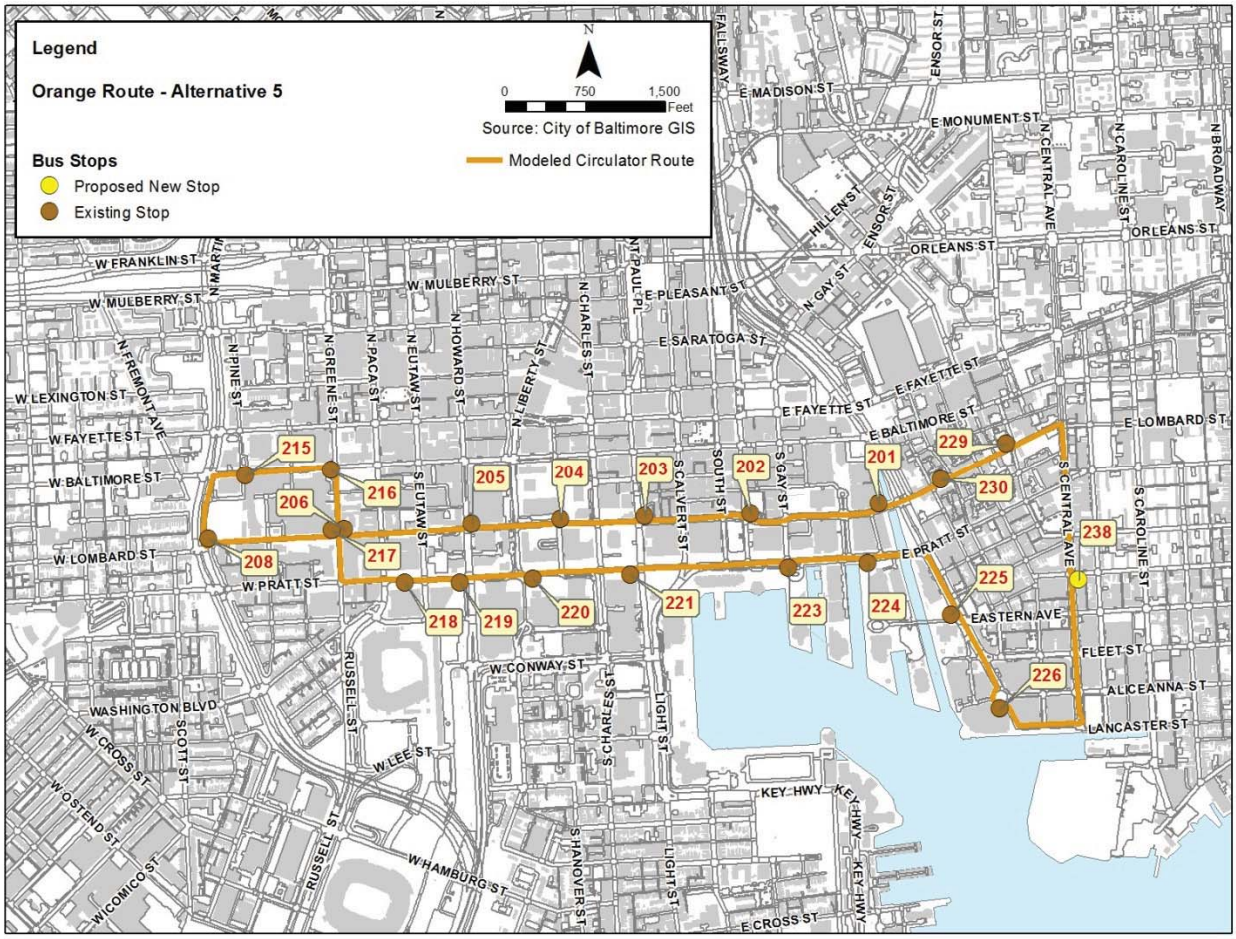

Figure 32. Orange Route Alternative 5

Green Route Alternative 1

The headway was changed to 20 minutes and followed the existing route and stopped at the existing bus stops.

Green Route Alternative 2A and 2B

This route shortens the route by 1.5 miles and creates a counter clockwise route between downtown Baltimore, Harbor East, and Johns Hopkins University Hospital. The existing route would remain between downtown Baltimore, Harbor East, and Johns Hopkins University Hospital, but adds Fayette Street between the hospital area and downtown Baltimore. The route would contain 21 stops, eleven (11) stops removed and five (5) added. The alternative may lose up to 7 percent from the altered route. Alternative 2A would operate at 15-minute headways and Alternative 2B would operate at 20-minute headways. Table 7 summarizes Green Route Alternative 2A and 2B. Figure 33 shows the route.

Table 7. Green Route Alternatives 2A and 2B Summary

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
Central Avenue/ Fayette Streets	☑		☑			Southbound Broadway stop pattern
North Front/ Fayette Streets	☑		☑		☑	Southbound Broadway stop pattern and shifted from other removed nearby stop
Gay /Fayette Streets	☑		☑			Lexington and Gay Street stop pattern
Calvert /Fayette Streets	☑		☑			Lexington and Gay Street stop pattern
South/ Calvert Streets	☑		☑		☑	Boardings shifted from Other removed nearby stop and alighting in similar pattern as Harbor East
Gough Street (Stop 104)		☑			☑	Shifted to Gough Street (Stop 124)
Broadway Market (Stop 105)		☑			☑	Shifted to Fells Point (Stop 123)
Maritime Park WB (Stop 106)		☑			☑	Shifted to Maritime Park EB (Stop 121)
Central Avenue (Stop 107)		☑		☑	☑	Alightings only shifted to Lancaster Street (Stop 120)
Harbor East (Stop (108)		☑		☑	☑	Alightings only shifted to Harbor East (Stop 119)
Reginald F Lewis Museum (Stop 109)		☑		☑	☑	Alightings only shifted to Lombard Street (Stop 117)
Market Place (Stop 110)		☑		☑	☑	Alightings only shifted to North Front /Fayette Streets (new stop)
Gay Street (Stop 111)		☑			☑	Shifted to North Front/ Fayette Streets (new stop)
High Street (Stop 112)		☑		☑		More than 1/3 mile to closest bus stop
Fallsway (Stop 113)		☑		☑		More than 1/3 mile to closest bus stop
Lexington Street (Stop 114)		☑		☑	☑	Boardings only shifted to South/Calvert Streets (new stop)

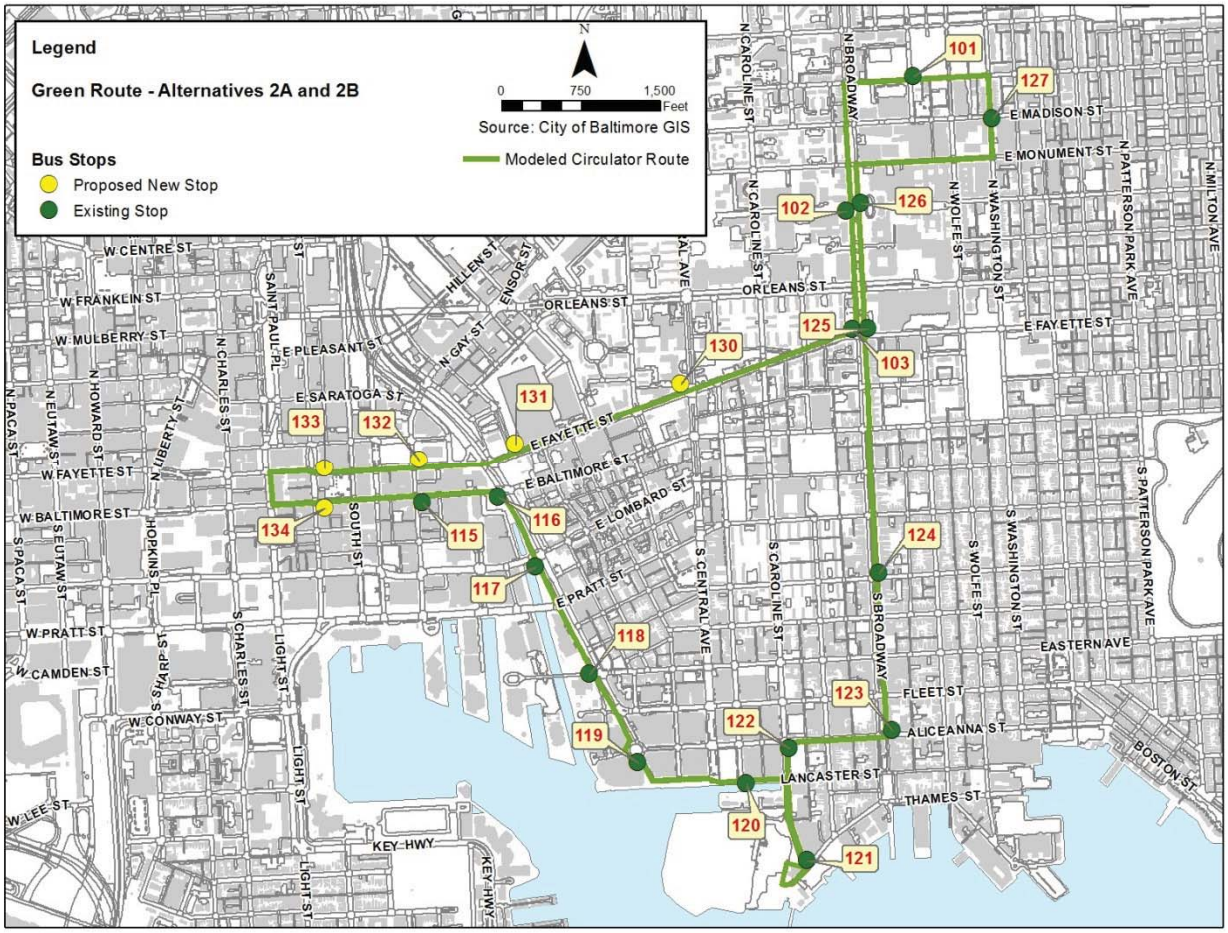

Figure 33. Green Route Alternatives 2A and 2B

Green Route Alternative 3

This route would follow the same route as Alternative 2; however, the extension to serve the Maritime Park would be removed. The route would contain 20 stops, twelve (12) stops removed and five (5) added. The alternative may lose up to 8 percent from the altered route. This alternative would operate at 15-minute headways. Table 8 summarizes Green Route Alternative 3. Figure 34 shows the route.

Table 8. Green Route Alternative 3 Summary

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
Central Avenue/Fayette Street	☑		☑			Southbound Broadway stop pattern
North Front/ Fayette Streets	☑		☑		☑	Southbound Broadway stop pattern and shifted from other nearby removed stops
Gay/Fayette Streets	☑		☑			Lexington and Gay Street stop pattern
Calvert/ Fayette Streets	☑		☑			Lexington and Gay Street stop pattern
South/ Calvert Streets	☑		☑		☑	Boardings shifted from other nearby removed stop and alighting similar pattern as Harbor East
Gough Street (Stop 104)		☑			☑	Shifted to Gough Street (Stop 124)
Broadway Market (Stop 105)		☑			☑	Shifted to Fells Point (Stop 123)
Maritime Park WB (Stop 106)		☑			☑	Shifted to Maritime Park EB (Stop 121)
Central Avenue (Stop 107)		☑		☑	☑	Alightings only shifted to Lancaster Street (Stop 120)
Harbor East (Stop (108)		☑		☑	☑	Alightings only shifted to Harbor East (Stop 119)
Reginald F Lewis Museum (Stop 109)		☑		☑	☑	Alightings only shifted to Lombard Street (Stop 117)
Market Place (Stop 110)		☑		☑	☑	Alightings only shifted to North Front/Fayette Streets (new stop)
Gay Street (Stop 111)		☑			☑	Shifted to North Front/ Fayette Streets (new stop)
High Street (Stop 112)		☑		☑		More than 1/3 mile to closest bus stop
Fallsway (Stop 113)		☑		☑		More than 1/3 mile to closest bus stop
Lexington Street (Stop 114)		☑		☑	☑	Boardings only shifted to South/Calvert Streets (new stop)
Maritime Park EB (Stop 121)		☑			☑	Shifted to Lancaster Street (Stop 120)

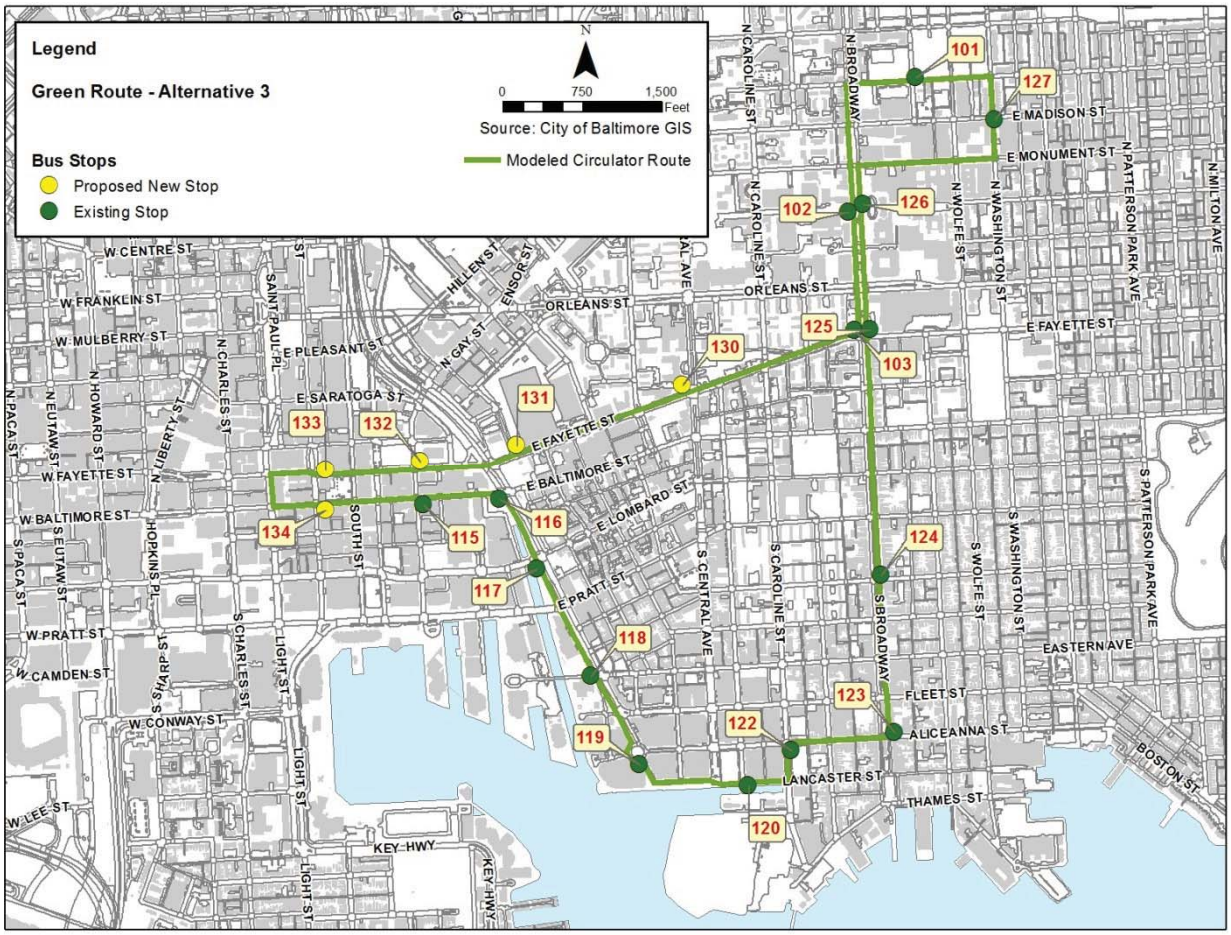

Figure 34. Green Route Alternative 3

Green Route Alternatives 4A and 4B

This route shortens the route by 2.8 miles and removes the connection to downtown Baltimore, thus focusing on the connection between Harbor East and Johns Hopkins University Hospital. The route would contain 14 stops, twelve (12) stops removed and none added. The alternative may lose up to 48 percent from the removal of the downtown connection. Alternative 4A would operate at 15-minute headways and Alternative 4B would operate at 20-minute headways. Table 9 summarizes Green Route Alternative 4A and 4B. Figure 35 shows the route.

Table 9. Green Route Alternatives 4A and 4B Summary

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
Maritime Park (Stop 106)		☑		☑	☑	Alightings shifted to Central Avenue (Stop 107)
Harbor East (Stop 108)		☑			☑	Safety issue – stop discontinued
Reginald F Lewis Museum (Stop 109)		☑		☑		More than 1/3 mile to closest bus stop
Market Place (Stop 110)		☑		☑		More than 1/3 mile to closest bus stop
Gay Street (Stop 111)		☑		☑		More than 1/3 mile to closest bus stop
High Street (Stop 112)		☑		☑		More than 1/3 mile to closest bus stop
Fallsway (Stop 113)		☑		☑		More than 1/3 mile to closest bus stop
Lexington Street (Stop 114)		☑		☑		More than 1/3 mile to closest bus stop
Gay Street (Stop 115)		☑		☑		More than 1/3 mile to closest bus stop
Market Place (Stop 116)		☑		☑		More than 1/3 mile to closest bus stop
Lombard Street (Stop 117)		☑		☑		More than 1/3 mile to closest bus stop
Little Italy (Stop 118)		☑		☑	☑	Boardings shifted to Harbor East (Stop 119)
Maritime Park Eastbound (Stop 121)		☑		☑	☑	Boardings shifted to Caroline Street (Stop 122)

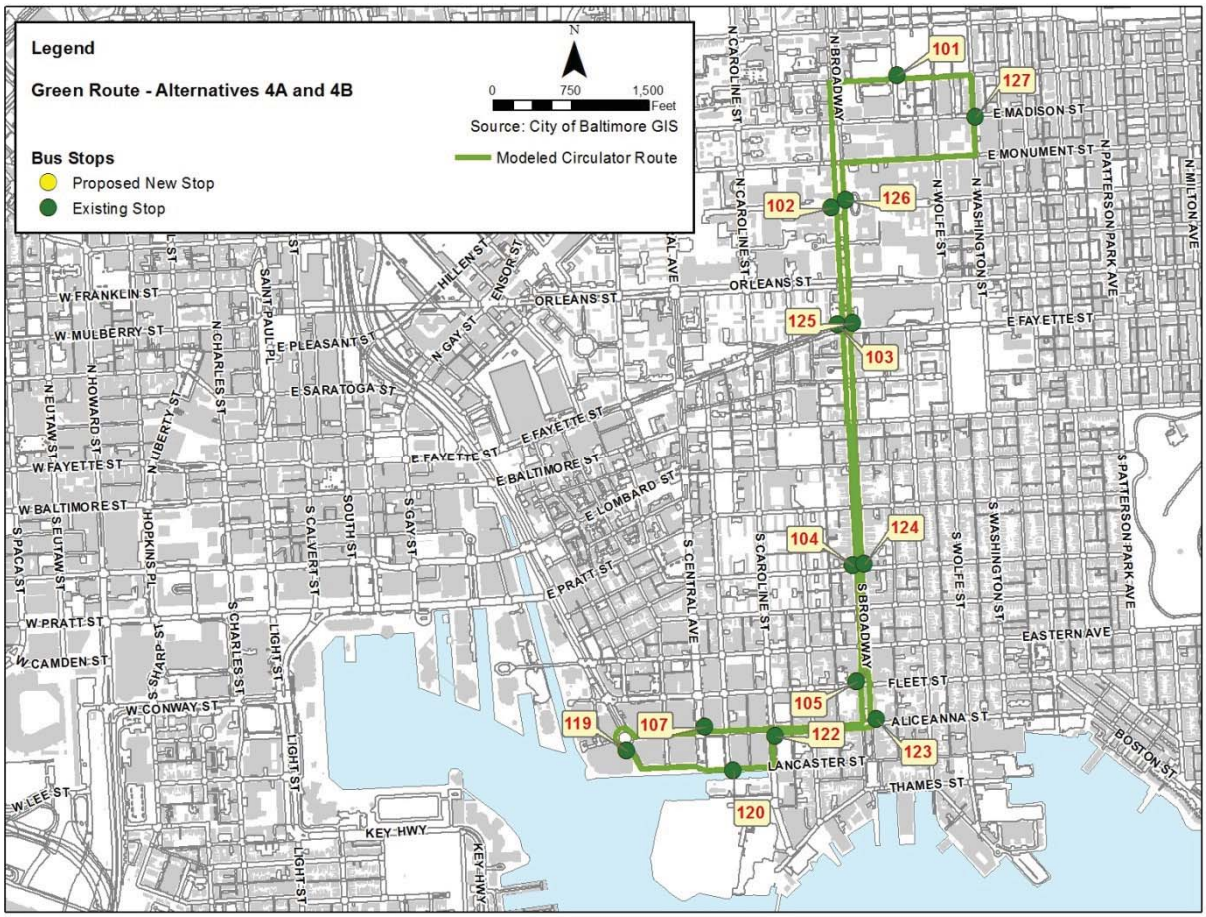

Figure 35. Green Route Alternatives 4A and 4B

Green Route Alternatives 5

This route shortens the route by 3.7 miles and removes the connection to downtown Baltimore and a direct connection to the Johns Hopkins University Hospital campus. The intent of this alternative is to develop the shortest route possible while still maintaining service along Broadway (a roadway with limited MTA service) and a connection between Harbor East and Johns Hopkins University Hospital. The route would contain nine (9) stops, twelve (12) stops removed and none added. The alternative may lose up to 48 percent of riders from the removal of the downtown connection. This alternative would operate at 20-minute headways. Table 10 summarizes Green Route Alternative 5. Figure 36 shows the route.

Table 10. Green Route Alternative 5 Summary

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
Rutland Avenue (Stop 101)		☑		☑		More than 1/3 mile to closest bus stop
Johns Hopkins (Stop 102)		☑			☑	Boardings shifted to Fayette Street (Stop 125)
Fayette Street (Stop 103)		☑			☑	Shifted to Fayette Street (Stop 125)
Maritime Park (Stop 106)		☑		☑	☑	Alightings shifted to Central Avenue (Stop 107)
Harbor East (Stop 108)		☑			☑	Safety issue – stop discontinued
Reginald F Lewis Museum (Stop 109)		☑		☑		More than 1/3 mile to closest bus stop
Market Place (Stop 110)		☑		☑		More than 1/3 mile to closest bus stop
Gay Street (Stop 111)		☑		☑		More than 1/3 mile to closest bus stop
High Street (Stop 112)		☑		☑		More than 1/3 mile to closest bus stop
Fallsway (Stop 113)		☑		☑		More than 1/3 mile to closest bus stop
Lexington Street (Stop 114)		☑		☑		More than 1/3 mile to closest bus stop
Gay Street (Stop 115)		☑		☑		More than 1/3 mile to closest bus stop
Market Place (Stop 116)		☑		☑		More than 1/3 mile to closest bus stop
Lombard Street (Stop 117)		☑		☑		More than 1/3 mile to closest bus stop
Little Italy (Stop 118)		☑		☑	☑	Boardings shifted to Harbor East (Stop 119)
Maritime Park Eastbound (Stop 121)		☑		☑	☑	Boardings shifted to Caroline Street (Stop 122)
Johns Hopkins (Stop 126)		☑			☑	Alightings shifted to Fayette Street (Stop 125)
Madison Street (Stop 127)		☑		☑		More than 1/3 mile to closest bus stop

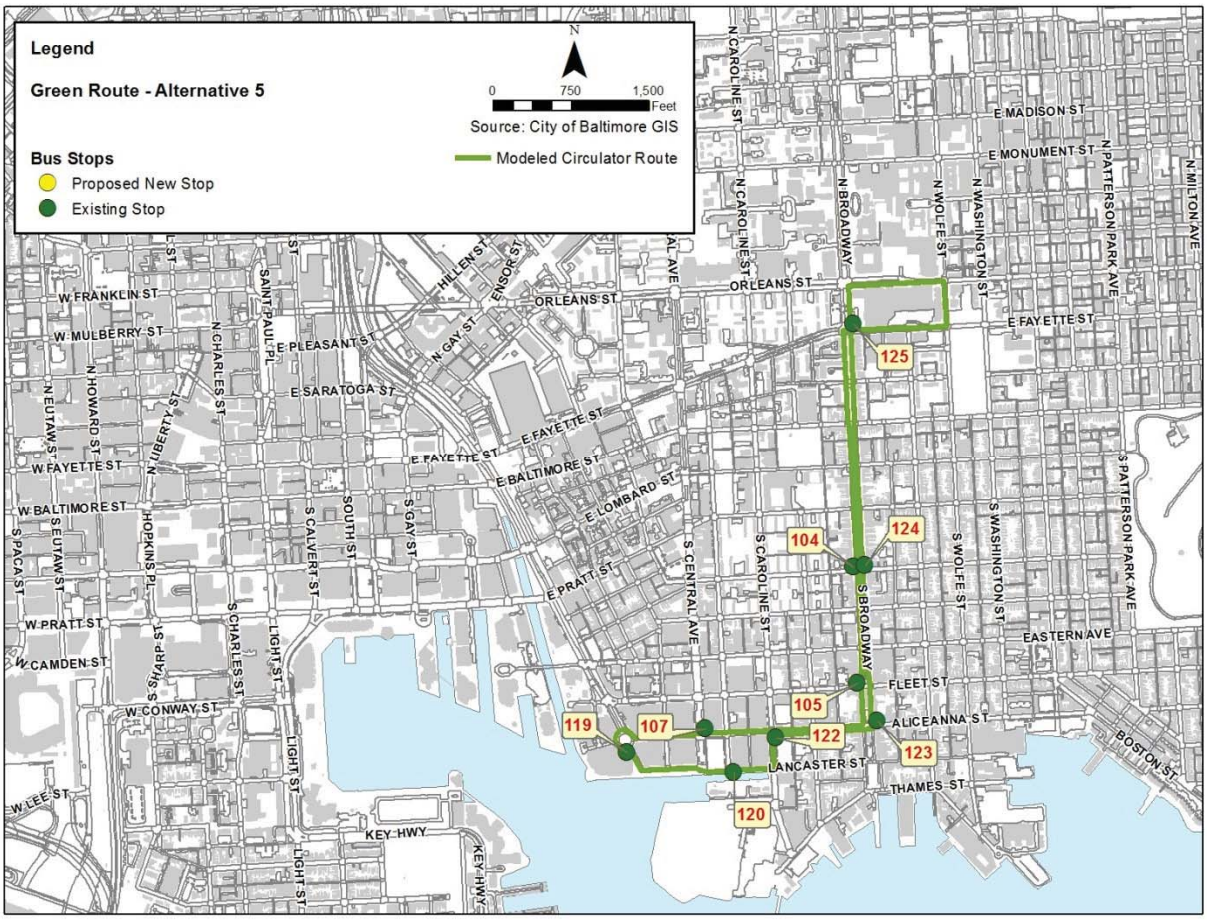

Figure 36. Green Route Alternative 5

Purple Route Alternative 1

The headway was changed to 15 minutes and followed the existing route and stopped at the existing bus stops.

Purple Route Alternatives 2A and 2B

This route lengthens the route by 2.66 miles adding stops between Penn Station and 33rd Street along Charles and St. Paul Streets. This includes the planned northern extension serving Charles Village, Old Goucher, and Johns Hopkins University. The route would contain 40 stops, twelve (12) stops added and none removed. The alternative may add up to 44 percent from the addition of the new stops serving the corridor between Penn Station and 33rd Street. Alternative 2A would operate at 10-minute headways and Alternative 2B would operate at 15-minute headways. Table 11 summarizes Purple Route Alternatives 2A and 2B. Figure 37 shows the route.

Table 11. Purple Route Alternatives 2A and 2B Summary

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	New or Shifted Ridership Source
North Avenue/ Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
22nd Street/ Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
25th Street/ Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
27th Street /Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
31st Street/Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
33rd Street/Charles Street	☑		☑			Average of Penn Station stops
33rd Street/St. Paul Street	☑		☑			Average of Penn Station stops
30th Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
27th Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
25th Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
22nd Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
North Avenue/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street

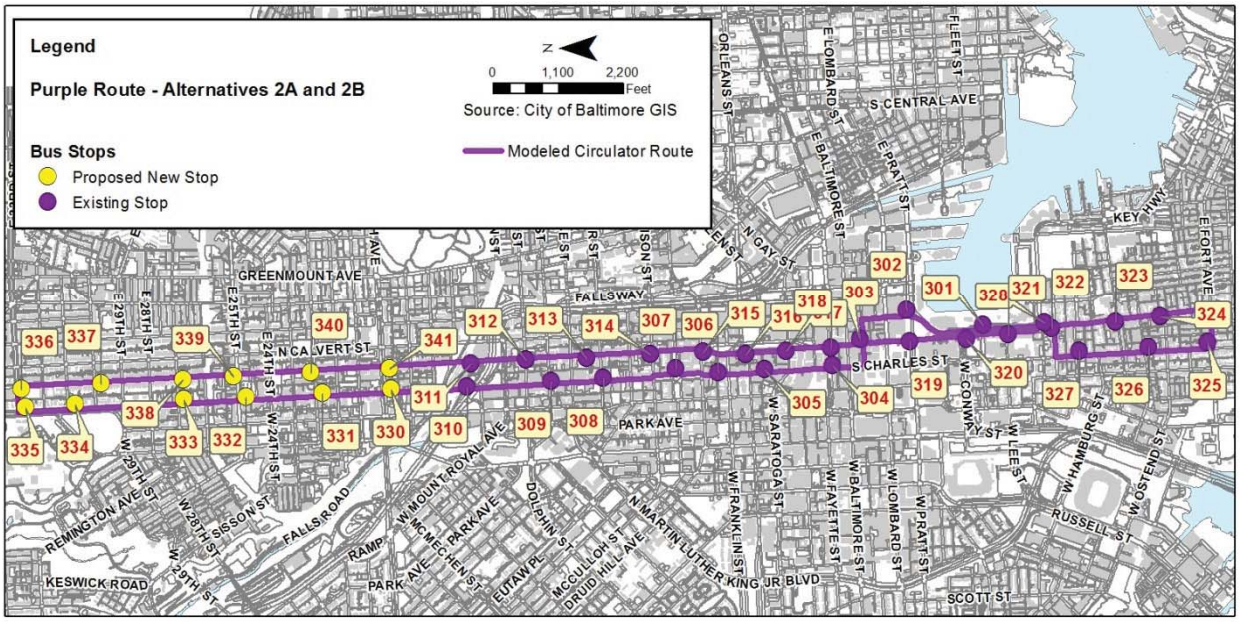

Figure 37. Purple Route Alternatives 2A and 2B

Purple Route Alternative 3

This route lengthens the route by 2.4 miles adding the same stops between Penn Station to 33rd Street. This route would shift the alignment from Light Street in the northbound direction to Charles Street, thus keeping the northbound route entirely on Charles Street to avoid the Calvert Street congestion. The route would contain 40 stops, 16 stops added and four (4) removed. The alternative may add up to 44 percent from the addition of the new stops serving the corridor between Penn Station and 33rd Street. This alternative would operate at 10-minute headways. Table 12 summarizes Purple Route Alternative 3. Figure 38 shows the route.

Table 12. Purple Route Alternative 3 Summary

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
North Avenue/ Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
22nd Street/Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
25th Street/Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
27th Street /Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
31st Street/Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
33rd Street/Charles Street	☑		☑			Average of Penn Station stops
33rd Street/St. Paul Street	☑		☑			Average of Penn Station stops
30th Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
27th Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
25th Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
22nd Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
North Avenue/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
Lee Street/Charles Street	☑				☑	Other removed nearby stop

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
Pratt Street/Charles Street	☑				☑	Other removed nearby stop
Redland Street/Charles Street	☑				☑	Other removed nearby stop
Otterbain (Stop 419)	☑				☑	Existing Banner Route stop new serving Purple Route
Baltimore Visitor Center (Stop 301)		☑				Shifted to Otterbain (Banner Route Stop 419)
Inner Harbor (Stop 302)		☑			☑	Shifted to Pratt Street/ Charles Street (new stop)
Light Street (Stop 303)		☑			☑	Shifted to Redland/Charles Street (new stop)
Key Highway (Stop 328)		☑			☑	Shifted to Lee Street/Charles Street (new stop

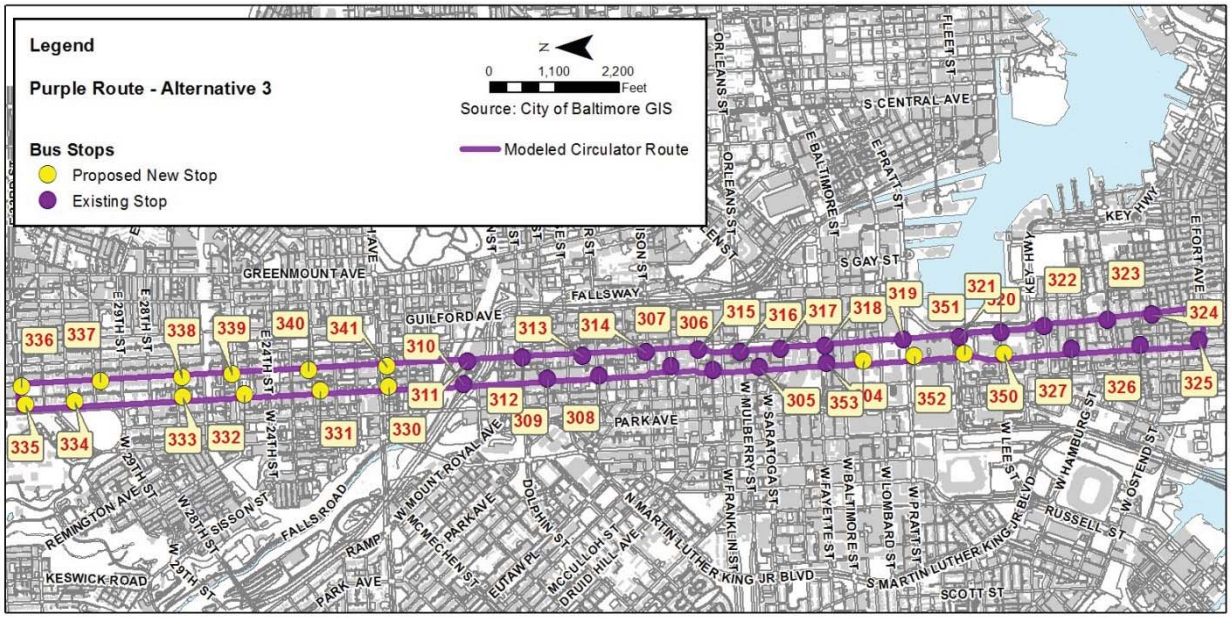

Figure 38. Purple Route Alternative 3

Purple Route Alternatives 4A and 4B

This route lengthens the route by 2.6 miles adding the same stops between Penn Station to 33rd Street. This route would shift the alignment from Light Street in the northbound direction to Charles Street north of Conway Street to avoid the Calvert Street congestion, but would

maintain the visitor center bus stop. The route would contain 40 stops, fourteen (14) stops added and two (2) removed. The alternative may add up to 44 percent from the addition of the new stops serving the corridor between Penn Station and 33rd Street. Alternative 4A would operate at 10-minute headways and Alternative 4B would operate at 15-minute headways. Table 13 summarizes Purple Route Alternative 2A and 2B. Figure 39 shows the route.

Table 13. Purple Route (Packages 3 and 4) Summary

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
North Avenue/ Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
22nd Street/ Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
25th Street/ Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
27th Street /Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
31st Street/ Charles Street	☑		☑			Average of Pleasant to Biddle Street northbound corridor along Charles Street
33rd Street/ Charles Street	☑		☑			Average of Penn Station stops
33rd Street/St. Paul Street	☑		☑			Average of Penn Station stops
30th Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
27th Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
25th Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
22nd Street/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street

Stop Location	New Stop	Stop Removed	New Riders	Riders Lost	Riders Shifted	Comments
North Avenue/St. Paul Street	☑		☑			Average of Preston to Saratoga Street southbound corridor along St. Paul Street
Pratt Street/Charles Street	☑				☑	Other removed nearby stop
Redland Street/Charles Street	☑				☑	Other removed nearby stop
Inner Harbor (Stop 302)		☑			☑	Shifted to Pratt Street/ Charles Street (new stop)
Light Street (Stop 303)		☑			☑	Shifted to Redland/Charles Street (new stop)

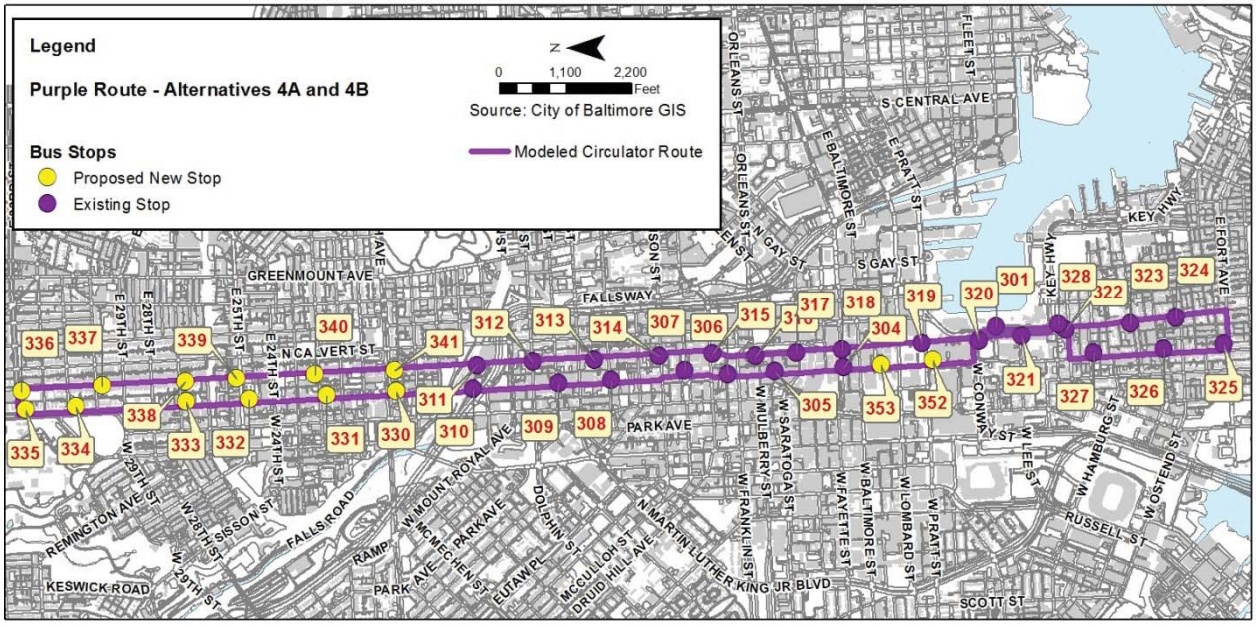

Figure 39. Purple Route Alternative 4A and 4B

E. Model Preparation for Alternative Testing

Eight (8) packages were developed, each containing one (1) alternative for the Purple, Orange, and Green Routes to address the key goals. Some packages include an alternative already modeled since there are more packages than alternatives developed for each Route. It should be noted that each bus route operates independently from one another along different alignments but are modeled together to simulate the system operations. There may be a condition where two routes stop at the same stop (seven (7) shared stops) at the same time and thus could cause a minor delay for one (1) route. This is a condition that could

also occur during normal operations.

Changes to the Banner Route were not modeled because the route only requires two (2) buses resulting in 20-minute headways. Its operation would need to be reduced to less than a 20-minute roundtrip travel time to reduce the bus operation to one (1) bus without lengthening the headway to 40 minutes. The existing data indicated the Banner Route operated with minimal travel time deviation; thus only a route with less than a 20 minute round trip travel time would allow the route to operate with one (1) bus.

		Headway	Package 1	Package 2	Package 3	Package 4	Package 5*	Package 6	Package 7	Package 8
Orange Route	Alternative 1	15 minutes	☑							
	Alternative 2	15 minutes		☑			☑		☑	
		20 minutes						☑		
	Alternative 3	15 minutes			☑					
	Alternative 4	15 minutes				☑				
	Alternative 5	15 minutes								☑
Green Route	Alternative 1	20 minutes	☑							
	Alternative 2	15 minutes		☑						
		20 minutes							☑	
	Alternative 3	15 minutes			☑					
	Alternative 4	15 minutes				☑	☑			
		20 minutes						☑		
	Alternative 5	15 minutes								☑
Purple Route	Alternative 1	15 minutes	☑							
	Alternative 2	10 minutes		☑					☑	
		15 minutes						☑		☑
	Alternative 3	10 minutes			☑					
	Alternative 4	10 minutes				☑	☑			
		15 minutes					☑			

*An additional model run was performed to cover the Purple Route to capture Alternative 4 with a 15-minute headway

F. Model Results

The results from the model simulations provide the average travel time for one (1) complete bus loop along with the estimated average ridership per bus and per hour. The travel times are based on the time for the bus to complete the full loop an incorporate the traffic impacts, time for passengers to board and alight, and time for the bus to service the bus stop (decelerate, open the doors, close the doors, and accelerate to the speed limit. The estimated ridership provides an indication of whether buses would be operating at capacity (includes standees).

