FOURSQUARE ITP
INTEGRATED TRANSPORTATION PLANNING

Regional Bus Service Provision Study

SUBMITTED TO THE METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS

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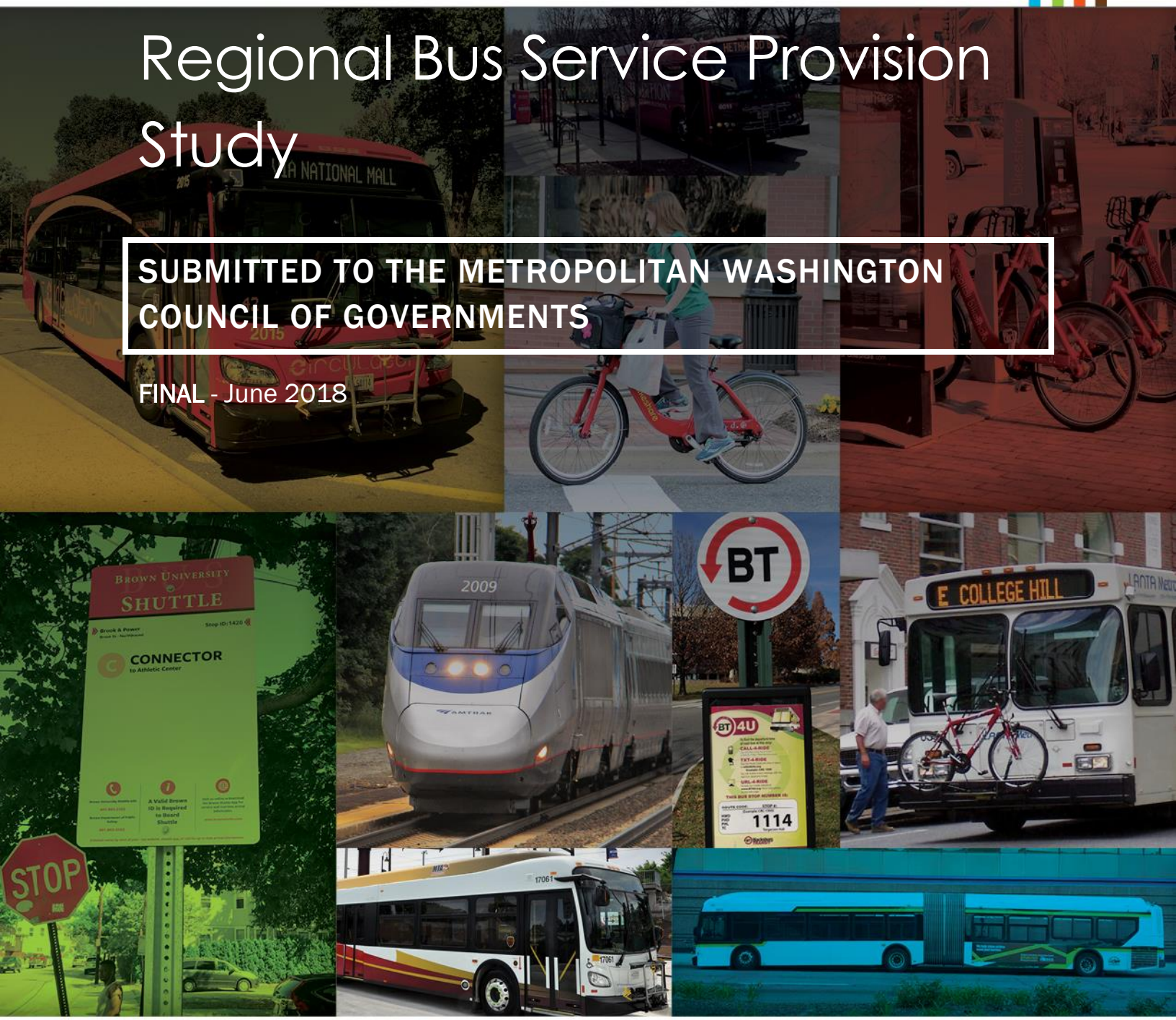

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I. INTRODUCTION

Bus service in the Metropolitan Washington region is provided by over ten different agencies, each with its own geography, cost drivers, funding structure, and operational practices. The purpose of this study was twofold: to better understand how and why agencies' costs vary, and to identify ways to further enhance efficiency and improve coordination, collaboration, and partnering between agencies in the delivery of transit service --- with an ultimate objective of improving the customer experience.

Study Overview and Purpose

With a complex web service areas and routes, the Metropolitan Washington area's bus service networks are extensive in coverage but also potentially confusing to the user and redundant or inefficient in some cases. Each agency's network of routes has been developed over years or decades based on careful analysis and consideration of many factors. The Washington Metropolitan Area Transit Authority (WMATA) is the largest single transit agency in the region, operating the Metrorail system as well as Metrobus local, regional, and express services in the District of Columbia, Maryland, Virginia, and the District of Columbia. The other bus providers in the region either have service areas that are limited to the local counties and cities that independently operate them, or provide limited commuter services from the outer suburbs to and from the regional core.

Past studies have analyzed the region's bus services from the perspective of comparing levels of service and coverage. However, prior to this study, there was relatively little understanding of exactly why agencies' costs per revenue hour, as reported to the National Transit Database, varied so significantly. One key purpose of this study was the development of an Operations and Maintenance (O&M) Cost Model to enhance the ability to compare agencies' costs by breaking down cost drivers and identifying the services included in one agency's costs versus another's. A second purpose was to make recommendations to the Metropolitan Washington Council of Governments (MWCOG) and region's service providers regarding candidate strategies for phased implementation based on the Cost Model and best practices identified through a local and national literature review.

Role of the Technical Advisory Committee

A Technical Advisory Committee (TAC) for this study provided oversight, guidance and information throughout the process. The TAC has members from agencies at the state (Maryland, Virginia, and the District of Columbia), regional (MWCOG, WMATA), multi-jurisdictional (Potomac and Rappahannock Commission[1], Northern Virginia Transportation Commission), county (Arlington, Charles, Fairfax, Frederick, Loudoun, Montgomery, Prince George's), and city (Alexandria, Fairfax) levels. The TAC met five times throughout the study process, each time providing valuable insight and guidance to inform the contents and quality of this study. The input of the TAC was instrumental in the development of this report, and the research team would like to acknowledge and thank each member for participating.

[1] The Potomac and Rappahannock Transportation Commission (PRTC) is a multi-jurisdictional agency in Virginia representing Prince William, Stafford and Spotsylvania Counties and the Cities of Manassas, Manassas Park and Fredericksburg.

Report Organization

This report contains detailed information related to bus service, costs, case examples, and analysis and recommendations of strategies for implementation in the Metropolitan Washington region to enhance the overall quality and efficiency of bus service.

- Chapter II (**Background**) provides basic information about the region's bus service providers and the services they offer.
- Chapter III (**Bus Service Provision Cost Components and Analysis**) explains the O&M Cost Calculator and the findings from detailed analysis of agencies with costs broken down by their various components and drivers.
- Chapter IV (**Literature and Peer Review**) summarizes of findings from a literature review on the topic of enhancing the efficiency of bus service provision, as well as both North American and local examples of such practices.
- Chapter V (**Regional Strategies Recommendations for Enhanced Efficiency**) presents specific regional strategy options to improve efficiency, along with an evaluation of the benefits and feasibility of each strategy.
- Chapter VI (**Additional Strategies**) includes a discussion of other strategies that can be pursued but that were not evaluated specifically for this region.
- Chapter VII (**Implementation and Next Steps)** highlights a timeframe for the implementation of each strategy and spells out immediate next steps that can be taken.

In addition, there are three appendices following the main body of the report.

- Appendix A (**References**) includes a list of references for the literature and peer review
- Appendix B (**Technical Advisory Committee**) includes a list of Technical Advisory Committee members
- Appendix C (**Services Evaluation**) includes a regional analysis of bus services throughout the region
- Appendix D (**Task 2 Technical Memorandum – Inventory of Regional Bus Service Cost Components**) includes a description of the common accounting model and summary of bus service cost components
- Appendix E (**Task 3 Technical Memorandum – Application of Cost Factors**) demonstrates the application of the common accounting model

II. BACKGROUND

Providers and Services

Table 1 below lists the agencies that provide fixed-route bus service in the Metropolitan Washington region.

Table 1: MWCOG Member Bus Service Providers in the Washington, DC Region

Agency Name[2]	Primary Service Area[3]	Directional Route Miles	Annual Passenger Trips	Vehicles Operated in Annual Maximum Service (VOMS)[4]
The Washington Metropolitan Area Transit Authority (WMATA)	Regional[5]	2,357	127,687,553	1,301
Arlington Transit (ART)	Arlington County, VA	269	3,111,575	46
DC Circulator	District of Columbia	43	5,407,530	52
City-University Energysaver (CUE)	City of Fairfax, VA	19	678,967	8
Driving Alexandria Safely Home (DASH)	City of Alexandria, VA	111	9,229,419	66
Fairfax Connector	Fairfax County, VA	1,104	8,984,286	226
TransIT[6]	Frederick County, MD	-	677,918	36
Loudoun County Transit (LCT)	Loudoun County, VA	431	1,775,888	92
OmniRide[7]	Prince William, Stafford, Spotsylvania Counties & Cities of Manassas, Manassas Park, and Fredericksburg, VA	565	2,805,181	128
Ride On	Montgomery County, MD	1,556	24,512,705	282
TheBus	Prince George's County, MD	523	3,188,513	76
VanGo	Charles County, MD	357	871,161	16

Source: National Transit Database, 2016

[2] The Regional Transportation Agency of Central Maryland (RTA) provides service to areas that overlap with other regional transit providers, however it was not included in the cost analysis portion of this study

[3] "Primary service area" refers to the jurisdiction(s) in which the agency primarily operates. In several cases, agencies' routes cross jurisdictional boundaries for a relatively small portion of the route, often for delivering riders to key transit hubs like metro stations. Some commuter bus services also travel through other jurisdictions that are not considered part of the primary service area.

[4] Vehicles Operated in Annual Maximum Service (VOMS) is the number of revenue vehicles operated to meet the annual maximum service requirement. This is the revenue vehicle count during the peak season of the year; on the week and day that maximum service is provided. Vehicles operated in maximum service (VOMS) excludes atypical days and one-time special events.

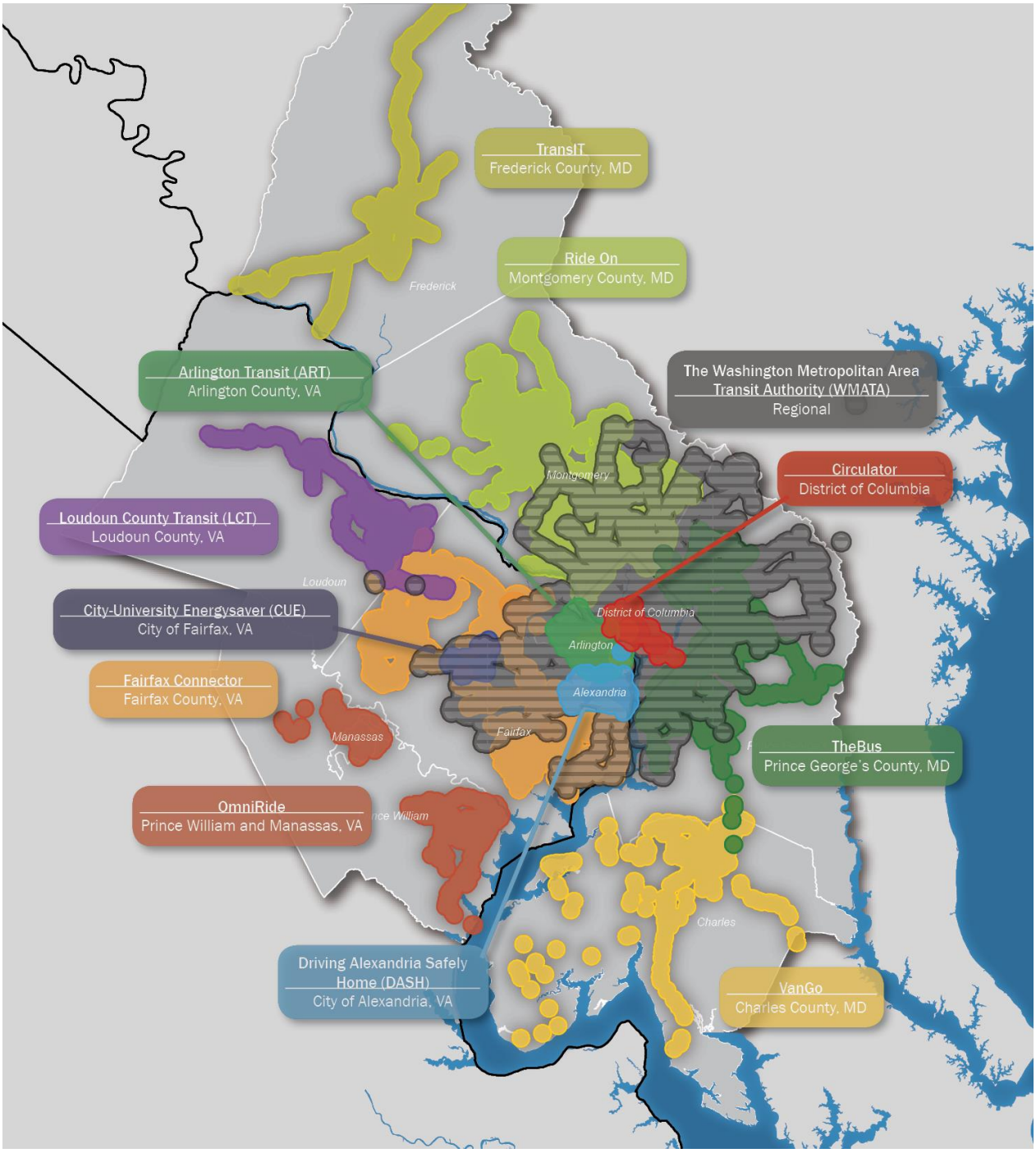
[5] WMATA's service area covers the District of Columbia, as well as Anne Arundel, Arlington, Fairfax, Loudoun, Montgomery, Price George's Counties and the Cities of Alexandria, Falls Church, and Laurel.