The results are presented by alternative and then summarized with comparison tables. The existing condition and/or Alternative 1 (allows for similar headway comparison) is placed next to each alternative result for ease of comparison.

Orange – Alternative 1

This alternative tested an increment in the headway along the existing route. The results showed that the current passenger demand over an hour would be compressed into four (4) buses per hour rather than the existing six (6) buses per hour. This would affect the bus service times at bus stops with high passenger volumes. Instead of the hourly passenger load being serviced every ten (10) minutes the same load would be serviced every 15 minutes. The PM peak period would encounter the heaviest impact resulting in over an eight (8) minute addition in travel time and no savings in the number of buses required to operate the route.

Existing Orange Route		
Route Length:	5.65 miles	Stops per Mile: 5.31
Number of Stops:	30	
Scheduled Headway:	10 minutes	
Buses in Operation:	5 buses	
Average Travel Time:	AM - 48.12 minutes	PM - 52.40 minutes
Average Headway:	AM - 13.51 minutes	PM - 16.69 minutes
Average Riders:	AM - 269 passengers	PM - 327 passengers

Orange Route - Alternative 1		
Route Length:	5.65 miles	Stops per Mile: 5.31
Number of Stops:	30	
Change in Average Riders:	AM - No Change	PM - No Change
Proposed Headway:	15 minutes	
Average Travel Time:	AM - 49.1 minutes	PM - 59.0 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 5 buses
Bus Capacity (based on 42 seats)	AM - 62% full	PM - 100% full
Bus Capacity (based on 72 passengers)	AM - 36% full	PM - 61% full

Pros:

- Limited or no loss in existing ridership.
- Route unchanged.

Cons:

- Longer wait times for passengers.
- No change in the number of buses required to operate the route.

Orange – Alternatives 2A and 2B

These alternatives tested a shorter route and increments in the headway. The results showed that the shorter route in combination with the increased headways provided enough travel time savings to reduce the number of buses required to operate the route. The 15-minute headway would allow for one (1) less bus than currently operates and the 20-minute headway would allow two (2) fewer buses required to operate the route. It should be noted that ridership may decline with 20-minute headways if many passengers choose to walk instead of using the free service (TCQSM, 2013). Connection lines are provided to help identify the key comparisons.

Existing Orange Route		
Route Length:	5.65 miles	Stops per Mile: 5.31
Number of Stops:	30	
Scheduled Headway:	10 minutes	
Buses in Operation:	5 buses	
Average Travel Time:	AM - 48.12 minutes	PM - 52.40 minutes
Average Headway:	AM - 13.51 minutes	PM - 16.69 minutes
Average Riders:	AM - 269 passengers	PM - 327 passengers

Orange Route - Alternative 1		
Route Length:	5.65 miles	Stops per Mile: 5.31
Number of Stops:	30	
Change in Average Riders:	AM - No Change	PM - No Change
Proposed Headway:	15 minutes	
Average Travel Time:	AM - 49.1 minutes	PM - 59.0 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 5 buses
Bus Capacity (based on 42 seats)	AM - 62% full	PM - 100% full
Bus Capacity (based on 72 passengers)	AM - 36% full	PM - 61% full

Orange Route - Alternative 2		
Route Length:	4.86 miles	Stops per Mile: 5.35
Number of Stops:	26	
Change in Average Riders:	AM - 12% decrease	PM - 9% decrease
Proposed Headway:	15 minutes (Alternative 2A)	
Average Travel Time:	AM - 43.6 minutes	PM - 53.8 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 4 buses
Bus Capacity (based on 42 seats)	AM - 69% full	PM - 86% full
Bus Capacity (based on 72 passengers)	AM - 40% full	PM - 50% full
Proposed Headway:	20 minutes (Alternative 2B)	
Average Travel Time:	AM - 45.0 minutes	PM - 55.0 minutes
Recommend Buses in Operation	AM - 3 buses	PM - 3 buses
Bus Capacity (based on 42 seats)	AM - 74% full	PM - 88% full
Bus Capacity (based on 72 passengers)	AM - 43% full	PM - 51% full

Pros:

- Limited or no loss in existing ridership.
- Route shortened to focus on primary connection between Lombard/Pratt Street corridors through downtown Baltimore, Harbor East, and University of Maryland Baltimore.
- Better access to the University of Maryland Baltimore BioPark.
- Savings of one (1) less bus required to operate the route (15 minute headway).
- Savings of two (2) fewer buses required to operate the route (20 minute headway).

Cons:

- Longer wait times for passengers.
- Loss of bus stop directly serving Hollins Market.
- Loss of bus stops directly serving Harbor East.

Orange – Alternative 3

This alternative tested a shorter route, stop consolidation, and an increment in headway. The results showed that reduction in bus stops provided a minimal travel time savings, since most of the passengers would shift to the next closest bus stop, thus extending the bus service time at these adjacent bus stops. Operations would be improved resulting in one (1) less bus required to operate the route. Connection lines are provided to help identify the key comparisons.

Existing Orange Route		
Route Length:	5.65 miles	Stops per Mile: 5.31
Number of Stops:	30	
Scheduled Headway:	10 minutes	
Buses in Operation:	5 buses	
Average Travel Time:	AM - 48.12 minutes	PM - 52.40 minutes
Average Headway:	AM - 13.51 minutes	PM - 16.69 minutes
Average Riders:	AM - 269 passengers	PM - 327 passengers

Orange Route - Alternative 2		
Route Length:	4.86 miles	Stops per Mile: 5.35
Number of Stops:	26	
Change in Average Riders:	AM - 12% decrease	PM - 9% decrease
Proposed Headway:	15 minutes (Alternative 2A)	
Average Travel Time:	AM - 43.6 minutes	PM - 53.8 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 4 buses
Bus Capacity (based on 42 seats)	AM - 69% full	PM - 86% full
Bus Capacity (based on 72 passengers)	AM - 40% full	PM - 50% full

Orange Route - Alternative 3		
Route Length:	4.86 miles	Stops per Mile: 4.73
Number of Stops:	23	
Change in Average Riders:	AM - 12% decrease	PM - 9% decrease
Proposed Headway:	15 minutes	
Average Travel Time:	AM - 42.9 minutes	PM - 53.3 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 4 buses
Bus Capacity (based on 42 seats)	AM - 52% full	PM - 62% full
Bus Capacity (based on 72 passengers)	AM - 31% full	PM - 36% full

Pros:

- Limited or no loss in existing ridership.
- Route shortened to focus on primary connection between Lombard/Pratt Street corridors. through downtown Baltimore, Harbor East, and University of Maryland Baltimore.
- Better access to the University of Maryland Baltimore BioPark.
- Savings of one (1) less bus required to operate the route (15 minute headway).
- Removal of bus stops slightly reduces travel time.

Cons:

- Longer wait times for passengers.
- Loss of bus stop directly serving Hollins Market.
- Loss of bus stops directly serving Harbor East.
- Removal of key bus stops serving the Convention Center and direct connection to the Penn Station bound Purple Route (closest bus stops one (1) block away from these sites).

Orange – Alternative 4

This alternative tested a shorter route, enforcement of the bus lanes along Pratt and Lombard Streets, and an increment in headway. The results showed that the bus lanes provide a small enough amount of relief in traffic congestion when passenger vehicles use the bus lanes for short distances to bypass long queues for upcoming left turn movements. If that activity is enforced, the result is a much worse traffic congestion issue along Lombard Street causing queuing well past Central Avenue. This action delays the buses and adds a significant amount of time to the route's travel time.

Existing Orange Route		
Route Length:	5.65 miles	Stops per Mile: 5.31
Number of Stops:	30	
Scheduled Headway:	10 minutes	
Buses in Operation:	5 buses	
Average Travel Time:	AM - 48.12 minutes	PM - 52.40 minutes
Average Headway:	AM - 13.51 minutes	PM - 16.69 minutes
Average Riders:	AM - 269 passengers	PM - 327 passengers

Orange Route - Alternative 4		
Route Length:	4.86 miles	Stops per Mile: 5.35
Number of Stops:	26	
Change in Average Riders:	AM - 12% decrease	PM - 9% decrease
Proposed Headway:	15 minutes	
Average Travel Time:	AM - 46.0 minutes	PM - 77.2 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 6 buses
Bus Capacity (based on 42 seats)	AM - 62% full	PM - 100% full
Bus Capacity (based on 72 passengers)	AM - 36% full	PM - 63% full

Pros:

- Limited or no loss in existing ridership.
- Route shortened to focus on primary connection between Lombard/Pratt Street corridors through downtown Baltimore, Harbor East, and University of Maryland Baltimore.
- Better access to the University of Maryland Baltimore BioPark.

Cons:

- Longer wait times for passengers.
- Travel time increased due to worsening traffic conditions along Lombard Street.
- Requires an additional bus to operate the route.
- Loss of bus stop directly serving Hollins Market.
- Loss of bus stops directly serving Harbor East.

Orange – Alternative 5

This alternative tested a shorter route than Alternative 2, stop consolidation, and an increment in headway. The results showed that the alternative provided almost a three (3) minute reduction in travel time compared to Alternative 2, but not enough to reduce the number of buses required to operate the route below four (4) buses during the PM peak period. Connection lines are provided to help identify the key comparisons.

Existing Orange Route		
Route Length:	5.65 miles	Stops per Mile: 5.31
Number of Stops:	30	
Scheduled Headway:	10 minutes	
Buses in Operation:	5 buses	
Average Travel Time:	AM - 48.12 minutes	PM - 52.40 minutes
Average Headway:	AM - 13.51 minutes	PM - 16.69 minutes
Average Riders:	AM - 269 passengers	PM - 327 passengers

Orange Route - Alternative 2		
Route Length:	4.86 miles	Stops per Mile: 5.35
Number of Stops:	26	
Change in Average Riders:	AM - 12% decrease	PM - 9% decrease
Proposed Headway:	15 minutes (Alternative 2A)	
Average Travel Time:	AM - 43.6 minutes	PM - 53.8 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 4 buses
Bus Capacity (based on 42 seats)	AM - 69% full	PM - 86% full
Bus Capacity (based on 72 passengers)	AM - 40% full	PM - 50% full

Orange Route - Alternative 5		
Route Length:	4.17 miles	Stops per Mile: 5.04
Number of Stops:	21	
Change in Average Riders:	AM - 20% decrease	PM - 15% decrease
Proposed Headway:	15 minutes	
Average Travel Time:	AM - 37.3 minutes	PM - 50.2 minutes
Recommend Buses in Operation	AM - 3 buses	PM - 4 buses
Bus Capacity (based on 42 seats)	AM - 62% full	PM - 76% full
Bus Capacity (based on 72 passengers)	AM - 36% full	PM - 65% full

Pros:

- Some loss in existing ridership.
- Savings of one (1) less bus required to operate the route.
- Route shortened to focus on primary connection between Lombard/Pratt Street corridors through downtown Baltimore, Harbor East, and University of Maryland Baltimore.

Cons:

- Longer wait times for passengers.
- Loss of bus stop directly serving Hollins Market.
- Loss of bus stops directly serving the University of Maryland BioPark.

Green – Alternative 1

This alternative tested an increment in the headway along the existing route. The results showed that the current passenger demand could be compressed into three (3) buses per hour rather than the existing six (6) buses per hour without affecting travel time. The number of buses required to operate the service would drop from six (6) to five (5). It should be noted that ridership may decline with 20-minute headways if many passengers choose to walk instead of using the free service (TCQSM, 2013).

Existing Green Route		
Route Length:	6.71 miles	Stops per Mile: 4.02
Number of Stops:	27	
Scheduled Headway:	10 minutes	
Buses in Operation:	6 buses	
Average Travel Time:	AM - 60.08 minutes	PM - 63.52 minutes
Average Headway:	AM - 17.01 minutes	PM - 20.51 minutes
Average Riders:	AM - 156 passengers	PM - 132 passengers

Green Route - Alternative 1		
Route Length:	6.71	Stops per Mile: 4.02
Number of Stops:	27	
Change in Average Riders:	AM - No Change	PM - No Change
Proposed Headway:	20 minutes	
Average Travel Time:	AM - 59.6 minutes	PM - 60.8 minutes
Recommend Buses in Operation	AM - 5 buses	PM - 5 buses
Bus Capacity (based on 42 seats)	AM - 100% full	PM - 74% full
Bus Capacity (based on 72 passengers)	AM - 64% full	PM - 43% full

Pros:

- Limited or no loss in existing ridership.
- Route unchanged.
- Savings of one (1) less bus required to operate the route.

Cons:

- Longer wait times for passengers.

Green – Alternatives 2A and 2B

These alternatives tested a route change, route shortening, and an increment in the headway. The results showed that the change in route would reduce the travel time by 19 minutes and require four (4) buses (Alternative 2A) and three (3) buses (Alternative 2B) to operate the route. Neither scenario would encounter a ridership capacity problem. It should be noted that ridership may decline with 20-minute headways if many passengers choose to walk instead of using the free service (TCQSM, 2013). Connection lines are provided to help identify the key comparisons.

Existing Green Route		
Route Length:	6.71 miles	Stops per Mile: 4.02
Number of Stops:	27	
Scheduled Headway:	10 minutes	
Buses in Operation:	6 buses	
Average Travel Time:	AM - 60.08 minutes	PM - 63.52 minutes
Average Headway:	AM - 17.01 minutes	PM - 20.51 minutes
Average Riders:	AM - 156 passengers	PM - 132 passengers

Green Route - Alternative 2		
Route Length:	5.23 miles	Stops per Mile: 4.02
Number of Stops:	21	
Change in Average Riders:	AM - 2% increase	PM - 7% decrease
Proposed Headway:	15 minutes (Alternative 2A)	
Average Travel Time:	AM - 52.3 minutes	PM - 45.9 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 4 buses
Bus Capacity (based on 42 seats)	AM - 76% full	PM - 60% full
Bus Capacity (based on 72 passengers)	AM - 44% full	PM - 35% full
Proposed Headway:	20 minutes (Alternative 2B)	
Average Travel Time:	AM - 53.5 minutes	PM - 45.5 minutes
Recommend Buses in Operation	AM - 3 buses	PM - 3 buses
Bus Capacity (based on 42 seats)	AM - 100% full	PM - 59% full
Bus Capacity (based on 72 passengers)	AM - 58% full	PM - 35% full

Pros:

- Creation of a counter-clockwise route connecting downtown Baltimore, Harbor East, Little Italy, Fells point, Butcher's Hill, Dunbar Broadway, and Johns Hopkins University Hospital.
- Fayette Street corridor served between Broadway and downtown.
- Small decrease in ridership.
- Reduction in travel time compared to existing route.
- Savings of two (2) fewer buses required to operate the route (15 minute headway).

- Savings of three (3) fewer buses required to operate the route (20 minute headway).

Cons:

- Travel between Harbor East and downtown Baltimore requires traveling via Johns Hopkins University Hospital.
- Park and Ride lot along North High Street no longer served.
- Travel along Broadway in the southbound direction no longer provided.

Green – Alternative 3

This alternative tested a similar route to Alternative 2 without the extension to Maritime Park. The results showed a travel time savings of 21 minutes compared to the existing condition and a three (3) minute savings compared to Alternative 2A. The same number of buses as Alternative 2A would be required to operate the route. Connection lines are provided to help identify the key comparisons.

Existing Green Route		
Route Length:	6.71 miles	Stops per Mile: 4.02
Number of Stops:	27	
Scheduled Headway:	10 minutes	
Buses in Operation:	6 buses	
Average Travel Time:	AM - 60.08 minutes	PM - 63.52 minutes
Average Headway:	AM - 17.01 minutes	PM - 20.51 minutes
Average Riders:	AM - 156 passengers	PM - 132 passengers

Green Route - Alternative 2		
Route Length:	5.23 miles	Stops per Mile: 4.02
Number of Stops:	21	
Change in Average Riders:	AM - 2% increase	PM - 7% decrease
Proposed Headway:	15 minutes (Alternative 2A)	
Average Travel Time:	AM - 52.3 minutes	PM - 45.9 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 4 buses
Bus Capacity (based on 42 seats)	AM - 76% full	PM - 60% full
Bus Capacity (based on 72 passengers)	AM - 44% full	PM - 35% full

Green Route - Alternative 3		
Route Length:	4.77 miles	Stops per Mile: 4.19
Number of Stops:	20	
Change in Average Riders:	AM - 2% increase	PM - 7% decrease
Proposed Headway:	15 minutes	
Average Travel Time:	AM - 49.9 minutes	PM - 43.3 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 4 buses
Bus Capacity (based on 42 seats)	AM - 74% full	PM - 62% full
Bus Capacity (based on 72 passengers)	AM - 43% full	PM - 36% full

Pros:

- Creation of a counter-clockwise route connecting downtown Baltimore, Harbor East, Little Italy, Fells point, Butcher's Hill, Dunbar Broadway, and Johns Hopkins University Hospital.
- Fayette Street corridor served between Broadway and downtown.
- Small decrease in ridership.
- Reduction in travel time compared to existing route.
- Savings of two (2) fewer buses required to operate the route.

Cons:

- Travel between Harbor East and downtown Baltimore requires traveling via Johns Hopkins University Hospital.
- Park and Ride lot along North High Street no longer served.
- Travel along Broadway in the southbound direction no longer provided.
- Fells Point no longer served.

Green – Alternatives 4A and 4B

These alternatives tested a route change, dramatic route shortening, and two (2) increments in the headway. The results showed that the change in route would reduce the travel time by 25 minutes and requires three (3) buses to operate the route. Neither scenario would encounter a ridership capacity problem. It should be noted that ridership may decline with 20-minute headways if many passengers choose to walk instead of using the free service (TCQSM, 2013). Connection lines are provided to help identify the key comparisons.

Existing Green Route		
Route Length:	6.71 miles	Stops per Mile: 4.02
Number of Stops:	27	
Scheduled Headway:	10 minutes	
Buses in Operation:	6 buses	
Average Travel Time:	AM - 60.08 minutes	PM - 63.52 minutes
Average Headway:	AM - 17.01 minutes	PM - 20.51 minutes
Average Riders:	AM - 156 passengers	PM - 132 passengers

Green Route - Alternative 4		
Route Length:	3.89 miles	Stops per Mile: 3.60
Number of Stops:	14	
Change in Average Riders:	AM - 48% decrease	PM - 26% decrease
Proposed Headway:	15 minutes	
Average Travel Time:	AM - 38.1 minutes	PM - 31.7 minutes
Recommend Buses in Operation	AM - 3 buses	PM - 3 buses
Bus Capacity (based on 42 seats)	AM - 71% full	PM - 57% full
Bus Capacity (based on 72 passengers)	AM - 42% full	PM - 33% full
Proposed Headway:	20 minutes	
Average Travel Time:	AM - 39 minutes	PM - 32.7 minutes
Recommend Buses in Operation	AM - 3 buses	PM - 2 buses
Bus Capacity (based on 42 seats)	AM - 81% full	PM - 71% full
Bus Capacity (based on 72 passengers)	AM - 47% full	PM - 42% full

Pros:

- Creation of a short route connecting Harbor East to Johns Hopkins University Hospital.
- Reduction in travel time compared to existing and other alternative routes.
- Savings of three (3) fewer buses required to operate the route.

Cons:

- Large decrease in ridership.
- Park and Ride lot along North High Street no longer served.
- Downtown Baltimore no longer served without connecting to the Orange Route.
- Fells Point no longer served.

Green – Alternative 5

This alternative tested a route change, dramatic route shortening, and an increment in the headway. The results showed that the change in route would reduce the travel time by 29 minutes and requires two (2) buses to operate the route compared to the existing condition. Compared to Alternative 4B, this alternative would reduce the travel time by four (4) minutes, enough to reduce the number of buses to operate from three (3) to two (2). It should be noted that ridership may decline with 20-minute headways if many passengers choose to walk instead of using the free service (TCQSM, 2013). Connection lines are provided to help identify the key comparisons.

Existing Green Route		
Route Length:	6.71 miles	Stops per Mile: 4.02
Number of Stops:	27	
Scheduled Headway:	10 minutes	
Buses in Operation:	6 buses	
Average Travel Time:	AM - 60.08 minutes	PM - 63.52 minutes
Average Headway:	AM - 17.01 minutes	PM - 20.51 minutes
Average Riders:	AM - 156 passengers	PM - 132 passengers

Green Route - Alternative 4		
Route Length:	3.89 miles	Stops per Mile: 3.60
Number of Stops:	14	
Change in Average Riders:	AM - 48% decrease	PM - 26% decrease
Proposed Headway:	20 minutes (Alternative 4B)	
Average Travel Time:	AM - 39 minutes	PM - 32.7 minutes
Recommend Buses in Operation	AM - 3 buses	PM - 2 buses
Bus Capacity (based on 42 seats)	AM - 81% full	PM - 71% full
Bus Capacity (based on 72 passengers)	AM - 47% full	PM - 42% full

Green Route - Alternative 5		
Route Length:	3.00 miles	Stops per Mile: 3.00
Number of Stops:	9	
Change in Average Riders:	AM - 59% decrease	PM - 67% decrease
Proposed Headway:	20 minutes	
Average Travel Time:	AM - 32.6 minutes	PM - 35.3 minutes
Recommend Buses in Operation	AM - 2 buses	PM - 2 buses
Bus Capacity (based on 42 seats)	AM - 67% full	PM - 43% full
Bus Capacity (based on 72 passengers)	AM - 39% full	PM - 25% full

Pros:

- Creation of a short route connecting Harbor East to southern perimeter of Johns Hopkins University Hospital.
- Reduction in travel time compared to existing and other alternative routes.
- Savings of four (4) less buses required to operate the route.

Cons:

- Large decrease in ridership.
- Park and Ride lot along North High Street no longer served.
- Downtown Baltimore no longer served without connecting to the Orange Route.
- Fells Point no longer served.

Purple – Alternative 1

This alternative tested an increment in the headway along the existing route. The results showed that the current passenger demand over an hour would be compressed into four (4) buses per hour rather than the existing six (6) buses per hour. This would affect the bus service times at bus stops with high passenger volumes. Instead of the hourly passenger load being serviced every ten (10) minutes the same load would be serviced every 15 minutes. Both peak periods would encounter a similar delay in travel time. The number of buses required to operate the service would drop, although there would be less than a five (5) minute gap between runs during the PM peak; therefore, this could require five (5) buses rather than the aggressive four (4) buses listed below. It should be noted that ridership may decline with 20-minute headways if many passengers choose to walk instead of using the free service (TCQSM, 2013).

Existing Purple Route		
Route Length:	5.50 miles	Stops per Mile: 5.09
Number of Stops:	28	
Scheduled Headway:	10 minutes	
Buses in Operation:	6 buses	
Average Travel Time:	AM - 45.43 minutes	PM - 53.12 minutes
Average Headway:	AM - 11.17 minutes	PM - 12.13 minutes
Average Riders:	AM - 386 passengers	PM - 409 passengers

Purple Route - Alternative 1		
Route Length:	5.50 miles	Stops per Mile: 5.09
Number of Stops:	28	
Change in Average Riders:	AM - No Change	PM - No Change
Proposed Headway:	15 minutes	
Average Travel Time:	AM - 47.0 minutes	PM - 55.5 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 4 buses
Bus Capacity (based on 42 seats)	AM - 100% full	PM - 100% full
Bus Capacity (based on 72 passengers)	AM - 68% full	PM - 75% full

Pros:

- Limited or no loss in existing ridership.
- Route unchanged.
- Savings of two (2) less bus required to operate the route.

Cons:

- Longer wait times for passengers.

Purple – Alternatives 2A and 2B

These alternatives tested a lengthened route and an increment in the headway (Alternative 2B only). The results showed that the longer route would add 16 minutes to the travel time and require seven (7) buses (with aggressive PM peak monitoring and intervention) or eight (8) buses – conservatively-to operate the route. Alternative 2A would have less than a five (5) minute gap between runs during the PM peak; this is the smallest layover time during the entire day. It is anticipated that the rest of the day can be readily accommodated with seven (7) buses; the PM peak may require extra monitoring and operational interventions such as assigning one bus to skip the northern-most loop, assigning a spare bus to operate for just the peak hour or two (2) hours, or other options (to be evaluated after observing actual operations). Alternative 2B would have passenger capacity problems during the AM peak resulting in some passengers unable to board the first bus that arrives. Connection lines are provided to help identify the key comparisons.

Existing Purple Route		
Route Length:	5.50 miles	Stops per Mile: 5.09
Number of Stops:	28	
Scheduled Headway:	10 minutes	
Buses in Operation:	6 buses	
Average Travel Time:	AM - 45.43 minutes	PM - 53.12 minutes
Average Headway:	AM - 11.17 minutes	PM - 12.13 minutes
Average Riders:	AM - 386 passengers	PM - 409 passengers

Purple Route - Alternative 2		
Route Length:	8.16 miles	Stops per Mile: 4.90
Number of Stops:	40	
Change in Average Riders:	AM - 44% increase	PM - 35% increase
Proposed Headway:	10 minutes (Alternative 2A)	
Average Travel Time:	AM - 58.6 minutes	PM - 68.8 minutes
Recommend Buses in Operation	AM - 7 buses	PM - 8 buses
Bus Capacity (based on 42 seats)	AM - 100% full	PM - 90% full
Bus Capacity (based on 72 passengers)	AM - 63% full	PM - 58% full
Proposed Headway:	15 minutes (Alternative 2B)	
Average Travel Time:	AM - 61.1 minutes	PM - 72.4 minutes
Recommend Buses in Operation	AM - 5 buses	PM - 6 buses
Bus Capacity (based on 42 seats)	AM - 100% full	PM - 100% full
Bus Capacity (based on 72 passengers)	AM - 94% full	PM - 74% full

Pros:

- Expansion of service north of Penn Station to 33rd Street serving Barclay, Charles Village, Harwood, Baltimore Museum of Art, and Johns Hopkins University.
- Increase in ridership.

Cons:

- Travel time increased due to route expansion.
- More buses required to operate the route.
- 10 minute headways required to avoid bus capacity issues.

Purple – Alternative 3

This alternative tested a lengthened route and a slight route change in the northbound direction to avoid a common congested area through the Inner Harbor. The results showed that the longer route would add fifteen (15) minutes to the travel time. There would be less than a five (5) minute gap between runs during the PM peak; therefore, an aggressive policy as discussed in Alternative 2 could operate with seven (7) buses rather than the conservative eight (8) buses listed below. The change in route to avoid the congested area only saved one (1) minute in travel time. Connection lines are provided to help identify the key comparisons.

Existing Purple Route		
Route Length:	5.50 miles	Stops per Mile: 5.09
Number of Stops:	28	
Scheduled Headway:	10 minutes	
Buses in Operation:	6 buses	
Average Travel Time:	AM - 45.43 minutes	PM - 53.12 minutes
Average Headway:	AM - 11.17 minutes	PM - 12.13 minutes
Average Riders:	AM - 386 passengers	PM - 409 passengers

Purple Route - Alternative 2		
Route Length:	8.16 miles	Stops per Mile: 4.90
Number of Stops:	40	
Change in Average Riders:	AM - 44% increase	PM - 35% increase
Proposed Headway:	10 minutes (Alternative 2A)	
Average Travel Time:	AM - 58.6 minutes	PM - 68.8 minutes
Recommend Buses in Operation	AM - 7 buses	PM - 8 buses
Bus Capacity (based on 42 seats)	AM - 100% full	PM - 90% full
Bus Capacity (based on 72 passengers)	AM - 63% full	PM - 58% full

Purple Route - Alternative 3		
Route Length:	7.90 miles	Stops per Mile: 5.06
Number of Stops:	40	
Change in Average Riders:	AM - 44% increase	PM - 35% increase
Proposed Headway:	10 minutes	
Average Travel Time:	AM - 55.9 minutes	PM - 67.6 minutes
Recommend Buses in Operation	AM - 7 buses	PM - 8 buses
Bus Capacity (based on 42 seats)	AM - 100% full	PM - 98% full
Bus Capacity (based on 72 passengers)	AM - 60% full	PM - 57% full

Pros:

- Expansion of service north of Penn Station to 33rd Street serving Barclay, Charles Village, Harwood, Baltimore Museum of Art, and Johns Hopkins University.
- Increase in ridership.
- Reduction in travel time compared to Alternative 2.

Cons:

- Visitor Center bus stop relocated to Charles Street.
- Travel time increased due to route expansion.

- More buses required to operate the route.
- 10 minute headways required to avoid bus capacity issues.

Purple – Alternatives 4A and 4B

These alternatives tested a lengthened route, an increase in headways (Alternative 4B only), and a smaller route change in the northbound direction than tested in Alternative 3 to avoid a common congested area through the Inner Harbor. The results showed that the route would add 18 minutes to the travel time for Alternative 4A and no savings compared to Alternative 2A. Alternative 4B showed a five (5) minute improvement over Alternative 2A; however, capacity problems would occur thus leaving many passengers wishing to board a bus at the curb. Connection lines are provided to help identify the key comparisons.

Existing Purple Route		
Route Length:	5.50 miles	Stops per Mile: 5.09
Number of Stops:	28	
Scheduled Headway:	10 minutes	
Buses in Operation:	6 buses	
Average Travel Time:	AM - 45.43 minutes	PM - 53.12 minutes
Average Headway:	AM - 11.17 minutes	PM - 12.13 minutes
Average Riders:	AM - 386 passengers	PM - 409 passengers

Purple Route - Alternative 2		
Route Length:	8.16 miles	Stops per Mile: 4.90
Number of Stops:	40	
Change in Average Riders:	AM - 44% increase	PM - 35% increase
Proposed Headway:	10 minutes (Alternative 2A)	
Average Travel Time:	AM - 58.6 minutes	PM - 68.8 minutes
Recommend Buses in Operation	AM - 7 buses	PM - 8 buses
Bus Capacity (based on 42 seats)	AM - 100% full	PM - 90% full
Bus Capacity (based on 72 passengers)	AM - 63% full	PM - 58% full

Purple Route - Alternative 4		
Route Length:	8.09 miles	Stops per Mile: 4.94
Number of Stops:	40	
Change in Average Riders:	AM - 44% increase	PM - 35% increase
Proposed Headway:	10 minutes (Alternative 4A)	
Average Travel Time:	AM - 57.0 minutes	PM - 71.0 minutes
Recommend Buses in Operation	AM - 7 buses	PM - 8 buses
Bus Capacity (based on 42 seats)	AM - 100% full	PM - 100% full
Bus Capacity (based on 72 passengers)	AM - 63% full	PM - 61% full
Proposed Headway:	15 minutes (Alternative 4B)	
Average Travel Time:	AM - 53.0 minutes	PM - 63.7 minutes
Recommend Buses in Operation	AM - 4 buses	PM - 5 buses
Bus Capacity (based on 42 seats)	AM - 100% full	PM - 100% full
Bus Capacity (based on 72 passengers)	AM - 88% full	PM - 76% full

Pros:

- Expansion of service north of Penn Station to 33rd Street serving Barclay, Charles Village, Harwood, Baltimore Museum of Art, and Johns Hopkins University.
- Increase in ridership.
- Reduction in travel time compared to Alternative 2.

Cons:

- Service along Light Street shifted to Charles Street north of Visitor Center bus stop.
- Travel time increased due to route expansion.
- More buses required to operate the route (10 minute headway).
- 10 minute headways required to avoid bus capacity issues.

Analysis Summary

The following can be concluded:

- Stop consolidation along the Orange Route would not improve the travel time enough to make a difference (to eliminate a bus).
- Enforcing the bus travel lanes along Lombard and Pratt Street would increase travel time for both the Orange and Purple Routes.
- Removing the Maritime Park stop at Harbor Point from the Johns Hopkins East Baltimore Campus – City Hall – Harbor East revised Green Route would not improve the travel time enough to make a difference (to eliminate a bus).
- Revising the Green Route to serve only the Johns Hopkins East Baltimore Campus and Harbor East would improve the travel time by as much as approximately 20 minutes and save three (3) buses with 20 minute headways (Alternative G4B).
- Revising the Green Route to a northern terminus of Orleans Street and a western terminus of Harbor East would improve the travel time and allow the route to be operated with only two (2) buses with 20 minute headways (Alternative G5).
- Revising the Purple Route to remain on Charles Street through the Inner Harbor or to switch to Charles Street at Conway Street rather than Redwood Street would not improve the travel time enough to make a difference.

H. References

(Google, 2014) GoogleMaps, https://maps.google.com/maps?output=classic&dg=brw. accessed November 26, 2014.

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CHARM CITY CIRCULATOR

SECTION 2
FINANCIAL ANALYSIS

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V. BACKGROUND

Known for its fast, friendly, and free service, the Charm City Circulator (CCC) provides frequent transit service through a network of four (4) routes linking critical downtown sections of the City of Baltimore. The service is provided by the City of Baltimore Department of Transportation (BCDOT) through a contract with Transdev, formerly Veolia, which operates, maintains, and dispatches the service.

BCDOT provides the service to connect close-in neighborhoods, less expensive fringe parking areas, major attractions, and downtown employers and services. The CCC connects major hospitals, universities, government offices, financial services, hotels, restaurants, the Convention Center, and other major attractions such as the Inner Harbor, Fells Point, and Fort McHenry. It connects with other transit modes serving the City of Baltimore, including the cross-harbor ferries and the Maryland Transit Administration's (MTA) buses, light rail, commuter rail, and subway systems, and Amtrak, which in turn connect to the Baltimore–Washington International Airport (BWI), surrounding suburbs, and additional intercity connections. Its goals are to tie together growing communities, reduce downtown congestion, limit air pollution, and increase the parking supply serving downtown and Harbor East. It serves visitors traveling between tourist sites in the City of Baltimore as well as convention center attendees, connects major medical centers, and provides opportunities for local business lunchtime outings or shopping.

The service is free, and the funding for this system depends on a number of sources. Costs for the service have outpaced the funding leading to a substantial deficit. Future operation depends on the following:

- Reducing the operating costs and/ or increasing revenues to reach a stable, sustainable level of service (this report primarily focuses on costs);
- Improving the service reliability;
- Improving reporting and accountability on the part of the operator; and
- Selecting a CCC bus operator for the next five (5) to seven (7) years through a competitive request for proposals (RFP) process.

To help achieve these goals, BCDOT retained Louis Berger to study CCC operations and provide recommendations to reduce the deficit. Section 1 of the report (under separate cover) presents the Operational Analysis. Section 2 (contained in this document) presents the Financial Analysis.

Section 1: The existing operational conditions review examines four (4) sample days covering the following day types:

- A summer with an event (Orioles game),
- A summer weekday without an event,
- An Autumn day without an event, and

- A weekend day (Saturday).

Detailed records from the sample days were compiled and reviewed in depth to evaluate the following:

- Travel times (average and range of deviation),
- Headways (average and range of deviation),
- Boarding and alighting data by route, time of day, and stop,
- Riders compared with bus capacity along each route, and
- Bus service chronology.

The development of operational alternatives explores various route changes, route extensions, new stops, removal of stops, and stop consolidation.

The analysis relies on collected data and on a transportation model developed for this study that covers the CCC bus network and over 400 intersections in the downtown area. The transportation model was used to provide the travel time estimates for alternative route configurations, including the effect of reassigning riders based on time and stop changes, and resulting capacity analyses. The transportation model and analysis also evaluated the feasibility and potential time savings (or not) for route changes and proposed operational streamlining efforts.

Section 2: Section 2 provides the Financial Analysis. The report reviews the overall financial status of the system as documented in the Department of Finance, Bureau of the Budget and Management Research (BBMR) report released by the City November 27, 2014. This section:

- Provides a benchmark analysis of comparable systems in terms of fleet size, vehicle type, contractual status, and other key parameters, with comparisons of average operating costs per hour, per mile, and per passenger.
- Summarizes the overall cost parameters of the service, and then reviews in greater detail existing fleet characteristics, including maintenance, vehicle availability, and fuel efficiency, as they affect the past and future financial status of the Circulator service.
- Includes a discussion of recommended options related to the bus fleet to increase the reliability of service and reduce the overall cost of future service.
- Reviews and summarizes revenues in the BBMR report and includes an overview of federal grant funding and potential third party revenue sources.
- Summarizes key findings from the Operations Analysis as they pertain to potential scenarios for the Financial Analysis in terms of headway and/or route changes, the resulting change in travel times and buses required, and the anticipated impacts on riders and bus capacity.

Finally, this section provides five (5) operating and financial scenarios and recommendations to establish alternative service levels that can be maintained under existing funding structures.

The appendices to the report pertaining to the financial analysis include the following:

B. Benchmarking Detail and Narrowing Process with National Transit Database (NTD) Profiles from benchmark agencies

C. Bus Purchase / Bus Lease Alternatives- Documentation and Spreadsheet

D. State and Federal Funding: Overview Summary of Capital and Operating Grant Programs and Requirements

E. Advertising Revenues: Summary of Recommended Practices

F. On-Board Survey Findings and Detailed Survey Results

G. Bibliography and Recommended Resources

H. Draft Request for Proposal (under separate cover)

I. Summary of Modifications – Additions and Deletions – from the Original Scope

VI. APPROACH

The revenue approach is primarily discussed in this subsection, while the cost analysis is summarized in this subsection and covered in depth in subsequent subsections.

The financial analysis approach for revenues basically accepts the key findings from the BBMR report regarding established revenues such as sales tax, state Locally Operated Transit Systems (LOTS) grants, advertising and existing partnerships for the modified baseline and alternatives analyses.

- A review of potential state and federal grants programs is included as Appendix D.
- Excerpts from two (2) Transit Cooperative Research Program (TCRP) studies identify recommended practices for increasing advertising revenue and are included as Appendix E.
- The BBMR report thoroughly documents the revenue sources and assumptions. The fare revenue analysis in particular is very complete, including implementation and operational costs, potential revenue gains, and likely ridership losses. The revenue sources are therefore not reiterated in this report.

The financial analysis approach for cost is supported by the in-depth assessment of the BBMR report, the operational analysis (Section 1), and industry benchmarking.

- A major difference from the BBMR report is the proposed disposition of the Design Line fleet, based on the operations and maintenance analysis presented below. (The BBMR report assumed that current Van Hool leases would be supplanted by Design Line buses, if service levels were reduced.) Design Line buses are replaced by additional bus leases in this analysis as needed to operate the desired level of service.

- A bus purchasing comparison, lease vs. buy, is briefly presented in this section and included in Appendix C. Bus leases are intended as a temporary measure, as securing state or federal grants to support the purchase of reliable, standard, easily serviced buses is preferable to leases, and preferable to continuing with the existing Design Line fleet. However, to err on the side of caution, the operating expenditures rely on leased buses to supplement the 12 City-owned Orion buses, as needed to meet the service requirements of the alternatives.

- The benchmark analysis of comparable contract bus systems developed alternative, fully-loaded cost rate structures, for comparison to the current CCC average hourly rate. These are for reference and comparison, and are not implemented in the financial analysis.

- The subsection presents an overview of the implications of the operations analysis on the financial analysis scenario. Alternatives identified for various routes are presented in terms of travel times, headways, buses required, and implications for operating costs, including lease costs.

- The subsection concludes with the findings from the alternatives analysis. An optimization model was developed to discover the combination of routes that will maximize ridership per operating hour within pre-set range of operating hours.

- The methodologies and findings for each of these elements are described in the appropriate subsections. Table 2.1. summarizes the major points of comparison between the BBMR forecast and the Louis Berger forecast.

Table 2.1. Major Points of Comparison between the BBMR Forecast and the Berger Forecast

Topic Area	BBMR Approach	Berger Approach	Comments/ Recommendations
Capital			
Current Bus Fleet	Retain Design Lines, retire 12 Design Line buses in 2021. If an alternative reduces bus requirements reduce Van Hool leases. Retire 8 Orion buses in 2023, 4 Orion buses in 2024.	Eliminate Design Lines now; temporarily replace with new leases (conservative cost assumption included in Financial Analysis). Similarly assume new leases for Orion buses retired in 2023 and 2024.	Only 4 of 13 Design Line buses are in active service as of 6/30/14; maintaining & operating even those is costly. Could deter bidders or force "risk premium" bid prices.
Renewing the Bus Fleet	Establish capital reserve fund for future buses	Work with MTA and FTA to get CCC into state and federal bus grant procurement cycle. Follow APTA, FTA bus procurement guidelines to secure proven, reliable bus technology. The analysis assumes additional buses needed are leased, including replacing the Orion buses in 2023 and 24.	Federal grants can cover up to 80% of eligible capital costs including buses, mid-life major refurbishments, and facilities. Grants are not guaranteed; the lease assumption is conservative but probably prudent at this time.
Operating Revenues			
Parking Tax	Preferred Option 2 increases tax from 20% to 22%	Maintain baseline BBMR projection	Can fall back to parking tax increase if needed after austerity, rationalization measures implemented
State LOTS Grant	Baseline, all options: $2 million/year through 2019	Maintain baseline assumptions.	Institute FTA reporting to NTD, work with legislature to continue and increase state & federal operating & capital grants
Existing Partnerships	Baseline, all options: Continue at current levels	Continue at current levels	Pursue increases in current support levels (inflation +); actively pursue new partners
New 3rd Party Partnerships	Preferred Option 2: Visit Baltimore partnership contributes $1 million per year to CCC	No partnership assumed.	Recommend actively pursuing partnership.

Topic Area	BBMR Approach	Berger Approach	Comments/ Recommendations
Institute Fare	Option 3 institutes a fare along with major service reductions on all routes, discontinues Banner Route (not recommended by BBMR)	Other alternatives such as service adjustments and revenue enhancements appear more reasonable with less passenger disruption	
Operating Expenses			
Bus Leases			
Hours of Service, Buses	Preferred Option 2	Maintain consistent hours year round.	
Purple Route	Remove one (1) bus, headways @ 12 minutes; add two (2) buses for extension	Maintain ten (10) minute headways, add one (1) bus for extension, with potential for p.m. peak minor delays	Net effect essentially the same- 7 buses on Purple Route, onus on operator to maintain
Orange Route	Remove one (1) bus, headways @ 15 minutes	Varies. Refer to alternatives.	Varies by alternative.
Green Route	Remove two (2) buses, headways @ 20 minutes	Shorten route, 20 minutes headways, remove four (4) buses; or eliminate route, refer to alternatives.	Shorten and rationalize the route to eliminate major overlaps with Orange Route.
Banner Route	Maintain current service @ 15 minute headways	Maintain current service @ 20 minute headways or eliminate the route.	Seek new partners – increase service if new funding supports it
Contractor Rate	Current rate increases with anticipated inflation, fuel, leases additional	Benchmark analysis: Lower and middle tier rates include fuel. Lower rates are not factored into financial analysis.	Lower cost structure appears feasible with competitive bid, “level playing field” on fleet composition. Contract to be bid may yield savings.

VII. FINDINGS

A. Benchmark Analysis

A benchmark analysis is undertaken to provide an objective comparison of a system or entity to a group of peers. It is important to use data and information that are collected in a consistent fashion across all entities, with consistent definitions for all elements. The NTD collects, validates, and reports data on all transit agencies across the country receiving categories of federal transit assistance. The NTD has been collecting this data for many decades, has established specific definitions and procedures for collecting and reporting data, and produces reports each year that document individual agencies' service and operating characteristics, facilitating objective comparisons. CCC does not report to the NTD, but most of the information required for an analysis was available from the BBMR report and from other sources such as maintenance files (for miles).

B. Benchmarking Approach

To gain insight into the operations of similar bus systems in the United States and to develop benchmarking tools, Louis Berger used 2012 data (the most recent report available) from the NTD. For 2012, 542 transit agencies submitted full reports covering general and financial information. General information includes urbanized area (UZA) statistics; service area statistics; service consumption (riders both system-wide and by mode); service supplied (miles and hours of service system-wide and by mode), and vehicles operated in maximum service (VOMS). The financial information includes fare revenues earned; fare revenues applied to operations; sources of operating funds expended; summary of operating expenses (OE); sources of capital funds expended; and uses of capital funds. Berger used 2013 data for the CCC for the benchmark analysis, because the operating costs from 2012 and prior years did not represent full service operations and included additional costs, as documented in the BBMR report.

For the benchmarking to be accurate, the search needed to be limited to agencies that had comparable operations to that of the CCC. Berger narrowed down the list of agencies to only those that had a similar fleet size and whose buses were purchased transportation (contracted service), as opposed to directly operated service. In 2013, the CCC fleet consisted of 27 buses with 19 being used on a daily basis (VOMS). (The established Federal Transit Administration (FTA) standard for spares for buses is 20%, to allow for regular preventive maintenance and repairs. Operating 19 vehicles in regular service would normally require four [4] spares, for a fleet size of 23 buses.) Therefore, any agencies with a purchased transportation fleet within a range of six (6) fewer to 12 more buses (VOMS) (from 13 to 31 VOMS) were examined more closely. With that in mind, Louis Berger was able to limit the selection to 24 different agencies.

Because bus sizes are not recorded in the NTD, Louis Berger conducted additional research to determine if the bus sizes of the 24 agencies were comparable to those in the CCC fleet. In 2013, the CCC fleet consisted of ten (10) 35-foot long Design Line models, twelve (12) 40-foot long Orion models, and five (5) 40-foot long Van Hool models. Of the 24 agencies with a similar fleet size, only 10 of those agencies operated 40-foot long buses, with the majority operating buses ranging from 25 feet long to 35 feet long. Any agencies that primarily operated buses shorter than 35 feet long were eliminated from the benchmarking, and the list was reduced to 18.

Benchmark Narrowing Process

Eleven (11) agencies similar to the CCC were selected for comparison.

The next criteria examined was the peak to base ratio, which is the number of vehicles operated in passenger service during the peak period divided by the number operated during the base period. The CCC has a peak to base ratio of one (1); that is the result of a consistent headway schedule throughout the day. Systems that operate more frequent service during peak hours are typically more commuter-oriented and have different operating and cost structures from more "steady-state" service, such as the CCC. It was decided that any agency with a peak to base ratio greater than 1.5 should be excluded for benchmarking purposes. This conclusion eliminated an additional five (5) agencies, reducing the list to 12.

A final element that was studied prior to delving into the financials was the average vehicle speed during revenue service. The CCC's average vehicle speed during revenue service is 6.9 miles per hour (MPH). This is a result of several factors, including the number of stops and passengers boarding and alighting on a route, traffic congestion, and the fact that the CCC operates in a central business district. Any agencies with an average vehicle speed higher than 19 MPH were eliminated from the benchmarking, and the list was reduced to 11.

C. Benchmarking Findings

One valuable tool used in the benchmarking analysis is the cost per vehicle revenue mile. This is calculated by dividing the operating expenses by the annual vehicle revenue miles. The CCC had a cost per vehicle revenue mile of $11.73, which was by far the highest of all of the agencies examined. The average of the other 11 agencies was $5.43; the CCC's cost per vehicle revenue mile is more than double that average.

Cost per Mile Comparison

CCC's cost per vehicle mile was more than double that of the 11 other agencies.

Another aspect studied was the cost per vehicle revenue hour. This is calculated by dividing the operating expenses by the annual vehicle revenue hours. The CCC had a 2013 cost per vehicle revenue hour of $90.15, including Van Hool and Design Line Lease/ Purchase costs, or $80.84, excluding lease and lease/purchase costs. Table 1 provides a breakdown and reconciliation of the 2013 operating costs and cost per hour shown in

the BBMR Report (pages 24 and 25, equating to $90.15 per hour for CCC with the operating costs comparable to the benchmark NTD transit systems ($80.84 for the CCC). It also roughly reconciles the hourly rate for Circulator service (from page 4 of the BBMR Report) with the full cost of the service, including fuel, leases and other minor City or BCDOT costs (not defined in the Report.) Table 2.2 summarizes the cost breakdown to achieve comparable rates.

Table 2.2. Charm City Circulator—2013 Operating Cost Breakdown for NTD Comparability

Charm City Circulator Operating Cost: Comparable with NTD-Breakdown/ Reconciliation	Total Cost	Cost per Hour
Operating Cost Adjusted (BBMR p. 24)	$ 8,882,569	$ 90.15
Lease- Purchase (Design Line)	$ 573,150	
Leases- Van Hool buses	$ 344,000	
Net Operating Cost (Comparable with NTD Agencies)	$ 7,965,419	$ 80.84
Veolia Contract Cost @ $68.55/ hour	$ 6,754,300	$ 68.55
Fuel Cost @ ~$10/ hour	$ 985,310	$ 10.00
Difference/ Other Misc. Costs	$ 225,809	$ 2.29

The average of the 11 other agencies was $79.86 with the highest at $102.97 and the lowest at $63.04. The NTD does not reveal whether the contract operators for purchased transportation were responsible for leasing or purchasing and depreciating the buses they operate. Based on calls to all sponsoring agencies, agencies typically purchase the buses that the contractors operate. In one (1) case, the sponsoring agency indicated that on rare occasions they will lease a single bus for a few months to meet a specific need, but this is an exception. Some agencies purchase fuel and even maintenance parts for the contractors; some also provide the facilities used by the operator. However, the operating costs, including sponsoring agency operating costs, fuel, parts, and labor for operations and maintenance, are captured in the operating expense line for the mode, as depicted on the Transit Profile (see Appendix B for each agency profile). There may be uncommon instances where the transit agency requires a contractor to buy or lease the vehicles in the fleet, but since most transit agencies have access to federal and sometimes state assistance to purchase buses using capital grants, most will take advantage of the grants to leverage local funds. The local share can be as low as 10 or 20% for capital (for example, if the state supplies 10% and the Federal Transit Administration supplies up to 80%); Federal grants for operating assistance are far more restrictive. Appendix D summarizes major grant sources and restrictions, as well as NTD reporting requirements.

In summary, to be conservative in the benchmarking, the assumption was made that the source municipality purchased the buses and provides the buses to the purchased transportation provider to operate and maintain. Given the efficient schedule operated by the CCC (with regular "clock" service and without the commuter-generated peaks that drive up costs) the CCC cost was somewhat higher than the average.

It should be noted that FY 2013 for the CCC was selected because prior years included anomalies that dramatically increased the costs, and 2014 and 2015 are anticipated to experience some adjustment challenges as well, as discussed in the BBMR report. The data from FY 2013 appear to represent the beginning of stabilization of service levels, and thus provide a reasonable foundation for comparison. It is also important to note that because the CCC is a fare-free service, it does not incur many of the operating and capital costs associated with a fare system.

The next factor examined was the cost per unlinked passenger trip, calculated by dividing the operating expenses by the annual unlinked passenger trips. The CCC had a cost per unlinked passenger trip of $1.88. With 4,235,978 annual unlinked trips, the CCC had more than double the number of unlinked trips than that of the next highest agency. This can be largely attributed to the fact that the CCC is a fare-free service. The average cost per unlinked passenger trip of the 11 agencies was $5.17, which suggests potentially longer trip lengths and fewer passengers.

Farebox recovery ratio is the fraction of operating expenses that are met by the fares paid by passengers. It is calculated by dividing the system's total fare revenue by its total operating expenses. Because the CCC is a fare-free service, it has a farebox recovery ratio of 0.0%. The average farebox recovery ratio of the 11 other agencies was 18%. Although it may seem difficult to compare a fare-free service to agencies that charge a fare, it is important to consider the likely range of revenues to be recovered and the passengers who will no longer ride, or will ride less frequently if a fare is charged. In its report, BBMR thoroughly evaluated the fare options, including costs, revenues, and riders.

Grouping Comparable Agencies into Tiers

With this information at hand, Louis Berger divided the 11 agencies into three (3) different groups. The first group, the lowest third, consists of four (4) agencies with the lowest cost per vehicle revenue hour. The top third consists of three (3) agencies with the highest cost per vehicle revenue hour. The second group, the middle third, consists of the remaining four (4) agencies. The first group has a slightly higher average cost per vehicle revenue mile than the middle tier, and has the lowest average cost per unlinked passenger trip. The second group/middle tier has the lowest average cost per vehicle revenue mile, but has the highest average cost per unlinked passenger trip. The third group/top tier has the highest average cost per vehicle revenue mile and the middle range in average cost per unlinked passenger trip.

Table 2.3. Charm City Circulator—2013 data

Transit Agency	Location	Purchased Buses - Required for Maximum Service	Operating Expenses	Annual Vehicle Revenue Miles	Annual Vehicle Revenue Hours	Cost Per Vehicle Revenue Mile	Cost Per Vehicle Revenue Hour
Charm City Circulator	Baltimore, MD	19	$8,525,869	679,261	98,531	$11.73	$80.84

Table 2.4. Lowest third—2012 data from the National Transit Database

Transit Agency	Location	Purchased Buses - Required for Maximum Service	Operating Expenses	Annual Vehicle Revenue Miles	Annual Vehicle Revenue Hours	Cost Per Vehicle Revenue Mile	Cost Per Vehicle Revenue Hour
Cape Cod Regional Transit Authority (CCRTA)	Barnstable Town, MA	25	$4,747,886	1,040,856	75,318	$4.56	$63.04
Metropolitan Area Transit (MAT)	Fargo, ND	22	$4,984,135	857,329	66,560	$5.81	$74.88
Yuba-Sutter Transit Authority (YSTA)	Sutter County, CA	14	$3,093,034	555,426	47,802	$5.57	$64.71
Kings County Area Public Transit Agency (KART)	Kings County, CA	26	$2,636,511	628,017	37,607	$4.20	$70.11
Sum/ Weighted Average			**$15,461,566**	**3,081,628**	**227,287**	**$5.02**	**$68.03**

Table 2.5. Middle third—2012 data from the National Transit Database

Transit Agency	Location	Purchased Buses – Required for Maximum Service	Operating Expenses	Annual Vehicle Revenue Miles	Annual Vehicle Revenue Hours	Cost Per Vehicle Revenue Mile	Cost Per Vehicle Revenue Hour
Mid Mon Valley Transit Authority (MMVTA)	Monessen-California, PA	24	$4,082,669	804,622	48,597	$5.07	$84.01
Escambia County Area Transit (ECAT)	Escambia County, FL	31	$8,126,624	1,451,900	104,760	$5.60	$77.57
Collier Area Transit (CAT)	Collier County, FL	16	$5,779,387	1,231,778	67,318	$4.69	$85.85
Merced County Transit (The Bus)	Merced County, CA	27	$5,606,435	1,255,179	72,147	$4.47	$77.71
Sum/ Weighted Average			**23,595,115**	**4,743,479**	**292,822**	**$4.97**	**$80.58**

Table 2.6. Top third—2012 data from the National Transit Database

Transit Agency	Location	Purchased Buses - Required for Maximum Service	Operating Expenses	Annual Vehicle Revenue Miles	Annual Vehicle Revenue Hours	Cost Per Vehicle Revenue Mile	Cost Per Vehicle Revenue Hour
Montachusett Regional Transit Authority (MART)	Leominster-Fitchburg, MA	19	$4,373,735	639,882	42,474	$6.84	$102.97
Central Midlands Regional Transit Authority (CMRTA)	Columbia, SC	28	$8,845,026	1,148,398	95,280	$7.70	$92.83
Bay County Transportation Planning Organization (BTT)	Bay County, FL	14	$3,063,969	573,714	35,105	$5.34	$87.28
Sum/ Weighted Average			**16,282,730**	**2,361,994**	**172,859**	**$6.89**	**$94.20**

Figures 2.1 and 2.2 summarize the results of the benchmark analysis. Appendix D includes the detailed backup, including the peers in each category and those that were eliminated through the described screening process (in the second and third tabs of the electronic Excel sheet).

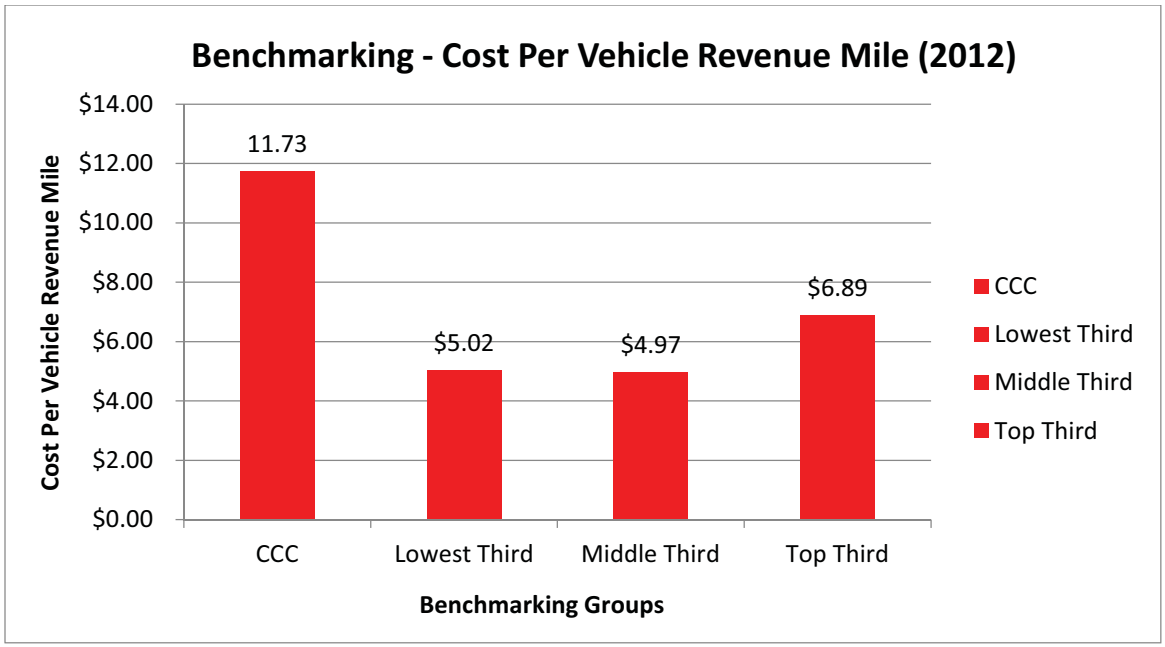


Figure 2.1. Cost per vehicle revenue mile

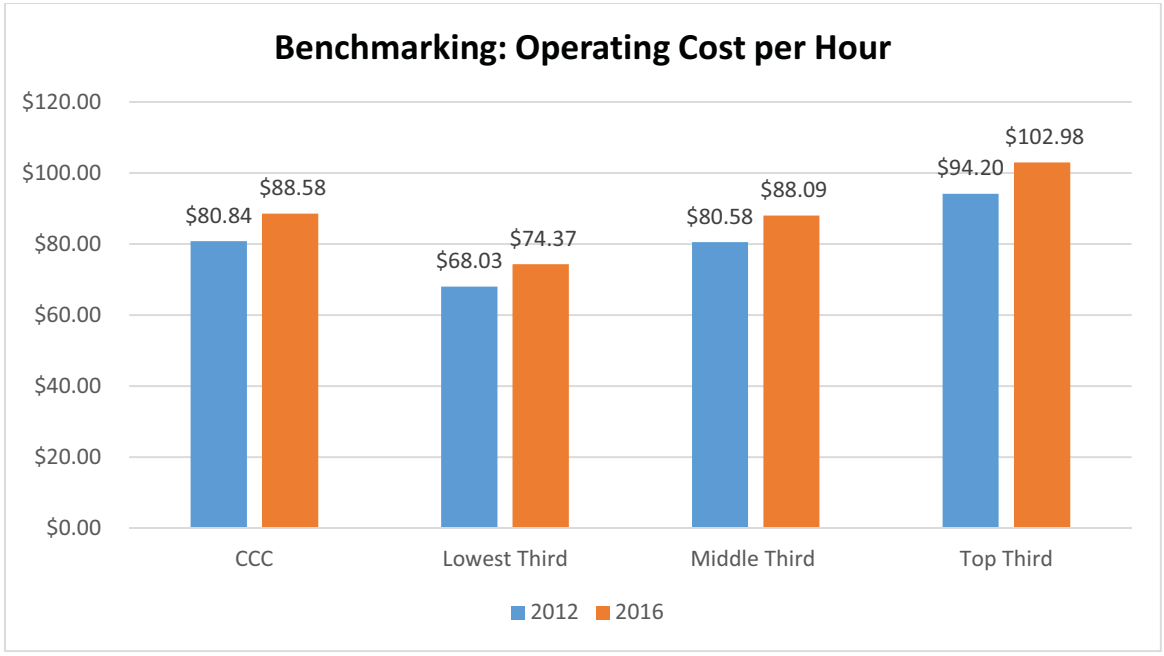


Figure 2.2. Cost per vehicle revenue hour

The benchmark analysis identified four (4) comparable systems with an average cost per revenue hour of $68.03 in 2012; cost per hour in this cohort ranged from $63.04 to $74.88. All operated contract (purchased transportation) service with buses that were the same size or larger than CCC. Two (2) systems are in northern cities—Cape Cod, Massachusetts, and Fargo, North Dakota, and two (2) are in California—better weather but higher costs, on average. By definition, the cost per hour includes all operator wages, supervision, maintenance labor, parts, fuel, and other costs required to operate the system.

The CCC cost of $80.84 (excluding Van Hool lease costs and Design Line Lease-Purchase payments) was 19% higher than the average of this lower cost cohort and is summarized in Table 2.2, above. The average Transdev, formerly Veolia, contract rate for 2013 was $68.55 – one-half year at $67.12 and the other half at $69.98. Fuel averaged approximately $10 per hour and was directly paid by the City. The additional $2.29 per hour in costs represented other City charges, as reconciled by the financial reviewers. The basic Transdev, formerly Veolia, cost structure was higher than that of its lower-cost-tier cohorts, which already included fuel and related administrative costs.

Note: the 2015 costs shown in Figure 2.1 represent projected costs; the CCC projected costs per hour are derived from the BBMR report, while the costs for the various tiers are derived by inflating 2012 costs by 2% per year to reach the average costs for 2016. The average costs per hour shown represent the full year average costs (excluding bus lease costs) shown in the Financial Analysis. The CCC cost difference from 2013 to 2016, using a 2% inflation rate, would be $85.78 compared with the $88.58 identified by BBMR. The BBMR baseline rate includes an anticipated contractual increase in January 2015; because this rate is moderately higher than the rate with 2% inflation, and thus presents a more conservative forecast, the Berger forecast has elected to use the BBMR rate for its baseline forecast. This also preserves as much consistency as possible between the two (2) forecasts, enabling reasonable comparisons.

The benchmark analysis identified four (4) systems in the middle tier, with an average 2012 cost per hour of $80.58, and with costs ranging from $77.57 per hour to $85.85 per hour. This cohort included Monessen-California, Pennsylvania; Escambia County, Florida; Collier County, Florida; and Merced County, California. The three (3) systems in the highest tier averaged $94.20 per hour, with costs ranging from $87.28 to $102.97. The systems in the highest tier included Leominster-Fitchburg, Massachusetts; Columbia, South Carolina; and Bay County, Florida. The CCC cost per hour was just higher than the average of the middle tier, and lower than all the higher tier cohorts.

The operating cost review examined the Transdev, formerly Veolia, cost structure as described in the initial contract (no additional detail was made available). The review then focused on fleet issues and maintenance, and the implications for the BBMR model and financial analysis.

D. Operating Cost Review

Operations Cost Categories

Table 2.7 provides the major categories of Transdev, formerly Veolia, operating costs that were anticipated to contribute to the 2014 contract rate of $72.34 (excluding bus leases, fuel, and other city costs). The cost categories and anticipated amounts correspond to the Transdev, formerly Veolia, contract established in 2009.

The center column (classifying costs as fixed or variable) is provided for guidance in reviewing the costs and is not absolute. For example, maintenance wages are based on numbers of people and thus are step-wise costs, but as miles increase, more preventive maintenance bus inspections will be required, more tires will need to be replaced, more parts will be required, and, overall, more maintenance labor will be required. Therefore, maintenance wages are expected to closely track with miles of service and are classified as variable. Supervisor and dispatch costs are also step-wise costs, but a significant increase in service area, service hours, and/or the number of buses and operators would have to be implemented to require an increase in the numbers of supervisors or dispatchers, so they are classified as fixed for this analysis.

The projected costs in Table 2.7 were used to derive the contract rate of $72.34 for calendar year 2014. The $6 million estimate was based on 83,429 hours, actual hours are projected to be 90,000, leading to a variance of 7,571 hours and approximately $550,000. In addition, Transdev, formerly Veolia, contract costs do not include fuel for buses, which is paid by the city and is approximately $10 per hour or close to $1 million per year (if hours approach 100,000 per year). Lease/purchase costs (repayment of loans for the Design Line bus purchases) and lease costs for the Van Hool buses are likewise not included in the Transdev, formerly Veolia, rate.

Based on the contract, Transdev, formerly Veolia, submits monthly invoices for its hours operated at the negotiated hourly rate.

Table 2.7. Operating expense categories and proportions of costs (anticipated Transdev, formerly Veolia, costs in year 5 for contract rate)

Major Expense Category		Year 5	Variable or Fixed (Generally)	Avg % of Total Cost
Operations	Driver Wages & Benefits	$1,822,819	V	30.16%
	Dispatch/Supervision Wages & Benefits	$437,313	F	7.25%
	MBE Subcontracted	$769,840	F	12.76%
Supervisor, others-not buses	Fuel	$25,803	V	0.43%
	Uniforms	$17,190	F	0.28%
	Radio/Cell Phone Expense	$69,894	F	1.16%
	Drug Testing/Physicals	$5,741	F	0.10%
	DriveCam Review	$8,101	F	0.13%
	TOTAL	**$3,156,701**		**52.31%**
Vehicle Maintenance				
	Maintenance Wages &	$382,745	V	6.34%
	Parts	$203,198	V	3.37%
	Battery Pack Replacements	$0		0.00%
	Tires	$35,580	V	0.59%
	Supplies	$21,346	V	0.35%
	Contracted Bus Washing	$53,660	V	0.89%
	TOTAL	**$696,529**		**11.54%**
Insurance				
	Vehicle Liability	$119,406	V	1.98%
	Perfonnance Bond Expense	$61,791	F	1.02%
	Workers Compensation	$103,349	V	1.71%
	TOTAL	**$284,546**		**4.72%**
General & Administrative				
	Staff Wages and Benefits	$242,488	F	4.02%
	Supplies	$14,005	F	0.23%
	Services	$3,332	F	0.06%
	Travel	$6,684	F	0.11%
	Janitorial	$13,367	F	0.22%
	Trash Removal	$13,367	F	0.22%
	Utilities	$66,837	F	1.11%
	Telephone	$20,051	F	0.33%
	IT/Internet Expense	$74,854	F	1.24%
	Marketing/Branding	$289,600	F	4.80%
	Recruitment	$6,008	F	0.10%
	Professional Fees	$6,684	F	0.11%
	TOTAL	**$757,277**		**12.55%**
	Facility Lease	$287,096	F	4.76%
	Building & Grounds	$20,051	F	0.33%
	Bus Lease	$0		0.00%
Fixed/Facility	Equipment/Fumishings			0.00%
	Depreciation	$150,350	F	2.49%
	Licensing/Taxes	$19,985	F	0.33%
	TOTAL	**$477,482**		**7.91%**
Profit	Profit	$361,293	V%	5.99%
Corporate Overhead	Corporate Overhead	$301,068	F	4.99%
	TOTAL EXPENSES	$6,034,896		100.00%
	Summary	**Costs**	**Cost per Hour**	**Percent of Cost**
	Sum Fixed Costs	$2,604,629	$31.22	43%
	Sum Variable Costs (Variable with Operations)	$2,767,906	$33.18	46%
Sum	**Sum Fixed and Variable Operations**	$5,372,535	$64.40	89%
	Profit & Corporate Overhead	$662,361	$7.94	11%
	Total Expenses	$6,034,896	$72.34	100%

Revenue Hours	83,429
Operating Rate per Hour	$72.34

Table 2.8 summarizes the above-defined categories of fixed and variable costs, in addition to the relative cost per hour of each major category.

Table 2.8. Cost summary—fixed and variable costs

Summary	Costs	Cost per Hour	Percent of Cost
Sum Fixed Costs	$2,604,629	$31.22	43%
Sum Variable Costs (Variable with Operations)	$2,767,906	$33.18	46%
Sum Fixed and Variable Operatio	$5,372,535	$64.40	89%
Profit & Corporate Overhead	$662,361	$7.94	11%
Total Expenses	$6,034,896	$72.34	100%
Revenue Hours	83,429		
Operating Rate per Hour	$72.34		

CCC service hours are likely to change significantly over the next five (5) years as services are first rationalized to fit revenue constraints, and then potentially expanded as additional sponsors and partners are identified and formalized. It may be advantageous for BCDOT to consider alternative mechanisms for establishing rates for future years (e.g., a "floor" for fixed costs and a much lower variable rate to reduce the volatility of service changes.) For discussion.

Fleet Composition/Review of Bus Fleet Maintenance and Performance

The CCC currently operates three (3) bus types—Design Line, Van Hool, and Orion. The Design Line buses were purchased when the bus service began and have incurred significant maintenance-related problems. These problems were described in the BBMR report, largely from a historical and contractual basis, including purchases and leases of additional buses to compensate for defects from the original purchase. However, the BBMR report assumed that the majority of the Design Line buses would continue to function throughout their theoretical useful life, until 2021. As shown in Figure 2.3, ten (10) Design Line buses were considered to be in service at the end of FY2013. However, at the end of FY2014 (June 30, 2014) the Transdev, formerly Veolia Fleet Inventory Report showed only four (4) active buses. This change in status was apparently not reflected in the BBMR analysis. Additionally, the fuel costs associated with the Design Line buses have been higher than CCC expected. As part of the financial review, Louis Berger examined the operating performance of the three (3) fleet lines. This section discusses the differences in maintenance and fuel costs for each of the fleets.

Figure 2.3 tells the story of the reduction of Design Line buses as they were pulled out of service. As described in the BBMR report, and as recounted by BCDOT, Transdev, formerly Veolia staff, and other interested parties, the Design Line bus represented a new technology (that might be the best way to operate in 20-year time, according to a Transdev, formerly Veolia mechanic.) However, the sensitive electronics were not suited to the heavy demands of near-constant

operation, the jostling and jarring of city street conditions, and the extremes of heat and cold in a bus environment. Design Line buses reportedly have trouble operating on hills, in hot weather, and in damp weather. (New York City decided not to purchase 800 buses after testing eight (8), which it returned to the manufacturer, and Charlotte, NC Douglas International Airport [the new hometown of the manufacturer] scrapped its buses after fewer than five [5] years.) The manufacturer went bankrupt in 2013 and was no longer able to supply parts or service the extended warranty provided; prior to that one (1) poorly performing bus was "cannibalized" to supply parts for other buses; subsequently the trend increased for other buses. Over a three (3)-year period (2012–2014), eight (8) buses were removed from the fleet. In the same period, no buses from the Van Hool and Orion fleets were pulled from service.

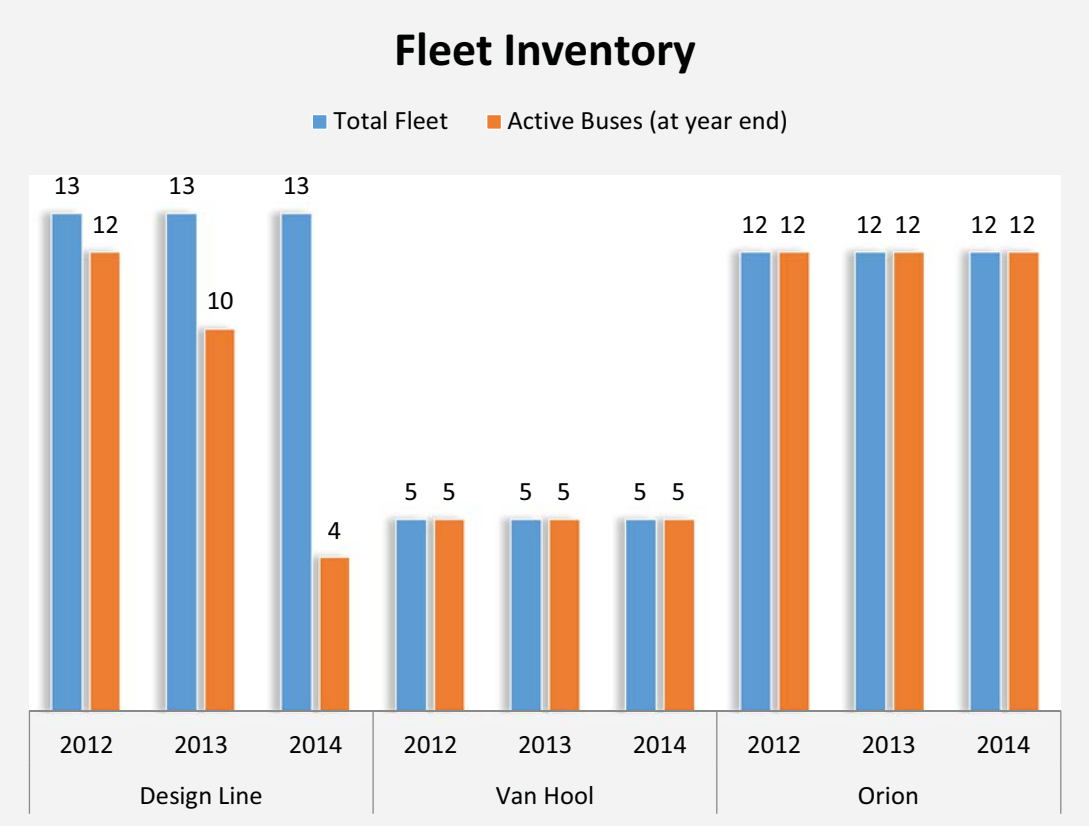


Figure 2.3. Fleet Inventory

Figure 2.4 displays the maintenance cost incurred by each fleet over the same three (3)-year period. The figure clearly illustrates the higher costs incurred by the Design Line fleet. Over the three (3)-year period, the Design Line fleet experienced an average annual cost of $1.55 per mile. These costs were much higher than those experienced by the two (2) other fleets. The Van Hool fleet experienced an average annual cost of $0.81 per mile, while the Orion fleet had the lowest average annual cost at only $0.35 per mile. The current costs associated with the Orion buses may be on the low side, when considering lifespan costs. Over the lifetime of a bus, large items, including engines and transmissions will be replaced, which will most likely increase the per

mile cost to $1.00 an hour. Even with the additional expenses on the Orion fleet, the Design Line, on average, still costs $0.55 per mile more to maintain. Considering these buses typically travel more than 2,000 miles per month, that is a substantial cost difference.

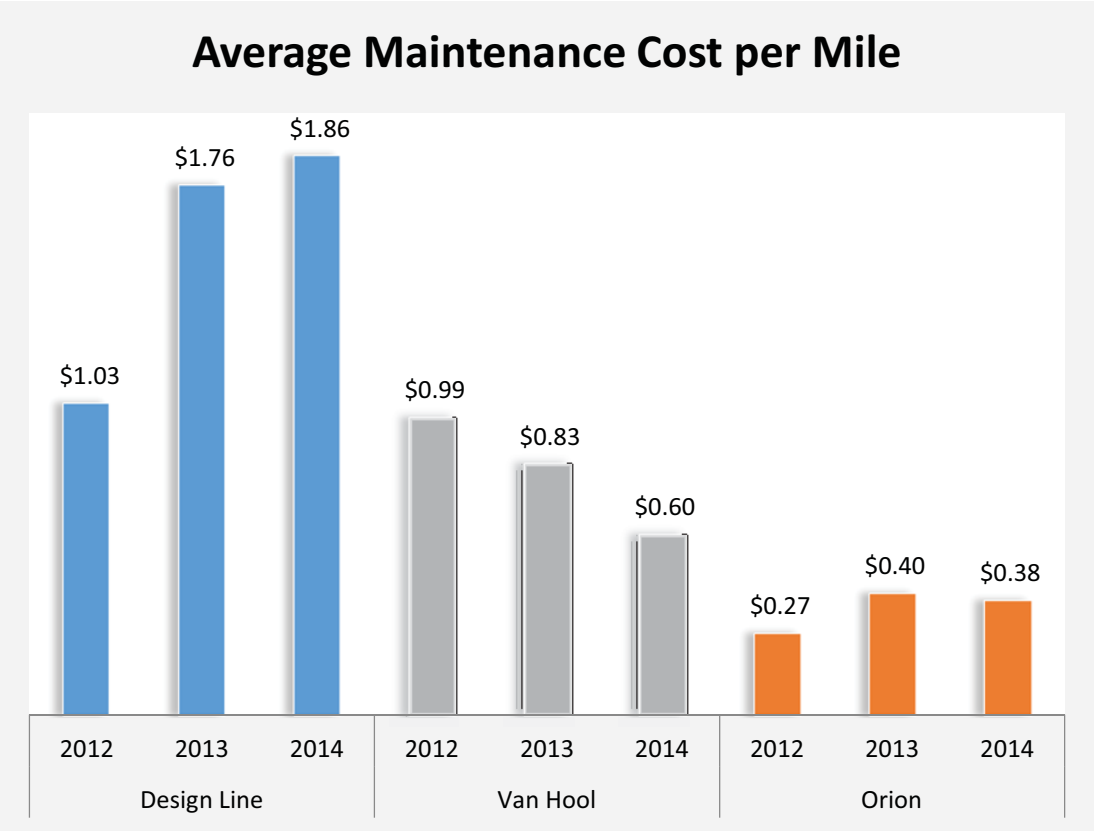


Figure 2.4. Average Maintenance Cost per Mile

Figure 2.5 compares average miles operated per active bus per month. As noted previously, the CCC relied less on the Design Line buses as they were taken out of operation, and those in operation are used sparingly due to reliability problems. Consequently, the Design Line fleet incurred a general reduction in average miles per month per bus over the three (3)-year period. As a result, the Van Hool and Orion fleets experienced increasing use throughout the same period. The highest average monthly bus mileage for the Design Line fleet was just under 2,000 miles, whereas the average monthly mileage for the Van Hool and Orion fleets started just above 2,000 miles and topped out at 2,500 miles per month. The Orion fleet had the busiest and most intense year out of all the buses in 2014, with almost 2,700 miles per month per bus.

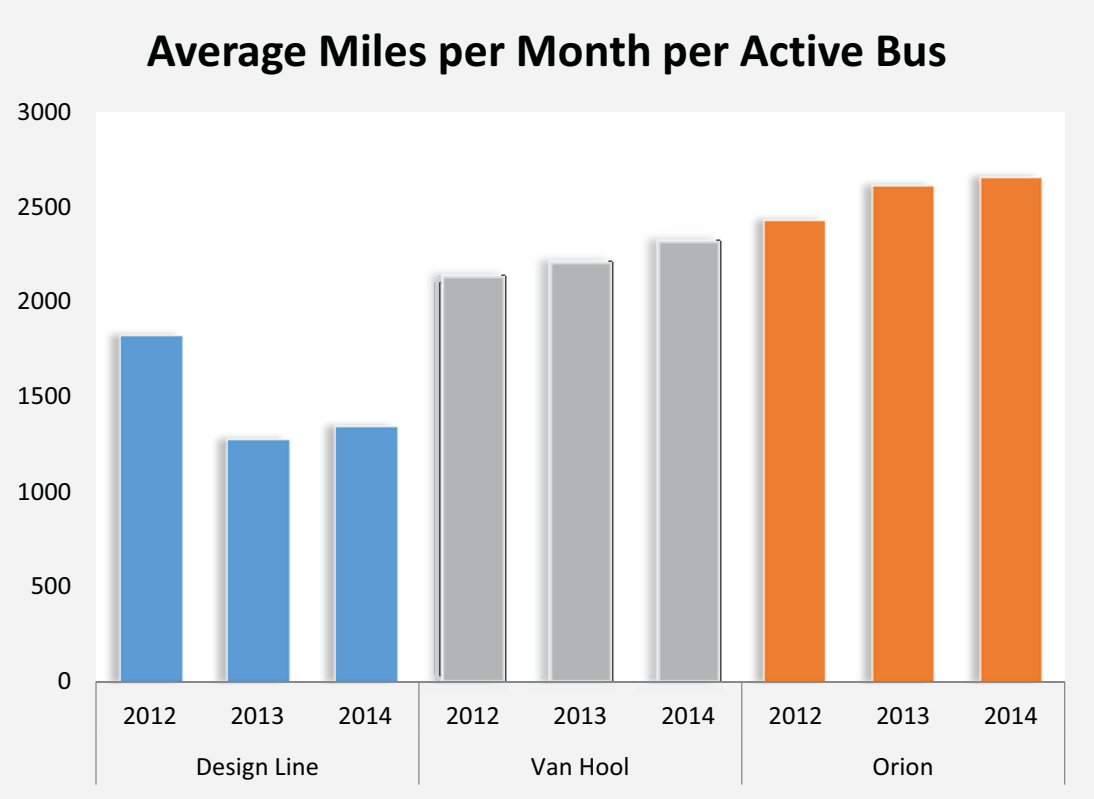


Figure 2.5. Average Miles per Month per Active Bus

Vehicle efficiency affects maintenance and operating costs. The Design Line buses were touted as being very fuel efficient, but the actual cost of running them disputes that claim. These buses experienced the worst gas mileage of all three (3) fleets in both summer and winter periods.