[6] Route miles not available in NTD profile

[7] The entity that provides the OmniRide service is the Potomac and Rappahannock Transportation Commission.

Figure 1 below shows the bus networks of each of these service providers.

Figure 1: Map Bus Routes in Metropolitan Washington Region by Provider



Existing Venues for Interagency Coordination

The Metropolitan Washington region's bus service providers already coordinate with each other in a variety of ways. Staff from all of the agencies included as part of this study communicate with each other to some degree through a combination of formal interagency arrangements and informal relationships that assist with coordination and sharing of information. Many agency staff also attend the same conferences each year and connect with each other through professional and industry organizations, giving them contacts to whom they can reach out when their specific issues requiring coordination.

In addition, there are formal structures for coordination between the region's transit service providers. The most prominent of these is National Capital Region Transportation Planning Board (NCR-TPB), which serves as the region's Metropolitan Planning Organization (MPO). Specifically, meetings of the TPB Regional Public Transportation Subcommittee and Regional Bus Subcommittee are where issues requiring interagency coordination most commonly begin. As noted in its mission and goals, the Regional Public Transportation Subcommittee is responsible for coordinating and evaluating planned projects, providing technical advice and input, facilitating technology transfer and sharing of information, and coordination with other regional committees and entities such as Commuter Connections (which provides travel demand management services in the region). It may also recommend the establishment under its jurisdiction of special task forces to address particular topics in greater depth, such as transit marketing or priority lanes. The Regional Bus Subcommittee provides a forum for transit providers to come together and discuss matters related specifically to the provision of bus service throughout the region.

Examples of interagency coordination and agreements are provided in Chapter IV (**Literature and Peer Review**).

III. BUS SERVICE PROVISION COST COMPONENTS AND ANALYSIS

The transit agencies that provide bus services in the Metropolitan Washington region range in both size and function. Each operator is subject to different conditions which affect both how service is provided and how much it costs to do so. Some of the characteristics that differ between operating entities include:

- Service types provided: local, express, commuter;
- Service area characteristics: density, mix of uses;
- Governance structures;
- Quality and quantity of service provided, including number of routes, frequency, span of service, etc.;
- Presence of existing labor agreements;
- Additional services provided, such as customer service, employer outreach, etc.;
- Whether service is operated directly or contracted/purchased; and
- Use of support services (i.e. legal, accounting) from other entities.

One of the main goals of this study was to identify the differences and similarities in costs between the operating agencies, and - to the extent possible - to quantify the true cost of operating bus service for each operating agency. The development of a common accounting model of operating costs could be used by the region to better understand the costs of operating bus service in the region, and to help the region make better decisions moving forward about how to structure, provide, and operate bus service in the future.

The development of a common accounting model, as well as a description of the differences in cost drivers, can be found below. In addition, two technical memoranda accompany this report that describe how the common cost accounting model was created and how it can be applied:

- **Appendix D - Task 2 Technical Memorandum: Inventory of Regional Bus Service Cost Components** – provides background information and the methodology used to develop the common accounting model, as well as a summary of historic trends and a description of elements influencing the differences in costs.
- **Appendix E - Task 3 Technical Memorandum: Application of Cost Factors** – demonstrates how the common cost accounting method can be applied to decision making on the provision of bus services in the region.

Operations & Maintenance (O&M) Cost Data Collection

Due to the many differences between transit service providers in this region, significant variation in O&M costs is expected. The first step in the analysis process was to gather all available information on O&M costs and operating characteristics from each of the operating agencies. To get a comprehensive understanding of the full range of costs associated with the provision of bus service at each operating agency, the study considered expense and level-of-service information gathered from three primary sources:

- **National Transit Database (NTD)[8]:** All federally-funded transit agencies report expense and service data to the NTD annually in a common format, which allows for the comparison of unit costs of service delivery across the various transit operators in the region.

  The NTD provides cost data ***by mode*** (e.g. bus or rail), ***method of operation*** (e.g. directly operated-DO vs. purchased transportation-PT), ***function*** (e.g. vehicle operations, vehicle maintenance, non-vehicle maintenance, and general administration), and ***object class*** (e.g., wages, fringe, fuel, parts, services). Using NTD data as the primary source also reduced the reporting burden on the agencies and sped up the data assembly process for this study. In addition, it allowed for the analysis of historic unit cost trends over time. This allows for a clearer understanding of and a higher level of confidence in the validity of the data used in the analysis.

- **Administrative expense data:** Participating agencies also provided detailed data on staffing headcounts and costs for various administrative functions. The data collection tool in Appendix D was provided to each operating agency to simplify the data collection process and ease the workload burden on agency staff. Unfortunately, not every agency was able to provide complete data, and it was therefore used only to supplement the NTD datasets. Where provided, this data was used to understand significant differences in costs between the operating agencies.

  The administrative expense data collected provided limited insights regarding the "back-office" functions provided by the local jurisdictions. While some jurisdictions provided great detail, some were not able to provide complete information, and some did not provide any administrative costs. For example, estimates of legal and information technology staffing headcounts were not available from any agency. Several jurisdictions provided sufficient staffing headcount information to suggest deep resources to support service planning functions which – if expanded - might be shared with (or sold to) neighboring jurisdictions. Because this information was not complete across all jurisdictions, this possibility was not pursued further in this study.

- **Contract Rates for Purchased Transportation:** Contract rates for purchased transportation services (i.e. when a jurisdiction contracts out for service operation) were requested. Of the five agencies that contract out operations, only four operating agencies were able to provide this information.

A summary of the data received from each operating agency is provided in **Appendix D**.

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[8] The National Transit Database (NTD) provides a convenient source of financial and operating data for the analysis of the cost of service delivery. The NTD reports costs by mode, by function, by service delivery type, and by object class. This provides the opportunity to be selective and precise in the derivation of unit costs. Accuracy in NTD reporting is supported through a standard set of definitions applied in the reporting of NTD data (and much of these definitions are "hard coded" into transit agency accounting system), training of transit agency staff by the National Transit Institute, reference materials provided by FTA, and validation of data by FTA. However, there is the opportunity for error in NTD data as a result of turnover in transit agency staff involved in NTD reporting and loss of intellectual capital and "institutional memory", changes in transit agency operations (e.g., transitions from directly operated to purchased transportation services), and changes in NTD reporting rules (e.g., the separation of Commuter Bus (CB) mode from Motor Bus (MB) mode. As a result, year-to-year changes may or may not reflect meaningful changes in the underlying cost structure. Users of NTD data should be aware of these limitations.

O&M Unit Cost Derivation

Because each operating agency provides a different quantity of transit service under different operating conditions, it is essential to derive unit costs for the purpose of cross agency comparison. In keeping with FTA and industry standards, several standard units and methods for calculating these costs are used.

Operations and maintenance unit costs were estimated using an O&M cost model that addresses the following types of costs and associated cost drivers:

- **Incremental Costs**: includes costs associated with vehicle operations (not including fuel and tires), represented as a function of vehicle revenue hours (cost/ Revenue Hour), and costs associated with vehicle maintenance (including fuel and tires), represented as a function of vehicle revenue miles (cost/ Revenue Mile).
- **Fully Allocated Costs**: includes incremental costs and additional costs associated with non-vehicle maintenance, as a function of peak-vehicles (cost/ Peak Vehicle), and costs associated with general administration as a function of vehicle revenue hours (cost/ Revenue Hour).

The cost drivers are defined by FTA[9] as follows:

- **Vehicle revenue hours:** The hours that vehicles travel while in revenue service. Vehicle revenue hours include layover and recovery time. Vehicle revenue hours exclude hours that a vehicle travels when out of revenue service including time spent leaving or returning to the garage, time spent changing routes, operator training hours, and vehicle maintenance testing hours, as well as school bus and charter services hours.
- **Vehicle revenue miles:** The miles that vehicles travel while in revenue service. Vehicle revenue miles exclude miles that a vehicle travels when out of revenue service including time spent leaving or returning to the garage, time spent changing routes, operator training miles, and vehicle maintenance testing miles, as well as and school bus and charter services miles.
- **Vehicles Operated in Annual Maximum Service (VOMS) - "Peak vehicles":** The number of vehicles operated to meet the annual maximum service requirement. This is the number of vehicles in revenue service during the week and day that maximum service is provided. Vehicles operated in maximum service (VOMS) excludes atypical days or one-time special events.
- **Deadhead hours and miles:** The hours or miles that a vehicle travels when out of revenue service, including for leaving or returning to the garage or yard facility, changing routes, and when there is no expectation of carrying revenue passengers.

Table 2 summarizes how cost drivers are associated with the functions defined in the NTD.

[9] Source: Federal Transit Administration, https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary

Table 2: Functions and their associated Cost Drivers

Function	NTD Definition	Cost Driver	Exception
Vehicle Operations	All activities associated with vehicle operations, including: ■ Transportation administration and support ■ Revenue vehicle movement control ■ Scheduling of transportation operations ■ Revenue vehicle operation ■ Ticketing and fare collection ■ System security	Vehicle revenue hours	Fuel/lubricants and tires/tubes applied in Vehicle Maintenance
Vehicle Maintenance	All activities associated with revenue and non-revenue (service) vehicle maintenance, including: ■ Administration ■ Inspection and maintenance ■ Servicing (cleaning, fueling, etc.) vehicles In addition, vehicle maintenance includes repairs due to vandalism and accident repairs of revenue vehicles.	Vehicle Revenue Miles	Includes fuel/lubricants and tires/tubes from Vehicle Operations
Non-Vehicle Maintenance	All activities associated with facility maintenance, including: ■ Administration ■ Repair of buildings, grounds, and equipment as a result of accidents or vandalism ■ Operation of electric power facilities ■ Maintenance of: – Vehicle movement control systems; Fare collection and counting equipment; Structures, tunnels and subways; Roadway and track; Passenger stations, operating station buildings, grounds and equipment; Communication systems; General administration buildings, grounds and equipment; Electric power facilities	Peak Vehicles	Applied in fully-allocated costs only
General Administration	All activities associated with the general administration of the transit agency, including: ■ Transit service development ■ Injuries and damages ■ Safety ■ Personnel administration ■ Legal services ■ Insurance ■ Data processing ■ Finance and accounting ■ Purchasing and stores ■ Engineering ■ Real estate management ■ Office management and services ■ Customer services ■ Promotion ■ Market research ■ Planning	Vehicle revenue hours	Applied in fully-allocated costs only

Source: National Transit Database, https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary

O&M Unit Costs Across Jurisdictions

Table 3 presents unit costs for each operating agency in 2017. Details on unit costs for preceding years can be found in Appendix D.