Figure 2.6 compares gas mileage across each fleet in summer operating conditions. These samples were taken from extracted data (fuel and mileage reports) in late June for each year (samples were extracted to ensure that mileage and fuel data was captured for each bus in service). In this figure, it is clear that the Design Line fleet was the least efficient with an average of 1.86 miles per gallon. Because the Design Line buses were supposed to be highly fuel efficient, the designers specified an unusually small fuel tank. Poor fuel efficiency on the Design Line buses is exacerbated by the small tank, such that Design Line buses have to be refueled midday (which costs extra miles and hours out of service.) The Van Hool fleet had an average gas mileage of 3.02 miles per gallon. The Orion was the most efficient of the three (3) fleets; it experienced an average gas mileage of 3.6 miles per gallon over the 3-year period.

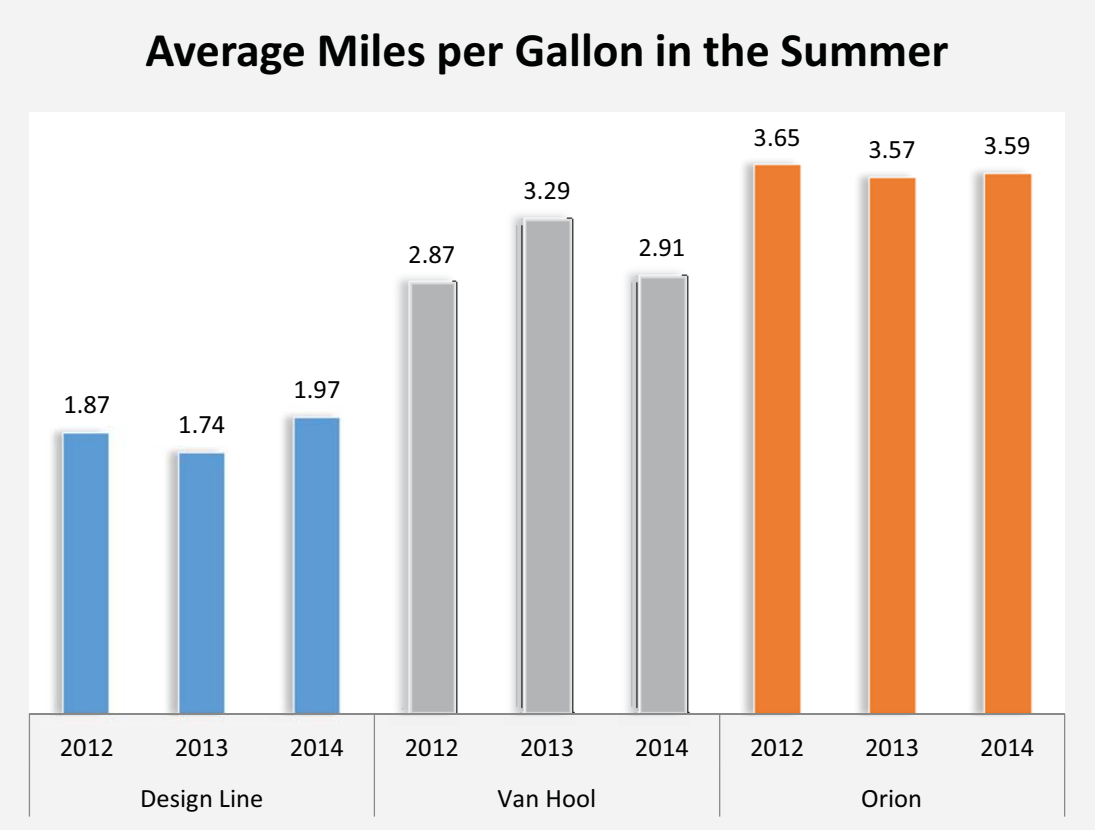


Figure 2.6. Average Miles per Gallon in the Summer (based on sample data)

Figure 2.7 examines gas mileage by each fleet for the winter period. Similar to the summer example, this graph summarizes data taken from sample days in late December. Also similar to the summer example, the Design Line experienced the worst gas mileage of all three (3) fleets, with an average gas mileage of 2.54 miles per gallon. The improved gas mileage is probably a result of increased efficiency associated with not needing to run the air conditioning. The other two (2) lines also experience improved gas mileage for the winter sample. The Van Hool fleet had an average gas mileage of 3.26 miles per gallon, and the Orion fleet had the best average gas mileage of 4.00 miles per gallon.

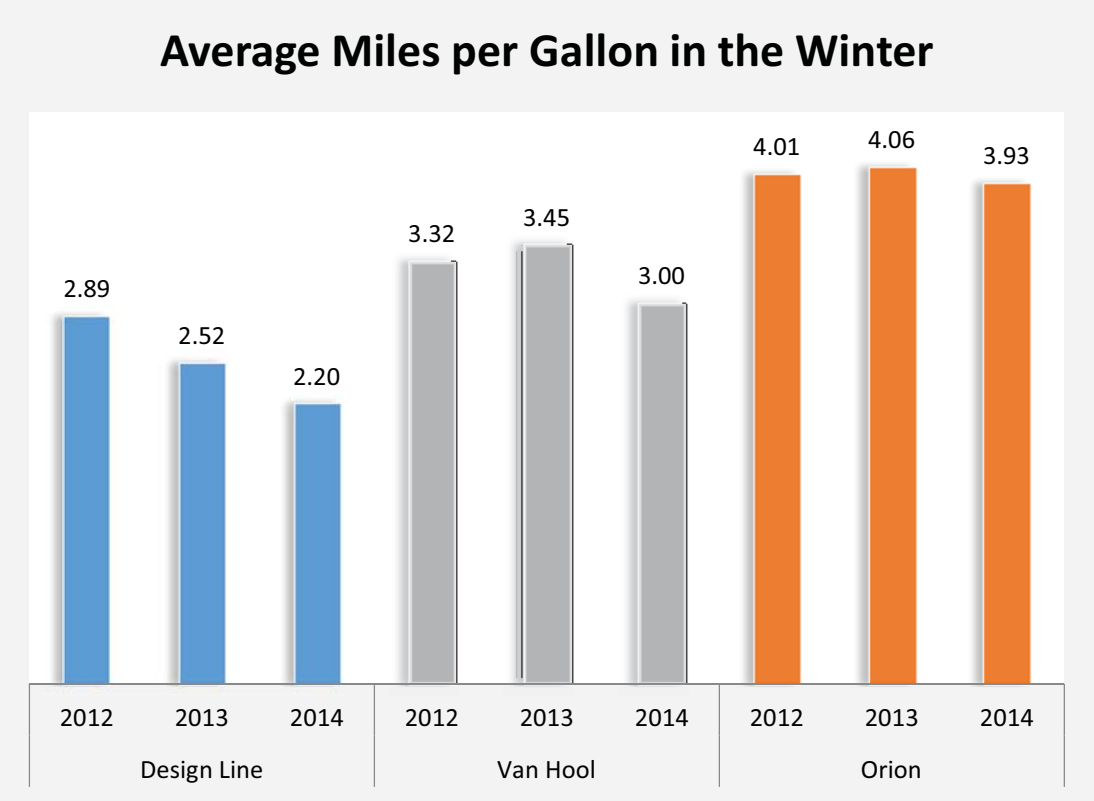


Figure 2.7. Average Miles per Gallon in the Winter (based on sample data)

Based on the existing data, the Orion fleet was the most cost efficient of all three (3) fleets. It incurred the lowest operating cost for both maintenance and gas mileage. It should be noted that this trend might not continue indefinitely. The Orion manufacturer also went bankrupt; other manufacturers continue to supply spare parts, so it is not currently as dire as the situation with the Design Lines. However, most parts must be ordered from Europe, and in some cases this causes substantial delays in repairs – an added strain on a fleet with half the bus industry standard spare ratio. As noted previously, buses normally require major overhaul and replacement of major components at least once in their 12-year life. Such major maintenance should be planned for over the next several years. The Van Hool fleet ranked second and the Design Line was by far the most expensive fleet to operate.

Implications of the Fleet Comparison and Design Line Status for the Financial Forecast and the Draft Request for Proposal

The history, costs, and trends strongly suggest that problems with the Design Line buses will continue and likely get worse, as the buses approach mid-life and need major systems replacements. Currently Transdev, formerly Veolia, hires an electrical engineer part-time just to troubleshoot the electronic systems of the few remaining active Design Line buses. Keeping these buses in the fleet presents a direct expense to Transdev, formerly Veolia, in terms of maintenance and a direct expense to the City in terms of fuel. It also presents a disservice to

customers, when trips are missed because buses are not available for operation. Bus systems typically maintain a 20% spare ratio to facilitate regular preventive maintenance and to cover for minor accidents or other service needs. As noted in the Operations Analysis, the service days were picked at random; not a single day in the sample had a full complement of 19 buses in operation. On two (2) of the days, only 15 buses were in operation.

If current service levels (headways) are expected to be maintained on all routes, at least two (2) new buses (leased or purchased) need to be added to the fleet to provide an adequate number of spares. Six (6) new or leased buses would need to be added to retire the remaining Design Line buses. The financial analysis examines combinations of alternatives of headway increases on some routes, as well as route realignments, to mitigate some of this impact. However, it seems clear that action must be taken soon, for the following reasons.

1) Current routes are not being served reliably with planned headways due to regular bus shortages; headways can be erratic as demonstrated in the Operating Analysis, meaning riders have to wait longer so the "Fast" in the "Fast, Friendly, Free" branding becomes a source of frustration for riders.
2) The reduced utilization of the Design Line buses creates an additional strain on the other buses. If those buses do not receive required preventive maintenance because they must fill in for non-working Design Line buses, they too will fail, exacerbating the problem in a downward spiral.
3) Design Line costs for fuel and maintenance are continuing to increase while reliability decreases; there are still no sources for unique parts and equipment, nor are any sources anticipated to materialize.
4) Providing a basis for a competitive RFP with many potential qualified bidders is essential to bring costs in line with the middle tier or the lowest-cost tier of the Benchmark Analysis. Potential bidders will be expected to examine the current fleet and maintenance records for the fleet. Such maintenance and fuel records are required based on the contract; the study team was provided with such records on request (samples for fuel). Reporting requirements (financial and operational) have not been consistently enforced throughout the term of the contract, as noted in the BBMR report, which greatly increases the challenges for effective monitoring and oversight. The new contract is anticipated to require and enforce comprehensive and effective reporting.) Stipulating the requirement to continue to maintain the remaining four (4) Design Line buses, with no manufacturer to supply parts, and essentially only Transdev, formerly Veolia, staff with any expertise on this "orphan" technology, would likely limit the number of qualified bidders and/or create the incentive for bidders to inflate costs for an essentially unknowable performance risk.
5) Based on an evaluation of the Design Line cost trends for fuel and maintenance compared with Orion buses, a lease of a hybrid bus comparable to the Orion at the same rate as the Van Hool bus would break even at just under 2,600 miles per month per bus (including

operating (fuel and maintenance only) and lease costs. Figure 8, columns 1 and 2, illustrate the parity. Although Design Line buses are not operating at 2,600 miles per month, the Orions are operating at that rate; and buses should be able to achieve that.

Design Line maintenance and fuel costs are expected to continue to escalate, as illustrated in Figure 2.8. The life-cycle cost for a standard 40-foot low floor large heavy-duty bus is modeled in the "Bus Lifecycle Cost Model for Federal Land Management Agencies," developed by the John A. Volpe Transportation Systems Center, and can be customized and fine-tuned for local conditions. (See Appendix G, Bibliography and Resource list.) That basic default analysis estimates four (4) mpg for a diesel engine, initial cost $350,000 and five (5) mpg for a hybrid, initial cost $500,000 (2012 report). Based on the BBMR analysis of procurement costs, a new bus with required passenger counters, wrap, AVL and other communications equipment, is anticipated at $735,285 (BBMR, 27, Table 10). Assuming a monthly lease cost at 1% of the full purchase price, five (5) miles per gallon, and $1.00 per mile life cycle maintenance cost (per the Volpe report), the City would break even on the operating cost (fuel and maintenance plus lease cost) when the Design Line buses get to about $2.75 per mile in maintenance cost, which could occur as early as 2016 based on recent trends (comparing the fourth from left and the final right-hand column in Figure 8.)

The fifth, sixth and seventh columns illustrate potential bid risk for the Design Line buses, where hypothetical bidders assume the maintenance risk for the Design Line buses at $3.00, $3.50 and $4.00 per mile respectively, and price their services accordingly. Note that these risks would only apply to the Design Line buses, and presumably would not extend to the entire fleet; however, the "premium" for having to maintain the Design Line buses would influence other costs.

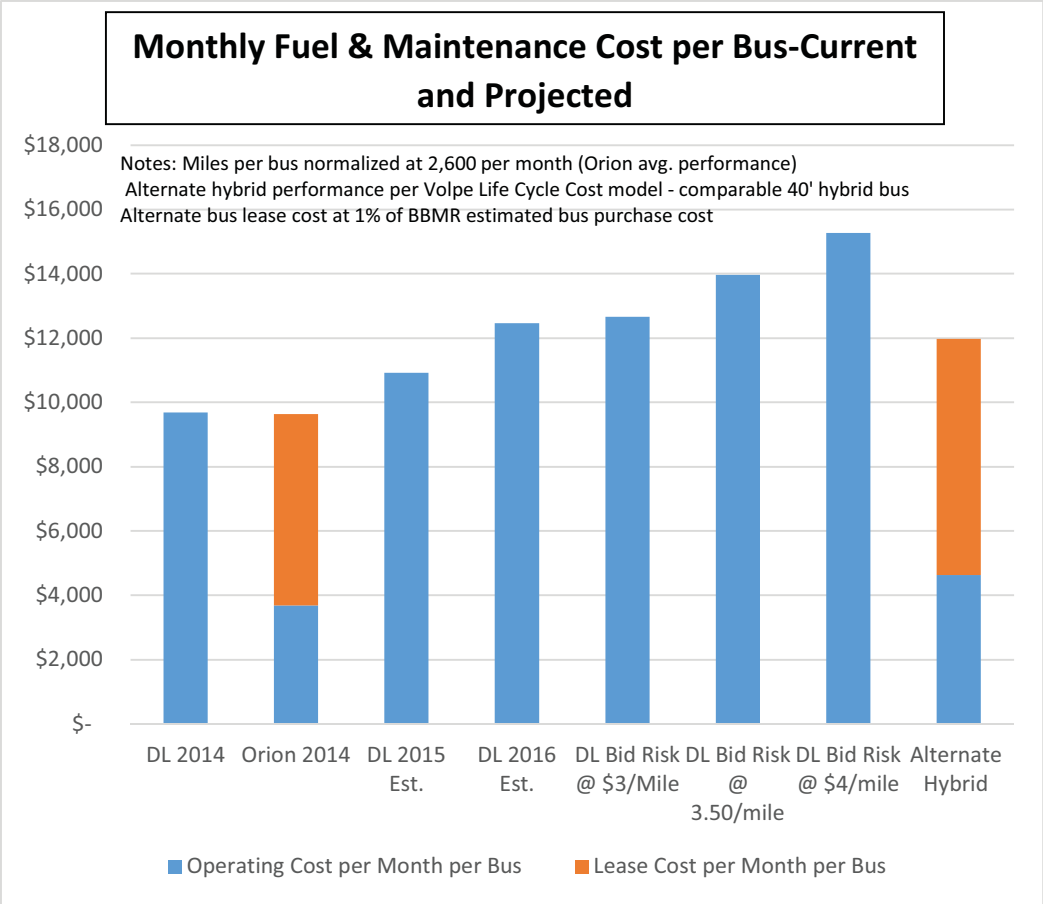


Figure 2.8. Average Monthly Fuel and Maintenance Cost per Bus, Current and Projected: Design Line vs. Alternate Bus (plus lease cost)

Applying the same basic figures to the bus lease versus purchase model developed for this study, the monthly lease cost would be $7,786 per month, with the breakeven point slightly higher. This is shown in Figure 9. The bus lease versus purchase model is included as an electronic spreadsheet as part of Appendix C. Appendix C provides the documentation for the model. As the model demonstrates, a purchase is generally preferable to a lease, especially if Federal and State grants can be secured to cover part of the cost. However, the procurement process usually requires up to two (2) years for new buses, so leases provide a more immediate resolution to an urgent problem.

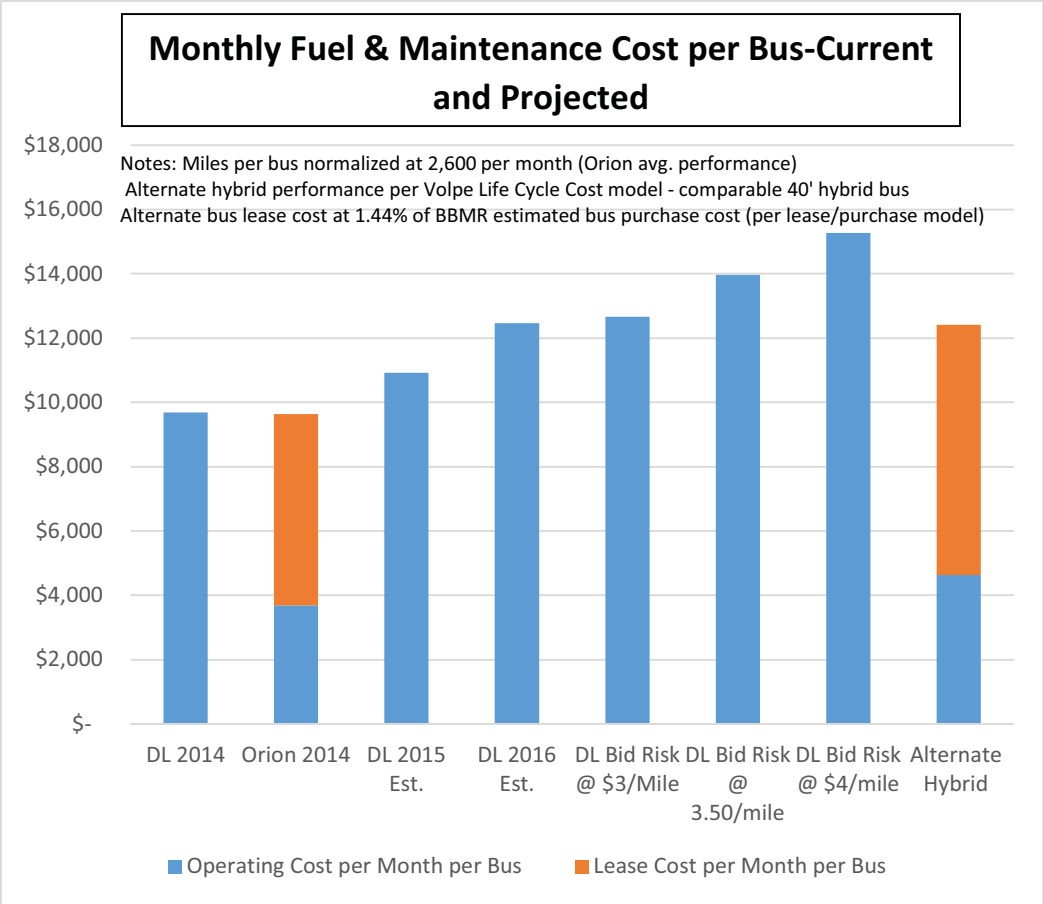


Figure 2.9. Alternate Figure 2.8. (Using lease vs. buy cost model figure)

E. Implications from Operations Analysis on Financial Review Alternatives

The operations analysis provides direction on selected service alternatives that are under consideration, while others are matters of policy rather than presenting a clear operational and financial advantage. Service alternatives of headways and route changes are presented in terms of buses saved. With "clock headways" every 10, 15, or 20 minutes, unless a headway or route change decreases travel time enough to eliminate a bus, it will not significantly reduce costs over the course of a year.

The exception is altering starting and ending times for service, as in the BBMR alternatives considered for operating "winter hours" year round. This alternative saves approximately $400,000 per year. All alternatives in the financial analysis adopt this practice.

Orange Route

Headways: The Orange Route is second in ridership to the Purple Route. While heavily used, it does have some excess capacity, as demonstrated in the Operational Analysis. The average travel time for the Orange Route is approximately 47 minutes. The current headway is scheduled at 10 minutes, with a requirement for 5 buses. However, as noted in the Operational Analysis (Section 1, Figure 1), the Orange Route is not always allocated the required buses. As shown in Section 1, Figure 17, the average effective headway for the Orange Line appears closer to 15 minutes, as opposed to the scheduled 10 minutes, while still providing reasonable capacity and levels of service. Rationalizing the Orange Route to a regular headway of 15 minutes, and enforcing that, would save 1 bus and approximately 3,900 hours of service per year (varying with other alternatives).

Service Change:

The recommended Orange Route is shortened on both the east and west ends of the route to shorten the travel time, improve access and travel times for students and tourists, and, on the east end, eliminate redundancy with the Green Route. On the west end, service is removed from the Hollis Market loop, maintaining the BioPark loop. On the east end, service extends to Caroline Street.[1] The bus is currently scheduled for 10 minute headways but typically operates at 15 minute headways. Shortening the route and rationalizing the service at 15 minute headways eliminates one (1) out of the five (5) buses currently required for the route. Increasing the headway to 20 minutes and shortening the route eliminates two (2) out of the five (5) buses currently required for the route. The proposed route change is shown on Figure 2.10, along with the proposed Green Route. If additional time savings is necessary for schedule adherence, in the future it may be advisable to eliminate the Biopark loop on the far west end, in addition to the current proposed elimination of the Hollis Market loop.

Green Route

Headways: The Green Route currently operates at a 10-minute headway, in theory, for a round trip, requiring six (6) buses (based on its round trip time it more likely requires seven (7) buses than six (6) to maintain a 10-minute headway.). It carries fewer riders than either the Orange or Purple Route. Based on the Operational Analysis, (Section 1, Figure 20) and on the typical bus headway, (Section 1, Figure 16) the current effective headway appears to be closer to 19 minutes than 10 minutes. Nevertheless, there is substantial capacity available, as shown in Section 1, Figure 20. There are three (3) different route configurations suggested in the alternatives, along with two (2) different headway lengths for each configuration. All five (5) iterations of alternatives result in different levels of required buses and therefore, different levels of cost.

[1] The modeling of the route used Center Street rather than Caroline Street; the additional separation from the Green Route along Broadway provides additional service and greater distinction between the routes.

Service Change:

Alternative 1. As shown in Section 1, Figures 10 and 11, most of the boardings and alightings on the Green Route take place near Washington Hill and Johns Hopkins East. Alternative 1 follows much of the existing route going east-southeast and north, then goes across town to City Hall and environs, roughly paralleling the MTA Metro from Johns Hopkins into downtown before looping back around to the east harbor area. Section 1, Figures 33 through 36 depicts the alternative routes and stops. The short "loop" down to Harbor Point saves about three (3) minutes but eliminates an effective connection to the Harbor Connector ferries; therefore, the alternative with the loop is the preferred option. Alternative 1 shortens the overall route by running the westbound route down Fayette Street.

Alternative 2A. This change, along with normalizing the schedule to 15 minutes and enforcing the schedule adherence through active monitoring and dispatching would save two (2) buses and approximately 7,800 hours from the "planned" schedule; riders would not notice an appreciable difference and would likely notice an improvement in reliability, as well as expectations.

Alternative 2B. Moving the headways to 20 minutes would again decrease operating costs by requiring only three (3) buses. Both Alternatives 1 and 2 remove many stops along the eastbound section of the route as shown in Section 1, Figure 33 (moving from Washington Hill to the harbor, and towards the intersection with the Orange Route). Considering that these stops generally had low boardings and alightings, this reduces travel time and improves system reliability, even while reducing the number of buses.

Alternative 3. This alternative (Section 1, Figure 34) shortens the length by removing most of the western section of the route, leaving the north-south route on the east side where the majority of ridership is located, as shown in Section 1, Figure 34. A total of 12 stops are removed in this alternative, and no stops added. This again reduces the necessary amount of buses to operate the route at a high level of service.

Alternative 4A. With a headway of 15 minutes, this new route would only require 3.5 buses. Additional testing and evaluation would be required to determine whether three (3) buses could adequately and reliably cover service during off-peak hours, and what accommodations might be required during congested hours of service. .

Alternative 4B. With even longer headways of 20 minutes, only 2.5 buses (rounded up to three [3]) would be required throughout the day to maintain service.

Alternative 5. The three (3) mile Green Route alternative (Section 1, Figure 36) can reliably operate on 20 minute headways using only two (2) buses. This is a reduction of four (4) buses from the current operation. The shortened route serves Fells Point and Harbor East and

eliminates duplication with the Orange Route and with MTA subway service and extensive bus service in the area. This has been selected as the preferred alternative for the Green Route.

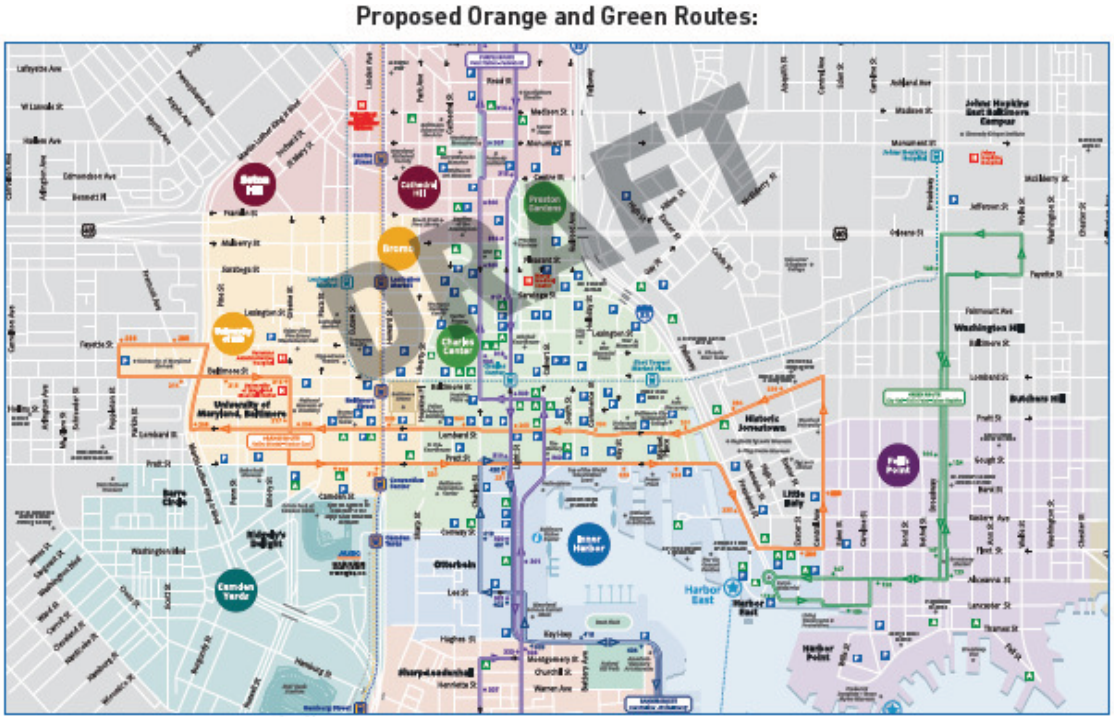


Figure 2.10 Proposed Orange and Green Routes.

Purple Route

Headways: The Purple Route is the most heavily used route, with a current overall average travel time of 45 to 53 minutes (Section 1, Table 2) and 10-minute headways. Six (6) buses are required to run the service (not including spares). As noted in the Operational Analysis (Section 1, Figure 19), Purple Route buses are often near or at capacity, with people standing on a regular basis. If the current 10-minute headways were lengthened to 15 minutes, overcrowding to the point of people not being able to board the bus could be a frequent occurrence, particularly during peak hours. Section 1, Tables 11 through 13 and accompanying discussion (about Package 5) document the findings- AM and PM peak average riders per hour and per bus would approach full capacity including standing room, meaning some riders would not be able to board their preferred bus and might have to wait for additional buses – as happens now, according to reports from riders, when buses are not operating at their planned frequency.

Transdev, formerly Veolia, prioritizes bus service on the Purple Route, as noted in the Operations Analysis. Nevertheless, there are still instances when the required six (6) buses are not deployed (see Section 1, Figure 1); and headways and passenger loads vary more widely as buses diverge from planned headways (see Section 1, Figure 15, for the variance in headways). In a typical example, as noted in the Operational Analysis Vehicle Chronology (Section 1, Figure

26), as a "lead" bus falls behind schedule, it picks up more and more passengers, slowing it further, while following buses catch up and travel virtually empty, unless dispatchers intervene to correct matters. If enough buses are not available to deploy for the full schedule, the problems tend to become worse.

Service Change: Based on repeated simulation runs, the extended Purple Route (northern loop extension only) can be traversed in less than 60 minutes during the AM peak, including passenger boarding and alighting time (see Section 1, Figure 8 and 9). This means the extended Purple Route would be able to operate with just seven (7) buses during mornings and midday, adding in 10 minutes for layover (recovery) time at the end of the route, compared with the two (2) buses identified in the BBMR report, based on estimates from Transdev, formerly Veolia. During the evening peak hour, the extended Purple Route requires approximately 70 minutes to traverse the route due to traffic and heavy passenger activity, according to the model and observations. Buses cycling into the second hour of the evening peak may experience delays, as there would rarely be opportunity for layover or recovery time. One option would be to routinely add a "tripper" bus; another option would be to accept delays for that brief period. Depending on passenger demand, another alternative would be to "short cut" an occasional bus to skip the upper loop to make up time. This would represent an inconvenience to some passengers, but would be far more economical than running an eighth bus all day. This represents a savings of one (1) bus compared to the BBMR/Transdev, formerly Veolia estimate.

Banner Route

The Banner Route is the most reliable of the existing routes. As can be seen in Section 1, Figure 22, the route had the most consistent travel times. Additionally, Section 1, Figure 1, shows that the route runs two(2) buses consistently. The headways are already at 20 minutes. Barring complete cancellation, or significant restructuring with a partnership to serve one (1) or more major employers or residential concentrations on the peninsula, the current route operates well with reasonably steady ridership levels.

F. Financial Review Alternatives

The financial review alternatives maintain revenue sources and assumptions constant, while analyzing the impacts of various operating alternatives. Key assumptions for revenues are summarized on Table 2.9 through Table 2.13 (same assumptions, replicated for ease of reference.)

The BBMR financial model has an excellent dashboard for analyzing options, tied into a comprehensive set of interactive alternative spreadsheets representing different scenarios. Berger extensively modified the financial model by increasing leasing costs for buses as required to

eliminate the Design Line buses from service and tailoring the requirement for leased buses to the fleet size required for each scenario. Berger also modified the model to facilitate the testing of different hourly cost options across various scenarios (which in the final analysis were not included) and created additional interfaces to display and summarize the results for multiple scenario alternatives. The financial model and operations assessments were combined to feed into the optimization model. Service elasticity factors were consistently applied to the "raw" riders from the operations analysis to identify impacts from service changes including headway changes. Performance metrics were established for each route alternative, including riders per hour and cost per hour. The optimization, set from 50,000 hours per year to 75,000 hours of service, calculated combinations of routes. These were then ranked into tiers based on the hours and costs.

The key to the reference numbers cited on each alternative is found on Table 2.9 through Table 2.13. Each alternative lists the revenues and expenses from FY 2015 through FY 2024. Operating expenses include cost per route, fuel, lease and other costs. Each alternative summarizes the annual operating surplus/ (deficit); the cumulative surplus / (deficit) from 2016 on, and the cumulative surplus/(deficit) from the initiation of service through 2024. All alternatives are based on consistent year-round "winter" hours. Each alternative includes Purple Route Alternative 2A (P2A). This represents the extended Purple Route with 10 minute headways operated with seven (7) buses, which consistently scored highest within each set of alternatives in the optimization analysis. For the Orange Route, Alternatives 2A (with 15 minute headways- O2A) and O2B (with 20 minute) headways, consistently scored highest in the optimization, with ranking changing based on resources available in any given set with other routes. The shortest Green Route alternative, G5, requiring only two (2) buses, always ranked highest in options. The standard Banner Route (B1) also scored well.

- Alternative 1 (Table 2.9) examines the financial implications of operating 17 buses per year for just under 64,000 hours per year. The route combination that returned the highest number of riders for this tier of hours includes the Purple 2A, the Orange 2B (20 minute headways), the short Green 5 (20 minute headways),and the standard Banner. Daily buses required are reduced by five (5) from current scheduled operations (from 19 to 14 for direct service, from 23 to 17 including spares. The Orion bus fleet plus the Van Hool leased buses adds up to 17 reliable buses.) An operating surplus is maintained every year from 2016 through 2019. In 2020, a small annual operating deficit is incurred. This annual operating deficit increases markedly in 2022 at which point the analysis assumes that additional buses will be leased to begin to replace the 12 Orion buses, which will be at the end of their useful life. As noted, if the bus fleet is stabilized and fully operational, a majority of current riders can be accommodated with the revised proposed headways and reconfigured routes. While riders would have to adjust to the reconfigured routes, on the whole riders would likely notice an improvement in reliability when the full scheduled complement of buses is dispatched and closely monitored with a more realistic service plan. (Please refer to the Recommendations

subsection for additional discussion on capital purchase versus lease options, particularly regarding the additional lease "hit" in 2023 and 2024.)

- Alternative 2 (Table 2.10) maintains the Purple Route 2A but improves the Orange Route to 15 minute headways. At the same time it eliminates the Banner and the Green Routes. This option is the lowest-cost option evaluated. This "bare bones" option provides just over 50,000 hours a year- approximately half of the current scheduled operation. It only requires 13 buses-11 plus two (2) spares. As shown in Table 2.10, this option demonstrates a positive financial balance every year, and even succeeds in eliminating the cumulative deficit by 2024. This is the most fiscally conservative alternative, designed to show that old debts can be repaid in a responsible manner, albeit with major reductions to service and geographic coverage.

Alternative 3 (Table 2.11) presents the first of two "median" alternatives. Table 2.11 shows the financial status for operating a little less than 55,000 hours per year, with 14 buses including spares. In this case, this level of hours, optimized, operates the Purple Route 2A, the shortened Orange 2B at 20 minute headways, and either the Green or the Banner Route. Similar to Alternative 2, this option produces a positive operating surplus each year, and almost (but not quite) eliminates the entire cumulative deficit.

Alternative 4 (Table 2.12) increases the operating hours to almost 60,000 hours per year and 16 buses including spares. This allows the (slightly shortened) Orange Route to operate at 15 minute headways rather than 20 minute headways, and also allows for either the shortened Green (G5) or the Banner Route to operate (but not both.) This alternative maintains a positive annual operating surplus until 2022. When the additional bus lease costs are incurred, this option incurs an annual operating deficit, but the cumulative balance (from the 2016 through 2024 perspective) is sufficient to weather adverse conditions and seek additional solutions.

Alternative 5 (Table 2.13) demonstrates the financial condition at over 68,000 hours and 18 buses. This alternative "buys" the (slightly shortened) Orange Route at 15 minute headways, plus both the Banner Route and the shortened (G5) Green Route. This alternative is basically one (1) tier more expansive than alternative 1. In this case, as in Alternative 1, operating imbalances first appear in 2020, but at higher levels than Alternative 1. The cumulative deficit (2010-2024) is also maintained at a higher level, ending in 2024 near the current $14 million level, where Alternative 1 is below $10 million. Finally, Alternative 1 has more symmetry- explaining to the public that the Purple Route has 10 minute headways and all other routes have 20 minute headways is easier than explaining three (3) tiers of headways.

Table 2.14 summarizes revenues, expenditures, and annual operating deficit for the baseline and each alternative. Table 2.15 summarizes key operating statistics for the baseline and each alternative including annual operating hours, average cost per hour in 2016 (with and without lease cost), and headways and buses required for each route.

Table 2.9. Alternative 1. Extend Purple Route@10 minutes headway; shorten Orange Route@20 minutes headway; Shorten Green Route @ 20 minutes headway; Operate Banner Route during standard hours.

Alternative 1	Tier 2 Hours (>60k), 3rd increment, no routes eliminated	FY2015	FY2016	FY2017	FY2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Modified Alternative Revenues											
	Parking Tax Revenue (net of Harbor Connector)	$5,340,400	$5,425,992	$5,520,724	$5,623,190	$5,733,586	$5,846,506	$5,961,544	$6,078,895	$6,198,553	$6,320,512
	LOTS Funding	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$0	$0	$0	$0	$0
	EBDI Funding	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
	University of Maryland Bio Park Contribution	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000
	SS200 Grant	$185,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Advertising Revenues	$120,000	$121,800	$123,627	$125,481	$127,364	$129,274	$131,213	$133,181	$135,179	$137,207
	Total Revenues Available for CCC	$7,770,400	$7,672,792	$7,769,351	$7,873,672	$7,985,950	$6,100,780	$6,217,757	$6,337,076	$6,458,732	$6,582,719
Modified Alternative Expenditures											
Scen. Abb.	**Base Operating Expenses**										
O2B	Orange Route	$1,905,225	$1,004,091	$1,024,173	$1,044,656	$1,065,549	$1,086,860	$1,108,597	$1,130,769	$1,153,385	$1,176,452
G5	Green Route	$2,266,942	$669,394	$682,782	$696,437	$710,366	$724,573	$739,065	$753,846	$768,923	$784,302
P2A	Purple Route	$2,266,942	$2,342,879	$2,389,736	$2,437,531	$2,486,282	$2,536,007	$2,586,727	$2,638,462	$2,691,231	$2,745,056
B1	Banner Route	$750,587	$669,394	$682,782	$696,437	$710,366	$724,573	$739,065	$753,846	$768,923	$784,302
	CCC Operating Expenses - Current Contract	$7,189,696	$4,685,758	$4,779,473	$4,875,061	$4,972,563	$5,072,013	$5,173,454	$5,276,923	$5,382,462	$5,490,112
	Fuel	$949,171	$639,864	$652,661	$665,715	$679,029	$692,609	$706,462	$720,591	$735,003	$749,703
	Subtotal Operating Expenses	$8,138,868	$5,325,622	$5,432,134	$5,540,776	$5,651,592	$5,764,622	$5,879,916	$5,997,514	$6,117,465	$6,239,815
	Other Costs Included in CCC Operations Costs										
	Van Hool / Other leases to replace Design Lines	$344,000	$350,880	$357,898	$365,056	$372,357	$379,804	$387,400	$395,148	$1,317,160	$1,343,503
	Lease Purchase Payments from Design Lines	573,211	573,211	286,605	0	0	0	0	0	0	0
	FY15 Outstanding Expenses per BBMR	$1,554,414	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Total CCC Operating Expenditures	$10,610,492	$6,249,713	$6,076,637	$5,905,831	$6,023,949	$6,144,426	$6,267,316	$6,392,662	$7,434,624	$7,583,317
		$9,056,078									
	Annual Operating Surplus/ (Deficit)	($2,840,092)	$1,423,079	$1,692,714	$1,967,841	$1,962,001	($43,646)	($49,558)	($55,586)	($975,892)	($1,000,599)
	Cumulative Surplus (Deficit) (from 2016 on)		$1,423,079	$3,115,793	$5,083,634	$7,045,635	$7,001,988	$6,952,430	$6,896,845	$5,920,952	$4,920,353
	Cumulative Deficit (from 2009 on)	($14,517,152)	($13,094,073)	($11,401,359)	($9,433,518)	($7,471,517)	($7,515,164)	($7,564,722)	($7,620,307)	($8,596,200)	($9,596,799)

Table 2.10. Alternative 2. Extend Purple Route@10 minutes headway; shorten Orange Route@15 minutes headway; Eliminate Green Route and Banner Route.

Alternative 2	Maximum Riders at Near-Lowest Tier of Hours	FY2015	FY2016	FY2017	FY2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Modified Alternative Revenues											
	Parking Tax Revenue (net of Harbor Connector)	$5,340,400	$5,425,992	$5,520,724	$5,623,190	$5,733,586	$5,846,506	$5,961,544	$6,078,895	$6,198,553	$6,320,512
	LOTS Funding	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$0	$0	$0	$0	$0
	EBDI Funding	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
	University of Maryland Bio Park Contribution	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000
	SS200 Grant	$185,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Advertising Revenues	$120,000	$121,800	$123,627	$125,481	$127,364	$129,274	$131,213	$133,181	$135,179	$137,207
	Total Revenues Available for CCC	$7,770,400	$7,672,792	$7,769,351	$7,873,672	$7,985,950	$6,100,780	$6,217,757	$6,337,076	$6,458,732	$6,582,719
Modified Alternative Expenditures											
Scen. Abb.	**Base Operating Expenses**										
O2A	Orange Route	$1,905,225	$1,338,788	$1,365,564	$1,392,875	$1,420,732	$1,449,147	$1,478,130	$1,507,693	$1,537,846	$1,568,603
GC	Green Route	$2,266,942	$0	$0	$0	$0	$0	$0	$0	$0	$0
P2A	Purple Route	$2,266,942	$2,342,879	$2,389,736	$2,437,531	$2,486,282	$2,536,007	$2,586,727	$2,638,462	$2,691,231	$2,745,056
BC	Banner Route	$750,587	$0	$0	$0	$0	$0	$0	$0	$0	$0
	CCC Operating Expenses - Current Contract	$7,189,696	$3,681,667	$3,755,300	$3,830,406	$3,907,014	$3,985,154	$4,064,857	$4,146,155	$4,229,077	$4,313,659
	Fuel	$949,171	$502,750	$512,805	$523,061	$533,523	$544,193	$555,077	$566,179	$577,502	$589,052
	Subtotal Operating Expenses	$8,138,868	$4,184,417	$4,268,105	$4,353,467	$4,440,537	$4,529,347	$4,619,934	$4,712,334	$4,806,579	$4,902,711
	Other Costs Included in CCC Operations Costs										
	Van Hool / Other leases to replace Design Lines	$344,000	$70,176	$71,580	$73,011	$74,471	$75,961	$77,480	$79,030	$1,007,240	$1,027,384
	Lease Purchase Payments from Design Lines	573,211	573,211	286,605	0	0	0	0	0	0	0
	FY15 Outstanding Expenses per BBMR	$1,554,414	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Total CCC Operating Expenditures	$10,610,492	$4,827,804	$4,626,290	$4,426,479	$4,515,008	$4,605,308	$4,697,414	$4,791,363	$5,813,819	$5,930,096
	Annual Operating Surplus/ (Deficit)	($2,840,092)	$2,844,988	$3,143,061	$3,447,193	$3,470,942	$1,495,472	$1,520,343	$1,545,713	$644,913	$652,623
	Cumulative Surplus (Deficit) (from 2016 on)		$2,844,988	$5,988,049	$9,435,242	$12,906,184	$14,401,656	$15,921,999	$17,467,712	$18,112,625	$18,765,248
	Cumulative Deficit (from 2009 on)	($14,517,152)	($11,672,164)	($8,529,103)	($5,081,910)	($1,610,968)	($115,496)	$1,404,847	$2,950,560	$3,595,473	$4,248,096

Table 2.11. Alternative 3. Extend Purple Route@10 minutes headway; shorten Orange Route@20 minutes headway; Operate Banner Route during standard hours; Eliminate Green Route.

Alternative 3	Maximum Riders at Third Tier of Hours	FY2015	FY2016	FY2017	FY2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Modified Alternative Revenues											
	Parking Tax Revenue (net of Harbor Connector)	$5,340,400	$5,425,992	$5,520,724	$5,623,190	$5,733,586	$5,846,506	$5,961,544	$6,078,895	$6,198,553	$6,320,512
	LOTS Funding	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$0	$0	$0	$0	$0
	EBDI Funding	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
	University of Maryland Bio Park Contribution	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000
	SS200 Grant	$185,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Advertising Revenues	$120,000	$121,800	$123,627	$125,481	$127,364	$129,274	$131,213	$133,181	$135,179	$137,207
	Total Revenues Available for CCC	$7,770,400	$7,672,792	$7,769,351	$7,873,672	$7,985,950	$6,100,780	$6,217,757	$6,337,076	$6,458,732	$6,582,719
Modified Alternative Expenditures											
Scen. Abb.	**Base Operating Expenses**										
O2B	Orange Route	$1,905,225	$1,004,091	$1,024,173	$1,044,656	$1,065,549	$1,086,860	$1,108,597	$1,130,769	$1,153,385	$1,176,452
GC	Green Route	$2,266,942	$0	$0	$0	$0	$0	$0	$0	$0	$0
P2A	Purple Route	$2,266,942	$2,342,879	$2,389,736	$2,437,531	$2,486,282	$2,536,007	$2,586,727	$2,638,462	$2,691,231	$2,745,056
B1	Banner Route	$750,587	$669,394	$682,782	$696,437	$710,366	$724,573	$739,065	$753,846	$768,923	$784,302
	CCC Operating Expenses - Current Contract	$7,189,696	$4,016,364	$4,096,691	$4,178,624	$4,262,197	$4,347,440	$4,434,389	$4,523,077	$4,613,539	$4,705,810
	Fuel	$949,171	$548,455	$559,424	$570,612	$582,025	$593,665	$605,539	$617,649	$630,002	$642,602
	Subtotal Operating Expenses	$8,138,868	$4,564,819	$4,656,115	$4,749,236	$4,844,222	$4,941,105	$5,039,928	$5,140,726	$5,243,541	$5,348,412
	Other Costs Included in CCC Operations Costs										
	Van Hool / Other leases to replace Design Lines	$344,000	$140,352	$143,159	$146,022	$148,943	$151,922	$154,960	$158,059	$1,084,720	$1,106,414
	Lease Purchase Payments from Design Lines	573,211	573,211	286,605	0	0	0	0	0	0	0
	FY15 Outstanding Expenses per BBMR	$1,554,414	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Total CCC Operating Expenditures	$10,610,492	$5,278,381	$5,085,879	$4,895,259	$4,993,164	$5,093,027	$5,194,887	$5,298,785	$6,328,261	$6,454,826
	Annual Operating Surplus/ (Deficit)	($2,840,092)	$2,394,411	$2,683,472	$2,978,413	$2,992,785	$1,007,753	$1,022,870	$1,038,291	$130,471	$127,892
	Cumulative Surplus (Deficit) (from 2016 on)		$2,394,411	$5,077,882	$8,056,295	$11,049,080	$12,056,834	$13,079,703	$14,117,994	$14,248,465	$14,376,357
	Cumulative Deficit (from 2009 on)	($14,517,152)	($12,122,741)	($9,439,270)	($6,460,857)	($3,468,072)	($2,460,318)	($1,437,449)	($399,158)	($268,687)	($140,795)

Table 2.12. Alternative 4. Extend Purple Route@10 minutes headway; shorten Orange Route@15 minutes headway; Shorten Green Route @ 20 minutes headway; Eliminate Banner Route.

Alternative 4	Tier 2 Hours (> 60k), 2nd increment	FY2015	FY2016	FY2017	FY2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Modified Alternative Revenues											
	Parking Tax Revenue (net of Harbor Connector)	$5,340,400	$5,425,992	$5,520,724	$5,623,190	$5,733,586	$5,846,506	$5,961,544	$6,078,895	$6,198,553	$6,320,512
	LOTS Funding	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$0	$0	$0	$0	$0
	EBDI Funding	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
	University of Maryland Bio Park Contribution	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000
	SS200 Grant	$185,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Advertising Revenues	$120,000	$121,800	$123,627	$125,481	$127,364	$129,274	$131,213	$133,181	$135,179	$137,207
	Total Revenues Available for CCC	$7,770,400	$7,672,792	$7,769,351	$7,873,672	$7,985,950	$6,100,780	$6,217,757	$6,337,076	$6,458,732	$6,582,719
Modified Alternative Expenditures											
Scen. Abb.	**Base Operating Expenses**										
O2A	Orange Route	$1,905,225	$1,338,788	$1,365,564	$1,392,875	$1,420,732	$1,449,147	$1,478,130	$1,507,693	$1,537,846	$1,568,603
G5	Green Route	$2,266,942	$669,394	$682,782	$696,437	$710,366	$724,573	$739,065	$753,846	$768,923	$784,302
P2A	Purple Route	$2,266,942	$2,342,879	$2,389,736	$2,437,531	$2,486,282	$2,536,007	$2,586,727	$2,638,462	$2,691,231	$2,745,056
BC	Banner Route	$750,587	$0	$0	$0	$0	$0	$0	$0	$0	$0
	CCC Operating Expenses - Current Contract	$7,189,696	$4,351,061	$4,438,082	$4,526,843	$4,617,380	$4,709,727	$4,803,922	$4,900,001	$4,998,000	$5,097,961
	Fuel	$949,171	$594,159	$606,043	$618,164	$630,527	$643,137	$656,000	$669,120	$682,502	$696,153
	Subtotal Operating Expenses	$8,138,868	$4,945,220	$5,044,125	$5,145,007	$5,247,907	$5,352,864	$5,459,922	$5,569,121	$5,680,502	$5,794,114
	Other Costs Included in CCC Operations Costs										
	Van Hool / Other leases to replace Design Lines	$344,000	$280,704	$286,318	$292,044	$297,885	$303,843	$309,920	$316,118	$1,239,680	$1,264,473
	Lease Purchase Payments from Design Lines	573,211	573,211	286,605	0	0	0	0	0	0	0
	FY15 Outstanding Expenses per BBMR	$1,554,414	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Total CCC Operating Expenditures	$10,610,492	$5,799,135	$5,617,048	$5,437,051	$5,545,792	$5,656,707	$5,769,842	$5,885,239	$6,920,182	$7,058,587
	Annual Operating Surplus/ (Deficit)	($2,840,092)	$1,873,657	$2,152,303	$2,436,621	$2,440,158	$444,073	$447,915	$451,837	($461,450)	($475,868)
	Cumulative Surplus (Deficit) (from 2016 on)		$1,873,657	$4,025,960	$6,462,580	$8,902,738	$9,346,811	$9,794,726	$10,246,563	$9,785,112	$9,309,244
	Cumulative Deficit (from 2009 on)	($14,517,152)	($12,643,495)	($10,491,192)	($8,054,572)	($5,614,414)	($5,170,341)	($4,722,426)	($4,270,589)	($4,732,040)	($5,207,908)

Table 2.13. Alternative 5. Extend Purple Route@10 minutes headway; shorten Orange Route@15 minutes headway; Shorten Green Route @ 20 minutes headway; Operate Banner Route during standard hours.

Alternative 5	Third Tier (> 70k hours), Maximum Riders	FY2015	FY2016	FY2017	FY2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Modified Alternative Revenues											
	Parking Tax Revenue (net of Harbor Connector)	$5,340,400	$5,425,992	$5,520,724	$5,623,190	$5,733,586	$5,846,506	$5,961,544	$6,078,895	$6,198,553	$6,320,512
	LOTS Funding	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$0	$0	$0	$0	$0
	EBDI Funding	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
	University of Maryland Bio Park Contribution	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000
	SS200 Grant	$185,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Advertising Revenues	$120,000	$121,800	$123,627	$125,481	$127,364	$129,274	$131,213	$133,181	$135,179	$137,207
	Total Revenues Available for CCC	$7,770,400	$7,672,792	$7,769,351	$7,873,672	$7,985,950	$6,100,780	$6,217,757	$6,337,076	$6,458,732	$6,582,719
Modified Alternative Expenditures											
Scen. Abb.	**Base Operating Expenses**										
O2A	Orange Route	$1,905,225	$1,338,788	$1,365,564	$1,392,875	$1,420,732	$1,449,147	$1,478,130	$1,507,693	$1,537,846	$1,568,603
G5	Green Route	$2,266,942	$669,394	$682,782	$696,437	$710,366	$724,573	$739,065	$753,846	$768,923	$784,302
P2A	Purple Route	$2,266,942	$2,342,879	$2,389,736	$2,437,531	$2,486,282	$2,536,007	$2,586,727	$2,638,462	$2,691,231	$2,745,056
B1	Banner Route	$750,587	$669,394	$682,782	$696,437	$710,366	$724,573	$739,065	$753,846	$768,923	$784,302
	CCC Operating Expenses - Current Contract	$7,189,696	$5,020,455	$5,120,864	$5,223,280	$5,327,746	$5,434,300	$5,542,987	$5,653,847	$5,766,923	$5,882,263
	Fuel	$949,171	$685,569	$699,280	$713,266	$727,531	$742,082	$756,923	$772,062	$787,503	$803,253
	Subtotal Operating Expenses	$8,138,868	$5,706,024	$5,820,144	$5,936,546	$6,055,277	$6,176,382	$6,299,910	$6,425,909	$6,554,426	$6,685,516
	Other Costs Included in CCC Operations Costs										
	Van Hool / Other leases to replace Design Lines	$344,000	$421,056	$429,477	$438,067	$446,828	$455,765	$464,880	$474,177	$1,394,640	$1,422,532
	Lease Purchase Payments from Design Lines	573,211	573,211	286,605	0	0	0	0	0	0	0
	FY15 Outstanding Expenses per BBMR	$1,554,414	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Total CCC Operating Expenditures	$10,610,492	$6,700,290	$6,536,226	$6,374,612	$6,502,105	$6,632,146	$6,764,790	$6,900,086	$7,949,065	$8,108,048
	Annual Operating Surplus/ (Deficit)	($2,840,092)	$972,502	$1,233,124	$1,499,059	$1,483,845	($531,366)	($547,033)	($563,010)	($1,490,334)	($1,525,330)
	Cumulative Surplus (Deficit) (from 2016 on)		$972,502	$2,205,626	$3,704,686	$5,188,530	$4,657,164	$4,110,131	$3,547,122	$2,056,788	$531,458
	Cumulative Deficit (from 2009 on)	($14,517,152)	($13,544,650)	($12,311,526)	($10,812,466)	($9,328,622)	($9,859,988)	($10,407,021)	($10,970,030)	($12,460,364)	($13,985,694)

Table 2.14. Financial Summary of Alternative Scenarios

Alternative 1	FY2015	FY2016	FY2017	FY2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Total Revenues Available for CCC	$7,770,400	$7,672,792	$7,769,351	$7,873,672	$7,985,950	$6,100,780	$6,217,757	$6,337,076	$6,458,732	$6,582,719
Total CCC Operating Expenditures	$10,610,492	$6,249,713	$6,076,637	$5,905,831	$6,023,949	$6,144,426	$6,267,316	$6,392,662	$7,434,624	$7,583,317
Annual Operating Surplus/ (Deficit)	($2,840,092)	$1,423,079	$1,692,714	$1,967,841	$1,962,001	($43,646)	($49,558)	($55,586)	($975,892)	($1,000,599)
Cumulative Deficit (from 2009 on)	($14,517,152)	($13,094,073)	($11,401,359)	($9,433,518)	($7,471,517)	($7,515,164)	($7,564,722)	($7,620,307)	($8,596,200)	($9,596,799)
Alternative 2	FY2015	FY2016	FY2017	FY2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Total Revenues Available for CCC	$7,770,400	$7,672,792	$7,769,351	$7,873,672	$7,985,950	$6,100,780	$6,217,757	$6,337,076	$6,458,732	$6,582,719
Total CCC Operating Expenditures	$10,610,492	$4,827,804	$4,626,290	$4,426,479	$4,515,008	$4,605,308	$4,697,414	$4,791,363	$5,813,819	$5,930,096
Annual Operating Surplus/ (Deficit)	($2,840,092)	$2,844,988	$3,143,061	$3,447,193	$3,470,942	$1,495,472	$1,520,343	$1,545,713	$644,913	$652,623
Cumulative Deficit (from 2009 on)	($14,517,152)	($11,672,164)	($8,529,103)	($5,081,910)	($1,610,968)	($115,496)	$1,404,847	$2,950,560	$3,595,473	$4,248,096
Alternative 3	FY2015	FY2016	FY2017	FY2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Total Revenues Available for CCC	$7,770,400	$7,672,792	$7,769,351	$7,873,672	$7,985,950	$6,100,780	$6,217,757	$6,337,076	$6,458,732	$6,582,719
Total CCC Operating Expenditures	$10,610,492	$5,278,381	$5,085,879	$4,895,259	$4,993,164	$5,093,027	$5,194,887	$5,298,785	$6,328,261	$6,454,826
Annual Operating Surplus/ (Deficit)	($2,840,092)	$2,394,411	$2,683,472	$2,978,413	$2,992,785	$1,007,753	$1,022,870	$1,038,291	$130,471	$127,892
Cumulative Deficit (from 2009 on)	($14,517,152)	($12,122,741)	($9,439,270)	($6,460,857)	($3,468,072)	($2,460,318)	($1,437,449)	($399,158)	($268,687)	($140,795)
Alternative 4	FY2015	FY2016	FY2017	FY2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Total Revenues Available for CCC	$7,770,400	$7,672,792	$7,769,351	$7,873,672	$7,985,950	$6,100,780	$6,217,757	$6,337,076	$6,458,732	$6,582,719
Total CCC Operating Expenditures	$10,610,492	$5,799,135	$5,617,048	$5,437,051	$5,545,792	$5,656,707	$5,769,842	$5,885,239	$6,920,182	$7,058,587
Annual Operating Surplus/ (Deficit)	($2,840,092)	$1,873,657	$2,152,303	$2,436,621	$2,440,158	$444,073	$447,915	$451,837	($461,450)	($475,868)
Cumulative Deficit (from 2009 on)	($14,517,152)	($12,643,495)	($10,491,192)	($8,054,572)	($5,614,414)	($5,170,341)	($4,722,426)	($4,270,589)	($4,732,040)	($5,207,908)
Alternative 5	FY2015	FY2016	FY2017	FY2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Total Revenues Available for CCC	$7,770,400	$7,672,792	$7,769,351	$7,873,672	$7,985,950	$6,100,780	$6,217,757	$6,337,076	$6,458,732	$6,582,719
Total CCC Operating Expenditures	$10,610,492	$6,700,290	$6,536,226	$6,374,612	$6,502,105	$6,632,146	$6,764,790	$6,900,086	$7,949,065	$8,108,048
Annual Operating Surplus/ (Deficit)	($2,840,092)	$972,502	$1,233,124	$1,499,059	$1,483,845	($531,366)	($547,033)	($563,010)	($1,490,334)	($1,525,330)
Cumulative Deficit (from 2009 on)	($14,517,152)	($13,544,650)	($12,311,526)	($10,812,466)	($9,328,622)	($9,859,988)	($10,407,021)	($10,970,030)	($12,460,364)	($13,985,694)

Table 2.15. Summary of Key Information for Alternatives

Operating Alternative, Assumptions & Outcomes	Alt.1	Alt.2	Alt.3	Alt.4	Alt.5
Summary Service Alternative Description	Extend Purple@10min hdwy; Short Orange@20min hdwy; short Green@20min hdwy	Extend Purple@10min hdwy; Short Orange@15min hdwy; Eliminate Green Route and Banner Route	Extend Purple@10min hdwy; Short Orange@20min hdwy; Eliminate Green Route	Extend Purple@10min hdwy; Short Orange@15min hdwy; short Green@20min hdwy; Eliminate Banner Route	Extend Purple@10min hdwy; Short Orange@15min hdwy; short Green@20min hdwy;
Annual Revenue Operating Hours	63,752	50,091	54,644	59,198	68,306
Operating Cost per Hour- Base Costs (11)	$83.54	$83.54	$83.54	$83.54	$83.54
Full CCC Operating Cost per Hour (with Lease Costs)	$98.03	$96.38	$96.60	$97.96	$98.09
Headways (minutes)					
Orange	20	15	20	15	15
Green	20	0	0	20	20
Purple	10	10	10	10	10
Banner	20	0	20	0	20
Buses Required					
Orange	3	4	3	4	4
Green	2	0	0	2	2
Purple	7	7	7	7	7
Banner	2	0	2	0	2
Subtotal Buses in service	14	11	12	13	15
Spares	3	2	2	3	3
Total buses required	17	13	14	16	18
Other Services Changes					
Adjusted Hours? (e.g. all "winter" hours)	No	No	No	No	No
Key Change in operating cost rate assumptions					
Average Annual Revenues (2016-2024)	$6,999,870	$6,999,870	$6,999,870	$6,999,870	$6,999,870
Annual Expenditures (2016-2024)	$6,453,164	$4,914,842	$5,402,497	$5,965,509	$6,940,819
Annual Surplus (Deficit) (2016-2024)	$546,706	$2,085,028	$1,597,373	$1,034,360	$59,051
Cumulative fund Balance Surplus/(Deficit) 2024	($9,596,799)	$4,248,096	($140,795)	($5,207,908)	($11,520,040)

G. Summary Recommendations

1. Preliminary Operating Recommendation (Alternative 2):

    - Extend Purple Route on northern loop with one (1) bus, maintain ten (10) minute headway (P2A).

    - Shorten Orange Route slightly and choose headway at 15 minutes (O2A).

    - Eliminate Green Route (GC).

    - Eliminate Banner Route (BC).

2. Eliminate the Design Line buses and stabilize the bus fleet with reliable, easy to maintain, cost effective buses. Lease for the short term; begin seeking grants for the long term.

    - Develop an RFP for leases. Investigate market and standard and preferred terms, e.g., hybrid 40-foot buses, seating capacity, less than 6 years old preferred or recently rebuilt, estimated three (3)- to five (5) -year lease term, flexibility to renew and expand or contract by up to three (3) buses with specified notice required on same lease terms.

3. Develop a "clean" RFP that will attract multiple bidders with a good fleet of buses, clear operating characteristics and performance expectations, with flexibility to expand or contract within established parameters. (The draft RFP is a separate deliverable.)

    - CCC service hours are likely to change significantly over the next five (5) years as services are first rationalized to fit revenue constraints, and then potentially expanded as additional sponsors and partners are identified and formalized. It may be advantageous for BCDOT to consider alternative mechanisms for establishing rates for future years (e.g., a "floor" for fixed costs and a much lower variable rate to reduce the volatility of service changes.) For discussion.

4. Establish a new RFP and new contract with clear operating performance and reporting requirements (financial, operating and maintenance reporting). Enforce reporting and performance requirements; including incentives and penalties from the beginning, incorporate NTD reporting.

5. Operating Grant support: Continue building relationships with MTA and grants offices to follow up on LOTS funding, make the case for its continuation beyond 2019, and identify other potential funding sources for operations.

6. Capital Grant support: Continue building relationships with MTA and BMC capital planning and grant staff to begin to work CCC bus and other capital requirements into the appropriate TIP (Transportation Improvement Program) and the CLRP (Constrained Long Range Plan.) (See Appendix D for more information on grant funding.)

    - The BBMR report recommends establishing a capital replacement fund for buses.

    - Another alternative is to begin actively reporting to the NTD and the state of Maryland to establish a reliable source of capital grant funding, to supplement parking revenues and other sources. Parking revenues could be set aside as the local match for capital grants (up to 80% federal) rather than funding 100% of (operating) lease costs.

    - Build CCC bus replacements into the capital replacement funding cycles and requests of the MTA and BMC capital program requests to the FTA.

    - This analysis assumes buses are leased; as noted in the benchmarking analysis and bus purchase versus lease section, and as noted in Appendix D, most transit agencies leverage local funds with federal and state capital funds to purchase buses and other capital items.

    - In addition to buses, the CCC may wish to consider establishing a bus maintenance and fueling facility, to further reduce the up-front and hourly costs of a selected transit operator.

7. Begin a clear and high-level focus on building relationships with potential partners in the City of Baltimore across agencies and with potential business partners.

    - Example: "Visit Baltimore" is funded from the Hotel Occupancy Tax. The tax rate was increased in 2011 and Visit Baltimore receives 40% of the revenue. The Visit Baltimore General Fund Budget has increased from $9.3 million in 2011 to $14.3 in 2015, according to the BBMR report; Visit Baltimore may now have more opportunity to support the CCC than in prior years. The CCC provides a significant value to visitors and to Visit Baltimore; a formal partnership with mutual recognition and promotion could help both organizations.

    - "Visit Baltimore, the Downtown Partnership, the Waterfront Partnership, and numerous other organizations and businesses benefit from the economic impact of bringing residents, commuters and tourists throughout the Central Business District and Downtown areas. While these agencies or businesses may not wish to promote fares, it may prove beneficial to instead provide direct financial support

to promote continuity of Circulator and Harbor Connector Operations." (BBMR report, 45.)

- Berger concurs that additional partnerships with businesses and organizations in the City of Baltimore can improve the financial foundation for the CCC as well as provide additional benefits to current and potential new partners. Partnerships with businesses could include bus sponsorships, established payment levels to extend more direct service to large businesses along existing routes (e.g., at peak hours), and other opportunities to demonstrate the CCC's inherent value to the City of Baltimore, and to its businesses, residents, and tourists.

8. Establish annual budgets for CCC operations and capital. Monitor finances and operations carefully. Identify the "City" costs that are being charged against the fund, create a line item and monitor closely. Adjust levels of service and annual budget as necessary to maintain stability and meet rider, City, and partner needs.

Operations Analysis Appendix A
Bus Routing Model Creation and Calibration

INTRODUCTION

The study relied on a micro-simulation model to help test various bus routing and headway alternatives. TransModeler™ version 4.0 Build 5800 was used to perform the modeling based on the software's advanced combination of traffic and transit modeling and analysis tools. As is the case in any transportation model, a model must be created and calibrated before any alternative testing can occur.

MODEL CREATION

DOT had an AM and PM peak hour Synchro™ model covering a large majority of the Charm City Circulator (CCC) roadway network. Each of these networks was imported into TransModeler. The Synchro™ networks covering the following five different regions:

- Central Business District (North Avenue, Conway Street, President Street, Martin Luther King, Jr. Blvd.)
- North Baltimore (University Parkway, North Avenue, York Road, Howard Street)
- East Baltimore (Madison Street, Fayette Street, Pulaski Highway, Greenmount Avenue/Ansor Street)
- West Baltimore (North Avenue, Pratt Street, Martin Luther King, Jr. Blvd., Franklintown Road)
- South Baltimore (Conway Street, Patapsco Avenue, Key Highway, Hanover Street)

The Synchro™ networks were reduced in size before they were imported into the model to incorporate enough roadways to cover the existing and proposed CCC network. Each Synchro™ file was imported into TransModeler™ and included the roadway network, traffic signal timings, and intersection turning movements. According to DOT, the turning movement counts represented 2009 conditions and the traffic signal timings represented the optimized plans as part of a city-wide traffic optimization project. DOT indicated that these traffic signal timings should still be in effect.

Synchro™ has a limited ability to match the actual roadway geometry; therefore, once the Synchro™ networks were successfully imported in TransModeler™, each intersection and main link was compared to the latest aerial imagery available through Google. Since TransModeler™ models traffic movements based on roadway geometry, adjustments were provided to match existing conditions to as close to the actual conditions. This includes turning lane lengths, precise locations of stop lines, number of lanes, lane markings prohibiting lane changes, and lane-based geometry assignment.

Once the geometry was thoroughly checked, traffic signal timings were sampled to ensure the cycle lengths, assigned phase order, and offset values matched the values contained in the Synchro™ files. Most of the network represented a simple grid pattern; however, a few intersections with more than four approaches or approaches at angles required minor adjustments after importing because the phases swapped between the main and minor roadways. In most cases, the traffic signal operations matched the Synchro™ values. This process covered the AM and PM peak hour timings.

The final set of data imported from Synchro™ was the intersection turning movement counts representing the AM and PM peak hour. A majority of intersections were sampled in TransModeler™ to ensure the correct volumes were imported and assigned to the correct approach. There were a few cases similar to the traffic signal issues where volumes were assigned to the wrong approach based on intersection approaches differing from a grid pattern. This was mainly due to differences between the two software packages in handling non-grid type intersections.

Since Little Italy, Harbor East, Harbor Point, and the Butchers Hill neighborhoods are not available in Synchro™ but are part of the existing and proposed CCC networks, additional roadways were added, including Fleet Street, Aliceanna Street, and Lancaster Street between President Street and Caroline Street, Aliceanna Street between Caroline Street and Broadway, Caroline Street between Harbor Point and Lombard Street, Broadway between Lancaster Street and Fayette Street, and Lombard Street between Caroline Street and Albemarle Street. In lieu of traffic signal timings and turning movement counts, these roadways were added to the model based on roadway geometry. The Google-based travel times were sampled for three routes to determine an appropriate speed to assign the roadways without traffic and traffic signals. The following summarizes the sample routes:

- Route A: Aliceanna Street eastbound from President Street to Central Avenue northbound to Lombard Street westbound ending at Albemarle Street—0.9 mile and 5 minutes in current traffic, resulting in a speed of 10.8 miles per hour (mph)
- Route B: Aliceanna Street eastbound from President Street to Broadway northbound ending at Fayette Street—1.1 miles and 8 minutes in current traffic, resulting in a speed of 8.25 mph
- Route C: Broadway southbound from Fayette Street to Aliceanna Street westbound ending at President Street—1.1 miles and 9 minutes in current traffic, resulting in a speed of 7.3 mph

Based on the sample routes, Louis Berger calculated an average speed of 8.78 mph, and assigned a travel speed of 8 mph to be conservative rounding down to the nearest whole number. This represents the traffic conditions and traffic signal delays a bus may encounter along these roadways where vehicle volumes and traffic signal timings were not available.

The completed network consisted of 371 signalized intersections, 32 unsignalized intersections, and more than 1,150 roadway segments. Figure A-1 shows the complete modeled network.

MODEL CALIBRATION

Before the model could be loaded with the CCC bus routes and used to test various alternatives, it needed to be calibrated. Calibration is a process of running the simulation while observing the conditions and viewing post simulation reports to determine any adjustments required to best match the actual conditions. Louis Berger performed both macro-level (model-wide) and micro-level (specific location) adjustments on the model, and implemented the following macro-level adjustments to improve the model accuracy in reflecting existing conditions:

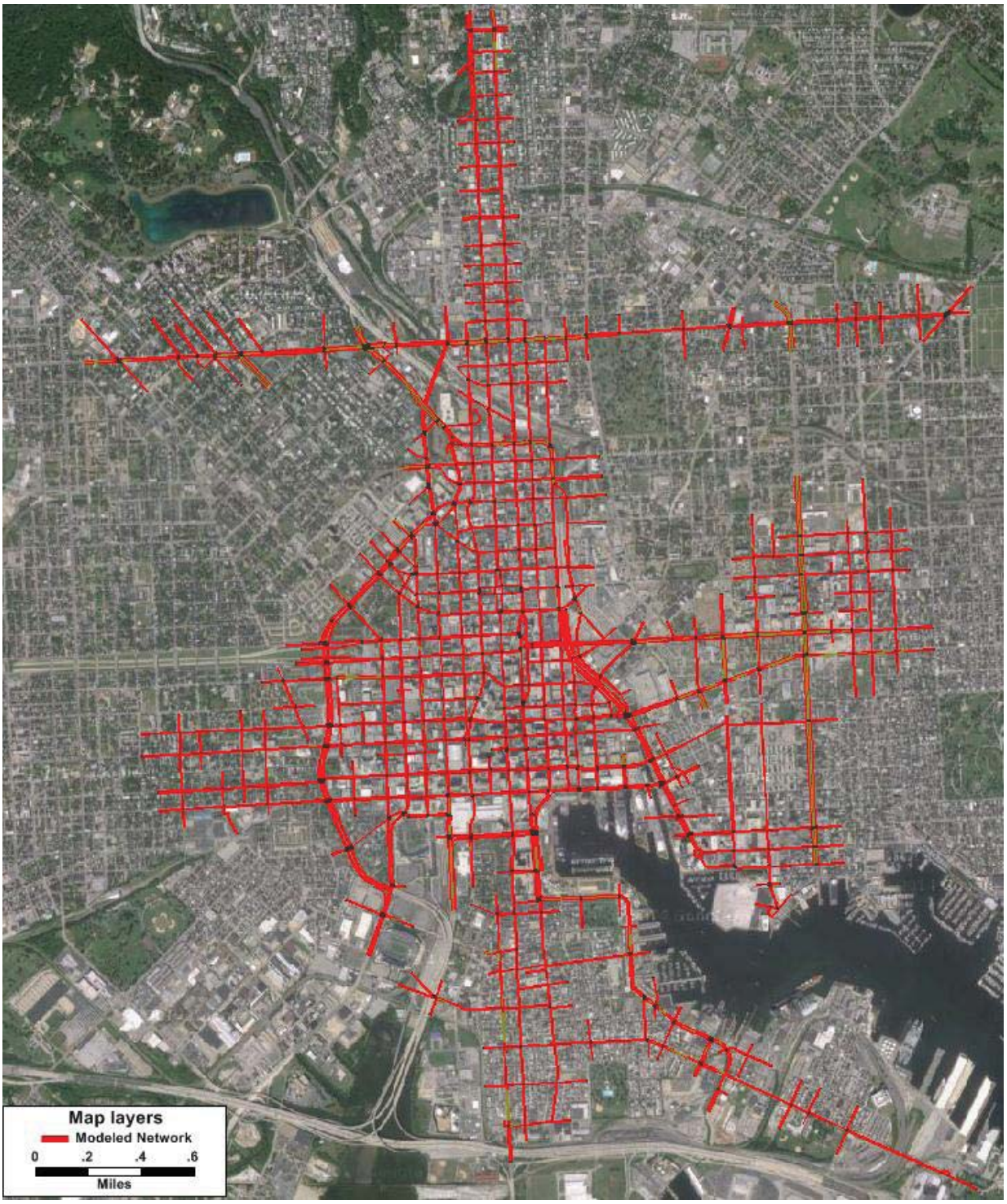


Figure A-1. Complete Modeled Network

Vehicle Volume Adjustments

The Synchro™ volumes included vehicle volumes from 2009. Given that these volumes were five years old, it was important to compare them to more recent counts. In addition, some of the CCC travel times exceeded 1 hour based on the existing condition data; therefore, 2-hour simulations were necessary to capture a good sample of bus travel times.

Maryland State Highway Administration (SHA) vehicle volumes were obtained for the following 10 key locations within the model area (Maryland SHA, 2014).

1. Fayette Street, east of Calvert Street (2013 count)
2. Light Street, north of Key Highway (2014 count)
3. Lombard Street, west of Calvert Street (2013 count)
4. Pratt Street, east of Green Street (2012 count)
5. St. Paul Street, north of Mount Royal Avenue (2011 count)
6. Charles Street, north of Mount Royal Avenue (2011 count)
7. Broadway, south of Monument Street (2012 count)
8. Martin Luther King, Jr. Blvd, north of Washington Blvd. (2012 count)
9. President Street, north of Lombard Street (2013 count)
10. Aliceanna Street, east of Broadway (2013 count)

The highest AM and PM peak hour were calculated across all 10 counts (8:00 AM during the morning and 4:00 PM during the evening). The 9AM and 5PM counts were compared to the peak hour and a percent difference was calculated to determine a percent drop in vehicle turning movement counts for the second hour. The second hour for both the AM and PM vehicle volume were added to the TransModeler™ databases to provide TransModeler™ with vehicle volumes to follow once the simulation completed the first hour. Based on the vehicle volumes, the second hour AM dropped by 13.656 percent and the second hour PM dropped by 3.486 percent.

Using the same 10 location vehicle counts, the volumes were compared to the Synchro™ 2009 vehicle volumes. This provided an indication of how close the 2009 counts were to the latest counts. Based on the data, the 2009 counts averaged 6.7 percent higher volumes than the most recent counts during the AM peak hour and 11.5 percent higher volumes than the most recent counts during the PM peak hour. As a result, the simulation counts were slightly higher than more recent counts and provide a more conservative traffic operation.

Tables A-1 and A-2 contain the AM and PM peak hour volume comparisons, respectively.

Table A-1. AM Peak Hour Vehicle Volumes

Location	Count Year	7:00 AM	8:00 AM	9:00 AM	Second Hour Adjust-ment	DOT Synchro Volume	Difference (Synchro vs 8 AM Volume)
		Maryland SHA Volumes					
Light Street SB	2014	2447	2623	1918	26.8776%	2752	4.7%
Fayette EB	2013	1104	1135	858	24.4053%	1057	-7.4%
Lombard WB	2013	2192	2115	1696	19.8109%	2171	2.6%
President Street NB	2013	1373	1333	1073	19.5049%	1411	5.5%
Charles Street NB	2011	979	1048	855	18.4160%	902	-16.2%
St Paul Street SB	2011	931	806	793	1.6129%	953	15.4%
Broadway NB	2012	336	399	344	13.7845%	402	0.7%
Aliceanna Street EB	2013	303	291	260	10.6529%	N/A	N/A
MLK Jr. Blvd NB	2012	2112	2244	2015	10.2050%	2590	13.4%
Pratt EB	2012	644	735	799	-8.7075%	1262	41.8%
Total Volume		**12,421**	**12,729**	**10,611**			
Percent Difference					**13.6562%**		**6.7%**

Table A-2. AM Peak Hour Vehicle Volumes

Location	Count Year	4:00 PM	5:00 PM	6:00 PM	Second Hour Adjust-ment	DOT Synchro Volume	Difference (Synchro vs 5 PM Volume)
		Maryland SHA Volumes					
Light Street SB	2014	1786	1838	1775	-2.9115%	2266	21.2%
Fayette EB	2013	775	650	633	16.1290%	650	-19.2%
Lombard WB	2013	1501	1396	1701	6.9953%	2187	31.4%
President Street NB	2013	1431	1383	1197	3.3543%	2134	32.9%
Charles Street NB	2011	1651	1780	1410	-7.8134%	2110	21.8%
St Paul Street SB	2011	802	778	781	2.9925%	1044	23.2%
Broadway NB	2012	367	379	278	-3.2698%	507	27.6%
Aliceanna Street EB	2013	453	391	407	13.6865%	N/A	N/A
MLK Jr. Blvd NB	2012	1890	1925	1792	-1.8519%	2154	12.3%
Pratt EB	2012	1086	1004	1024	7.5506%	735	-47.8%
Total Volume		**11,742**	**11,524**	**10,998**			
Percent Difference					**3.4862%**		**11.5%**

Vehicle Fleet Mix

The vehicle fleet represents the mixture of different vehicle types ranging from small cars to large tractor trailers. Maryland SHA classification counts were obtained for the following 10 key locations within model area (Maryland SHA, 2014).

1. Route 295, north of Lee Street (2014 count)
2. Interstate 395, north of Martin Luther King, Jr. Blvd (2010 count)
3. Lombard Street, west of Calvert Street (2013 count)
4. Pratt Street, east of Green Street (2012 count)
5. St. Paul Street, north of Mount Royal Avenue (2011 count)
6. Charles Street, north of Mount Royal Avenue (2011 count)
7. Broadway, south of Monument Street (2012 count)
8. Martin Luther King, Jr. Blvd, north of Washington Blvd. (2012 count)
9. President Street, north of Lombard Street (2013 count)
10. Aliceanna Street, east of Broadway (2013 count)

Each classification count provided a breakdown by hour of 13 different classes of vehicles developed by the Federal Highway Administration. For the purposes of the model, the 13 classes were narrowed by combining the five single-unit truck categories and the four multi-trailer truck categories. Because the I-395 and Route 295 classification counts contained several days of counts, two of the days were averaged representing a Tuesday, Wednesday, or Thursday. These values were averaged with the eight other locations to determine an AM and PM peak hour percent fleet mixture. For simplicity and since the AM and PM mixtures were similar in magnitude, they were averaged to create an overall vehicle fleet mixture for all modeling to follow. Table A-3 presents the vehicle fleet categories and mixture percent. Table A-4 contains the AM peak hour detailed site vehicle fleet mixtures, and Table A-5 contains the PM peak hour detailed site vehicle fleet mixtures.