Table 3: 2017 Unit Costs by Operating Agency

Agency	Vehicle Operations	Vehicle Maintenance	Non-Vehicle Maintenance	General Administration
City of Alexandria	$45.04	$1.92	$4,918.68	$15.06
Arlington County	$37.97	$1.97	$6,845.50	$20.11
Charles County	$33.06	$0.63	$295.75	$32.16
City of Fairfax	$61.78	$1.18	$2,937.75	$23.68
DDOT	$66.76	$3.90	$9,520.52	$13.07
Fairfax County	$62.56	$2.17	$3,898.65	$17.45
Frederick County	$45.95	$1.66	$722.28	$15.24
Loudoun County	$55.07	$1.44	$3,858.59	$21.39
Montgomery County	$60.96	$2.30	$18,061.87*	$60.96
Prince George's County	$67.14	$2.50	$2,097.80	$15.91
PRTC	$108.18	$2.72	$14,761.39**	$29.88
WMATA	$78.07	$4.67	$48,359.52***	$18.65

** Montgomery County's non-vehicle maintenance costs were high due to increasing spending on non-vehicle maintenance services in recent years*

*** High non-vehicle maintenance costs for PRTC are the result of the separation of reporting Commuter Bus (CB) from Motor Bus (MB) beginning in 2013*

**** High non-vehicle maintenance costs were confirmed with WMATA, and are due to high costs of non-vehicle maintenance wages and fridge benefits*

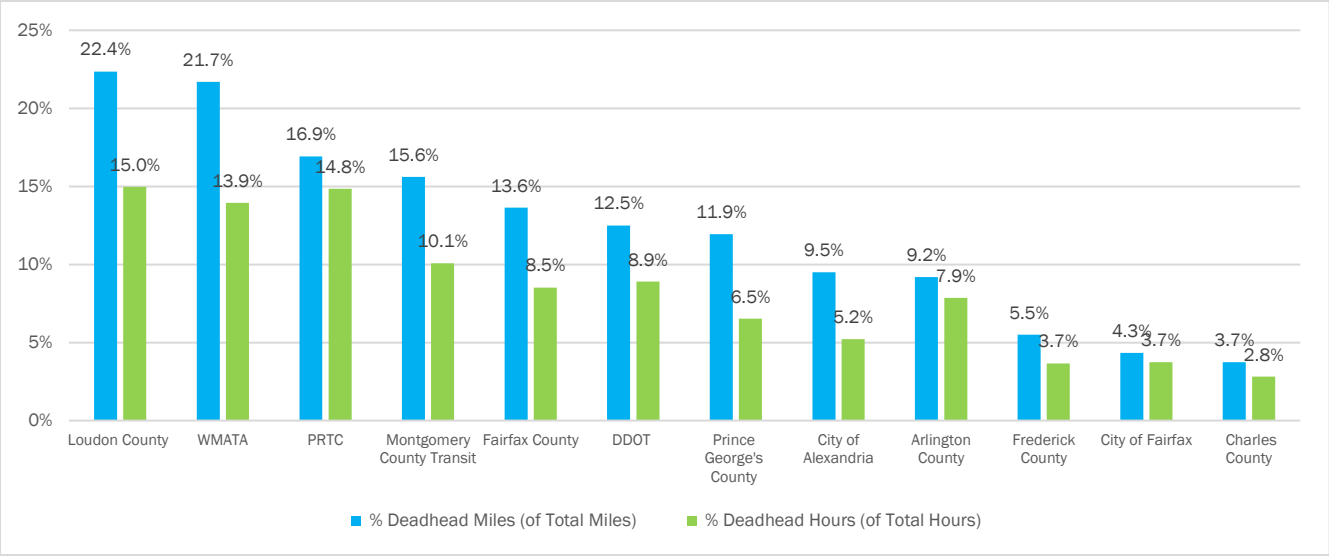
A range of operating characteristics, contractual issues, and governance structures can dramatically impact these O&M unit costs. Further examination of the NTD expense and service data partially explains the significant range in unit costs across transit providers. Among the most important explanations of the differences are:

- Deadheading: the amount of time and distance that vehicles operate outside of regular revenue service.
- Labor contracts: including operator wages, union work rules, and service profile.
- Fringe benefits: all non-salary benefits, including pensions.

The location of bus garages where overnight storage, maintenance, cleaning, fueling, and driver dispatching occurs relative to the locations where buses enter revenue service on a route varies significantly from operator to operator. This is revealed in Figure 2 which examines deadhead miles and hours as a percentage of total

miles and total hours. Loudoun County has the highest portion of deadhead miles of any of the operating agencies in the region, at least in part due to the long-distance commuter services that the agency operates. WMATA has a similarly high portion of deadhead miles, contributing to the agency's high Vehicle Operations Unit Cost.

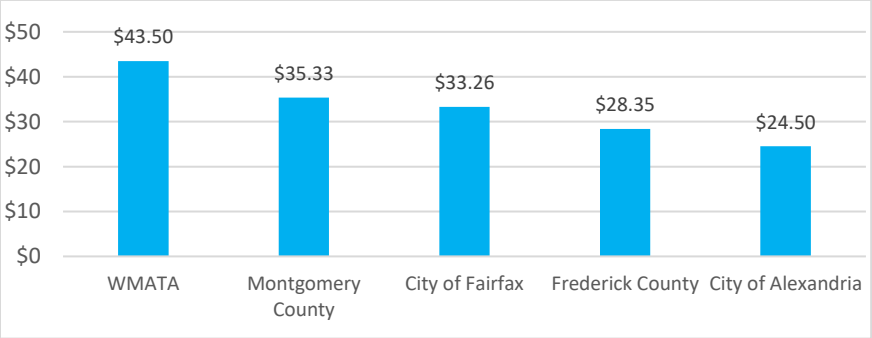
Figure 2: Deadhead Hours and Miles as a Percentage of Total Hours and Total Miles (FY17)



Source: 2017 NTD Data provided by operating agencies.

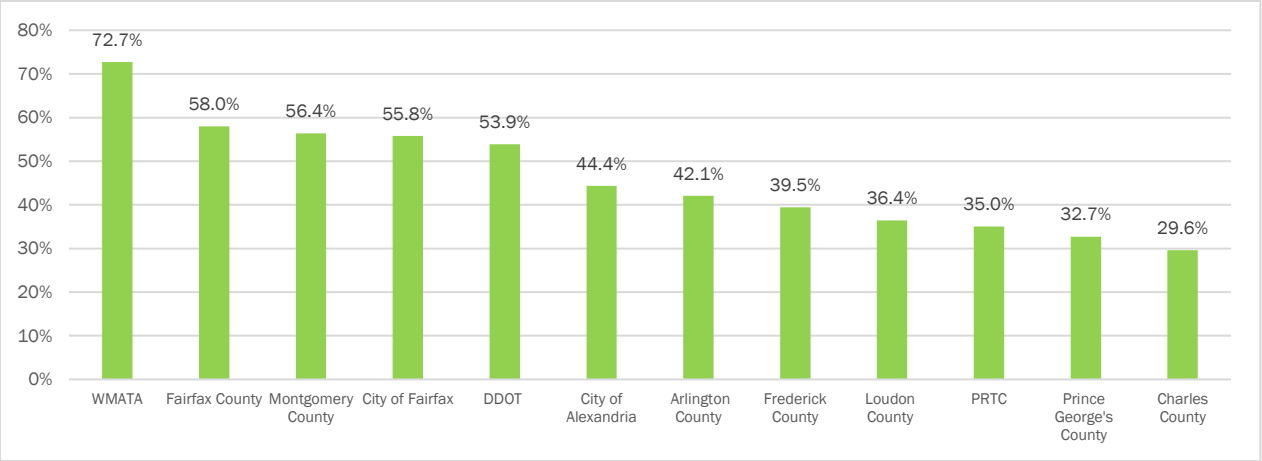
The average straight time wage rate for bus operators is not revealed in the NTD data, and only five agencies were able to provide that information for use in this study. Figure 3 illustrates the average wage rate per revenue hour at each of these agencies. The average wage rate incorporates not only regular wages but any labor contract provisions which affect payment, including overtime and other pay premiums, wage progression from entry level to top hourly wage, and the service profile (peak-to-base ratio) which can affect the amount of overtime and premiums paid. Of the agencies reporting this information, WMATA Operator wages are 23 percent, or approximately $8/revenue hour higher than the next highest operating agency.

Figure 3: Operator Wages per Revenue Hour (FY17)



The ratio of total fringe benefits paid to wages paid is shown in Figure 4. Note that this includes hourly and salaried employees, both represented (union) and non-represented. It is important to note that the high value for WMATA is partially explained by a large retired workforce receiving pension benefits. The other operators in the region have a smaller ratio of retired to working employees, and fewer retired or working employees entitled to pension benefits.

Figure 4: Fringe Benefits as a Percentage of Total Wage and Salaries (FY17)



Some additional cost data was provided by a subset of operating agencies, which is highlighted in more detail in Appendix D. This data provided further insight into the differences in general administration costs between operating agencies. A review of this data revealed that it is important to consider the amount and quality of general administration services that are provided by the operating agencies when making any comparisons.

- General administration costs for the suburban operating agencies are generally a relatively smaller proportion of total expenses than for WMATA. This is partially explained by the broad set of administrative responsibilities that WMATA has in supporting a very large network of regional and non-regional services in two states and the District of Columbia.
- Fairfax County and Arlington County have relatively large service planning and customer service functions compared to the other suburban operating agencies. Arlington County includes their significant customer outreach efforts, including the Commuter Stores in these costs, which results in higher costs than most other providers in this category.

Table 4 compares the effective rate per revenue hour of contracted purchased bus service for those agencies that were able to report this information. Market prices drive much of the differences among the jurisdictions that purchase transportation services for the delivery of bus service.

Table 4: Contractor Price for Purchased Transportation

Agency	Contractor Price Per Hour
Arlington County	$ 62.25
Charles County	70.63
Loudoun County (MV)	$ 63.68
Loudoun County (TD)	$ 133.38 *
Prince George's County	$ 97.96

Note: the value for Arlington County includes the combination of hourly, mileage-based, and fixed rate service.
** The high contract rate for Loudoun County may be due to a high share of deadhead miles/hours (See: Fig. 2)*

Transfer of Service Test Scenarios

As part of this study, test scenarios were analyzed for the potential impacts of transferring route operations between different operating agencies. The detailed methodology and results of the test scenarios can be found in **Appendix E**.

A hypothetical route, ten-miles long with an all-day 30-minute service frequency, was assumed as the test scenario for all jurisdictions. The average travel speed of the route was varied based on geography, with the understanding that bus services in more urbanized and congested areas tend to travel more slowly than services in more suburban or exurban areas where there is less congestion. Based on the operating characteristics highlighted above, the annual vehicle revenue hours and miles, and the number of vehicles required to operate this hypothetical route were calculated.

The following general results were found:

- In most cases, both the incremental and fully-allocated cost estimates derived from the local jurisdictional operator NTD-based unit costs and contractor rates were lower than the incremental and fully-allocated cost estimates from the WMATA NTD-based unit costs and prices for regional and non-regional Metrobus services.
- Differences in vehicle operating speed have a significant impact on the cost estimates for the test scenario. Generally, to deliver the same headways, slower speeds mean that more vehicles are required and also drive up vehicle revenue hours. All of this results in higher costs on slower routes. To improve total O&M costs for bus services, the region may want to consider ways to increase operating speeds.

IV. LITERATURE AND PEER REVIEW

There are substantial opportunities for local and regional bus operators to work together to improve efficiency in the provision of bus services through collaboration and integration of functions. This section summarizes relevant examples from academic literature and highlights strategies that other, similar metropolitan regions throughout North America have pursued to work together to make bus operations more efficient.

References for the information provided in this chapter are listed in **Appendix A: References.**

Literature Review

The importance of coordination and integration by transit agencies has been well recognized by researchers and transit practitioners.[10] Some coordination strategies contribute to efficiency gains from an operational perspective, others lead to improvement of the user experience, and some contribute to both. Research on the topic of regional resource coordination and integration has identified strategies that can be broadly categorized into two groups:

1. Customer-Oriented Coordination Activities – includes strategies undertaken to provide customers with seamless travel.
2. Agency-Oriented Coordination Activities – includes administrative changes affecting procurement, maintenance, capital planning, and staffing.

Customer-Oriented Strategies

This category includes coordination efforts that aim to improve the transit user experience, and often have a direct effect on the quality of service in a transit system. The following strategies have been highlighted by research in this area.

Table 5: Customer-Oriented Strategies Identified through Literature Review

	Strategy	Efficiencies Gained	Literature References
1	**Schedule Coordination –** Coordinate service schedules along major service corridors	■ Improves operational efficiency by: — Reducing bunching around stops to speed up service — Reducing long transfer times, especially when there are long headways (e.g. off-peak hours) ■ Improves rider experience by allowing passengers to seamlessly transfer from one bus system to another to optimize transfer times ■ Schedule coordination can be substantially enhanced by implementing real-time operational coordination using vehicle location and passenger load data	Rivasplata et al., 2012 Iseki et al, 2011 Goldman et al., 2015 Miller et al., 2005

[10] Goldman et al., 2015; Miller et al., 2005; Iseki et al, 2011; Rivasplata et al., 2012.

	Strategy	Efficiencies Gained	Literature References
2	**Shared Passenger Facilities –** Transit hubs and centers that provide passengers with comfortable spaces to make transfers, information services, and other passenger amenities	■ Reduces the perceived burden of transferring buses by providing more seamless transfers ■ Increases customer comfort and experience	Goldman et al., 2015 Iseki et al, 2011 Miller et al., 2005
3	**Regional Fare Structure –** Provide consistent pricing on all transit operators in the region	■ Simplifies complex fare structures ■ Provides uniformity and predictability to transit customers ■ Allows customers to pay only once Note: May add less value where SmartCards are used because complex charges can be automatically calculated and collected.	Goldman et al., 2015 Iseki et al, 2011 Miller et al., 2005
4	**Regional Fare Media (Smart Card) –** Adopt a single fare card or pricing mechanism that can be used for travel on all transit services	■ Enhances convenience for both riders and bus operators ■ Improves regular bus service speed by reducing transaction time ■ Can lower costs to collect fares ■ Makes it easier to use tiered pricing	Rivasplata et al., 2012 Goldman et al., 2015
5	**Information/Data Coordination –** Multiple agencies work together to: share data on operations; market transit services; produce schedule brochures; or operate a joint call center or information center	■ Agencies sharing real-time data allows agencies to better coordinate schedules and respond more quickly to operational disruptions ■ Can be a useful tool for reporting and responding to accidents and emergencies ■ Data on arrival time and delays can be conveyed to passengers in real time ■ Providing information about multiple agencies' services makes using the system easier and less confusing for the customer ■ If data processing and call center responsibilities are consolidated into one operation, can significantly lower costs	Iseki et al, 2011 Goldman et al., 2015

Agency-Oriented Strategies

Agency-oriented coordination strategies address efficiency in organizational, administrative, and financial operations of transit operators. These strategies are implemented behind the scenes and can substantially increase the efficient delivery of service without any change to the customer's experience. The following individual strategies have been identified through the literature review.

Table 6: Agency-Oriented Strategies Identified through Literature Review

	Strategy	Efficiencies Gained	Literature References
1	**Joint Procurement –** Multiple transit providers in a region team to purchase buses, gasoline, and other equipment	■ Leads to cost savings and expands purchasing power ■ Joint training and maintenance are easier if agencies purchase the same vehicles, software, and equipment ■ Helps small agencies in particular	Murray et al., 2015 Goldman et al., 2015
2	**Shared Fleet –** Multiple operators share a vehicle fleet	■ Optimizes the use of buses across providers – especially if agencies have a high spare ratio ■ If vehicles are operating under capacity, can substitute smaller vehicles from a shared fleet to enhance cost savings	Murray et al., 2015 Murray et al., 2015b
3	**Merge Duplicative Routes –** When two or more agencies operate buses along the same route, they can be taken over by one operator	■ Reduces operating costs (labor hours and operation expenses)	Goldman et al., 2015
4	**Joint Maintenance, Storage, and other Facilities –** One transit agency can provide maintenance/ vehicle storage services to other transit agencies, or maintenance can be contracted to one, third-party provider	■ Can lead to significant cost savings ■ Reduces need to purchase and maintain multiple facilities ■ Reduces maintenance expenses ■ Reduce deadheading especially for commuter buses, reducing fuel costs and vehicle wear and tear	Goldman et al., 2015
5	**Joint Staff Training –** Provide unified regional training program for personnel from all operators	■ Reduces overall training costs ■ Provides a uniform level of training and knowledge across the region ■ Brings uniformity to customer service across agencies	Goldman et al., 2015 Murray et al., 2015 Murray et al., 2015b
6	**Shared Technology –** All regional transit providers use the same systems including dispatching/scheduling platforms, GPS systems, AVL systems, and/or customer information platforms	■ Reduces overall cost for larger purchases ■ Makes training uniform across agencies ■ Makes data collected across agencies easier to compare	Goldman et al., 2015 Murray et al., 2015 Murray et al., 2015b

	Strategy	Efficiencies Gained	Literature References
7	**Shared Infrastructure -** Multiple agencies share fully or partially separated, dedicated, fixed-guideways for bus operations.	■ Provides faster, more reliable service ■ Reduces costs by reducing service hours ■ Improves travel time ■ Can create stronger relationships between providers	Goldman et al., 2015 Murray et al., 2015 Murray et al., 2015b
8	**Shared Service Standards/MOEs –** Multiple agencies agree on a set of shared performance metrics to achieve regional goals.	■ Enhances service quality across providers ■ Creates a process to achieve regional goals for transit operations and service delivery ■ Can create stronger relationships between transit operators	
9	**Shared Administrative Services –** Agencies combine their administrative functions – Finance, grants, contracting, compliance, human resources.	■ Leads to significant cost savings by eliminating redundancies across agencies ■ May lead to improved reliability in the provision of transit as similar service standards would exist across multiple providers ■ Can fill gaps in specialized knowledge ■ Streamlines book-keeping and decision making ■ Reduces competition for grant funding ■ Increases the collective and institutional knowledge – especially for smaller agencies acquiring more experienced staff	Goldman et al., 2015 Murray et al., 2015 Murray et al., 2015b
10	**Contractual Mergers –** Multiple agencies combine their operations into one agency, or smaller agencies are absorbed by a larger one	■ Provides uniformity of service in the region ■ Reduces redundancies in bus routes, costs, jobs, and maintenance and storage facilities across agencies	Goldman et al., 2015

National Peer Examples

Throughout North America, there are numerous examples of bus service providers in large metropolitan regions engaging in coordination activities. The follow examples illustrate the coordination efforts made in other similarly sized metropolitan areas, and quantifiable results are noted where available.

San Francisco, CA Metro Area - Metropolitan Transportation Commission (MTC)[11]

Coordinating Service Providers: Alameda-Contra Costa Transit (AC Transit), Bay Area Rapid Transit (BART), Caltrain, Golden Gate Transit, Golden Gate Ferry, SamTrans, San Francisco Municipal Transportation Agency (SFMTA or "Muni"), Santa Clara Valley Transportation Authority (VTA)

The Metropolitan Transportation Commission (MTC) is the metropolitan planning agency (MPO - i.e., the planning, coordination, and financing agency) in the San Francisco Bay Area. Though MTC is not a transit operator, it coordinates service in the region. There are no regional bus operators in the region; rather, each jurisdiction operates its own local bus service and the BART system provides regional rail connections.

Efficiency and Coordination Activities

Actions Taken:

- The providers worked together to implement the Clipper Card, a unified fare payment system, in 2010, which is currently used by over 20 service providers throughout the region.
- In response to budget shortfalls throughout the region, MTC initiated the "Transit Sustainability Project" to address productivity challenges. This program tied the provision of future funds to meeting cost reduction targets of 5 percent over a 5-year period. The providers were given flexibility to choose how to achieve the cost reductions. Other regional coordination recommendations of the project included: integration of bus/rail scheduling software; completion of multi-agency short range transit plans; enhancement of paratransit efficiency by introducing travel training and the creation of sub regional mobility manager; and the coordination of system schedules between BART and Caltrain.

Results:

- The Transit Sustainability Project illustrated a viable process that could be followed in other regions to achieve regional goals for transit operations and service delivery.
- After coordinating schedules with BART and Caltrain, Caltrain experienced a 17 percent increase in ridership over 4 months.[12]

Minneapolis-St. Paul, MN Metro Area – Metro Transit and Suburban Transit Association[13]

Coordinating Service Providers: Metro Transit, Minnesota Valley Transit Authority, Plymouth Metrolink, Shakopee Transit, SouthWest Transit, Prior Lake Laker Lines, and Maple Grove Transit

In the Twin Cities Region, transit services are provided by Metro Transit, the primary urban bus operator, and six surrounding suburban systems. Metro Transit is a division of the Metropolitan Council, the regional planning agency and MPO, and accounts for the overwhelming majority (90%) of all bus trips in the region. The six

[11] Sources: Goldman et al., 2015; Murray et al., 2015; Murray et al., 2015b; WMATA Marketability Study

[12] Miller et al., 2005; Iseki et al, 2011

[13] Sources: Goldman et al., 2015; Murray et al., 2015; Murray et al., 2015

smaller transit operators that serve the surrounding areas formed their own association called the Suburban Transit Association (STA), with their own board and governing apparatus.

Efficiency and Coordination Activities

Actions Taken:

- Development of a regional fare structure
- Unified route numbering
- Shared operations protocols for transit facilities
- Regional performance standards
- Coordinated scheduling along major downtown routes – In Downtown Minneapolis, two dedicated transit corridors were redesign optimize vehicle flows for all providers operating; this involved reassigning bus stops, optimizing bus schedules, and creating operational protocols.
- Regional fleet procurement – The Metropolitan Council owns the titles to all vehicles purchased in the region; this enables optimization of fleet management and more centralized control and oversight of capital initiatives.
- Shared technology – Metro Transit paid for and installed the same AVL system in buses of all transit service providers (except MVTA) – Trapeze ITS Transit Master system.
- Coordination regarding facilities – For example, the Mall of America Intermodal Transit Station accommodates 1.2 million light rail trips, 900,000 bus trips, and additional paratransit and rideshare passengers at a single facility.
- Shared customer service functions – Metro Transit operates the region's "Transit Information Center," which provides trip planning assistance and information on all regional operators to customers.

Results:

- Overall, these activities have improved service quality and customer information, and created an experience of transit services that are uniquely branded, but very well integrated from the passengers' point of view
- Unified route numbering has made the regional bus network more legible and coordinated from the passenger perspective
- Regional fleet purchasing/ central title ownership has led to cost savings and elimination of redundancies, and increased the resource pool for all agencies. When one operator no longer needs certain buses, Met Council can easily transfer them to another agency.
- Marq2 has been seen as one of the region's biggest and best success stories for coordination, leading to a smoothly running corridor that maximizes through traffic and travel speeds.
- Common AVL system has allowed for better coordination of all regional services and uniform information to customers.

Phoenix, AZ Metro Area - Valley Metro and Surrounding Local Transit Systems[14]

Coordinating Service Providers: Maricopa County Regional Public Transit Authority (RPTA) – AKA: Valley Metro, City of Phoenix, City of Tempe, City of Mesa, City of Gilbert, City of Chandler, City of Scottsdale

The regional transit authority for the majority of the Phoenix Metro Area is the Maricopa County Regional Public Transportation Authority (RPTA), commonly referred to as Valley Metro. Laws passed in the 1980's in Arizona allowed for local cities and counties to vote on funding for public transit. The regional transit system developed out of a series of locally adopted sales taxes which each supported a separate, local system. RPTA created

[14] Sources: Goldman et al., 2015; Murray et al., 2015

Valley Metro as the unified and consistent identity applied to the entire regional transit system. Local bus systems are marketed under the same Valley Metro branding (logo and paint) to create a seemingly unified regional system to passengers, even though the localities still operate their own networks.

Efficiency and Coordination Activities

Actions Taken:

- Joint branding and passenger Information – The look of the transit system in the region is the same, even though there are multiple operators, and passengers all refer to the same webpage and schedules for information on public transit services
- Unified fare system across all operators – The same fares apply across all regional operators
- Consolidated back office functions –
  - Shared bus procurement (managed by the city of Phoenix, but future purchases by Valley Metro)
  - Scheduling software (HASTAS) is the same for the region (managed by the city of Phoenix)
  - Long-range planning, fare policy, collection/distribution of fares, complaint line, paratransit services, rider surveys, passenger research (managed by Valley Metro)
- Service standards and guidelines – Valley Metro conducted Service Efficiency and Effectiveness Study (SEES) in 2007 and created shared service standards and process for service development based on performance measures
- Unified governance – PRTA and Valley Metro Rail have merged into one agency with shared executive functions, staff, and boards.
- Merged contracts – Joint contract between RPTA and City of Tempe transit services
- Dial-A-Ride – Valley Metro is responsible for operating ADA and Dial-A-Ride services marketed as East Valley Dial-A-Ride (EVDAR) for Tempe, Mesa, Gilbert, Chandler, and Scottsdale
- Regional planning – Valley Metro plays a larger role in regional planning than it did previously

Results:

- Overall, the coordination efforts have helped:
  - Increase ridership
  - Strengthen public support
  - Make the system easy to use and understand
  - Led to cost savings through joint contracting
- Joint branding – Made the system easier to understand and use and allowed for simplification of some functions, so a smaller staff is necessary
- Serve standards and guidelines – supports a system for service management and helps create consistency across service providers
- Unified governance – merger reduced staff and saved a significant amount of money
  - $1 million in savings by reducing senior staff from 10 people to 5
  - $1.2 million in additional savings from further staff reorganization
- Dial-A-Ride – Services were consolidated to reduce overall costs and provide seamless service between municipalities

Quebec, Canada - Associacion de Transport Urbain Du Quebec (ATUC)[15]

Coordinating Service Providers: 9 bus operators in Quebec in the cities of: Montreal, Quebec City, Longueuil, Laval, Levis, Saquenay, Sherbrooke, Trois-Rivieres, and L'Outaouias

ATUQ functions as a membership organization that is funded with dues collected from nine public transit agencies in the Province of Quebec. Montreal is the single largest operator of bus transit in the region, and there is little overlap in each of the operators' service areas. The association was created in 1983 by a series of individual bus operators that banded together to try to save money through group purchases, and represent the collective interests of the operators in policy making. Over the past 35 years, the group has implemented coordinated policies to increase efficiency.