Table A-3. Vehicle Fleet Mixture

Vehicle Fleet Type	Mixture
Motorcycles	0.4%
Passenger cars	84.1%
Light trucks	10.0 %
Buses	1.9%
Single-unit trucks	3.5 %
Multi-trailer trucks	0.1 %

Table A-4. AM Peak Hour Vehicle Fleet Mixture

Location	Motor-cycles	Passenger Cars	Light Trucks	Buses	Single Unit Truck	Multi-trailer Truck
I-395 NB	17	1,342	118	24	98	45
I-395 NB	11	2,288	266	27	142	17
(two-day avg.)	14	1,815	192	26	120	31
(mixture)	0.6%	82.6%	8.7%	1.2%	5.5%	1.4%
Route 295	4	1,836	115	15	80	2
Route 295	3	1,686	143	9	62	1
(two-day avg.)	4	1,761	129	12	71	2
(mixture)	0.2%	89.0%	6.5%	0.6%	3.6%	0.1%
Lombard Street	7	1,642	270	84	107	3
(mixture)	0.3%	77.7%	12.8%	4.0%	5.1%	0.1%
President Street	8	1,046	176	16	62	0
(mixture)	0.6%	80.0%	13.5%	1.2%	4.7%	0.0%
Charles Street	2	888	146	46	17	0
(mixture)	0.2%	80.8%	13.3%	4.2%	1.5%	0.0%
St Paul Street	5	664	83	20	55	2
(mixture)	0.6%	80.1%	10.0%	2.4%	6.6%	0.2%
Broadway	1	318	51	5	15	0
(mixture)	0.3%	81.5%	13.1%	1.3%	3.8%	0.0%
Aliceanna Street	1	244	16	4	14	0
(mixture)	0.4%	87.5%	5.7%	1.4%	5.0%	0.0%
MLK Jr. Blvd	5	1,896	153	10	102	3
(mixture)	0.2%	87.4%	7.1%	0.5%	4.7%	0.1%
Pratt Street	2	590	84	36	23	0
(mixture)	0.3%	80.3%	11.4%	4.9%	3.1%	0.0%
Average Vehicle Mixture	**0.4%**	**82.7%**	**10.2%**	**2.2%**	**4.4%**	**0.2%**

Table A-5. PM Peak Hour Vehicle Fleet Mixture

Location	Motor-cycles	Passenger Cars	Light Trucks	Buses	Single Unit Truck	Multi-trailer Truck
I-395 NB	4	1513	182	10	45	0
I-395 NB	2	1499	194	16	38	2
(two-day avg.)	3	1506	188	13	41.5	1
(mixture)	0.2%	85.9%	10.7%	0.7%	2.4%	0.1%
Route 295	2	1315	110	4	45	0
Route 295	4	1352	103	3	40	0
(two-day avg.)	3	1333.5	106.5	3.5	42.5	0
(mixture)	0.2%	89.6%	7.2%	0.2%	2.9%	0.0%
Lombard Street	26	1058	170	40	91	0
(mixture)	1.9%	76.4%	12.3%	2.9%	6.6%	0.0%
President Street	6	1147	194	4	68	0
(mixture)	0.4%	80.8%	13.7%	0.3%	4.8%	0.0%
Charles Street	2	1550	145	41	21	0
(mixture)	0.1%	88.1%	8.2%	2.3%	1.2%	0.0%
St Paul Street	0	672	53	28	5	0
(mixture)	0.0%	88.7%	7.0%	3.7%	0.7%	0.0%
Broadway	2	321	45	5	5	0
(mixture)	0.5%	84.9%	11.9%	1.3%	1.3%	0.0%
Aliceanna Street	2	321	38	11	11	3
(mixture)	0.5%	83.2%	9.8%	2.8%	2.8%	0.8%
MLK Jr. Blvd	1	1750	113	7	31	1
(mixture)	0.1%	92.0%	5.9%	0.4%	1.6%	0.1%
Pratt Street	11	805	118	26	21	1
(mixture)	1.1%	82.0%	12.0%	2.6%	2.1%	0.1%
Average Vehicle Mixture	**0.5%**	**85.2%**	**9.9%**	**1.7%**	**2.6%**	**0.1%**

YELLOW Light Tolerance Adjustment:

By adjusting the YELLOW light tolerance, more vehicles pass through all congested intersections during the YELLOW phase to more accurately reflect driver behavior in Baltimore. This allows the intersections to process more vehicles per hour.

The following micro-level adjustments were applied to improve the model accuracy in reflecting existing conditions:

Intersection Specific Adjustments:

A number of specific measures were implemented to improve the efficiency of vehicle throughput where appropriate. In addition, specific intersections were targeted to increase vehicle volumes.

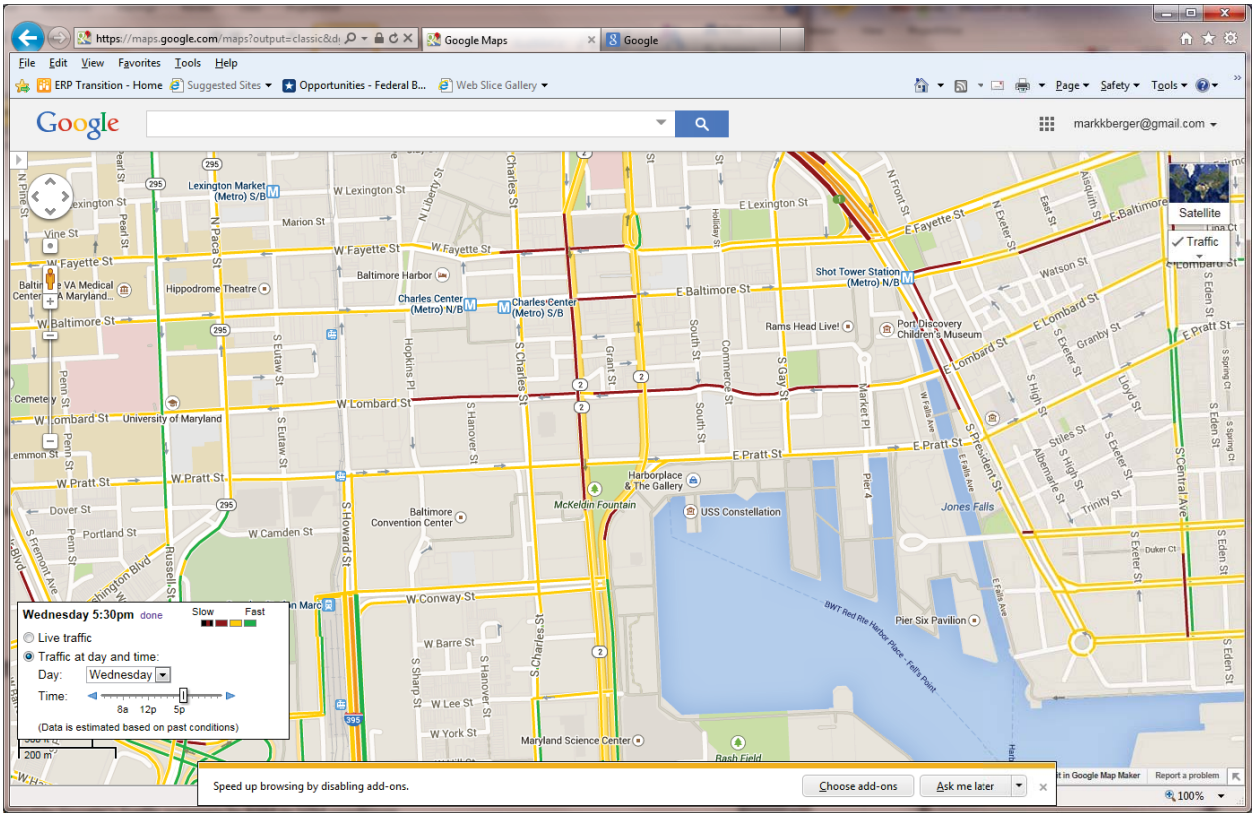
According to Google Map's Traffic view for the PM peak hour and based on observation, certain roadways such as Light Street between East Baltimore and Conway Street and Lombard Street between South President Street and South Greene Street experience heavy traffic delays (Google, 2014). Using vehicle turning movement counts results in TransModeler™ loading the network by assigning new trips to the external roadway links. The vehicle trips then move through the network by following the turning movement volume percentages either turning left, right, or continuing straight. Any failing intersections serving the external roadway links may keep vehicles from entering the network and thus not reaching the high traffic locations.

To attempt to rectify this situation, two actions were implemented. The first action focused on adjusting the existing network through various means to allow more vehicles to enter and circulate thorough the network. The second action relied on adding more vehicles to specific roadways to force the volume to reach the targeted roadways. The first action is best to try first and focused on the following:

- Optimize the traffic signal timing at the President Street and Fleet Street intersection, a location where a number of vehicles were not entering the network and a direct feeder of traffic to the downtown area.
- Extend the left-turn lane stopping point during the GREEN phase for unprotected left turn movements at key intersections to ensure drivers attempting a left-turn with no safe gaps complete the turn during at the end of each YELLOW phase. For example the East Fayette Street and North Central Avenue intersection eastbound left-turns were queuing back to President Street along Fayette Street and impacting the southbound President Street approach, another supplier of vehicle trips to downtown area.
- Switch the order of the traffic signal phases at isolated intersections to better match the nearby intersection to ensure coordinated phasing. For example, the Lombard Street at Albemarle Street traffic signal was not timed to coordinate with the Lombard Street at President Street traffic signal, thus trapping vehicles along Lombard at the Albemarle Street intersection while the next intersection receives a GREEN light.

- Adjust the lane connectors (moves from each approach lane to each departing lane) at intersections to ensure left or right turning vehicles could use any available departing lane space in cases where the departing roadway lanes were mostly full of queued vehicles. This procedure was also used to ensure where multiple turning lanes were provided, the vehicles were distributed evenly to reduce the overall left-turn queue. This process was applied to numerous intersections in the downtown area.

Once these measures were applied, the simulated turning movement volumes were compared to the 2009 Synchro™ volumes to determine the difference, especially along the corridors where Google Map Traffic View illustrated daily heavy traffic (Figure A-2). Because the volumes were still lower than necessary at key locations (i.e., Lombard and Light Street intersection), the second action was implemented by creating a new turning movement volume table for the PM peak hour containing the volume differences along Lombard Street between Market Square and Greene Street, Light/St. Paul Streets between Lexington Street and Conway, Pratt Street between Greene Street and Market Place, and Conway Street between Light Street and Howard Street.



Source: GoogleMaps, 2014

Figure A-2. Google Traffic Map Representing 5:00 PM

Louis Berger observed the simulation with the additional turning movement volume table added and the traffic was still not queuing along Lombard and Light Streets to the extent that is reported by Google Maps Traffic View and where observed. Therefore, a third turning

movement table was created specifically targeting these corridors. The volumes were increased in 100 vehicle increments until the level of congestion best matched observation and the Google Maps Traffic View. The resulting table added 1,100 more vehicles to the network broken out in Table A-6.

Table A-6. Additional Vehicle Volume Added

Corridor	Vehicles Added	Total Vehicles Added
Light Street southbound	1,000	1,100
Lombard Street westbound	100	
Conway Street westbound	400	1,100
Key Highway eastbound	700	

The network was checked for other major queue areas occurring in both the AM and PM simulations to ensure these were fixed before using the model to run the existing bus routes. A few other issues cropped up mainly consisting of left-turn queues systematically delaying the mainline flow through multiple intersections. The solution required minor tweaks to the signal phasing by adding more left-turn GREEN time for protected lefts or for non-protected left-turns, extending the left-turn lane stopping point during the GREEN phase to ensure one to two vehicles turn left once the RED phase begins. This is a typical action that occurs in many metropolitan cities, including Baltimore.

APPENDIX B: BENCHMARKING DETAIL AND NARROWING PROCESS WITH NTD TRANSIT PROFILES FOR BENCHMARKED AGENCIES

Electronic file includes back-up detail and narrowing process, as well as scalable benchmark summary sheet.

Transit Agency	Location	ID Number	Bus Picture	Purchased Buses	Vehicles Available for Maximum Service	Peak to Base Ratio	Operating Expenses (2012/13)	Fare Revenues	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehical Revenue Hours	Average Fleet Age in Years	Percent Spares	Cost per Vehicle RevenueMile	Cost per Vehicle Revenue Hour	Cost per Unlinked Passenger Trip	Farebox Recovery Ratio	Avg. Vehicle Speed (Revenue Service)
Charm City Circulator	Baltimore, MD	N/A		19	27		$7,965,419	$0	679,261	4,235,978	98,531	3.3	42%	$11.73	$80.84	$1.88	0.0%	6.9
Notes on Charm City data, sources					3 Design Lines out of service		See breakdown/ reconciliation below		Total miles from fuel reports	2014 base	Per pro forma 2013							
Lowest third							2012 most recent data available for National Transit Database											
Cape Cod Regional Transit Authority (CCRTA)	Barnstable Town, MA	1105		25	36	1.00	$4,747,886	$919,483	1,040,856	480,405	75,318	4.7	44%	$4.56	$63.04	$9.88	19.4%	13.8
City of Fargo, DBA: Metropolitan Area Transit (MAT)	Fargo, ND	8003		22	28	1.00	$4,984,135	$658,311	857,329	1,604,693	66,560	6.6	27%	$5.81	$74.88	$3.11	13.2%	12.9
Yuba-Sutter Transit Authority (YSTA)	Sutter County, CA	9061		14	18	1.00	$3,093,034	$549,985	555,426	975,805	47,802	6.3	29%	$5.57	$64.71	$3.17	17.8%	11.6
Kings County Area Public Transit Agency (KART)	Kings County, CA	9200		26	21	1.00	$2,636,511	$605,645	628,017	771,754	37,607	4.3	31%	$4.20	$70.11	$3.42	23.0%	16.7
Sum / Weighted average					103		$15,461,566	$2,733,424	3,081,628	3,832,657	227,287			$5.02	$68.03	$4.03	17.7%	13.6
Middle Third																		
Mid Mon Valley Transit Authority (MMVTA)	Monessen-California, PA	3061		24	28	1.06	$4,082,669	$631,755	804,622	335,371	48,597	7.8	17%	$5.07	$84.01	$12.17	15.5%	16.6
Escambia County Area Transit (ECAT)	Escambia County, FL	4038		31	45	1.15	$8,126,624	$1,734,533	1,451,900	1,473,412	104,760	8.9	45%	$5.60	$77.57	$5.52	21.3%	13.9
Collier Area Transit (CAT)	Collier County, FL	4140		16	23	1.00	$5,779,387	$1,195,029	1,231,778	1,207,866	67,318	5.1	44%	$4.69	$85.85	$4.78	20.7%	18.3
Merced County Transit (The Bus)	Merced County, CA	9173		27	38	1.00	$5,606,435	$1,072,043	1,255,179	837,815	72,147	5.8	41%	$4.47	$77.71	$6.69	19.1%	17.4
Sum / Weighted average					134		$23,595,115	$4,633,360	4,743,479	3,854,464	292,822			$4.97	$80.58	$6.12	19.6%	16.2

Transit Agency	Location	ID Number	Bus Picture	Purchased Buses	Vehicles Available for Maximum Service	Peak to Base Ratio	Operating Expenses (2012/13)	Fare Revenues	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehical Revenue Hours	Average Fleet Age in Years	Percent Spares	Cost per Vehicle RevenueMile	Cost per Vehicle Revenue Hour	Cost per Unlinked Passenger Trip	Farebox Recovery Ratio	Avg. Vehicle Speed (Revenue Service)
Top Third																		
Montachusett Regional Transit Authority (MART)	Leominster-Fitchburg, MA	1061		19	26	1.27	$4,373,735	$590,393	639,882	671,364	42,474	9.6	37%	$6.84	$102.97	$6.51	13.5%	15.1
Central Midlands Regional Transit Authority (CMRTA)	Columbia, SC	4141		28	41	1.47	$8,845,026	$1,824,142	1,148,398	1,568,790	95,280	8.4	46%	$7.70	$92.83	$5.64	20.6%	12.1
Bay County Transportation Planning Organization (BTT)	Bay County, FL	4185		14	27	1.00	$3,063,969	$538,419	573,714	774,384	35,105	6.4	52%	$5.34	$87.28	$3.96	17.6%	16.3
Sum / Weighted average					94		$16,282,730	$2,952,954	2,361,994	3,014,538	172,859			$6.89	$94.20	$5.40	18.1%	13.7
Totals/ Average All Systems							$55,339,411		10,187,101	10,701,659	692,968			$5.43	$79.86	$5.17		14.7

Charm City Circulator Operating Cost: Comparable with NTD-Breakdown/ Reconciliation	Total Cost	Cost per Hour
Operating Cost Adjusted (BBMR p. 24)	$ 8,882,569	$ 90.15
Lease- Purchase (Design Line)	$ 573,150	$ 5.82
Leases- Van Hool buses	$ 344,000	$ 3.49
Net Operating Cost (Comparable with NTD Agencies)	$ 7,965,419	$ 80.84
Veolia Contract Cost @ $68.55/ hour	$ 6,754,300	$ 68.55
Fuel Cost @ ~$10/ hour	$ 985,310	$ 10.00
Difference/ Other Misc. Costs	$ 225,809	$ 2.29

NTD Transit Profiles for Benchmark Agencies

ID Number: 1105
www.capecodrta.org
215 Iyannough Road, Route 28, P.O. Box 1988
Hyannis, MA 02601

Cape Cod Regional Transit Authority (CCRTA)

Purchased transportation provider(s) filing a separate report: Plymouth & Brockton Street Railway Company (1117)

Administrator: Mr. Thomas Cahir
(508) 775-8504

General Information

Urbanized Area (UZA) Statistics - 2000 Census

Barnstable Town, MA	
Square Miles	277
Population	246,695
Population Ranking out of 465 UZAs	152
Other UZAs Served	

Service Area Statistics

Square Miles	395
Population	221,049

Service Consumption

Annual Passenger Miles	17,664,419
Annual Unlinked Trips	1,000,011
Average Weekday Unlinked Trips [2]	3,282
Average Saturday Unlinked Trips [2]	1,449
Average Sunday Unlinked Trips [2]	899

Service Supplied

Annual Vehicle Revenue Miles	5,033,741
Annual Vehicle Revenue Hours	334,349
Vehicles Operated in Maximum Service	157
Vehicles Available for Maximum Service	176
Base Period Requirement	23

Financial Information

Fare Revenues Earned		$7,834,076
Sources of Operating Funds Expended		
Fare Revenues	(45%)	$7,834,076
Local Funds	(9%)	$1,514,490
State Funds	(19%)	$3,284,426
Federal Assistance	(27%)	$4,710,339
Other Funds	(1%)	$147,204
Total Operating Funds Expended		$17,490,535
Sources of Capital Funds Expended		
Local Funds	(0%)	$0
State Funds	(28%)	$914,832
Federal Assistance	(72%)	$2,394,328
Other Funds	(0%)	$0
Total Capital Funds Expended		$3,309,160

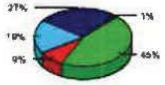
Summary Operating Expenses

Salary, Wages, Benefits	$714,073
Materials and Supplies	$5,307
Purchased Transportation	$16,002,502
Other Operating Expenses	$663,947
Total Operating Expenses	$17,385,829
Reconciling Cash Expenditures	$104,706

Vehicles Operated in Maximum Service and Uses of Capital Funds

Mode	Directly Operated	Purchased Transportation [1]	Revenue Vehicles	Systems and Guideways	Facilities and Stations	Other	Total
Bus	0	25	$0	$385,281	$737,951	$385,696	$1,508,928
Demand Response	0	60	$926,445	$319,217	$42,944	$511,626	$1,800,232
Demand Response - Taxi	0	70	$0	$0	$0	$0	$0
Commuter Bus	0	2	$0	$0	$0	$0	$0
Total	0	157	$926,445	$704,498	$780,895	$897,322	$3,309,160

Sources of Operating Funds Expended



Sources of Capital Funds Expended

Modal Characteristics

Mode	Operating Expenses [1]	Fare Revenues [1]	Uses of Capital Funds	Annual Passenger Miles	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehicle Revenue Hours	Fixed Guideway Directional Route Miles	Vehicles Available for Maximum Service	Average Fleet Age in Years	Vehicles Operated in Maximum Service	Peak to Base Ratio	Percent Spares
Bus	$4,747,886	$919,483	$1,508,928	8,118,845	1,040,856	480,405	75,318	N/A	36	4.7	25	1.00	44%
Demand Response	$9,448,888	$3,977,568	$1,800,232	4,040,016	2,869,097	398,080	191,339	N/A	66	4.8	60	N/A	13%
Demand Response - Taxi	$2,692,621	$2,549,413	$0	838,260	1,020,009	55,884	63,751	N/A	70	N/A	70	N/A	0%
Commuter Bus	$496,434	$387,612	$0	4,667,298	163,779	67,642	3,942	N/A	2	N/A	2	1.00	0%

Performance Measures

Mode	Service Efficiency: Operating Expense per Vehicle Revenue Mile	Service Efficiency: Operating Expense per Vehicle Revenue Hour	Service Effectiveness: Operating Expense per Passenger Mile	Service Effectiveness: Operating Expense per Unlinked Passenger Trip	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Mile	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Hour
Bus	$4.56	$63.04	$0.58	$9.88	0.46	6.38
Demand Response	$3.29	$49.38	$2.34	$23.66	0.14	2.07
Demand Response - Taxi	$2.64	$42.24	$3.21	$48.18	0.05	0.88
Commuter Bus	$3.03	$125.93	$0.11	$7.34	0.41	17.16

Operating Expense per Vehicle Revenue Mile

Operating Expenses per Passenger Mile

Unlinked Passenger Trips per Vehicle Revenue Mile

Operating Expense per Vehicle Revenue Mile

Operating Expenses per Passenger Mile

Unlinked Passenger Trips per Vehicle Revenue Mile

ID Number: 8003
www.matbus.com
650 23rd St N
Fargo, ND 58102

City of Fargo, DBA: Metropolitan Area Transit (MAT)

Provides purchased transportation to: City of Moorhead-Transit (5026)

Planning Director: Mr. Jim Gilmour
(701) 241-1476

General Information

Urbanized Area (UZA) Statistics - 2000 Census

Fargo, ND-MN

Square Miles	70
Population	176,676
Population Ranking out of 485 UZAs	194
Other UZAs Served	

Service Area Statistics

Square Miles	45
Population	134,149

Service Consumption

Annual Passenger Miles	5,348,200
Annual Unlinked Trips	1,659,236
Average Weekday Unlinked Trips	6,263
Average Saturday Unlinked Trips	1,730
Average Sunday Unlinked Trips	14

Service Supplied

Annual Vehicle Revenue Miles	1,193,843
Annual Vehicle Revenue Hours	92,002
Vehicles Operated in Maximum Service	34
Vehicles Available for Maximum Service	42
Base Period Requirement	22

Financial Information

Fare Revenues Earned		$984,707
Sources of Operating Funds Expended		
Fare Revenues	(15%)	$984,707
Local Funds	(26%)	$1,569,036
State Funds	(9%)	$573,828
Federal Assistance	(32%)	$2,007,314
Other Funds	(17%)	$1,096,252
Total Operating Funds Expended		$6,230,937
Sources of Capital Funds Expended		
Local Funds	(19%)	$25,375
State Funds	(0%)	$0
Federal Assistance	(81%)	$105,499
Other Funds	(0%)	$0
Total Capital Funds Expended		$130,874

Summary Operating Expenses

Salary, Wages, Benefits	$1,226,154
Materials and Supplies	$1,582,740
Purchased Transportation	$2,546,394
Other Operating Expenses	$875,649
Total Operating Expenses	$6,230,937
Reconciling Cash Expenditures	$0

Vehicles Operated in Maximum Service and Uses of Capital Funds

Mode	Directly Operated	Purchased Transportation[1]	Revenue Vehicles	Systems and Guideways	Facilities and Stations	Other	Total
Bus	0	22	$0	$42,601	$0	$88,273	$130,874
Demand Response	0	12	$0	$0	$0	$0	$0
Total	0	34	$0	$42,601	$0	$88,273	$130,874

Sources of Operating Funds Expended

Sources of Capital Funds Expended

Modal Characteristics

Mode	Operating Expenses[1]	Fare Revenues[1]	Uses of Capital Funds	Annual Passenger Miles	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehicle Revenue Hours	Fixed Guideway Directional Route Miles	Vehicles Available for Maximum Service	Average Fleet Age in Years	Vehicles Operated in Maximum Service	Peak to Base Ratio	Percent Spares
Bus	$4,984,135	$658,311	$130,874	5,050,293	857,329	1,604,693	86,560	N/A	28	6.6	22	1.00	27%
Demand Response	$1,246,802	$308,396	$0	297,907	336,514	54,543	25,442	N/A	14	3.7	12	N/A	17%

Performance Measures

Mode	Service Efficiency: Operating Expense per Vehicle Revenue Mile	Service Efficiency: Operating Expense per Vehicle Revenue Hour	Service Effectiveness: Operating Expense per Passenger Mile	Service Effectiveness: Operating Expense per Unlinked Passenger Trip	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Mile	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Hour
Bus	$5.81	$74.88	$0.99	$3.11	1.87	24.11
Demand Response	$3.71	$49.01	$4.19	$22.86	0.16	2.14

Operating Expense per Vehicle Revenue Mile

Operating Expenses per Passenger Mile

Unlinked Passenger Trips per Vehicle Revenue Mile

Operating Expense per Vehicle Revenue Mile

Operating Expenses per Passenger Mile

Unlinked Passenger Trips per Vehicle Revenue Mile

1 Excludes data for purchased transportation reported separately

Data Source: 2012 National Transit Database

ID Number: 9081
www.yubasuttertransit.com
2100 B Street
Marysville, CA 95901

Yuba-Sutter Transit Authority (YSTA)

Transit Manager: Mr. Keith Martin
(530) 634-6880

General Information

Urbanized Area (UZA) Statistics - 2000 Census

Yuba City, CA	
Square Miles	39
Population	116,719
Population Ranking out of 465 UZAs	270
Other UZAs Served	28

Service Area Statistics

Square Miles	817
Population	119,420

Service Consumption

Annual Passenger Miles	8,068,458
Annual Unlinked Trips	1,204,530
Average Weekday Unlinked Trips	4,393
Average Saturday Unlinked Trips	1,787
Average Sunday Unlinked Trips	0

Service Supplied

Annual Vehicle Revenue Miles	1,178,129
Annual Vehicle Revenue Hours	79,137
Vehicles Operated in Maximum Service	34
Vehicles Available for Maximum Service	46
Base Period Requirement	16

Financial Information

Fare Revenues Earned		$1,374,962
Sources of Operating Funds Expended		
Fare Revenues	(24%)	$1,374,962
Local Funds	(0%)	$0
State Funds	(39%)	$2,247,926
Federal Assistance	(37%)	$2,162,536
Other Funds	(1%)	$51,028
Total Operating Funds Expended		$5,836,452
Sources of Capital Funds Expended		
Local Funds	(0%)	$0
State Funds	(100%)	$2,690,772
Federal Assistance	(0%)	$0
Other Funds	(0%)	$0
Total Capital Funds Expended		$2,690,772

Summary Operating Expenses

Salary, Wages, Benefits	$249,162
Materials and Supplies	$1,013,057
Purchased Transportation	$4,185,433
Other Operating Expenses	$388,800
Total Operating Expenses	$5,836,452
Reconciling Cash Expenditures	$0

Vehicles Operated in Maximum Service and Uses of Capital Funds

Mode	Directly Operated	Purchased Transportation [1]	Revenue Vehicles	Systems and Guideways	Facilities and Stations	Other	Total
Bus	0	14	$0	$0	$2,690,772	$0	$2,690,772
Demand Response	0	10	$0	$0	$0	$0	$0
Commuter Bus	0	10	$0	$0	$0	$0	$0
Total	0	34	$0	$0	$2,690,772	$0	$2,690,772

Sources of Operating Funds Expended

Sources of Capital Funds Expended

Modal Characteristics

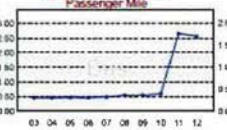
Mode	Operating Expenses [1]	Fare Revenues [1]	Uses of Capital Funds	Annual Passenger Miles	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehicle Revenue Hours	Fixed Guideway Directional Route Miles	Vehicles Available for Maximum Service	Average Fleet Age in Years	Vehicles Operated in Maximum Service	Peak to Base Ratio	Percent Spares
Bus	$3,093,034	$549,985	$2,690,772	1,209,998	555,426	975,805	47,602	N/A	18	6.3	14	1.00	29%
Demand Response	$1,388,713	$137,498	$0	300,551	300,211	68,776	22,711	N/A	15	4.3	10	N/A	50%
Commuter Bus	$1,356,705	$687,481	$0	6,557,909	322,492	158,949	6,824	N/A	13	5.2	10	5.00	30%

Performance Measures

Mode	Service Efficiency: Operating Expense per Vehicle Revenue Mile	Service Efficiency: Operating Expense per Vehicle Revenue Hour	Service Effectiveness: Operating Expense per Passenger Mile	Service Effectiveness: Operating Expense per Unlinked Passenger Trip	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Mile	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Hour
Bus	$5.57	$64.71	$2.56	$3.17	1.76	20.41
Demand Response	$4.62	$61.08	$4.61	$20.16	0.23	3.03
Commuter Bus	$4.21	$157.32	$0.21	$8.48	0.50	18.55

Operating Expense per Vehicle Revenue Mile

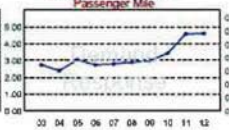
Operating Expenses per Passenger Mile



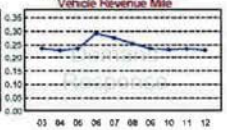
Unlinked Passenger Trips per Vehicle Revenue Mile

Operating Expense per Vehicle Revenue Mile

Operating Expenses per Passenger Mile



Unlinked Passenger Trips per Vehicle Revenue Mile



1 Excludes data for purchased transportation reported separately

Data Source: 2012 National Transit Database

ID Number: 9200
www.MYKARTBUS.com
1340 North Drive
Hanford, CA 93230

Kings County Area Public Transit Agency (KART)

Executive Director: Mrs. Angie Dow
(559) 852-2691

General Information

Urbanized Area (UZA) Statistics - 2000 Census

Hanford, CA	
Square Miles	28
Population	87,041
Population Ranking out of 465 UZAs	333
Other UZAs Served	63

Service Area Statistics

Square Miles	13
Population	70,287

Service Consumption

Annual Passenger Miles	4,115,696
Annual Unlinked Trips	805,763
Average Weekday Unlinked Trips	2,803
Average Saturday Unlinked Trips	1,532
Average Sunday Unlinked Trips	0

Service Supplied

Annual Vehicle Revenue Miles	727,736
Annual Vehicle Revenue Hours	51,844
Vehicles Operated in Maximum Service	24
Vehicles Available for Maximum Service	35
Base Period Requirement	14

Financial Information

Fare Revenues Earned		$658,079
Sources of Operating Funds Expended		
Fare Revenues	(18%)	$658,079
Local Funds	(0%)	$0
State Funds	(40%)	$1,411,650
Federal Assistance	(42%)	$1,491,461
Other Funds	(0%)	$405
Total Operating Funds Expended		$3,561,604
Sources of Capital Funds Expended		
Local Funds	(0%)	$325
State Funds	(65%)	$1,711,756
Federal Assistance	(30%)	$779,022
Other Funds	(5%)	$123,667
Total Capital Funds Expended		$2,614,770

Summary Operating Expenses

Salary, Wages, Benefits	$265,699
Materials and Supplies	$456,511
Purchased Transportation	$2,456,055
Other Operating Expenses	$386,199
Total Operating Expenses	$3,544,464

Reconciling Cash Expenditures	$17,140

Vehicles Operated in Maximum Service and Uses of Capital Funds

Mode	Directly Operated	Purchased Transportation[1]	Revenue Vehicles	Systems and Guideways	Facilities and Stations	Other	Total
Bus	0	16	$868,512	$19,627	$1,489,162	$0	$2,377,301
Demand Response	0	8	$0	$0	$237,469	$0	$237,469
Total	0	24	$868,512	$19,627	$1,726,631	$0	$2,614,770

Sources of Operating Funds Expended

Sources of Capital Funds Expended

Modal Characteristics

Mode	Operating Expenses[1]	Fare Revenues[1]	Uses of Capital Funds	Annual Passenger Miles	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehicle Revenue Hours	Fixed Guideway Directional Route Miles	Vehicles Available for Maximum Service	Average Fleet Age in Years	Vehicles Operated in Maximum Service	Peak to Base Ratio	Percent Spares
Bus	$2,636,511	$605,645	$2,377,301	3,997,686	628,017	771,754	37,607	N/A	21	4.3	16	1.00	31%
Demand Response	$907,953	$52,434	$237,469	118,010	99,719	34,009	14,237	N/A	14	3.2	8	N/A	75%

Performance Measures

Mode	Service Efficiency: Operating Expense per Vehicle Revenue Mile	Service Efficiency: Operating Expense per Vehicle Revenue Hour	Service Effectiveness: Operating Expense per Passenger Mile	Service Effectiveness: Operating Expense per Unlinked Passenger Trip	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Mile	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Hour
Bus	$4.20	$70.11	$0.66	$3.42	1.23	20.52
Demand Response	$0.11	$63.77	$7.69	$26.70	0.34	2.39

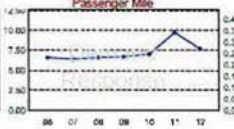
Operating Expense per Vehicle Revenue Mile

Operating Expenses per Passenger Mile

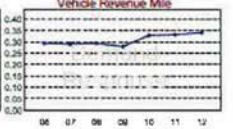
Unlinked Passenger Trips per Vehicle Revenue Mile

Operating Expense per Vehicle Revenue Mile

Operating Expenses per Passenger Mile



Unlinked Passenger Trips per Vehicle Revenue Mile



1 Excludes data for purchased transportation reported separately

Data Source: 2012 National Transit Database

Mid Mon Valley Transit Authority (MMVTA)

ID Number: 3081
www.mmvta.com
1300 McKean Avenue
Charleroi, PA 15022

Executive Director: Mr Marc Roncone
(724) 489-0880

General Information

Urbanized Area (UZA) Statistics - 2000 Census

Monessen-California, PA

Square Miles	45
Population	66,086
Population Ranking out of 465 UZAs	417
Other UZAs Served	27

Service Area Statistics

Square Miles	79
Population	56,508

Service Consumption

Annual Passenger Miles	5,131,898
Annual Unlinked Trips	336,127
Average Weekday **Unlinked** Trips	1,197
Average Saturday **Unlinked** Trips	412
Average Sunday **Unlinked** Trips	185

Service Supplied

Annual Vehicle Revenue Miles	609,842
Annual Vehicle Revenue Hours	49,315
Vehicles Operated in Maximum Service	28
Vehicles Available for Maximum Service	30
Base Period Requirement	17

Financial Information

Fare Revenues Earned		$634,779
Sources of Operating Funds Expended		
Fare Revenues	(15%)	$634,779
Local Funds	(1%)	$54,842
State Funds	(60%)	$2,474,803
Federal Assistance	(22%)	$916,680
Other Funds	(2%)	$67,504
Total Operating Funds Expended		$4,146,588
Sources of Capital Funds Expended		
Local Funds	(1%)	$13,061
State Funds	(26%)	$237,310
Federal Assistance	(72%)	$647,750
Other Funds	(0%)	$1,055
Total Capital Funds Expended		$899,176

Summary Operating Expenses

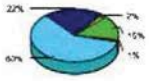
Salary, Wages, Benefits	$421,641
Materials and Supplies	$639,922
Purchased Transportation	$2,851,374
Other Operating Expenses	$235,651
Total Operating Expenses	$4,148,588

Reconciling Cash Expenditures $0

Vehicles Operated in Maximum Service and Uses of Capital Funds

Mode	Directly Operated	Purchased Transportation[1]	Revenue Vehicles	Systems and Guideways	Facilities and Stations	Other	Total
Bus	0	24	$0	$764,136	$135,040	$0	$899,176
Demand Response	0	2	$0	$0	$0	$0	$0
Total	0	26	$0	$764,136	$135,040	$0	$899,176

Sources of Operating Funds Expended



Sources of Capital Funds Expended

Modal Characteristics

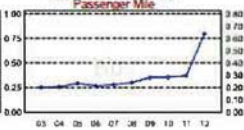
Mode	Operating Expenses[1]	Fare Revenues[1]	Uses of Capital Funds	Annual Passenger Miles	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehicle Revenue Hours	Fixed Guideway Directional Route Miles	Vehicles Available for Maximum Service	Average Fleet Age in Years	Vehicles Operated in Maximum Service	Peak to Base Ratio	Percent Spares
Bus	$4,062,889	$631,755	$899,176	5,128,678	804,822	335,371	48,597	7.8	28	7.8	24	1.06	17%
Demand Response	$85,919	$3,024	$0	5,220	5,220	756	718	N/A	2	8.0	2	N/A	0%

Performance Measures

Mode	Service Efficiency: Operating Expense per Vehicle Revenue Mile	Service Efficiency: Operating Expense per Vehicle Revenue Hour	Service Effectiveness: Operating Expense per Passenger Mile	Service Effectiveness: Operating Expense per Unlinked Passenger Trip	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Mile	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Hour
Bus	$5.07	$84.01	$0.80	$12.17	0.42	6.80
Demand Response	$12.63	$91.81	$12.63	$87.19	0.14	1.05

Operating Expense per Vehicle Revenue Mile

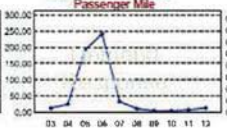
Operating Expenses per Passenger Mile



Unlinked Passenger Trips per Vehicle Revenue Mile

Operating Expense per Vehicle Revenue Mile

Operating Expenses per Passenger Mile



Unlinked Passenger Trips per Vehicle Revenue Mile

1 Excludes data for purchased transportation reported separately

Data Source: 2012 National Transit Database

ID Number: 4038
www.goecat.com
1515 West Fairfield Drive
Pensacola, FL 32501-1128

Escambia County Area Transit (ECAT)

General Manager: Ms. Mary Lou Franzoni
(850) 595-3226

General Information

Urbanized Area (UZA) Statistics - 2000 Census

Pensacola, FL-AL	
Square Miles	233
Population	340,067
Population Ranking out of 465 UZAs	113
Other UZAs Served	

Service Area Statistics

Square Miles	236
Population	341,785

Service Consumption

Annual Passenger Miles	8,258,162
Annual Unlinked Trips	1,523,099
Average Weekday Unlinked Trips	5,434
Average Saturday Unlinked Trips	2,279
Average Sunday Unlinked Trips	392

Service Supplied

Annual Vehicle Revenue Miles	1,865,432
Annual Vehicle Revenue Hours	130,600
Vehicles Operated in Maximum Service	55
Vehicles Available for Maximum Service	73
Base Period Requirement	27

Financial Information

Fare Revenues Earned		$1,907,034
Sources of Operating Funds Expended		
Fare Revenues	(20%)	$1,907,034
Local Funds	(40%)	$3,815,282
State Funds	(15%)	$1,413,825
Federal Assistance	(26%)	$2,470,378
Other Funds	(0%)	$40,504
Total Operating Funds Expended		$9,647,023
Sources of Capital Funds Expended		
Local Funds	(0%)	$0
State Funds	(0%)	$0
Federal Assistance	(100%)	$162,608
Other Funds	(0%)	$0
Total Capital Funds Expended		$162,608

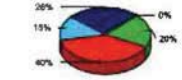
Summary Operating Expenses

Salary, Wages, Benefits	$24,554
Materials and Supplies	$0
Purchased Transportation	$9,538,131
Other Operating Expenses	$84,338
Total Operating Expenses	$9,647,023
Reconciling Cash Expenditures	$0

Vehicles Operated in Maximum Service and Uses of Capital Funds

Mode	Directly Operated	Purchased Transportation[1]	Revenue Vehicles	Systems and Guideways	Facilities and Stations	Other	Total
Bus	0	31	$0	$0	$162,608	$0	$162,608
Demand Response	0	24	$0	$0	$0	$0	$0
Total	0	55	$0	$0	$162,608	$0	$162,608

Sources of Operating Funds Expended



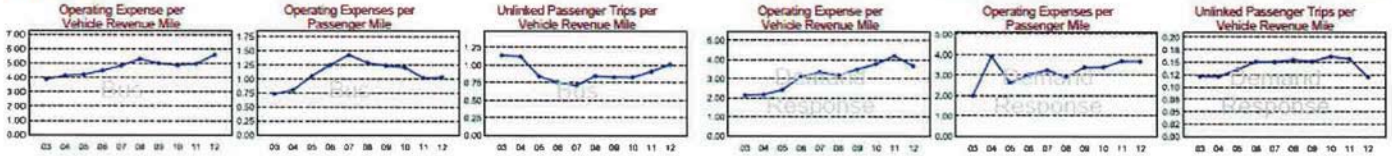
Sources of Capital Funds Expended

Modal Characteristics

Mode	Operating Expenses[1]	Fare Revenues[1]	Uses of Capital Funds	Annual Passenger Miles	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehicle Revenue Hours	Fixed Guideway Directional Route Miles	Vehicles Available for Maximum Service	Average Fleet Age in Years	Vehicles Operated in Maximum Service	Peak to Base Ratio	Percent Spares
Bus	$8,126,624	$1,734,533	$162,608	7,844,630	1,451,900	1,473,412	104,760	N/A	45	8.9	31	1.15	45%
Demand Response	$1,520,399	$172,501	$0	413,532	413,532	49,687	25,840	N/A	28	2.0	24	N/A	17%

Performance Measures

Mode	Service Efficiency: Operating Expense per Vehicle Revenue Mile	Service Efficiency: Operating Expense per Vehicle Revenue Hour	Service Effectiveness: Operating Expense per Passenger Mile	Service Effectiveness: Operating Expense per Unlinked Passenger Trip	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Mile	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Hour
Bus	$5.60	$77.57	$1.04	$5.52	1.01	14.06
Demand Response	$3.68	$58.84	$3.68	$30.60	0.12	1.92



1 Excludes data for purchased transportation reported separately

Data Source: 2012 National Transit Database

Collier Area Transit (CAT)

ID Number: 4140
www.colliergov.net
8300 RADIO RD
Naples, FL 34104

Administrator, Public Services Division: Mr. Steve Carnell
(239) 252-8466

General Information

Urbanized Area (UZA) Statistics - 2000 Census

Bonita Springs, FL

Square Miles	187
Population	310,295
Population Ranking out of 465 UZAs	121
Other UZAs Served	

Service Area Statistics

Square Miles	1,998
Population	323,785

Service Consumption

Annual Passenger Miles	11,372,395
Annual Unlinked Trips	1,323,444
Average Weekday Unlinked Trips	4,134
Average Saturday Unlinked Trips	3,597
Average Sunday Unlinked Trips	1,562

Service Supplied

Annual Vehicle Revenue Miles	2,456,153
Annual Vehicle Revenue Hours	135,319
Vehicles Operated in Maximum Service	41
Vehicles Available for Maximum Service	53
Base Period Requirement	16

Financial Information

Fare Revenues Earned		$1,354,270
Sources of Operating Funds Expended		
Fare Revenues	(15%)	$1,354,270
Local Funds	(45%)	$4,173,737
State Funds	(16%)	$1,505,437
Federal Assistance	(24%)	$2,237,359
Other Funds	(0%)	$0
Total Operating Funds Expended		$9,270,803
Sources of Capital Funds Expended		
Local Funds	(17%)	$707,059
State Funds	(24%)	$1,006,284
Federal Assistance	(60%)	$2,552,115
Other Funds	(0%)	$0
Total Capital Funds Expended		$4,265,458

Summary Operating Expenses

Salary, Wages, Benefits	$876,391
Materials and Supplies	$1,814,742
Purchased Transportation	$6,153,182
Other Operating Expenses	$426,488
Total Operating Expenses	$9,270,803
Reconciling Cash Expenditures	$0

Vehicles Operated in Maximum Service and Uses of Capital Funds

Mode	Directly Operated	Purchased Transportation[1]	Revenue Vehicles	Systems and Guideways	Facilities and Stations	Other	Total
Bus	0	16	$1,123,071	$1,155,885	$1,746,146	$123,646	$4,148,748
Demand Response	0	25	$116,710	$0	$0	$0	$116,710
Total	0	41	$1,239,781	$1,155,885	$1,746,146	$123,646	$4,265,458

Sources of Operating Funds Expended

Sources of Capital Funds Expended

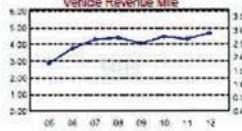
Modal Characteristics

Mode	Operating Expenses[1]	Fare Revenues[1]	Uses of Capital Funds	Annual Passenger Miles	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehicle Revenue Hours	Fixed Guideway Directional Route Miles	Vehicles Available for Maximum Service	Average Fleet Age in Years	Vehicles Operated in Maximum Service	Peak to Base Ratio	Percent Spares
Bus	$5,779,387	$1,195,029	$4,148,748	10,146,075	1,231,778	1,207,866	67,318	N/A	23	5.1	16	1.00	44%
Demand Response	$3,491,416	$159,241	$116,710	1,226,320	1,224,375	115,578	68,001	N/A	30	3.7	25	N/A	20%

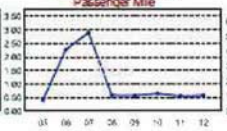
Performance Measures

Mode	Service Efficiency: Operating Expense per Vehicle Revenue Mile	Service Efficiency: Operating Expense per Vehicle Revenue Hour	Service Effectiveness: Operating Expense per Passenger Mile	Service Effectiveness: Operating Expense per Unlinked Passenger Trip	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Mile	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Hour
Bus	$4.69	$85.85	$0.57	$4.78	0.98	17.94
Demand Response	$2.85	$51.34	$2.85	$30.21	0.09	1.70

Operating Expense per Vehicle Revenue Mile



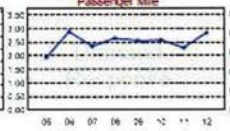
Operating Expenses per Passenger Mile



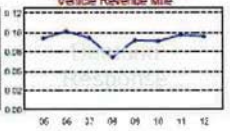
Unlinked Passenger Trips per Vehicle Revenue Mile

Operating Expense per Vehicle Revenue Mile

Operating Expenses per Passenger Mile



Unlinked Passenger Trips per Vehicle Revenue Mile



1 Excludes data for purchased transportation reported separately

Data Source: 2012 National Transit Database

Merced County Transit (The Bus)

ID Number: 9173
www.mercedthebus.com
880 Thornton Rd.
Merced, CA 95341

Interim Executive Director: Ms. Marjorie Kirn
(209) 723-3153

General Information

Urbanized Area (UZA) Statistics - 2000 Census

Merced, CA	
Square Miles	48
Population	136,999
Population Ranking out of 465 UZAs	236
Other UZAs Served	300

Service Area Statistics

Square Miles	30
Population	120,000

Service Consumption

Annual Passenger Miles	2,934,778
Annual Unlinked Trips	1,031,454
Average Weekday Unlinked Trips [2]	3,773
Average Saturday Unlinked Trips [2]	1,184
Average Sunday Unlinked Trips [2]	0

Service Supplied

Annual Vehicle Revenue Miles	1,981,045
Annual Vehicle Revenue Hours	115,428
Vehicles Operated in Maximum Service	54
Vehicles Available for Maximum Service	80
Base Period Requirement	27

Financial Information

Fare Revenues Earned		$1,544,667
Sources of Operating Funds Expended		
Fare Revenues	(17%)	$1,544,667
Local Funds	(0%)	$0
State Funds	(77%)	$6,831,231
Federal Assistance	(5%)	$399,776
Other Funds	(1%)	$68,752
Total Operating Funds Expended		$8,844,426
Sources of Capital Funds Expended		
Local Funds	(0%)	$0
State Funds	(64%)	$1,186,426
Federal Assistance	(34%)	$635,415
Other Funds	(2%)	$42,956
Total Capital Funds Expended		$1,864,797

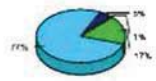
Summary Operating Expenses

Salary, Wages, Benefits	$285,540
Materials and Supplies	$1,612,801
Purchased Transportation	$6,878,580
Other Operating Expenses	$49,615
Total Operating Expenses	$8,826,536
Reconciling Cash Expenditures	$17,890

Vehicles Operated in Maximum Service and Uses of Capital Funds

Mode	Directly Operated	Purchased Transportation [1]	Revenue Vehicles	Systems and Guideways	Facilities and Stations	Other	Total
Bus	0	27	$130,103	$671,873	$0	$50,360	$852,336
Demand Response	0	26	$1,012,461	$0	$0	$0	$1,012,461
Demand Response - Taxi	0	1	$0	$0	$0	$0	$0
Total	0	54	$1,142,564	$671,873	$0	$50,360	$1,864,797

Sources of Operating Funds Expended



Sources of Capital Funds Expended

Modal Characteristics

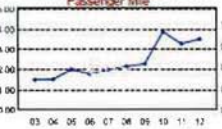
Mode	Operating Expenses [1]	Fare Revenues [1]	Uses of Capital Funds	Annual Passenger Miles	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehicle Revenue Hours	Fixed Guideway Directional Route Miles	Vehicles Available for Maximum Service	Average Fleet Age in Years	Vehicles Operated in Maximum Service	Peak to Base Ratio	Percent Spares
Bus	$5,608,435	$1,072,043	$852,336	1,594,178	1,255,179	837,815	72,147	N/A	36	5.8	27	1.00	41%
Demand Response	$3,192,192	$468,652	$1,012,461	1,334,636	701,088	192,114	43,011	N/A	42	4.2	26	N/A	62%
Demand Response - Taxi	$27,809	$3,972	$0	5,962	4,778	1,525	270	N/A	0	N/A	1	N/A	-100%

Performance Measures

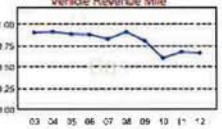
Mode	Service Efficiency: Operating Expense per Vehicle Revenue Mile	Service Efficiency: Operating Expense per Vehicle Revenue Hour	Service Effectiveness: Operating Expense per Passenger Mile	Service Effectiveness: Operating Expense per Unlinked Passenger Trip	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Mile	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Hour
Bus	$4.47	$77.71	$3.52	$8.69	0.67	11.61
Demand Response	$4.55	$74.22	$2.39	$16.62	0.27	4.47
Demand Response - Taxi	$5.84	$103.37	$4.68	$18.30	0.32	5.65

Operating Expense per Vehicle Revenue Mile

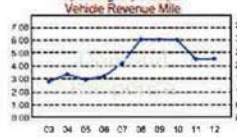
Operating Expenses per Passenger Mile



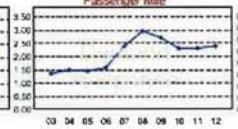
Unlinked Passenger Trips per Vehicle Revenue Mile



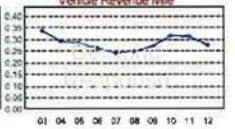
Operating Expense per Vehicle Revenue Mile



Operating Expenses per Passenger Mile



Unlinked Passenger Trips per Vehicle Revenue Mile



1 Excludes data for purchased transportation reported separately

2 Average UPT values not available for DT Demand Response Taxi

Data Source: 2012 National Transit Database

ID Number: 1081
www.mrta.us
1427R Water Street
Fitchburg, MA 01420-7266

Montachusett Regional Transit Authority (MART)

Administrator: Mr. Mohammed Khan
(978) 345-7711

General Information

Urbanized Area (UZA) Statistics - 2000 Census

Leominster-Fitchburg, MA	
Square Miles	85
Population	116,960
Population Ranking out of 485 UZAs	269
Other UZAs Served	10, 81

Service Area Statistics

Square Miles	591
Population	217,194

Service Consumption

Annual Passenger Miles	5,466,364
Annual Unlinked Trips	1,078,478
Average Weekday Unlinked Trips [2]	4,052
Average Saturday Unlinked Trips [2]	1,011
Average Sunday Unlinked Trips [2]	306

Service Supplied

Annual Vehicle Revenue Miles	2,903,068
Annual Vehicle Revenue Hours	184,822
Vehicles Operated in Maximum Service	156
Vehicles Available for Maximum Service	216
Base Period Requirement	15

Financial Information

Fare Revenues Earned		$2,570,079
Sources of Operating Funds Expended		
Fare Revenues	**(21%)**	$2,570,079
Local Funds	**(14%)**	$1,745,575
State Funds	(38%)	$4,640,129
Federal Assistance	(20%)	$2,450,754
Other Funds	(7%)	$912,987
Total Operating Funds Expended		$12,319,524
Sources of Capital Funds Expended		
Local Funds	(0%)	$0
State Funds	(8%)	$435,259
Federal Assistance	(86%)	$4,629,347
Other Funds	(6%)	$324,499
Total Capital Funds Expended		$5,389,105

Summary Operating Expenses

Salary, Wages, Benefits	$694,015
Materials and Supplies	$1,150,889
Purchased Transportation	$8,781,272
Other Operating Expenses	$1,151,240
Total Operating Expenses	$11,777,416
Reconciling Cash Expenditures	$542,108

Vehicles Operated in Maximum Service and Uses of Capital Funds

Mode	Directly Operated	Purchased Transportation [1]	Revenue Vehicles	Systems and Guideways	Facilities and Stations	Other	Total
Bus	0	19	$0	$467,637	$2,782,229	$30,820	$3,280,686
Demand Response	0	129	$422,172	$734,376	$645,220	$306,651	$2,108,419
Demand Response - Taxi	0	8	$0	$0	$0	$0	$0
Total	0	156	$422,172	$1,202,013	$3,427,449	$337,471	$5,389,105

Sources of Operating Funds Expended

Sources of Capital Funds Expended

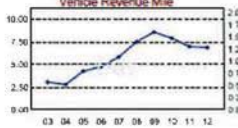
Modal Characteristics

Mode	Operating Expenses [1]	Fare Revenues [1]	Uses of Capital Funds	Annual Passenger Miles	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehicle Revenue Hours	Fixed Guideway Directional Route Miles	Vehicles Available for Maximum Service	Average Fleet Age in Years	Vehicles Operated in Maximum Service	Peak to Base Ratio	Percent Spares
Bus	**$4,373,735**	**$590,393**	**$3,280,686**	3,115,787	639,882	671,364	42,474	**N/A**	26	9.6	19	1.27	**37%**
Demand Response	**$7,347,796**	**$1,972,402**	**$2,108,419**	2,291,223	2,227,298	401,265	140,844	**N/A**	182	6.3	129	N/A	**41%**
Demand Response - Taxi	**$55,888**	**$7,284**	**$0**	58,374	35,988	5,849	1,504	**N/A**	8	**N/A**	8	N/A	**0%**

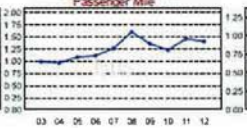
Performance Measures

Mode	Service Efficiency: Operating Expense per Vehicle Revenue Mile	Service Efficiency: Operating Expense per Vehicle Revenue Hour	Service Effectiveness: Operating Expense per Passenger Mile	Service Effectiveness: Operating Expense per Unlinked Passenger Trip	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Mile	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Hour
Bus	**$6.84**	**$102.97**	**$1.40**	**$6.51**	1.05	15.81
Demand Response	$3.30	$52.17	$3.21	$18.31	0.18	2.85
Demand Response - Taxi	$1.56	$37.16	$0.96	$9.55	0.16	3.89

Operating Expense per Vehicle Revenue Mile

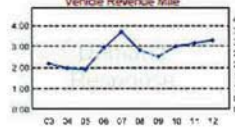


Operating Expenses per Passenger Mile

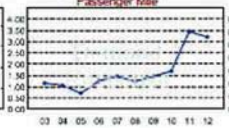


Unlinked Passenger Trips per Vehicle Revenue Mile

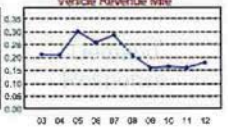
Operating Expense per Vehicle Revenue Mile



Operating Expenses per Passenger Mile



Unlinked Passenger Trips per Vehicle Revenue Mile



[1] Excludes data for purchased transportation reported separately [2] Average UPT values not available for DT Demand Response Taxi

Data Source: 2012 National Transit Database

Central Midlands Regional Transit Authority (CMRTA)

ID Number: 4141
www.goCMRTA.com
P.O. Box 214
Columbia, SC 29201-0214

Executive Director: Mr. Robert Schneider
(803) 255-7087

General Information

Urbanized Area (UZA) Statistics - 2000 Census

Columbia, SC	
Square Miles	380
Population	549,777
Population Ranking out of 465 UZAs	75
Other UZAs Served	

Service Area Statistics

Square Miles	129
Population	254,000

Service Consumption

Annual Passenger Miles	5,581,164
Annual Unlinked Trips	1,625,999
Average Weekday Unlinked Trips	6,165
Average Saturday Unlinked Trips	464
Average Sunday Unlinked Trips	485

Service Supplied

Annual Vehicle Revenue Miles	1,681,947
Annual Vehicle Revenue Hours	120,688
Vehicles Operated in Maximum Service	41
Vehicles Available for Maximum Service	62
Base Period Requirement	19

Financial Information

Fare Revenues Earned		$2,026,825
Sources of Operating Funds Expended		
Fare Revenues	(19%)	$2,026,825
Local Funds	(65%)	$6,955,358
State Funds	(5%)	$526,443
Federal Assistance	(10%)	$1,101,013
Other Funds	(1%)	$121,271
Total Operating Funds Expended		$10,732,910
Sources of Capital Funds Expended		
Local Funds	(0%)	$0
State Funds	(0%)	$0
Federal Assistance	(100%)	$78,565
Other Funds	(0%)	$0
Total Capital Funds Expended		$78,565

Summary Operating Expenses

Salary, Wages, Benefits	$231,899
Materials and Supplies	$1,197,018
Purchased Transportation	$7,880,151
Other Operating Expenses	$1,423,842
Total Operating Expenses	$10,732,910
Reconciling Cash Expenditures	$0

Vehicles Operated in Maximum Service and Uses of Capital Funds

Mode	Directly Operated	Purchased Transportation [1]	Revenue Vehicles	Systems and Guideways	Facilities and Stations	Other	Total
Bus	0	28	$0	$0	$0	$78,565	$78,565
Demand Response	0	13	$0	$0	$0	$0	$0
Total	0	41	$0	$0	$0	$78,565	$78,565

Sources of Operating Funds Expended

Sources of Capital Funds Expended

Modal Characteristics

Mode	Operating Expenses [1]	Fare Revenues [1]	Uses of Capital Funds	Annual Passenger Miles	Annual Vehicle Revenue Miles	Annual Unlinked Trips	Annual Vehicle Revenue Hours	Fixed Guideway Directional Route Miles	Vehicles Available for Maximum Service	Average Fleet Age in Years	Vehicles Operated in Maximum Service	Peak to Base Ratio	Percent Spares
Bus	$8,845,026	$1,824,142	$78,565	5,000,187	1,148,398	1,568,790	95,280	N/A	41	8.4	28	1.47	46%
Demand Response	$1,887,884	$202,683	$0	580,977	533,549	57,209	25,408	N/A	21	8.0	13	N/A	62%

Performance Measures

Mode	Service Efficiency: Operating Expense per Vehicle Revenue Mile	Service Efficiency: Operating Expense per Vehicle Revenue Hour	Service Effectiveness: Operating Expense per Passenger Mile	Service Effectiveness: Operating Expense per Unlinked Passenger Trip	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Mile	Service Effectiveness: Unlinked Passenger Trips per Vehicle Revenue Hour
Bus	$7.70	$92.83	$1.77	$5.64	1.37	16.47
Demand Response	$3.54	$74.30	$3.25	$33.00	0.11	2.25

Operating Expense per Vehicle Revenue Mile

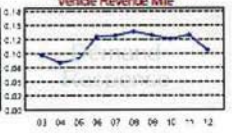
Operating Expenses per Passenger Mile

Unlinked Passenger Trips per Vehicle Revenue Mile

Operating Expense per Vehicle Revenue Mile

Operating Expenses per Passenger Mile

Unlinked Passenger Trips per Vehicle Revenue Mile



[1] Excludes data for purchased transportation reported separately

Data Source: 2012 National Transit Database

APPENDIX C: BUS PURCHASE/ BUS LEASE ALTERNATIVES: DOCUMENTATION (SPREADSHEET INCLUDED IN ELECTRONIC FILE)

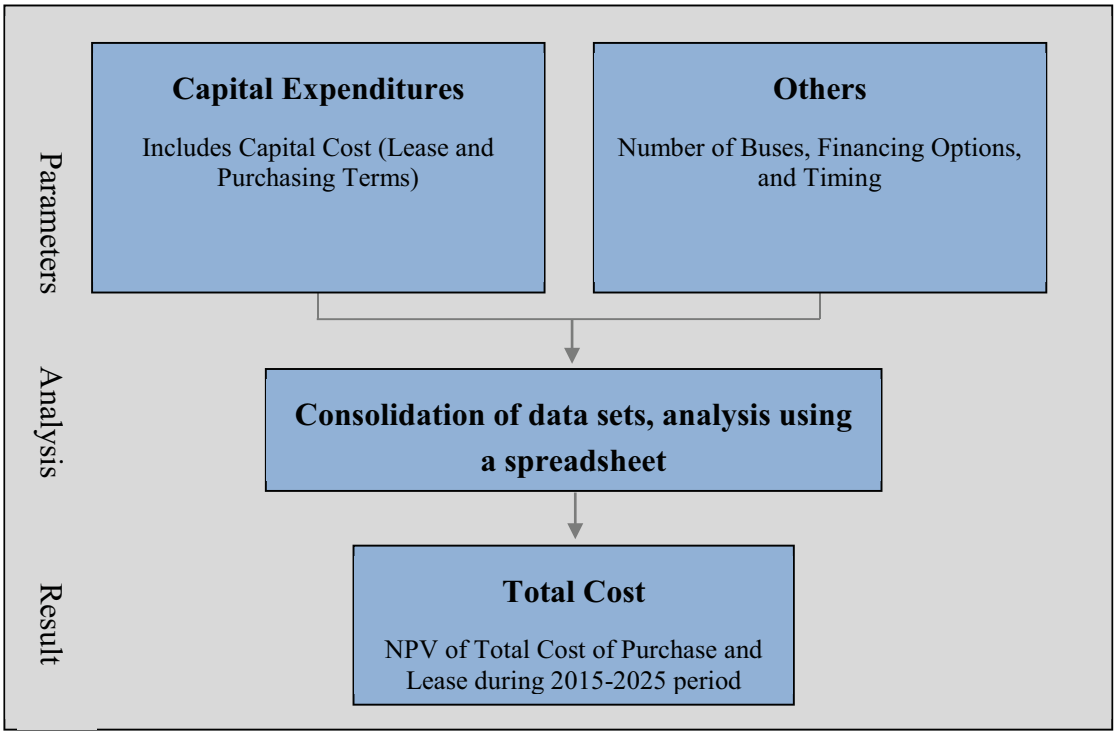
LEASE VS PURCHASE COST ANALYSIS

A Cost Analysis was undertaken to provide a sound analytical basis to compare the costs of leasing new buses vs purchasing new buses at the current established prices. The purpose of the analysis is to estimate the option with the lower cost to the City of Baltimore. The financial cost estimates are generated using a spreadsheet cost analysis developed by the Consultant.

The analysis involved the following components:

- Parameters – Assumptions associated with purchasing price and lease terms, number of buses, financing options, and year of the current buses to be retired.
- Methodology – Consolidation of multiple data sets using a spreadsheet model.
- Results – The total cost to the City of Baltimore of purchasing vs leasing the new buses.

Analysis Approach



Cost Analysis Parameters

Bus Fleet

The current fleet comprises of 21 buses (13 of which are leased through 2016). The maximum number of buses required is 19 plus 4 spares (20%).

It is assumed that the 21 existing buses will be gradually retired between 2016 and 2024. The cost model allows for sensitivity analysis on the time of retirement, which triggers the acquisition or lease of a new hybrid bus.

Capital Costs

The capital costs associated with the acquisition of new buses are the following:

- Price of New Bus Fleet:

Item	
Bus	$700,000
Camera System	$7,430
GPS	$3,499
Voice Announcement System	$9,114
Pax Counting System	$3,700
Bus Wrapping	$11,543
Total	$735,286

- Lease Rate of New Bus Fleet:

Item		
Lease Term	7	years
Finance Rate	0.00166	4% interest rate
Administrative Fees	3.5%	BBMR Report pg.18
Residual Value	$183,822	25% of Price
Depreciation	$6,565	Per bus per month
Bus Wrapping	$1,221	Per bus per month
Total	$7,786	Per bus per month

Cost Analysis Results

In order to compare the cost of Purchasing versus Leasing options the sum of the total costs estimated during the 2015-2025 period are expressed in Net Present Value terms to account for the time value of money over 10 years, at an 8% discount rate.

Lease Option

The costs for the leasing option are presented below:

Item	2015	2016	2017	2018	2019	2020	2025
Total Buses	23	23	23	23	23	23	23
New Lease Payments	$186,855	$560,565	$747,420	$1,027,703	$1,027,703	$1,027,703	$2,148,833
Administrative Costs	$6,540	$19,620	$26,160	$35,970	$35,970	$35,970	$75,209
Maintenance Costs	$14,706	$44,117	$58,823	$110,293	$169,116	$198,527	$419,113
Design Line Payments	$573,211	$573,211	$286,605	$0	$0	$0	$0
Federal Funding (N/A)							
TOTAL	$781,311	$1,197,513	$1,119,008	$1,173,965	$1,232,788	$1,262,200	$2,643,156
NPV @8%	**$10,582,549**						

Source: Consultant estimates

Purchasing Option

The costs for the purchasing option (excluding federal grants) are presented below:

Item	2015	2016	2017	2018	2019	2020	2025
Total Buses	23	23	23	23	23	23	23
Purchase Amount	$1,470,572	$ 2,941,144	$ 1,470,572	$ 2,205,858	$ -	$ -	$ -
Maintenance Costs	$14,706	$44,117	$ 58,823	$ 110,293	$169,116	$198,527	$419,113
Federal Funding	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL	$1,485,278	$2,985,251	$1,529,395	$ 2,316,151	$ 169,116	$198,527	$ 419,113

NPV @8%	**$12,512,747**

Source: Consultant estimates

The comparison between the NPVs of Leasing and Purchasing Costs show that the lease option is more attractive than purchase cost if Federal funding is not available. The comparison changes if Federal funds can be secured (see Sensitivity Analysis).

LEASE COST (NPV) 2015-2015	**$10,582,549**
PURCHASE COST (NPV) 2015-2025	**$12,512,747**

Sensitivity Analysis

Sensitivity analysis was performed on a few variables to observe the impact it would have on the total cost. The variables are:

- Buses required for service from 23 (19+4 spares) to 20 (17+3 spares)

The spread between the two options will shrink but not enough to make the purchase option more attractive (assuming no federal funds available).

LEASE COST (NPV) 2015-2025	**$8,962,474**
PURCHASE COST (NPV) 2015-2025	**$10,911,952**

- Federal Funding

The biggest impact on the cash flow will come from the Federal Funding variable which offsets 50% of the purchasing cost in this sensitivity analysis (funding can range from 20% to 80% of the cost of a bus.) Federal funding at 50% of the bus cost means that the NPV of the purchasing option is approximately half making purchase preferable.

LEASE COST (NPV) 2015-2025	**$10,582,549**
PURCHASE COST (NPV) 2015-2025	**$6,874,734**

The breakeven point for this variable will be at around 20% Federal Funding.

LEASE COST (NPV) 2015-2025	**$10,582,549**
PURCHASE COST (NPV) 2015-2025	**$10,257,542**

- Lease Terms

As the lease terms become more attractive, spreading over more than 7 years, lower interest rate than 4% or higher residual value, the leasing option will obviously become cheaper over a 10 period analysis.

Finally, more sensitivity on the variables can be performed, including changes on a combination of any of them.

APPENDIX D: STATE AND FEDERAL FUNDING: OVERVIEW OF CAPITAL AND OPERATING GRANT PROGRAMS AND REQUIREMENTS

History of Funding for CCC

The Charm City CCC (CCC) has received some federal funding for capital. These grants have included an American Reinvestment and Recovery Act (Ferry Boat) Discretionary grant, a FHWA Public Lands Highway Discretionary grant, and an FTA Alternative Transportation in Parks and Public Lands grant. The project also received a Congestion Mitigation and Clean Air Quality grant (CMAQ) for operating costs. State-level funding has included a LOTS grant (Local Operating Transit Systems) and a Star-Spangled 200 grant, both of which are for operating costs. The following are observations about funding programs:

- CCC has only received state funding (through MTA) for operating costs to date.
- MTA is the designated recipient for FTA 5307, 5311 and 5310 grants. If a project or local operating transit system seeks those funds, they must apply through MTA. MTA administers all federal grants for local systems now, per a contact at FTA.
- Several FTA grants have been reorganized with the authorization of MAP-21 (Moving Ahead for Progress in the 21rst Century, authorized July 6, 2012), which reauthorized surface transportation programs through FY 2014. Each reauthorization amends the Federal Transit Laws codified in 49 USC Chapter 53. MAP-21 took effect on October 1, 2012, and took the place of SAFETEA-LU (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, August 2005).
- Urbanized Area Formula Funding (Section 5307) is the largest source of transit funding under MAP-21, authorizing $4.398 and $4.459 billion authorized in FY 2013 and FY 2014.
- A new rule under MAP-21 – the ‘‘100 bus rule’’ – has been included, allowing systems with 76–100 buses operating in peak service to use up to 50% of their 5307 funding for operating expenses and those operating 75 or fewer buses to use up to 75% for operating expenses, for communities of a population greater than 200,000[1]. (Previously, communities with populations greater than 200,000 could not use 5307 grants for operating expenses at all).
- Some programs were repealed by MAP-21; however, funds authorized and appropriated for repealed programs are available for obligation (and expenditure) through their authorized period of availability, unless and until Congress takes action directing otherwise. Programs falling under this category include the Clean Fuels Grant Program, Job Access and Reverse Commute, New Freedom, Transit

[1] American Public Transportation Association, “MAP-21: A Guide to Transit-Related Provisions,” http://www.apta.com/gap/legissues/authorization/Documents/APTA%20MAP-21%20Guide.pdf.

in the Parks, Alternatives Analysis, Bus and Bus Facilities, Fixed Guideway Modernization, and Over-the-Road Bus Program.

- Congress passed a continuing resolution that authorizes funding for remainder of FY (December, 2014), however MAP 21 is only authorized until the end of May, so FTA can only apportion funds for 2/3 of the year until the law is reauthorized or extended.
- In Maryland, for federal grants that go through MTA, there is generally a 25/25 split – if $100,000 is total project cost, for example, $50,000 is generally received from the FTA grant, $25,000 from the state, and $25,000 from the county/local government.
- MTA funding contributions are from the transportation trust fund, gas tax, titling fees, registration fees, and driver's license fees paid into transportation. These funds may vary somewhat from year to year based on general economic activity and demographic changes.
- MTA has historically been the operator of local transit systems. CCC started their program independently. Two years ago they sought state funding, which requires an annual application basis. CCC will soon receive their applications for FY 2016 funding, which is due in March. They are required to request even the annual $2 million LOT Grant through that process.

Table D.1 provides a listing of grants the CCC has been awarded in the past (some of which are no longer available) and grants the CCC might potentially be eligible for in the future.

Table D.1 Historic grants and potential applicable grants

Grant Type	Purpose	Grant Administration	Amount Received	Outlook/Reporting/ Other Notes
Federal Grants				
5339 Grants (Formerly 5309 Grant) Bus and Bus Facility State of Good Repair (Section 5339)	Capital only (Replacement of buses, additional buses, other capital)	Through FTA, MTA is the recipient of these grant funds. Decisions, fund allocation based on ATPs, needs. (Total FY 2014 was $427.8 Million) Requires 20% local match. Each state receives a certain amount. with remaining total to be allocated based on population, vehicle revenue miles, and passenger miles	$0 received by CCC to date	Expected to be flat-depending upon federal budget. Competitive basis with all projects throughout the state competing for funds. FTA TEAM Reporting

Grant Type	Purpose	Grant Administration	Amount Received	Outlook/Reporting/ Other Notes
TIGER Grant (Transportation Investment Generating Economic Recovery) Began in 2009	Funding for broad types of transportation projects – planning and construction	Through U.S. BCDOT Typically $2 non-grant match per $1 grant, although can be as low as a 20% match of total project costs for urban applicants. Local governments can apply directly, or state agencies and regional transportation organizations	$0 received by CCC to date, although The City of Baltimore has received funding for other projects	About $600 million total available in FY 2014. Still available, but highly competitive. Last year urban requested $10 billion, so able to issue only 5%. ($120 million earmarked for rural applicants). Modal administration would work out a reporting requirement, typically funds dispersed on drawdown basis, performance measurements defined. Quarterly reporting required for funding, project progress, and how well meeting performance measurements. Grants go through MTA
Congestion Mitigation and Air Quality Improvement Program Funds (CMAQ) (Section 1113)	Operating Costs	Through FHWA, MD BCDOT receives funds and can pass through to support local projects. Administered through MTA	$375,000 to CCC (of $1.6 million total awarded) in FY 2009	This grant program appears to still be available. Go through MTA
Recovery Act -- Ferry Boat Discretionary Program	Capital Costs Discretionary program	American Recovery and Reinvestment Act Grant via FHWA	$1,590,000 in FY 2009 awarded to CCC	Program no longer in operation. FHWA now offers Formula Ferry Grant Program
FHWA Ferry Boat Formula Program (Section 1121)	Capital Costs Only, e.g. purchase of ferries, construction of ferries, and other capital costs.	FHWA Grant, can be Flexed to FTA and administered by MTA. This program began in FY 2013. Formula based on ferry miles, ridership, and	$0 to CCC to date. FY 2013 and 2014 $67 Million total awarded each year.	Relatively new program. In order to be eligible, applicants must submit to the National Census of Ferry Operators

Grant Type	Purpose	Grant Administration	Amount Received	Outlook/Reporting/ Other Notes
Public Lands Highway Discretionary Grant Program	Capital Costs Discretionary Program	FHWA Grant Flexed through FTA Replaced by the Access to Public Lands Program. Administered through MTA	$90.9 Million total awarded in FY 2011, $1,560,000 awarded to CCC for Fort McHenry bus acquisition	Program appears to have been repealed Under MAP-21 Program still in Quarterly reporting requirements – through FTA TEAM System
Alternative Transportation in Parks and Public Lands Program (Also called the Paul S. Sarbanes Transit in Parks Program)	Discretionary Program Capital Purpose is to increase access to federal lands	FTA Grant	$1,164,000 awarded to CCC in FY 2012 for Fort McHenry bus acquisition.	Program repealed under MAP-21. Quarterly progress reporting required via FTA TEAM System
Federal Lands Access Program (Section 1119)	Funds can be used for capital or operating costs. Formula-driven.	FHWA Program – Began in FY 2012. Appears to have replaced, in a sense, Public Lands Highway Discretionary (PLHD) Program Transportation in Public Lands	Total of $250,000 awarded in FY 2014. $0 to CCC	Formula based on recreational visitation to state, federal land area in state, federal public road miles in state, and federal public bridges in state, as well as portion of federal public lands in state
Passenger Ferry Grant Program (Section 5307)	Discretionary program, capital projects only in FY 2013/2014	MTA is designated recipient of funds. FY 2013/2014 will be a pass-through from the State, will require a $150,000 match from the City in FY 2015. Funds to help purchase ferry and build electric vessel and recharging station	$854,130 total awarded to CCC, reportedly in FY 2013 and FY 2014 Funds are awarded based on factors such as the age and condition of existing ferry boats, terminals and related infrastructure; benefits to riders, such as increased reliability;	Program still in operation; FTA representatives indicate that CCC should be reporting directly to National Transit Database

Grant Type	Purpose	Grant Administration	Amount Received	Outlook/Reporting/ Other Notes
			project readiness; and connectivity to other modes of transportation	
Urbanized Area Formula Grants (Sections 5307, 5340)	Public transportation capital, planning, job access and reverse commute projects	$30 Million for ferries. Could only be used for capital (because the City of Baltimore's population is > 200,000) unless certain conditions apply. One condition is a transit system < 100 vehicles. CCC qualifies under this. Federal share is 80% for capital, 50% for operating. Formula based on a combination of bus revenue vehicle miles, bus passenger miles, fixed guideway revenue vehicle miles, and fixed guideway route miles, population, population density and number of low income individuals. MTA is the designee for 5307 funds	FY 2014 -- $4,833,448,449 total awarded the City of Baltimore -- $62,218,589 Ferry Program began in FY 2013 – Authorized under MAP-21. Previously Discretionary Ferry Boat Program under FHWA	CCC would need to indicate capital needs in Annual Plans. Section 5340 allocates additional funds based on high growth and high density. According to MTA representative, receipt of 5307 grants necessitates direct reporting to National Transit Database
State Grants				
State Grant Large Urban Area Funds (also referred to as "LOTS" Grant)	Operating Costs	Amount for each locality/project allocated based on negotiations through passage	$12 Million total, $2 Million/ year for six (6) years. Must	Amount expected to remain flat into the future. No anticipated changes in how funds are divided among transit

Grant Type	Purpose	Grant Administration	Amount Received	Outlook/Reporting/ Other Notes
		of the Infrastructure Investment Act of 2013	submit application annually. FY 2014 – FY 2019	programs in the state. May be subject to MTA's discretion in "out" years
Star-Spangled 200 Grant Program (SS200 Grant)	Operating and Capital Costs	State allocates funds FY 2014 – FY 2015. Funding is provided through surcharges from the U.S. Mint's sale of Star-Spangled Banner Commemorative Coins, as well as private contributions made to Star-Spangled 200, Inc. All proceeds go to MD	$522,500 total, spread over two years. Support the operating costs of the Banner Route and planning and implementing signage, landscape, etc. on route. $337,500 received in FY 2014	Appears to be an ongoing program. Total level of funding available for grants depends upon incoming revenues (coin sales and donations. Funding cannot be used for overhead costs, permanent staffing costs, marketing costs

Reporting

Below are some findings regarding reporting:

- Any transit authority, including Maryland Local Operating Transit Systems (LOTS) must submit a Form 2A to the state on a quarterly basis, if they receive any state funds.
- Entities receiving Federal 5307 grant funds (directly or indirectly, through a state transit authority) must input data directly into the National Transit database (NTD). Small systems (less than 31 total vehicles) have less burdensome reporting requirements. An FTA representative indicates that small systems still need to report, however less data is required.
- A representative of the FHWA Ferry Boat Formula Program indicates that in order to be eligible for funding, operators must submit data to the National Ferry Census Database. Data requested would pertain to the ferry portion of the project only.
- A contact at the FTA indicates that in the Baltimore area, the MTA is the only entity directly reporting data to the NTD. The contact indicates that some smaller systems voluntarily report to the NTD, and try to obtain additional funding from the reporting entity, based on additional funds the project might elicit, based on the formula, then try to ensure any additional resulting funds received are passed

along to their system. Attachment C.1 provides a flow chart illustrating the formula for 5307 funding. In the past, larger entities have been permitted to report data to the NTB on behalf of smaller programs, but that practice will no longer be allowed.

- All recipients of FTA grants are required to report in the TEAM (Transportation Electronic Award System) on a quarterly basis. These reports are progress reports on the funded project. (This system will transition to the TRAM System – Transportation Award Management System in upcoming months.)

Funding sources that were explored but deemed to be unsuitable for the CCC based on grant eligibility and ridership or grants no longer being offered are listed in Table D.2.

Table D.2 Funding sources for which CCC is not eligible or which are not in operation

Funding Type	FY 2013	Notes about Program
Federal Formula Funding		
Job Access and Reverse Commute (JARC)	Funding for employment transportation for low income workers. Operating $1,467,207, Capital $2,072,236 (Program ends in FY14)	Program ended. Some funds remain, but CCC not eligible based on criteria and ridership
Section 5311	Funding for rural public transit programs- population under 50,000. Operating $13.2M (50% Federal, 25% State and 25% Local funds). Capital $1.2M (80% Federal, 10% State, 10% Local) RTAP – Training and technical assistance to S.5311 transit operators $150,000	The City of Baltimore is not rural, therefore not relevant
State Formula Funding		
State Transit Operating Assistance	Matching funds for Federal Sections 5307 and 5311 funds, as well as funding for small urban communities that do not receive Section 5307 funds, $7.2M	The City of Baltimore would not fall into this category
Americans with Disabilities Act (ADA)	State funds to transit systems that provide fixed route service to provide complimentary paratransit service to persons with	Not applicable to CCC based on ridership

	disabilities, operating $1.3M. (Operating maximum State share 75% of deficit)	
Statewide Special Transportation Assistance Program (SSTAP)	State funds to provide general public transportation service for elderly and disabled, $4.3M (Operating maximum State share 75% of deficit, capital maximum state share 95% of cost)	Not applicable to CCC based on ridership
Discretionary Capital Funding		
Section 5310	Funding vehicles for private, non-profit organizations providing specialize transportation for elderly and disabled persons, $4.2M. (Federal Funds)	Not applicable to CCC based on ridership
Transit Investment for Greenhouse Gas and Energy Reduction Grants (TIGGER Grant)	Capital projects. FTA program for alternative energy and energy efficiency projects	Program appears to have ceased operating
Discretionary Funding for Special Projects		
Ridesharing	Funding to promote commuter alternatives at the county or regional level $1.5M (Federal Funds)	Not applicable to CCC based on ridership. (Geared for commuters coming from outside of city)
Senior Ride	Senior volunteer driver program, $187,497 State funds	Not applicable to CCC based on ridership

APPENDIX E. ADVERTISING REVENUES: SUMMARY OF RECOMMENDED PRACTICES

Excerpts from TCRP Report 133 – Practical Measure to Increase Transit Advertising Revenue

Issues Facing Transit Advertising:
1. Transit advertising's positioning – the benefits its target audience perceives it to offer – is neither highly motivating nor differentiated from billboards.
2. Transit advertising has serious image and product deficiencies.
3. The level of product innovation is insufficient to generate interest and enthusiasm among media planners and advertisers.
4. Aside from sales activities, there is no promotion of the product to its target audiences.
5. Transit agencies *not* in top 20 media markets face greater obstacles to growth.
6. Transit advertising sales materials are not as effective as they could be at "making the case."
7. The overall level of satisfaction with transit media sales representatives is low.