Efficiency and Coordination Activities

Actions Taken:

- Group purchasing of buses, tires, and gasoline
- Created an integrated SmartCard fare system (OPUS Smart Card)
- Created service standards for all of the member operators that can be tracked through integrated benchmarking
- Lobbied the provincial and federal government on issues related to public transportation
- Operators that become experts on new technologies teach member agencies best practices

Results:

- Group purchasing has led to 15% average savings
- Lobbying efforts helped create a dedicated funding source for public transportation
- Implemented corrective actions based on benchmarking to improve performance

Los Angeles, CA Metro Area - LA Metro and Surrounding Local Transit Systems[16]

Coordinating Service Providers: Los Angeles County Metropolitan Transit Authority (LACMTA) – LA Metro, Antelope Valley Transit Authority, Culver CityBus, Foothill Transit, Gerdena Municipal Bus Lines, Long Beach Transit, City of Los Angeles Dept. of Transportation "DASH", Metrolink, Montebello Municipal Bus Lines, Norwalk Transit District, City of Santa Clarita Transit, Santa Monica Big Blue Bus, and Torrance Transit

In LA county, bus service is provided by LA Metro, and 12 individually branded municipal operators that serve specific parts of the county. LA Metro is by far the largest operator in the region, accounting for 2/3 of all bus service. Most of the smaller transit operators provide service that overlaps with LA Metro service areas, and there is substantial coordination among transit providers.

Efficiency and Coordination Activities

Actions Taken:

- General manager level coordination
- Financial coordination
- Coordinated service planning to keep track of service and coordinate scheduling
- LA Metro also provides technical assistance to smaller agencies

[15] Sources: Goldman et al., 2015; Murray et al., 2015

[16] Source: WMATA Marketability Study

- Unified payment system, but no coordinated fares

Seattle, WA Metro Area - Sound Transit and Surrounding Local Transit Systems[17]

Coordinating Service Providers: Sound Transit, Everett Transit, Community Transit, King County Metro Transit, Pierce Transit, and Washington State Ferries

Sound Transit was formed as an umbrella organization to provide high quality, high-capacity bus service throughout the Center Puget Sound Area. The local transit providers predate Sound Transit, the central, regional agency that has forged ahead with service coordination and integration projects.

Efficiency and Coordination Activities

Actions Taken:

- ORCA smart card integrated fare collection system
- Regional transit planning (ex. Sound Move – 10-year regional transit plan)
- Many cooperative infrastructure projects:
  - Transit Centers
  - Park and Ride Facilities

Pittsburgh, PA Metro Area - Port Authority of Allegheny County (PAAC)[18]

Coordinating Service Providers: Port Authority of Allegheny County (PAAC), Mid Mon Valley Transit Authority, Beaver County Transit Authority, Westmoreland County Transit Authority, Butler County Transit Authority, Fayette Area Coordinated Transportation, and New Castle Area Transit Authority.

The Port Authority system includes fully separated, dedicated busways (fixed-guideways) for bus operations between downtown Pittsburgh and the surrounding suburbs. There are three lines – East, West, and South, and vehicles using these lanes are faster and more reliable.

Efficiency and Coordination Activities

Actions Taken:

- PAAC allowed other regional operators to use the busways system shortly after the first busway opened in 1977.
- When the West busway (the most recently built busway) was being planning in the 1990's, the planning process assumed that it would allow other regional operators to use it.

Results:

- Reduces operating costs for transit agencies by reducing service hours necessary
- Improves travel time and reliability
- Strengthened the regional network overall, and strengthened relationships between systems
- The use of the regional busways by suburban operators has led to Penn Station becoming a de-facto regional transit center for all services traveling downtown
- Allowed the region to develop a regional transit network without integrating the services and operators

[17] Sources: Miller et al., 2005; Goldman et al., 2015; Murray et al., 2015

[18] Sources: Goldman et al., 2015; Murray et al., 2015

Local Examples of Collaboration and Cooperation

The Metropolitan Washington region's bus service providers already coordinate with each other in a variety of ways. Staff from all of the agencies included as part of this study communicate with each other to some degree through a combination of formal interagency arrangements and informal relationships that assist with coordination and sharing of information.

The following list has been compiled through regional research and with the help of members of the TAC.

Customer-Oriented Strategies

The following examples of customer-oriented strategies have been identified.

Table 7: Examples of Customer-Oriented Strategies Used in the Washington, DC Region

	Strategy	Local Examples
1	**Schedule Coordination –** Coordinate service schedules along major service corridors	■ DASH and PRTC coordinate with VRE, especially for off-peak and weekend trips. ■ Transit providers in the region regularly coordinate schedules for a wide variety of reasons (e.g., transfers, to provide a family of services in a corridor, bus stop/bay capacity)
2	**Shared Passenger Facilities –** Transit hubs and centers that provide passengers with comfortable spaces to make transfers, information services, and other passenger amenities.	■ Regional Examples: Metrorail Stations; Takoma/Langley Transit Center; Mark Center Transit Center; Pentagon Transit Center ■ Shirlington Transit Center; Seven Corners Transit Center ■ Lakeforest Transit Center; Westfield Montgomery Mall Transit Center; MARC train connections at Rockville and Silver Spring Metrorail stations; Other shared transfer nodes throughout the region that are coordinating locations for multiple providers (ex. Southern Towers in Alexandria)
3	**Regional Fare Structure -** Provide consistent pricing on all transit operators in the region	■ 2-hour transfer credit recognized by all providers
4	**Regional Fare Media – Smart Card –** Adopt a single fare card or pricing mechanism that can be used for travel on all transit services	■ SmarTrip card accepted by all local transit providers, except for the VRE commuter rail system.
5	**Information/ Data Coordination –** Multiple agencies work together to: share data on operations; market transit services; produce schedule brochures; operate a joint call center or information center	■ Shared commuter stores and associated marketing ■ WMATA Trip Planner includes all local services ■ Single agency websites providing regional information (Commuter Connections (MWCOG), Commuter Page (Arlington County)

Agency-Oriented Strategies

Bus service providers in the Metropolitan Washington area have implemented many agency-oriented strategies to enhance efficiency. Examples are provided in the table below.

Table 8: Examples of Agency-Oriented Strategies Used in the Metropolitan Washington Region

	Strategy	Local Examples[19]
1	**Joint Procurement –** Multiple transit providers in a regional team to purchase buses, gasoline, and other equipment	■ MTA has piggybacked in the past on WMATA bus purchases ■ DDOT has piggybacked on both Connecticut and Washington State procurement contracts, the former executed by WMATA on DDOT's behalf through a MOU ■ PRTC used DRPT's contract to purchase buses for TIGER. ■ ART utilizes a Fairfax County tire contract ■ MWAA tagged onto Fairfax County for buses ■ ART piggybacked off the last WMATA Procurement for buses ■ CUE used Montgomery County's contract to procure buses ■ MWCOG oversees a cooperative purchasing program that includes diesel fuel ■ The Virginia State bus procurement (DRPT) – allows local operators the ability to purchase under their contract
3	**Merge Duplicative Routes –** When two or more agencies operate buses along the same route, they can be taken over by one operator	■ Transit providers in the region frequently merge duplicative service through ongoing planning processes and coordination. ■ Fairfax County and Arlington County have both taken over WMATA routes that are now operated (largely the same as before) as local services. ■ Arlington TDP identifies a network of frequent WMATA corridor services, with ART providing local services. ■ WMATA line studies at times recommend discontinuation of service where overlaps occur ■ In planning for its BRT corridors, Montgomery County is studying local services to identify opportunities to reduce duplicative routes while maintaining an acceptable level of service while enhancing connectivity to BRT.

■ [19] Example from just outside of the region:
— Contractual Merger: RTA of Central Maryland was formed as a result of the merger of two agencies; previously, they were two agencies overseen by a contract manager.

	Strategy	Local Examples[19]
4	**Joint Maintenance, Storage, and other Facilities[20] –** One transit agency can provide maintenance/ vehicle storage services to other transit agencies, or maintenance can be contracted to one, third-party provider	■ WMATA has a 75-year lease from Fairfax County for the two agencies to co-occupy the West Ox bus facility. WMATA also pays a commensurate share of the facility operating and infrastructure renewal costs. ■ Fairfax County performs bus acceptance and maintenance audits for smaller providers such as ART.
5	**Joint Staff Training –** Provide unified regional training program for personnel from all operators	■ WMATA and Maryland MVA license CDL drivers in Maryland through a training program. DDOT is interested in joining the partnership, which may also be useful for other providers.
6	**Shared Technology –** All regional transit providers use the same systems including dispatching/scheduling platforms, GPS systems, AVL systems, and/or customer information platforms	■ The TIGER Transit Service Priority Project is an example of regional collaboration; buses now run along the same corridors, across jurisdictions, with TSP treatments that use the same technology. ■ DC region DCU3 farebox upgrade to update existing fare boxes by replacing obsolete technical components ■ WMATA is planning to rollout a new mobile-payment platform in 2019[21]
7	**Shared Infrastructure -** Multiple agencies share fully or partially separated, dedicated, fixed-guideways for bus operations.	■ Metroway in Arlington/Alexandria – allows multiple bus operators to use certain parts of the fixed guideway
9	**Shared Administrative Services –** Agencies combine their administrative functions – finance, grants, contracting, compliance, human resources.	■ WMATA currently manages First Transit's operation of DC Circulator through MOU with DDOT.

[20] Joint Facility just outside of the Metropolitan Washington region: Howard and Anne Arundel Counties both invested in the construction of a $14.8 million, 105-bus facility for RTA via a Memorandum of Understanding (MOU) for joint facility ownership, use, and management.

[21] Source: WMATA, https://www.wmata.com/about/news/mobile-ready.cfm

V. REGIONAL STRATEGY RECOMMENDATIONS FOR ENHANCED EFFICIENCY

1. Transfer or Merging of Service between Agencies

What is it?

Transferring services from one agency to another is the process of shifting the responsibility of operating a bus route or service to another agency with an overlapping service area. In the Metropolitan Washington Region, the majority of overlap is between the regional transit agency, WMATA, and locally operated transit providers in the cities and counties throughout the region, but in some areas two local agencies may have overlapping service areas. In some circumstances it may make sense for local agencies to take over the operation of service from WMATA, whereas in others it may make more sense for a local operator to transfer service to WMATA. The decision to pursue any of these options has financial implications that affect the cost efficiency of the provision of bus service in the region.

A merger of duplicative services can prove beneficial if two or more agencies operate buses along the same route. In these cases, the two routes may be merged into one which is either operated by a single agency, or jointly operated by two or more agencies.

Benefits

Transferring services from one agency to another can bring both financial and logistical benefits. If the hourly rate for operating bus service is less for one agency than another, transferring service to the cheaper agency can result in substantial cost savings. It should be noted that this only applies to local routes that operate within or just outside of one jurisdiction since most local transit operators in this region are not equipped to operate long-haul regional routes. Even if there are no savings to be found, the decision to transfer service from one agency to another can provide logistical or practical benefits. If an agency is struggling to keep certain routes performing at acceptable frequencies, another agency may have it within their capability to take over these struggling routes and provide higher quality service even if it may cost more to do so.

The merger of duplicative routes can also bring financial benefits by reducing operating costs based on the elimination of a route in service for one or more operators in the region.

Transfer of Service Test Scenarios

As part of this study, test scenarios were analyzed for the potential impacts of transferring route operations between different operating agencies. The detailed methodology and results of the test scenarios can be found in **Appendix E**.

A hypothetical route, ten-miles long with an all-day 30-minute service frequency, was assumed as the test scenario for all jurisdictions. The average travel speed of the route was varied based on geography, with the understanding that bus services in more urbanized and congested areas tend to travel more slowly than services in more suburban or exurban areas where there is less congestion. Based on the operating characteristics highlighted in **Chapter II**, the annual vehicle revenue hours and miles, and the number of vehicles required to operate this hypothetical route were calculated.

In most cases, both the incremental and fully-allocated cost estimates derived from the local jurisdictional operator NTD-based unit costs and contractor rates were lower than the incremental and fully-allocated cost estimates from the WMATA NTD-based unit costs and prices for regional and non-regional Metrobus services.

Regional Strategy Options

Each potential transfer of service in the region is included in the table below. Operators that have service areas that significantly overlap were included for comparison.

Evaluation Method

Benefits were determined as low, medium, or high, based on the incremental and fully-allocated cost savings realized by transferring operating responsibilities from one operator to another, described in Appendix E. In circumstances where a transfer of service would lead to higher operating costs, the benefit was listed as "low." Feasibility was determined based on the size of the agencies considered, and whether they would be able to take on additional provision of transit services. For instance, shifting responsibility for operating a route in the District of Columbia from WMATA to the DC Circulator would result in a medium benefit through modest cost savings, but has low feasibility based on the fact that the DC Circulator is a very small operator without the additional resources necessary to take on new services.

Table 9: Evaluation of Possible Transfers of Service

Jurisdiction	Operator	Benefit	Feasibility
District of Columbia	A. WMATA to Circulator B. Circulator to WMATA	Med Low	Low High
City of Alexandria/ Arlington County	C. WMATA to Dash D. WMATA to Art E. Dash to WMATA F. Art to WMATA	High High Low Low	Med Med High High
Fairfax County/ Fairfax City	G. WMATA to Connector H. WMATA to CUE I. Connector to WMATA J. CUE to WMATA	Med Med Low Low	Med Low High High
Montgomery County	K. WMATA to RideOn L. RideOn to WMATA	Med Low	Med High
Prince George's County	M. WMATA to The Bus N. TheBus to WMATA	Med Low	Low High

Issues/Implementation

Whether transferring service from one agency to another, or merging routes operated by multiple providers, the unique circumstances, operating costs, and desired level of service must be considered to weigh the costs and benefits of such changes.

2. Shared Maintenance, Storage, and Parking Facilities

What is it?

Shared maintenance, storage, and parking facilities provide space for multiple agencies to fulfill their needs. The way these types of facilities are organized can take on a variety of forms. Multiple regional and local

agencies can fund and operate a facility together and all parties can access and use the facility, or one agency can fund the facility and lease space to other agencies.

Benefits

There are many benefits that can be gained by pursuing shared facilities that can lead to cost savings and efficiency gains. One of the main benefits is reducing the overall number of properties that need to be purchased and maintained throughout the region to ensure that all agencies are able to maintain their fleets and continue to provide a high level of service. Though the size of the property that needs to be purchased for a shared facility may be larger than it would be if each agency purchased separate space, the number of real estate purchases is reduced. Completing a facility may also be made easier with the financial weight of multiple agencies and have a higher potential for making progress with multiple agencies involved that have a stake in ensuring that the project moves forward. In addition, if a shared facility is built that requires specialized labor replaces multiple smaller facilities, this can reduce the necessity for redundancies in staff and equipment.

In the case of storage and parking facilities, pursuing shared facilities throughout the region may reduce expenses associated with deadhead time. This is especially the case for commuter bus routes that have high demand in one direction during certain periods of the day. If these agencies partner with other local transit providers to park and store their buses during downtimes, they can avoid lengthy deadhead trips back to their originating jurisdiction.

Case examples:

- In Seattle, WA – Sound Transit contracts with three other operators in the region to store 20-25 buses during the day in a downtown Seattle location. Since peak hour demand is one-directional, this agreement was pursued to reduce deadheading back to other storage facilities. This has led to cost savings on fuel and vehicle wear and tear.

Regional Strategy Options

In the Metropolitan Washington region there are many planned facilities that are slated for geographic locations where sharing may make sense to improve efficiency. Each of the following facilities have been identified due to their ability to serve the needs of multiple bus transit service providers in the region.

Evaluation Method

For each of the proposed facilities, a specific location was determined based on publicly available information on the proposed project. If a specific location was not determined, a point was chosen within the proposed area (i.e. zip code or district) that contained zoning and surrounding land use compatible with a vehicle maintenance or storage facility.

An analysis was then completed using GIS to determine the number of transit providers that operate routes within a 5-mile radius of each proposed facility, and the total number of routes that each of those providers operate. A determination of low, medium, or high benefit was determined based on these two figures. The feasibility of each shared facility was determined as low, medium, or high based on the density of development within 0.25 miles in all directions of each facility. In this sense, the feasibility measure represents the general feasibility of building a sufficiently sized structure in each area.

As future facilities are planned by jurisdictions and transit operators in the region, a similar analysis can be performed to determine if the location of the planned facilities is within close proximity of the routes of multiple bus operators.

Table 10: Evaluation of Planned Maintenance, Storage, and Parking Facilities

Facility	Benefit	Feasibility	Notes
A. Arlington - New ART Satellite Parking Facility (Nauck, VA)	High	High	6 agencies and 175 routes operated within a 5-mile radius
B. DC - New DC Circulator Maintenance Facility (option 1): Armed Forces Retirement Home	High	Med	6 agencies and 169 routes operated within a 5-mile radius
C. DC - New DC Circulator Maintenance Facility (option 2): Southeast Blvd	High	High	7 agencies and 213 routes operated within a 5-mile radius
D. Montgomery - New Ride On Maintenance Facility	Low/None	Low	1 agency and 23 routes operated within a 5-mile radius
E. Arlington - New ART Heavy Maintenance Facility	Medium	Med	4 agencies and 83 routes operated within a 5-mile radius
F. WMATA - New Parking Facility and Bus Division (option 2): Bailey's Crossroads	Medium	Med	5 agencies and 128 routes operated within a 5-mile radius
G. WMATA - New Parking Facility and Bus Division (option 3): Silver Spring	Medium	Low	4 agencies and 124 routes operated within a 5-mile radius
H. Prince George's County – New TheBus maintenance facility to provide capacity for vision plan expansion*	NA	NA	NA

**Vision Plan in progress*

Issues/Implementation

The decision to pursue a shared facility or an agreement to share parts of a facility depends greatly on the circumstances at hand, the space available, and needs of the agencies involved. The more that any two agencies have in common (i.e. vehicles, technology, fuel types used), the less space and less redundancy in equipment and staff is needed within a given facility.

3. Shared Infrastructure – High Investment Corridors (Bus Rapid Transit)

What is it?

Shared infrastructure refers to arrangements where multiple agencies share operating infrastructure. Though shared infrastructure can take various forms, this strategy primarily refers to partially or fully separated fixed-guideway transit corridors.

Benefits

Allowing multiple operators to utilize operating infrastructure can provide faster and more reliable service across all transit operators that access the facility. These types of investments can increase travel speed, reduce delay, and increase the overall reliability of bus service, making the routes that run along them more efficient. Increased reliability can both reduce costs by reducing the service hours of a given route, and increase ridership by making travel by bus a more attractive option. In addition, working together to coordinate schedules and service along shared infrastructure can create stronger relationships between transit operators, and improve regional service.

Case Examples:

- In the Twin Cities Metropolitan Area, two downtown Minneapolis roadways, Marquette and 2nd Avenues, were redesigned as a pair of dedicated transit corridors providing two lanes of bus-only traffic in opposite directions. The City of Minneapolis and Metro Transit coordinated efforts with four other agencies – SouthWest Transit, Maple Grove Transit, Minnesota Valley Transit Authority and Plymouth Metrolink – to optimize the flow of vehicles throughout the corridors, reassign bus stops, optimize service schedules, and create a shared operational protocol for all systems accessing the corridors. The result of this coordinated effort has been smoothly running bus-only corridors that maximize throughput and travel speeds for riders among all the bus systems that access it.
- In Pittsburgh, PA, the Port Authority of Allegheny County (PAAC) has constructed three fully separated, fixed-guideway corridors for bus operations between downtown Pittsburgh and the surrounding suburbs. Since the first busway opened in 1977, PAAC has allowed other regional transit operators to access the systems, providing faster, more reliable service to bus passengers. As a result, operating costs have been reduced. By reducing the number of service hours, travel time and reliability have improved, and the operators in the region have formed close working relationships. In addition, the use of the busways by suburban operators has led to Penn Station, the downtown terminus point, becoming a de-facto regional transit center. By sharing these facilities, the Pittsburgh metro area has developed a strong regional transit network without integrating services and operators.

Regional Strategy Options

Each of the following projects represents a planned high-investment corridor project with dedicated (fixed guideway) infrastructure for buses. Though each of these is in a different planning phase, many of them may be designed to be utilized by multiple transit operators in order.

Evaluation Method:

Using publicly available information on the project limits for each planned high-investment corridor in the region, a GIS analysis was completed to determine: the total number of agencies that operate along the corridor today, the number of routes that each agency operates along the corridor, and the total length of all routes operating along the corridor. Benefits were determined as low, medium, or high based on these three measures. Feasibility was determined based on the ability of multiple bus types to physically access and utilize an improved corridor. For example, corridors that are being planned with off-board payment systems and level boarding stations and stops cannot be utilized fully by other agencies that do not operate compatible buses

and services (i.e., express versus local service), unless the buses are simply gaining advantage from the priority treatments and do not plan to serve any stops/stations.

Table 11: Evaluation of Planned High-Investment Corridor Projects

Facility	Benefit	Feasibility	Notes
A. Arlington - Columbia Pike Premium Transit Network	High	High	2 agencies, 11 routes, total length of all routes: 24.1 miles
B. Fairfax - VA-7 Transitway	High	High	3 agencies, 15 routes, total length of all routes: 18.0 miles
C. Fairfax - US-1 Transitway	Medium	High	2 agencies, 7 routes, total length of all routes: 30.3 miles
D. Alexandria - West End Transitway	Medium	High	3 agencies, 14 routes, total length of all routes: 18.8 miles
E. Alexandria - Duke Street Transitway	Low	High	2 agencies, 9 routes, total length of all routes: 18.4 miles
F. Montgomery - MD 355 BRT corridor	High	Low – level boarding/ off-board payment, infrequent stations	2 agencies, 11 routes, total length of all routes: 35.6 miles
G. Montgomery - US 29 BRT corridor	High	Low – level boarding/ off-board payment, and infrequent stations	2 agencies, 12 routes, total length of all routes: 42.0 miles
H. MTA - Southern Maryland Rapid Transit Project	Medium	High	3 agencies, 8 routes, total length of all routes: 17.6 miles

Issues/Implementation

The decision to allow multiple agencies to utilize a fixed-guideway corridor is mostly based on the needs of the transit agencies that overlap where the infrastructure is to be built, and the characteristics of the system being planned. For instance, if a fixed-guideway Bus Rapid Transit corridor is being planning and built along a major arterial with provisions for level boarding and off-board fare collection, the types of buses that can operate within this corridor are unique. For additional agencies to utilize the system, they would also need to purchase vehicles that are compatible with the infrastructure. In addition, if opportunities are identified for commuter services to run along high investment routes, agencies planning the routes must consider differences in the character of the service provided. Since commuter routes make few stops, the ability to share infrastructure may be highly limited by the presence of frequent stop services.

4. Joint Procurement

What is it?

Joint procurement refers to the process of two or more transit providers joining forces to collective purchase vehicles, parts, fuel, and services. These agreements usually lead to higher volume purchases that may allow for more competitive pricing and interoperability amongst the agencies participating. Joint procurement can be a great strategy to make new bus propulsion technologies and intelligent devices more accessible to all regional bus service providers.

Benefits

Joint procurement of new assets, fuel, parts, and or services can increase an individual agency's purchasing power by introducing economies of scale into the process of purchasing. Most vendors will lower the per-unit purchase price if the total amount of materials or vehicles that are being purchased increases. In addition, under federal and state regulations, the administration of any given procurement contract can be extremely burdensome. If joint procurement agreements are sought, this could shift the burden of administration onto one primary agency, thus reducing regional redundancies. This can be particularly effective for smaller agencies, especially if they collaborate with larger ones that have more resources dedicated to procurement processes and administration.

Case Examples:

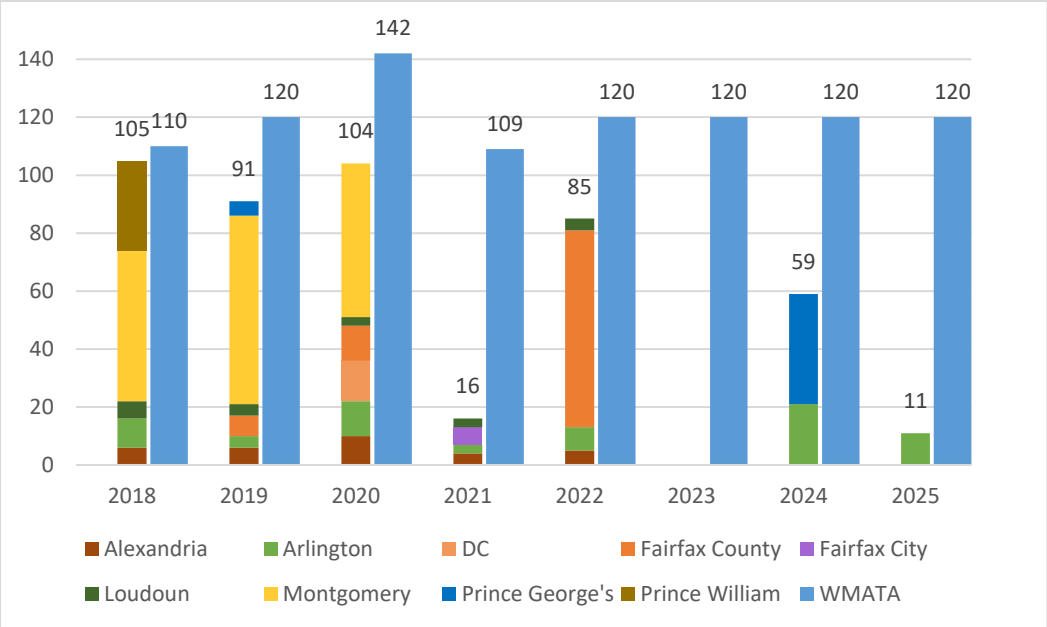
- In the Twin Cities Metropolitan areas, the Metro Council oversees a regional fleet purchasing agreement, and maintain the titles to the entire fleet of vehicles centrally. This agreement has led to cost savings and the elimination of redundancies in purchasing, and has also increased the resource pool available to all agencies to the Metro Council owning the title to all vehicles purchased. If one agency no longer needs certain vehicles, they can easily be transferred to another agency.
- In Quebec, Canada, the Associacion de Transport Urbain Du Quebec (ATUC) maintains a collective purchasing agreement for buses, tires, and gasoline for the 9 operators in the province that participate. The group purchasing agreement led to an average of 15% savings across the region.
- As a small transit provider, the Eastern Contra Costa Transit Authority collaborated with two other small-sized agencies to procure updated paratransit management software, which would have been out of their reach had they sought to purchase this on their own. The three-agency agreement has grown into a 21-member coalition over the years, and staff from each agency share the administrative burdens associated with the procurement contracts. This has reduced overall administrative costs for each agency, and has allowed these small transit providers to negotiate lower prices for buses and other equipment.