"Transit advertising is a small but important contributor to the operating budgets of public transit agencies across the United States. Thanks in part to advertising revenue, which typically represents less than 5% of a transit agency's operating funds, public transit agencies are able to keep fares within reach of the populations they serve, thus meeting the most fundamental aspect of their missions.

"The best available estimate is that transit media generated sales of $801 million in 2007. It is fair to say that roughly 50% to 60% of the sales revenue made its way into the hands of public transit agencies. The rest was kept by the advertising sales contractors that actually generated the sales, in the majority of cases.

"Transit is currently just 0.4% of all media spending in the United States. APTA has set an objective of capturing 1% of U.S. media dollars; in other words, growing transit advertising from an $800 million business to a $2 billion business—two-and-a-half times its current size.

"TCRP Synthesis 51 reported that, in 2002, the actual amount of dollars coming into transit agencies from the sale of advertising ranged from $50,000 for the smallest agencies (e.g., Ben Franklin Transit in Richmond, WA) to $150,000 to $300,000 for mid-range agencies (e.g., Fresno Area Express) to anywhere from $3.5 million to $20 million for large transit agencies in top 20 media markets (1, 19). Furthermore, advertising revenue typically represents an extremely small portion of transit agency total revenue. Based on its survey of 53 transit agencies representing a cross section in terms of size, location and whether the agency was a bus-only, rail only or a bus-and-rail system, the study reported that advertising revenue constitutes between 0.1% and 3.2% of transit agency revenue.

"TCRP Synthesis 51 states that the key determinants of an agency's revenue from advertising are the transit agency's size, which in turn determines the amount of advertising inventory available, and the rates the agency is able to charge for its advertising inventory. Rates, in turn, are dependent on the population of the market, the placement of the ad, and the size of the ad. The study found that, among bus exterior advertising options, bus wraps could command a significantly high premium. For example,

full bus wraps were priced four (4) higher than the package of two kings, a tail and a headlight in some larger markets. In some medium to smaller markets, bus wraps sold at prices five (5) to 10 times the price of a king.

“Among the 13 medium to small agencies that responded to the study survey (all bus-only systems), above average revenue performance was attributed to two factors. One factor was negotiating advertising sales contracts during an economic boom. The other factor was selling advertising in house.

“It found as well that a minority of public transit authorities (less than 20%) sell advertising space on fare cards, tickets, transfers, schedules, maps, paratransit vehicles, and structures that are part of the right-of-way.

Excerpts from TCRP Synthesis 51 – Transit Advertising Sales Agreements

“While accepting advertising, transit agencies may opt to limit the size or placement of advertisements. Bus wraps in particular generate varied reactions and are often limited in number, time, or place, or banned altogether. In restricting advertising sales, transit agencies may be motivated by aesthetic considerations, often driven by the preferences of the governing board. Agencies may also seek to create a clean and uncluttered appearance on their property and vehicles to maximize the prominence of agency logos and other branding.

“Advertising may also be sold at transit centers; on fare cards, tickets, transfers, schedules, and maps; and on other property such as station clocks. Fewer than 20% of all agencies surveyed sell advertising on these media.

“Paid advertising constitutes the main use of advertising space on transit property and generates the bulk of advertising revenues for transit agencies. Paid advertising includes both advertising displayed solely for the commercial purpose of selling a product or service and noncommercial advertising that conveys a social or political message. As discussed in chapter six (6), some transit agencies only accept commercial advertisements.

“In addition to paid advertising, advertising space is also frequently used for transit agency promotions and unpaid PSAs. These are important uses of the space, even though they may consume only a fraction of the total advertising space.

“Transit agencies typically reserve 10% of the total advertising space for their own communications, although the %age among agencies surveyed varied from none to 15%. In addition to the space set aside for this purpose, transit agencies may sometimes also use unsold space. Three-quarters of the transit agencies surveyed use some or all of the unsold space for their own purposes.

“A common use of in-house space is for co-promotions with local attractions, such as museums, zoos, sports teams, and special events. The co-promotions often encourage riders to take public transportation to an event or attraction.

“The large majority of transit agencies surveyed (84%) use outside advertising sales contractors. The contractors sell advertising space and post and remove the advertising.

“Media trades offer a way for transit marketing departments to advertise on radio, television, and in print without incurring regular budgeted costs. The transit agency provides space on its property to the radio or television station or newspaper in exchange for space (or time) on radio or television, or in the newspaper.

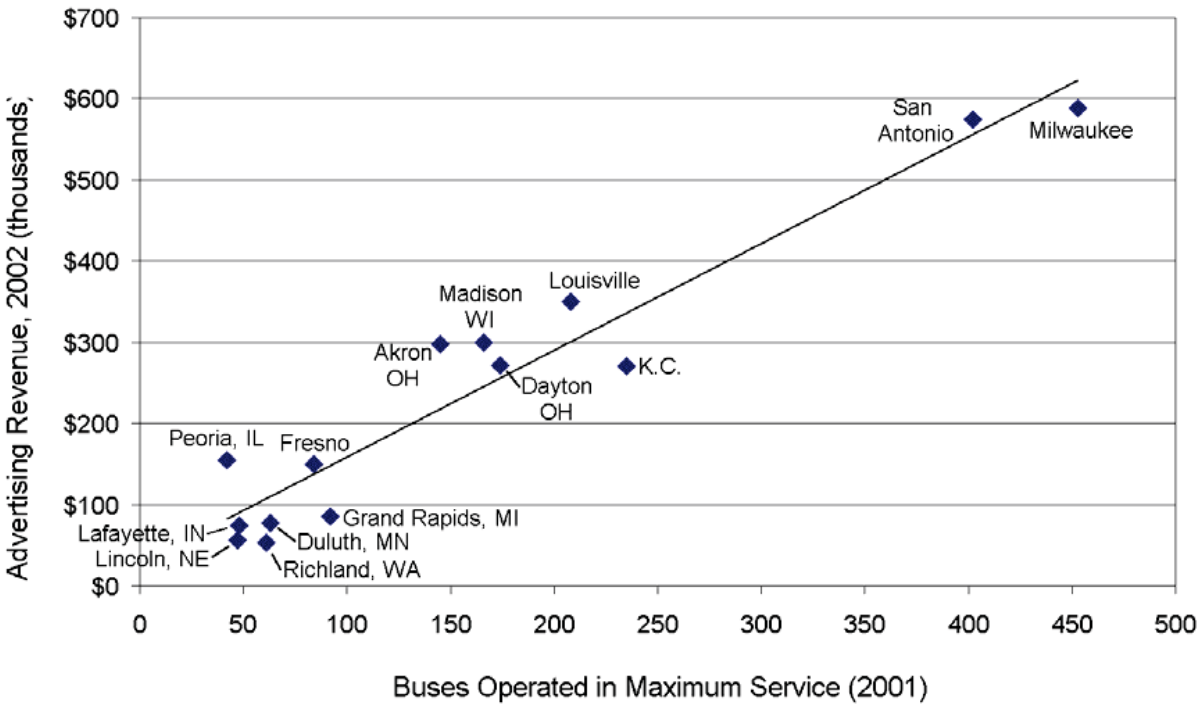
“Advertising rates are one determinant of transit agency revenues from advertising sales. Rates vary depending on the market, with larger metropolitan areas commanding higher rates. Size and placement of advertisements also critically affect advertising rates.

“Most bus advertising is likely derived from advertisements on the sides of buses, most commonly exterior king advertisements. These displays command the highest rates in large metropolitan areas. Among large transit agencies in the top 20 media markets, exterior king bus advertisements sell in the range of $520 to $735 for a 4-week posting, based on rate cards from SEPTA, WMATA, CTA, and the San Francisco Municipal Railway (Muni). Tails sell for somewhat less, in the range of $400 to $500 for a 4-week posting.

“Interior advertising generates far less revenue because of the smaller audience of on-board customers as opposed to drivers and pedestrians outside the bus. Interior car cards are priced at $16 to $24 per 4 weeks at large agencies.

“Revenues from advertising sales at transit agencies that operate bus service but not rail service correlate strongly with the size of their bus fleets. This is not surprising, because the revenue from advertisements on the outside of the buses provides the bulk of the revenue. Counting buses is akin to counting billboards.

“Figure 13 shows 2002 revenues from advertising sales and ridership (unlinked trips) for the 14 bus-only agencies that responded to the survey. Revenues for most agencies were between $1,100 and $1,800 per bus, with an overall range of from $870 to $3,700. Excluding the highest and lowest values, the average was $1,472 per bus.



"The display of advertising represents a small but significant source of revenue for transit agencies. Among 43 transit agencies surveyed for this study, total revenues from advertising sales were 1.5% of total operating funds, with a range of 0.1% to 3.2%.

"In 2002, large agencies in top 20 media markets averaged 3.5 cents per passenger trip compared with an average of 2.2 cents per trip for transit agencies not in the top 20 media markets.

APPENDIX F. ON-BOARD SURVEY FINDINGS AND DETAILED SURVEY RESULTS

The consultant team developed a short survey instrument at BCDOT's request. The team then distributed and collected short survey cards on each route during regular operations. A major purpose of the survey was to identify frequencies of additional trip purposes (such as doctor/ hospital/clinic visits) on the different routes than had been collected on the prior fare study.

The card that was distributed was printed on light card stock and included an introduction and questions, as shown in Figure E.1 (distributed in black and white rather than color):

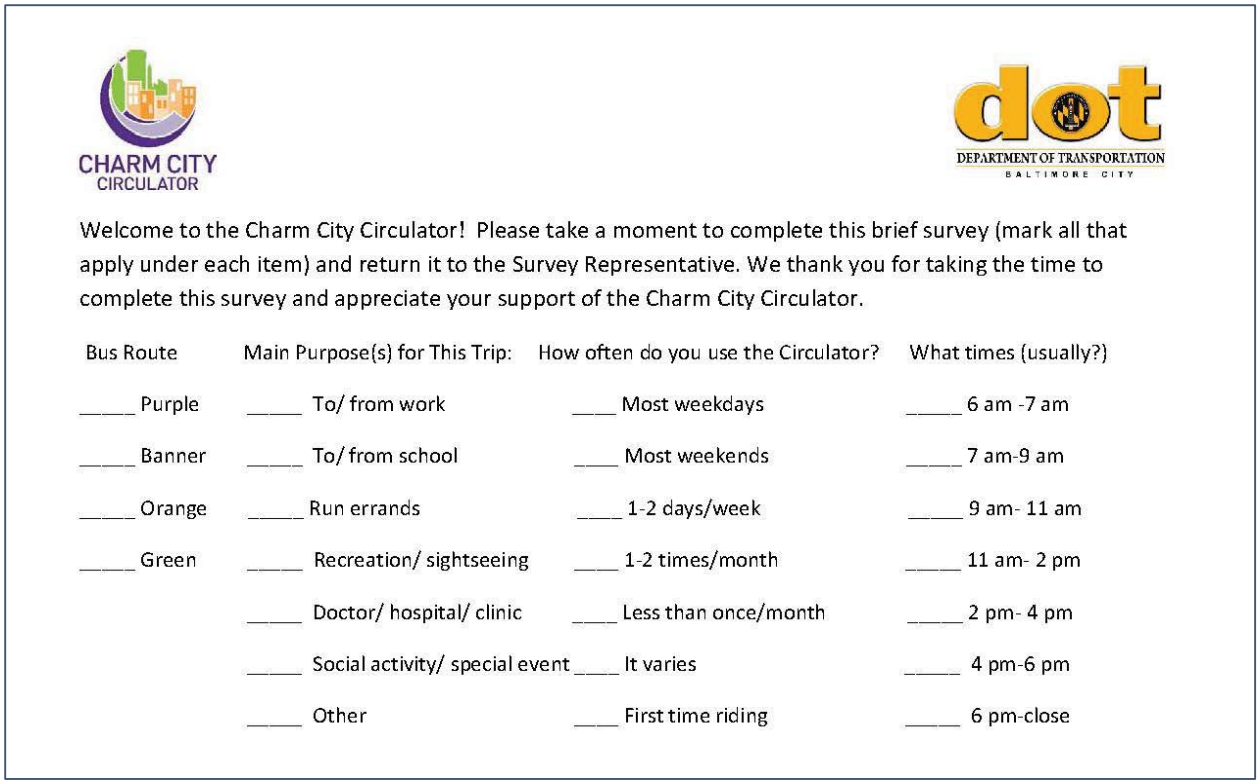


Figure F.1. On-Board Survey Form for CCC

A total of 350 surveys were collected from riders on the various routes. A summary of the findings from the survey follows.

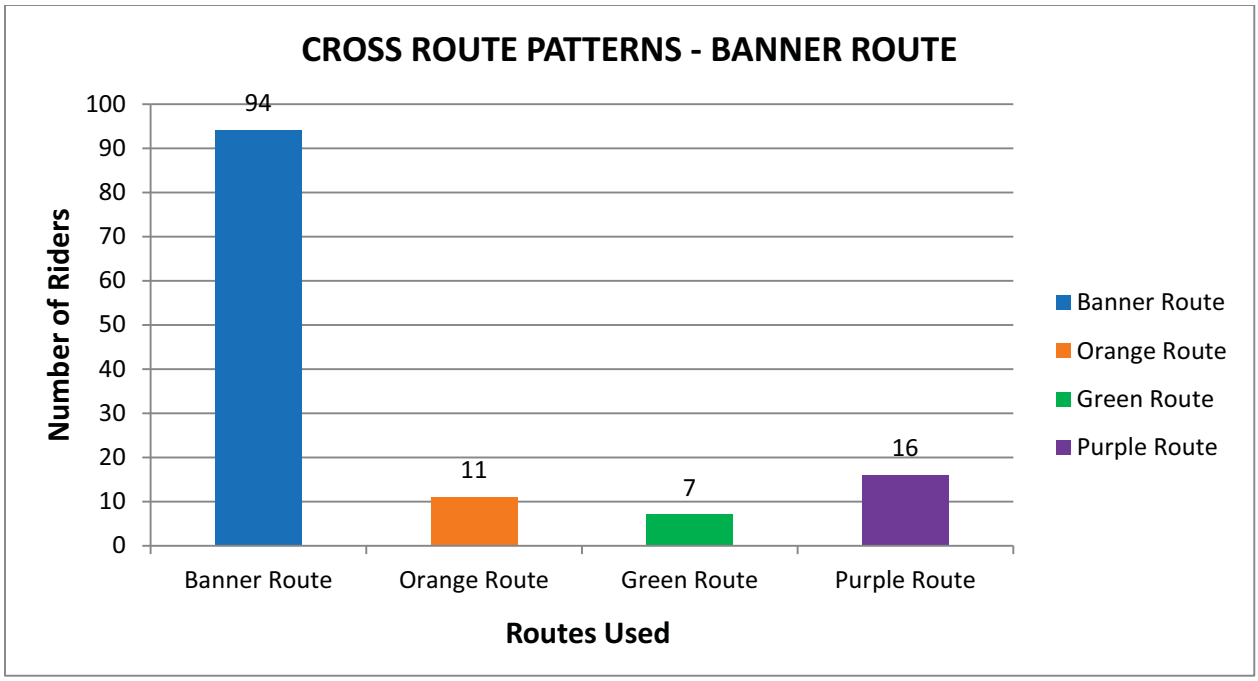


Figure F.2. Cross route patterns—Banner Route

Banner Route: There were 94 passengers surveyed on the Banner Route. Of those 94 passengers, 11 also ride the Orange Route, 7 also ride the Green Route, and 16 also ride the Purple Route.

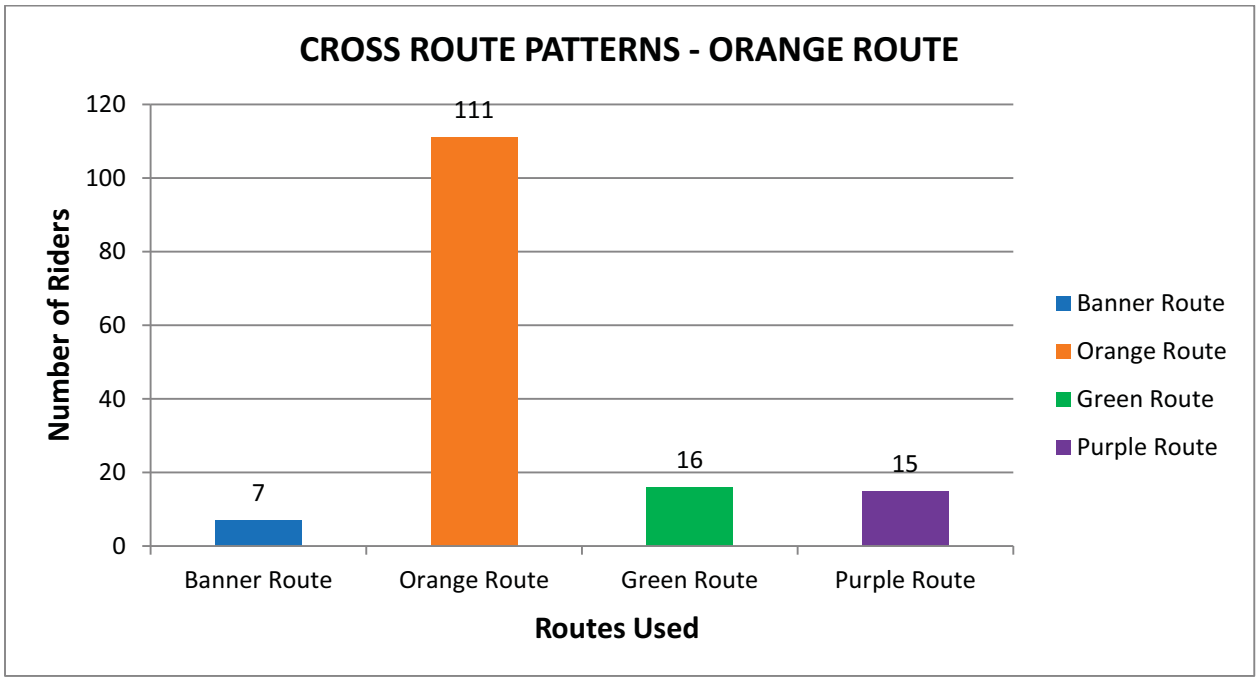


Figure F.3. Cross route patterns—Orange Route

Orange Route: There were 111 passengers surveyed on the Orange Route. Of those 111 passengers, 7 also ride the Banner Route, 16 also ride the Green Route, and 15 also ride the Purple Route.

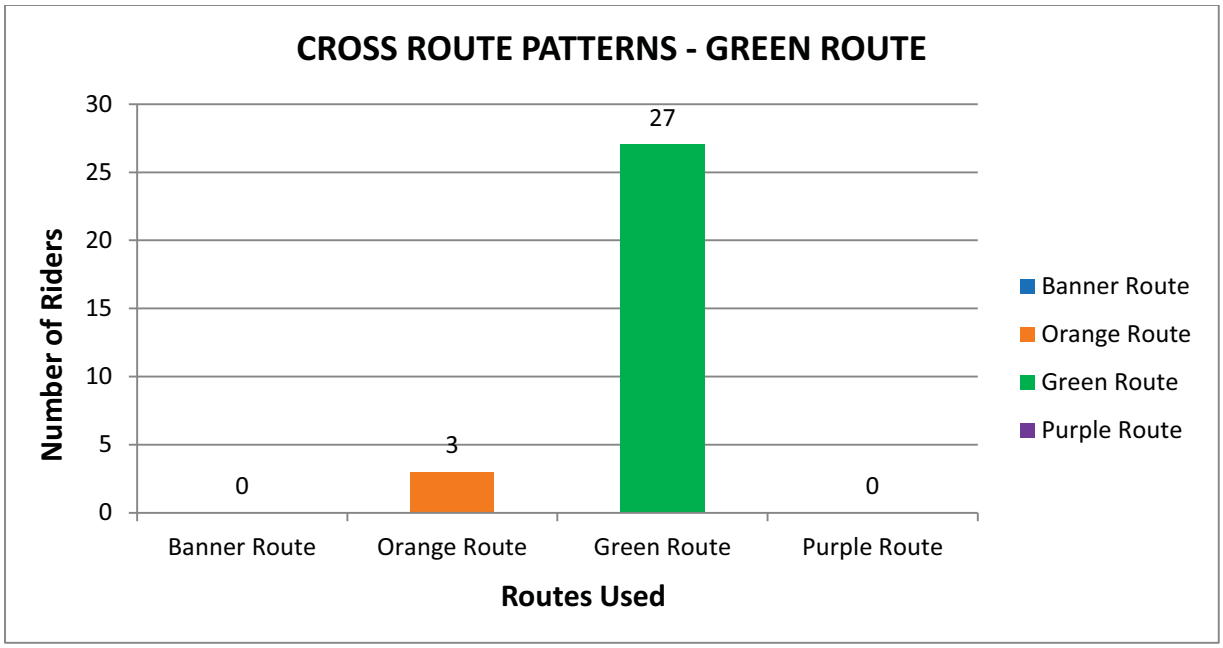


Figure F.4. Cross route patterns—Green Route

Green Route: There were 27 passengers surveyed on the Green Route. Of those 27 passengers, three (3) also ride the Orange Route.

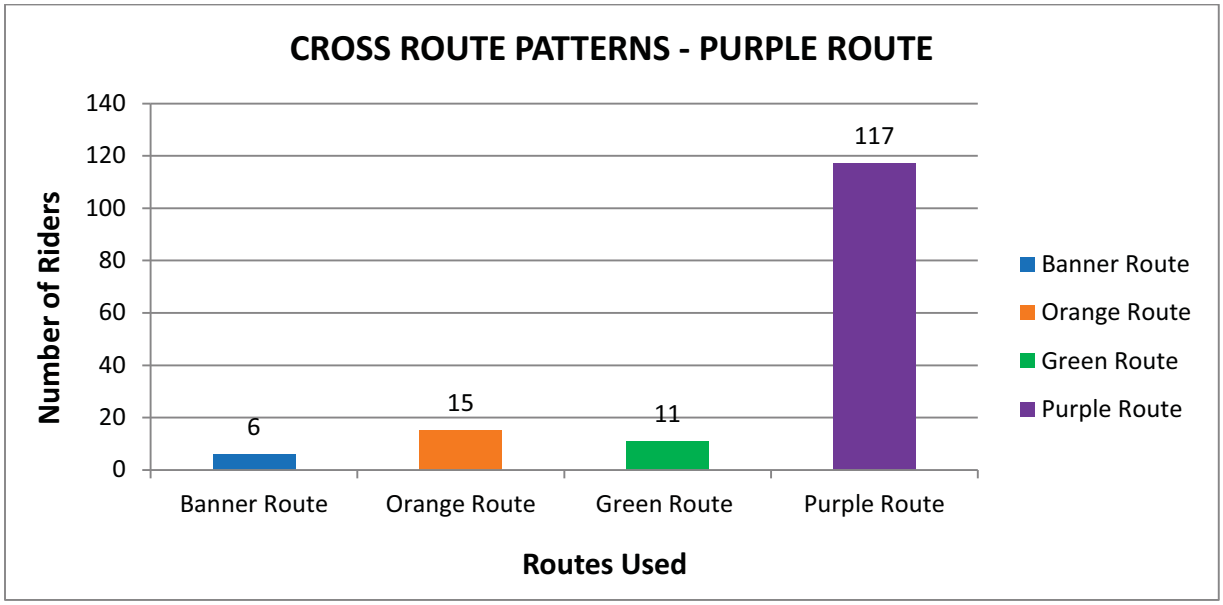


Figure F.5. Cross route patterns—Purple Route

Purple Route: There were 117 passengers surveyed on the Purple Route. Of those 118 passengers, 6 also ride the Banner Route, 15 also ride the Orange Route, and 11 also ride the Green Route.

Table F.1. Cross route patterns—summary

CROSS ROUTE PATTERNS	Rides Banner Route	Rides Orange Route	Rides Green Route	Rides Purple Route
Banner Route Surveys	94	11	7	16
Orange Route Surveys	7	111	16	15
Green Route Surveys	0	3	27	0
Purple Route Surveys	6	15	11	118

A. Cross Route Patterns—Conclusions

The riders on the Purple Route and Orange Route carried the most passengers and were the most responsive to completing the survey.

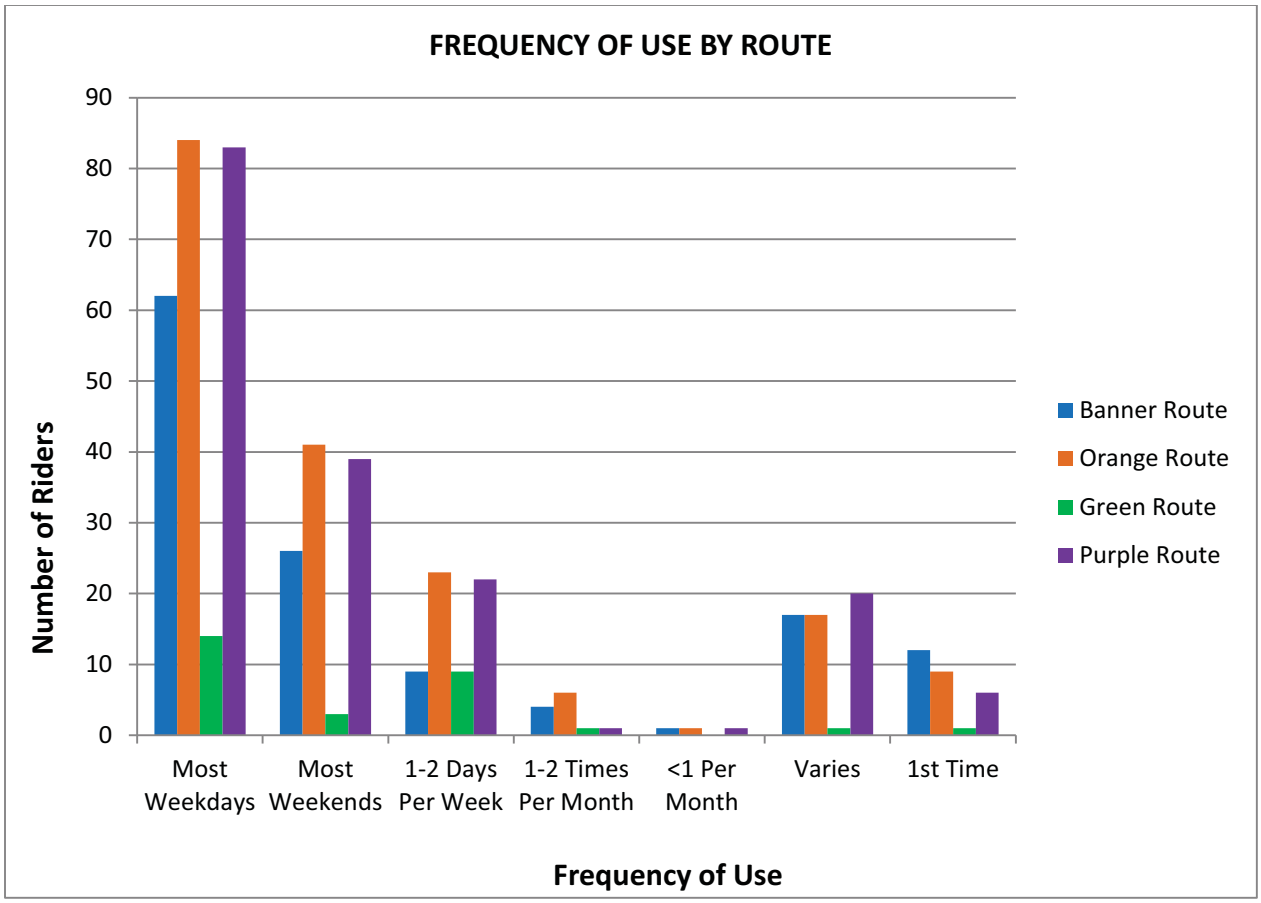


Figure F.6. Frequency of use

Table F.2 Frequency of use—summary

FREQUENCY OF USE	Banner Route	Orange Route	Green Route	Purple Route
Most Weekdays	62	84	14	83
Most Weekends	26	41	3	39
1-2 Days Per Week	9	23	9	22
1-2 Times Per Month	4	6	1	1
<1 Per Month	1	1	0	1
Varies	17	17	1	20
1st Time	12	9	1	6

B. Frequency of Use—Conclusions

The majority of passengers on all of the routes use the CCC service on most weekdays. This is most likely because passengers are using the service to get to and from work, school, or medical appointments. Use of the CCC on most weekends was another prevalent response from the passengers, with the exception of the Green Route. The least checked frequency across the board

was “less than once per month.” One interesting discovery worth noting is how similar the responses are for the Purple Route and Orange Route.

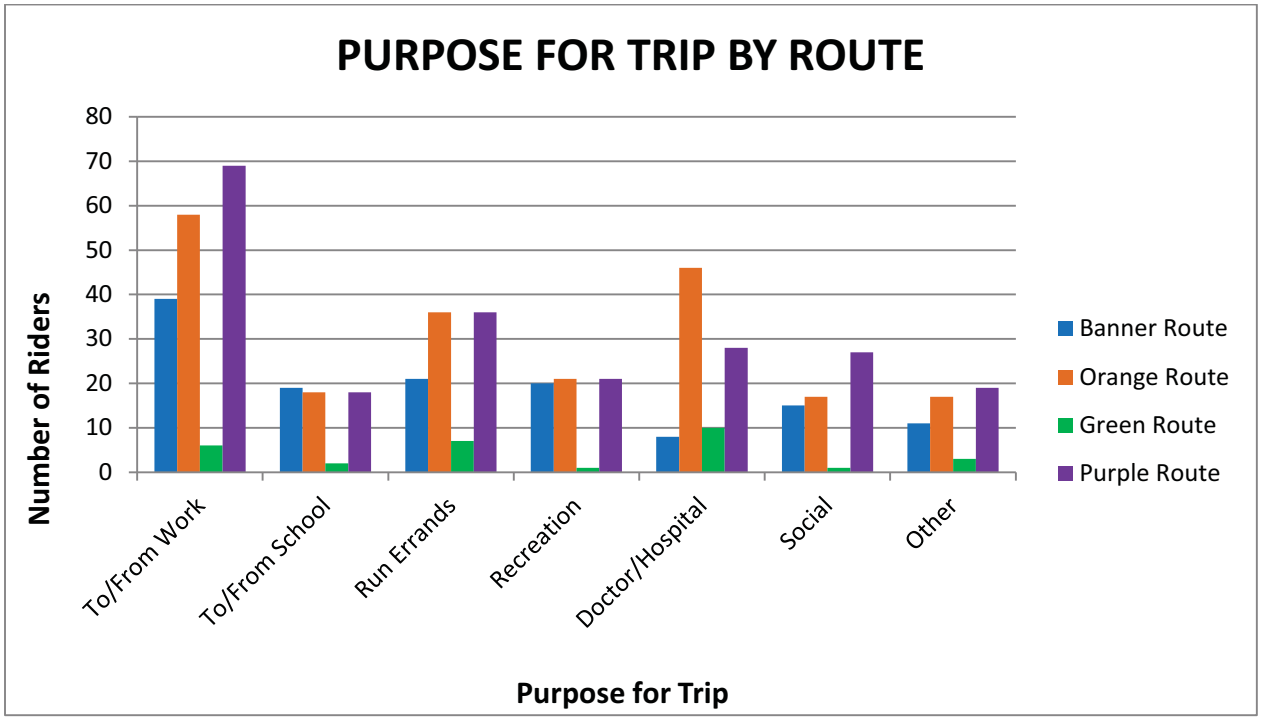


Figure F.7 Purpose for Trip

Table F.3. Purpose for trip—summary

PURPOSE FOR TRIP	Banner Route	Orange Route	Green Route	Purple Route
To/From Work	39	58	6	69
To/From School	19	18	2	18
Run Errands	21	36	7	36
Recreation	20	21	1	21
Doctor/Hospital	8	46	10	28
Social	15	17	1	27
Other	11	17	3	19

C. Purpose for Trip—Conclusions

Based on the data collected, the most prevalent purpose for using the CCC is to get to and from work, with the exception of those riding the Green Route. The most popular purpose on the Green Route was to get to and from doctors/hospitals. The least predominant purpose for using the CCC varied from route to route. Just as with the “frequency of use” data, the responses provided from

passengers on the Purple Route and Orange Route are quite similar, with the exception of the "doctors/hospitals" category. The passengers on the Orange Route are more likely to use the CCC for medical appointments then those on the Purple Route; however, that is most likely due to the fact that the University of Maryland Medical Center is located along the Orange Route.

Figure F.8. Time of use

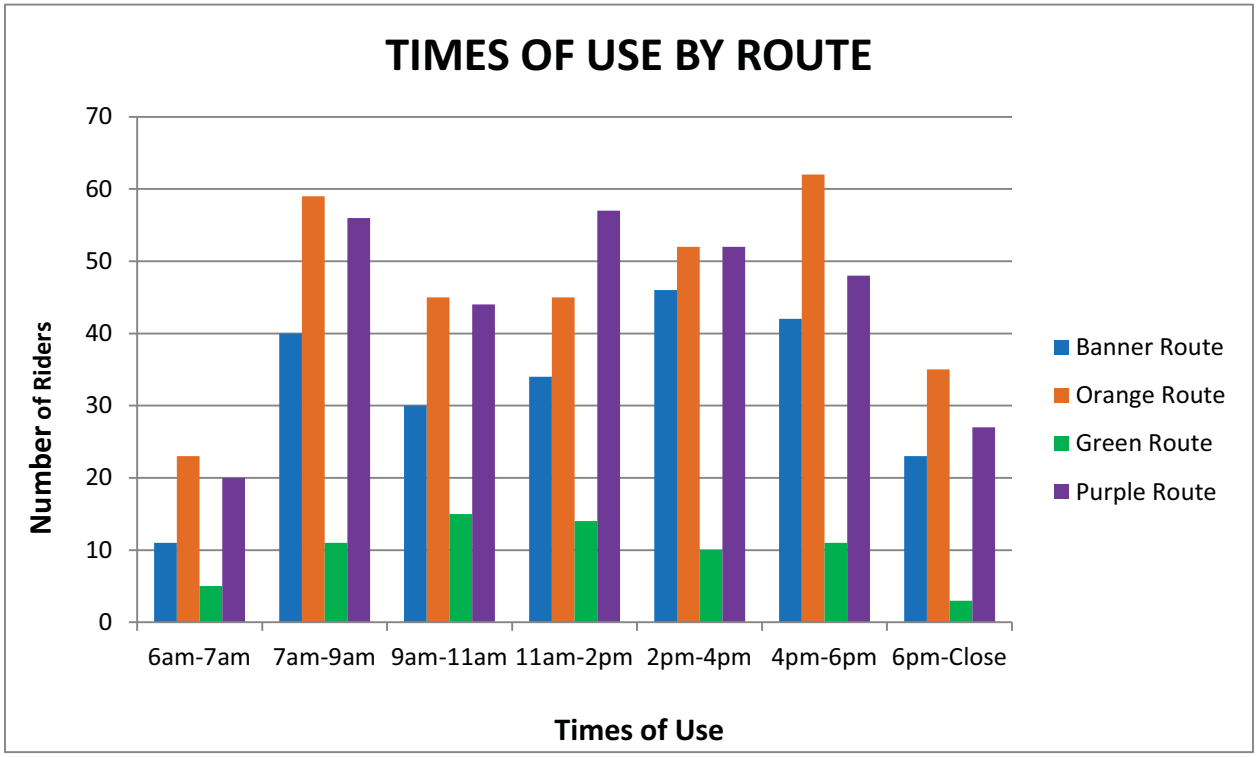


Table F.4. Time of use—summary

TIME OF USE	Banner Route	Orange Route	Green Route	Purple Route
6am-7am	11	23	5	20
7am-9am	40	59	11	56
9am-11am	30	45	15	44
11am-2pm	34	45	14	57
2pm-4pm	46	52	10	52
4pm-6pm	42	62	11	48
6pm-Close	23	35	3	27

D. Time of Use—Conclusions

Based on the data, the least predominant times of day for passengers to use the CCC are from 6:00 AM–7:00 AM and from 6:00 PM–close. This coincides with the fact that most riders are using the CCC to get to and from work, school, or medical appointments, and for the majority of the respondents, those times of day are either too early or too late for such purposes. The answers provided by the riders on all of the routes indicated that ridership is fairly steady from 7:00 AM–6:00 PM.

Passenger Feedback

Passengers were also given an opportunity to write in comments about the CCC. Although not every passenger took the opportunity, the majority of those that did respond indicated that they were very satisfied with the service. The most commonly listed complaints included: timeliness of the buses, desire for longer hours, and the need for additional buses. Other popular responses included the need for additional stops/routes, lack of cleanliness of the buses, and issues with the homeless using the service as a means for shelter.

APPENDIX G. PARTIAL BIBLIOGRAPHY AND RECOMMENDED RESOURCES

Advertising Revenues

Alpers, J. 2009. *Transit Cooperative Research Program (TCRP) Report 133 – Practical Measures to Increase Transit Advertising Revenue*. Denneen & Company, Boston, MA.

Silverberg, B. R. 1998. *Transit Cooperative Research Program (TCRP) Synthesis 32 - Transit Advertising Revenue: Traditional and New Sources and Structures, A Synthesis of Transit Practice*. Beverly R. Silverberg, Communications, Inc., Hyattsville, MD.

Schaller, B. 2004. *Transit Cooperative Research Program (TCRP) Synthesis 51 - Transit Advertising Sales Agreements, A Synthesis of Transit Practice.* Schaller Consulting, Brooklyn, NY.

Nelson/Nygarrd. 2012. *Cache Valley Transit District: Short Range Transit Plan (SRTP) – Final Report.* Nelson\Nygaard Consulting Associates, Inc., San Francisco, CA.

Multisystems, Mundle & Associates, and Simon & Simon. 2003. *Transit Cooperative Research Program (TCRP) Report 94 - Fare Policies, Structures and Technologies.* Multisystems, Inc., Cambridge, MA. Mundle & Associates, Inc., Philadelphia, PA. Simon & Simon Research and Associates, Inc., Ellicott City, MD.

Bus Lease vs. Purchase Analysis and Bus Life-Cycle Cost Resource

Bus Life Cycle Cost Model for Federal Land Management Agencies- User Guide and Spreadsheet- John A. Volpe National Transportation Systems Center

APPENDIX H. DOCUMENTATION OF ADJUSTMENTS TO ORIGINAL SCOPE AND STATUS AS OF DECEMBER 26, 2014

Proposal Date: September 11, 2014
Task 33: Review and Recommendations for Charm City Circulator
Proposal Amount: $130,141.32

Scope of Work:

1) Operations Evaluation Operations Evaluation
    a. On-time service evaluation - ***Completed***
    b. Ridership patterns evaluation - ***Completed***
    c. Service consolidation/ service reduction options - ***Completed***
    d. Service expansion options - ***Completed***
    e. Initial cost evaluation - ***Completed***
    f. Summary report on findings and recommendations - ***Completed***
2) Revenue Evaluation
    a. Review Advertising Revenue - ***See Appendix – Utilized reports from the Transportation Research Board for recommendations***
    b. Identify and review summary operations and funding sources for at least two (2) free circulators - ***Completed by BBMR***
    c. Evaluate potential for Charm City fare revenue – ***Completed by BBMR***
3) Operating Cost and Contract Evaluation
    a. Identify operating costs including fuel and vehicle leases – ***Completed with the exception of verifying the status and condition of the buses originally purchased to operate the service due to the failure of the Design Line buses***
    b. Identify cost parameters for expanded service under a conceptual new contract - ***Completed***
    c. Identify areas of potential savings for a future contract – ***Researched Cobb County (GA) and DC Circulator bus contracts and identified practices with the greatest potential to incentivize reliable service to customer and affordable service to the City***
    d. Section C, Item III - Identify potential cost savings under new contract that applies best practices to contract provisions***- Replaced by benchmarking analysis***
    e. Draft a RFP for a new bus contract incorporating the findings of the previous tasks – ***Draft completed- to be revised pending discussion and agreement with BCDOT***
    f. Summary report on findings and recommendations – ***Completed***

******Additional Work Completed – benchmarking analysis, bus purchase versus bus lease analysis, and intense maintenance review.***

4) Long Term Financial Operations Alternatives – ***Built on the BBMR model – modified to include bus replacement and benchmarking***
    a. Identify a baseline "as is" operation with costs and revenues (advertising and dedicated parking revenues) continuing into future years (5 year forecast/10 year forecast) - ***Completed***

b. Develop optimization model to evaluate different sets of alternatives. – ***Completed***
c. Develop four (4) to six (6) alternative forecasts with different sets of alternatives. – ***Completed five (5) alternative forecasts***
d. Develop one (1) or two (2) preferred alternatives for the long-range forecast – ***Completed***
e. Summary report on findings and recommendations – ***Completed***