Regional Strategy Options

Though there are multiple local examples demonstrating circumstances in which multiple transit providers in the region have sought to procure assets and equipment (See: Local Examples), there is great opportunity to formalize and expand such agreements in the Metropolitan Washington Region.

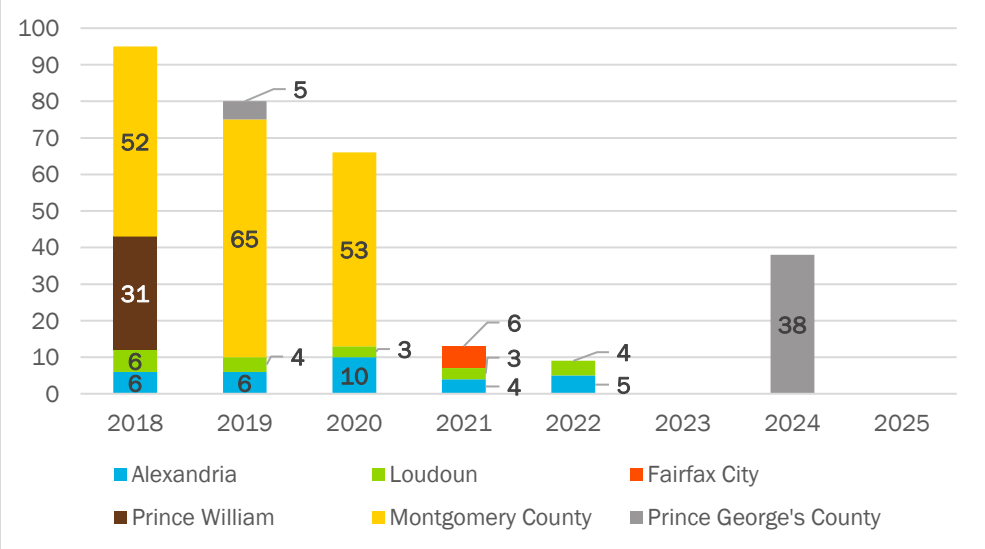
One of the most common strategies for joint procurement is joining together to purchase new buses to negotiate more favorable terms with bus manufacturers. Figure 1 illustrates the number of planned bus purchases by all jurisdictions in the region between now and 2025. Over 1,400 buses are scheduled to be purchased throughout the region over this period. Though most of those purchases will be by WMATA, this also includes nearly 500 buses operated by other agencies.

Figure 5: Planned Bus Purchase by Jurisdiction (2018-2025)[22]



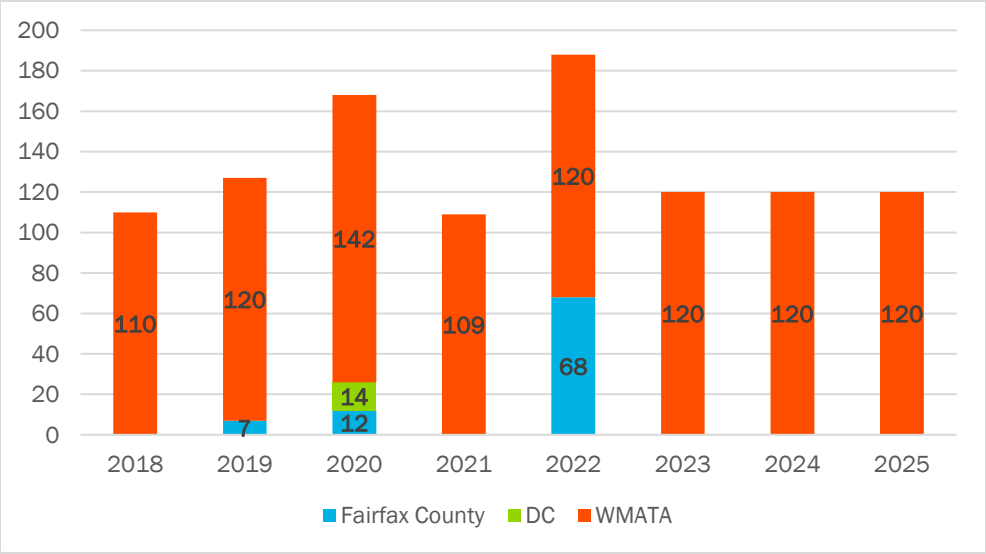
Joint procurement of buses only works in circumstances where multiple transit providers operate vehicles made and sold by the same auto manufacturer. Figures 3 and 4 below show overlap in the scheduled bus purchases by make. These 2 graphs illustrate the potential for joint procurement of Gilig and New Flyer buses in the near future.

Figure 6: Planned Gilig Bus Purchases by Jurisdiction (2018-2025)



[22] Data represents information included in each agency or jurisdiction's long-range planning documents, including Transit Development Plans and Fleet Management Plans. Actual, updated numbers may vary

Figure 7: Planned New Flyer Bus Purchases by Jurisdiction (2018-2025)



Evaluation Method:

The benefit of each of the procurement strategies outlined below was determined as low, medium, or high based on the scale of the financial impact of the proposed strategy. Feasibility was determined based on the legal and administrative ease of implementing each strategy.

Table 12: Joint Procurement Strategies

Strategy	Benefit	Feasibility	Notes
A. Regional Procurement Contract for Buses	High	Low	▪ This can lead to the greatest number of buses purchased under one contract, and can generate the most favorable pricing. ▪ If all regional bus operators participate, this will create a fleet of compatible vehicles across multiple operators, which can reduce costs associated with maintenance and training, can lead to universal fuel types at shared fueling facilities, and allow agencies to purchase vehicles from one another based on demand.
B. Regional Procurement Contract for other purchases: Fuel, Parts, Services	High	Medium	▪ This can lead to the greatest amount of fuel, parts, and services purchased under one contract, and can generate the most favorable pricing.

Strategy	Benefit	Feasibility	Notes
C. Procurement Agreement for Buses between Two or more Jurisdictions	Medium	High	■ Can generate modest cost savings comparted to a regional contract ■ Provides all the same benefits as a regional agreement, but on a smaller scale
D. Procurement Agreement for Other Purchases between Two or more Jurisdictions	Low	High	■ Can generate modest cost savings compares to a regional contract

Issues/Implementation

To assess if a joint procurement agreement is feasible, agencies that are looking to partner with one another should complete a full analysis of joint procurement opportunities. This can be done by compiling an inventory of facilities and assets to identify overlap in equipment and fueling needs, as well as when new vehicle purchases will need to be made.

In the Metropolitan Washington Region, one additional challenge is that Maryland, Virginia, and the District of Columbia have different procurement procedures and requirements. To pursue to region-wide agreement, the procurement contract needs to consider the requirements of each jurisdiction.

5. Shared Customer Service Functions

What is it?

The sharing of customer service functions entails multiple agencies or operators coordinating to jointly market transit services and/or provide information and customer support services to riders. Examples include:

- Jointly operating a customer information and/or customer support center
- Jointly marketing transit services provided (via materials development, marketing/advertising, and/or market research activities)

The operation of a joint customer information center would likely entail the sharing of data and programs on service operations, enabling service providers to have accurate and timely information about on-the-ground conditions and changes.

Benefits

Consolidating customer information or support services into one operation can lead to cost savings by achieving economies of scale and eliminating or reducing redundancies. It also creates a better experience for the customer, as customer service providers have up-to-the-minute information on various services, enabling them, for example, to advise customers of alternative travel options in the event of a disruption.

Case Examples:

- In the Twin Cities Metropolitan area, seven transit operators have created a Transit Information Center, which provides trip-planning assistance and information on all regional operators. The Center is led by Metro Transit, which is governed by the Metropolitan Council, the region's MPO. The Transit Information Center activities have improved service quality and integrated customer information, despite the providers maintaining distinct brands. Furthermore, the agencies' common AVL system has allow for better coordination of all regional services and consistent (and accurate) information to customers.
- In the Phoenix region, the Maricopa County Regional Public Transportation Authority (RPTA) created Valley Metro as the unified and consistent brand that applies to all transit services (from various providers) throughout the entire region. The coordinating providers have: established a website with information about services from all participating providers integrated; begun using shared scheduling software, complaint lines, and passenger research efforts; and created a unified governance structure that requires fewer total staff. While no causation can be proven, ridership, public support, and cost savings have increased following the change.
- Research from the private sector indicates that incorporating new customer service tools (such as online chat options for resolving customer questions or issues) can result in significant cost savings for companies. While implementation of such services can be expensive, the pooling of resources between multiple agencies can increase the feasibility of implementation to achieve longer term cost savings.

Regional Strategy Options

The following have been identified as realistic shared customer service that regional transit agencies may collaborate on functions in the Metropolitan Washington region.

Evaluation Method:

The benefit of customer service strategy outlined below was determined as low, medium, or high based on either potential cost savings or improvements to the rider experience. Feasibility was determined based on the technological, legal, and administrative ease of implementing each strategy.

Table 13: Shared Customer Service Strategies

Strategy	Benefit	Feasibility	Notes
A. Regional coordination and promotion of transit information resources (e.g. CommuterPage.com)	Medium	High	■ Improved customer information and experience
B. Establish a consistent channel (e.g. committee of representatives from each agency that meets regularly) to coordinate communications regarding construction and service disruptions	Medium	Medium	■ Achieve efficiencies through coordinated fleet deployments ■ Improved customer experience and improved resolution of disruption-related issues
C. Joint regional call (and communications) center	High	Low	■ Achieve efficiencies and economies of scale through reduced staffing ■ Improved customer experience
D. Shared customer service studies (e.g. mystery rider, on-board surveys)	Medium	Medium	■ Achieve efficiencies and economies of scale through reduced procurements

Issues/Implementation

In this region, each agency has its own website and methods of communicating information about services, service changes, and service disruptions (scheduled or unscheduled). However, these are generally not coordinated. Jointly updating and promoting a centralized resource for transit and travel information (such as commuterpage.com, which is operated by Arlington County), as well as coordinating with each other to discuss how information about planned disruptions will be communicated (and what alternative travel options are available), would significantly reduce customer confusion and could save money for each individual agency.

Each agency currently maintains its own customer service department for responding to customer questions or complaints. If the agencies pooled their resources to support one regional call center (which could be locally or internationally-based, and could also include additional features such as customer service via chat or chatbot), significant cost savings and efficiencies could be achieved, as well as consistent messaging. A regional call center would also be effective in communicating information about services from multiple providers, and could include within its scope providing information regarding complementary modes or services, such as bikeshare options for first mile/last mile connections or guaranteed ride home (GRH) programs. Some of these proposed strategies (e.g., joint regional call center or shared customer service studies) could be accomplished through joint procurement mechanisms.

6. Shared Administrative Functions

What is it?

Shared administrative functions is the sharing and/or coordination between multiple agencies or service providers to carry out business functions that have similarities across organizations. The main difference between this strategy and shared customer service functions is that shared administrative functions involves "back end" activities (i.e., those that are not visible to the public and, generally, do not directly affect the customer experience). The purpose of such coordination is to achieve efficiencies (by reducing redundancies, filling gaps in specialized knowledge, and/or streamlining decision-making), thereby freeing up funds to invest in improved service and infrastructure (or other functions or investments). Administrative functions that could be shared could relate to:

- Staff
- Facilities
- Financial management services
- Legal/compliance services
- Contracting
- Grant management
- Human resources (HR)
- Asset inventories, maintenance, condition assessment, or disposal
- Service operations
- Security services

Benefits

Across transit agencies, many administrative functions, as well as the regulations and requirements governing them, are similar. In many cases, there are significant economies of scale that can be realized. For example, if one HR department manages health care benefits for three agencies, the total amount of staff hours that must be dedicated to identifying and negotiating health care plan options for employees could be significantly reduced. The number of staff hours needed to undertake tasks such as processing payroll, acquiring software programs, etc. could also be reduced.

Case Examples:

- While it is difficult to specify the cost reductions that can be expected from implementing shared administrative functions, given the level of potential variation in costs, required staffing, etc., the experience of RPTA and Valley Metro in the Phoenix region provides a helpful point of reference. When the two entities formally merged in in 2013-14, the agency achieved $2.2 million in savings in the first year -- $1 million in savings by reducing senior staff from 10 people to 5, and $1.2 million in additional savings from further staff reorganization. In that case, the merged RPTA and Valley Metro entities began sharing executive functions, staff, and a governing board.
- In 2009, the New York State Comptroller examined the potential for sharing administrative functions between New York's 3,175 local governments and estimated that potential savings from such actions -- which range from consolidation of police functions to the sharing of facilities, joint infrastructure purchases, and records management -- were as high as $765 million annually statewide.[23]
- In the DC region, there are already several successful examples of collaboration to share administrative functions. The TIGER Grant for Priority Bus Transit in the National Capital Region is an example of several regional agencies coming together to implement Transit Signal Priority (TSP) treatments to enhance bus service across jurisdictional lines.

[23] Source: New York State, Office of the State Comptroller, https://www.osc.state.ny.us/localgov/pubs/research/sharedservices.pdf

Regional Strategy Options

The following have been identified as specific administrative functions that regional transit agencies in the Metropolitan Washington region may collaborate on.

Evaluation Method:

The benefit of each administrative function strategy outlined below was determined as low, medium, or high based on potential cost savings. Feasibility was determined based on the technological, legal, and administrative ease of implementing each strategy

Table 14: Shared Administrative Function Strategies

Strategy	Benefit	Feasibility	Notes
A. One agency performs bus acceptance for other agencies	Medium	Medium	• Critical function that many smaller agencies may not have in-house
B. Regional collaboration on asset disposal and auction or other asset management functions	Medium	Medium	• Achieve efficiencies and economies of scale
C. Merging of governance, staff, operations, and/or other functions between bus service providers in the same state or entire region	High	Low (same state); Very Low (entire region)	• Major efficiency and economies of scale gains • New agency can choose best practices from merging agencies to employ
D. Information sharing regarding successful practices in administration	Medium	High	• A step down from sharing of functions, there is still a lot to be gained from sharing information relative to the level of effort

Issues/Implementation

Given the relatively low feasibility of the strategies that would have the highest regional impact (merging governance and other major agency functions), that the most practical strategy to pursue would be for the region's bus service providers to (or continue to) collaborate to identify new or enhanced ways of sharing administrative functions where there are significant gains that can be achieved -- for example, by adding additional services or functions to existing arrangements and working together to identify the administrative areas most ripe for combining functions. In this case, as with the previous strategy, existing joint procurement or MOU arrangements could be seen as the building blocks upon which increased sharing of functions can be built.

7. Joint Training

What is it?

The consolidation and sharing of resources described in the strategies above create an opportunity to further reduce administrative costs through joint trainings. Even without shared customer service or administrative staffing, joint trainings remain a potential way to improve the regional provision of transit service. A portion of the cost of labor in a specialized field like public transit comes from staff trainings, some of which are required by local regulations, and some of which are the result of changing policies and technologies. Examples include extensive training requirements for maintenance personnel, bus operator training and education, dispatcher training, safety and security training, and leadership training.

Benefits

Opportunities exists to organize, procure, and conduct these trainings across agencies, resulting in less duplication and greater savings to individual agencies and the region as a whole. Currently, each agency is responsible for training its own personnel, resulting in the same type of work duplicated many times over across the region. By consolidating at least some of this work, the cost of these trainings would be reduced for each agency and the savings to the entire region could be significant.

Case Examples:

- In the Research Triangle region of North Carolina, seven local transit providers attempted to consolidate much of their service under one umbrella. Although full consolidation was eventually deemed impractical, they created a formal means of coordination under the Seamless Public Transportation Service Project Committee. This body of representatives from each provider met quarterly to identify and discuss regional coordination projects and goals. One of the outcomes of the committee was a coordinated approach to providing safety and security training. Other types of trainings are also conducted regionally, including leadership training. Although the agencies involved did not provide a precise measure of this strategy's impact, they nonetheless concluded that it had a positive effect on the region's transit network.
- In the Twin Cities region, Metro Transit created a ground-breaking program that incorporates elements of career training, education, and on-the-job experience. The program begins with classroom education and a summer paid internship at one of Metro Transit's bus garages. Participants who are interested then complete a two-year associates degree at a nearby technical college, while continuing to work as full-time paid interns at Metro Transit. Upon completion of the academic degree, full-time employment at Metro Transit is available to the graduates. Of the approximately 40 participants who started the program, 19 of them completed the summer internship and enrolled for their two-year degree, with an expected graduation date in the summer of 2018.
- Currently, the Urban Institute is in the process of developing a competency-based occupational framework for "transit bus technicians," that defines companies, knowledge, skills, and personal attributes associated with high performance in the workplace. This project serves as a guide for developing a technician training program for bus technicians and can be adapted to the specific circumstances in this, and other regions.

Regional Strategy Options

The following have been identified as specific training opportunities that regional transit agencies in the Metropolitan Washington region have expressed interest in collaborating on.

Evaluation Method:

The benefit of each joint training opportunity outlined below was determined as low, medium, or high based on either potential cost savings or the potential of the joint training program to address a critical regional challenge. Feasibility was determined based on the technological, legal, and administrative ease of implementing each strategy.

Table 15: Joint Training Strategies

Strategy	Benefit	Feasibility	Notes
A. Joint CDL Training	Low	High	• Smaller agencies can piggyback on larger agency training programs • Improves driver availability
B. Joint Clever Devices Training	Low	High	• Smaller agencies can piggyback on larger agency training programs • Improved data sharing
C. Maintenance Trainings	Low	Medium	• Smaller agencies can piggyback on larger agency training programs • Sharing of information and techniques can improve SOGR region-wide
D. Safety and Security Training	Low	High	• Smaller agencies can piggyback on larger agency training programs • Can create a uniform standard for safety and security across all agencies
E. Regional Technician Training Program	High	High	A regional pipeline of trained bus maintenance personnel would address an ongoing regional shortage of qualified bus mechanics.

Issues/Implementation

There are challenges to providing joint trainings to transit employees across the Metropolitan Washington region. First, some of the region's transit providers have a unionized workforce. Each union may have different training requirements for their members, making it difficult to provide comprehensive trainings which meet the requirements of all the regional unions. Second, the technology and the transit vehicles used by each provider vary by jurisdiction. There are dozens of bus vehicle models in service across the region, each with its own specialized maintenance needs and prerequisite trainings. Identifying opportunities for shared maintenance trainings will be a challenge.

As a result, the types of trainings which would be easiest to coordinate concern technologies and skills which are shared by all or a portion of the region's transit providers. These include trainings on the use of fareboxes and Clever devices, and safety protocols and skills. Additionally, training related to specific bus components that are common across many fleets such as HVAC, clean diesel, transmissions, and other major bus components.

8. Shared Technology

What is it?

With technology playing an increasingly important role in the region's transportation system, it is important that transit providers not only keep abreast of the latest developments in the industry, but also coordinate their use of technology across jurisdictions. This includes utilizing compatible Automatic Vehicle Location (AVL) and GPS systems, adopting Transit Signal Priority (TSP) protocols, and providing easy access to Automatic Passenger count and other data.

Benefits

The benefits to coordinating shared technologies are primarily experienced by the region's transit riders, rather than as costs savings to the providers. Nonetheless, this strategy can have a significant positive impact on creating a more integrated transit network across a region which is easier and more convenient to use. For example, shared technologies across transit providers make it possible to create trip planning tools for riders to help navigate a region's transit system, and to push out real-time information over many platforms from many providers.

Case Examples:

- The seven transit providers in the Twin Cities Metropolitan area undertook a massive regional coordination effort, which included shared systems and technologies to streamline service and improve the rider experience. Investments in uniform farebox systems and integrated AVL technologies enabled a mix of cascading down-stream improvements, including a regional fare payment tool and real-time bus arrival information. Coordination around shared technologies significantly improved the rider experience for transit-users in the Minneapolis-St. Paul region. In addition to a consistent fare payment system (a strategy which the DC region already employs), the investments in AVL technologies enabled riders to know when their bus would arrive in real-time, making it easier to use transit across the region. The local providers reported that this, in turn, reduced the number of calls to the call-center, potentially decreasing administrative costs. These benefits were not exclusively felt by riders: investments in computer servers and software allowed the region's transit providers to share automated passenger count (APC) and AVL data. The integrated AVL system also facilitated more efficient scheduling and dispatching across transit providers.

Regional Strategy Options

The following have been identified as possible opportunities for shared technology in the Metropolitan Washington region that regional transit agencies may collaborate on.

Table 16: Shared Technology Strategies

Strategy	Benefit	Feasibility	Notes
A. Standardized processes for the collection and dissemination of GTFS, APC, and AVL data	High	Medium	■ All agencies collecting and reporting the same data makes analysis easier, and shared data products feasible, including shared call centers, real-time arrival information,

Strategy	Benefit	Feasibility	Notes
			and better coordination in dispatching and scheduling. ■ Easier for transit riders to use regional system, transferring between providers with greater ease. ■ Transit providers benefit from gained efficiencies resulting from uniform data.
B. Transit Signal Priority Systems	High	High	■ Implementing roadside equipment with TSP and equipping buses from multiple agencies with devices that allow them to interact with TSP systems will increase reliability of the system as a whole while reducing costs from time savings. ■ Transit riders experience improvements to the service via reduced travel times and improved reliability.
C. Flex Services	Low	Medium	■ Coordination among agencies to contract for flex services where fixed-route is inefficient can reduce costs while improving access and mobility. Zonal flex services can be cross-jurisdictional through a single contract.

Issues/Implementation

Implementing joint technology initiatives is inherently challenging. Each agency has different information/technology needs, making it difficult to create technology solutions which satisfy all the parties involved. And even when the needs of agencies do overlap, the specific tools and protocols of each agency's IT department vary significantly. While the goal of this strategy is to reduce this variation, making progress towards this goal can be complicated. Technology procurement is also a laborious and complex process. And if the region does manage to consolidate some of its technology platforms under the same vendor, making upgrades to that technology to reflect new innovations in the industry can be even more difficult than under the status quo. The question of who owns, manages, and stores the data is also a potential obstacle to regional collaboration. When it comes to TSP, the number of stakeholders involved increases significantly, expanding beyond simply the transit providers to Public Works departments, State highway officials, and local politicians. The DC region has experience navigating this mix of stakeholders, but further implementation on a wider scale will only increase the challenge.

VI. ADDITIONAL STRATEGIES

Beyond the strategies highlighted and evaluated in Section VI, there are additional strategies that transit providers in this region can pursue to realize efficiencies in the provision of bus service and improve the passenger experience. Each of these strategies have either been found to be effective in the Metropolitan Washington region or in other similar region in the North America, and are good policies to follow.

Schedule Coordination

What is it?

Schedule coordination refers to when transit providers actively track and coordinate transit service schedules along major service corridors with other agencies and modes.

Benefits

Coordinating schedules across multiple transit providers can improves operational efficiency by reducing bunching around stops to speed up service, and reducing long transfer times, especially when there are long headways (e.g. off-peak hours). In addition, this strategy can improve rider experience by allowing passengers to seamlessly transfer from one bus system to another to optimize transfer times, or from bus to commuter rail. Schedule coordination can be substantially enhanced by implementing real-time operational coordination using vehicle location and passenger load data.

Case Examples:

- In the Twin Cities, regional transit agencies coordinate scheduling along major downtown routes and have experienced substantial efficiency gains. Specifically, in Downtown Minneapolis, two dedicated transit corridors were redesigned to optimize vehicle flows for all providers; this involved reassigning bus stops, optimizing bus schedules, and creating operational protocols. Marq2, the nickname of these two transit corridors, has been seen as one of the region's biggest and best success stories for coordination, leading to a smoothly running corridor that maximizes through traffic and travel speeds.
- In the San Francisco Metropolitan area, MTC complete the "Transit Sustainability Project", which, in part, called for the integration of bus and rail scheduling software. One result of the implementation of this was a recorded 17 percent increase in ridership over a 4-month period once BART and Caltrain schedules were coordinated.

Regional Fare Policy

What is it?

The goal of a regional fare policy is to create a consistent pricing structure on all transit operators in the region. The region currently implements aspects of this strategy, including certain agencies matching Metrobus fares and honoring free transfers between systems, but gaps and disparities in the network exist and more could be done to create a uniform regional policy.

Benefits

A regional fare policy results in a less complex fare structure, which makes it easier for riders to use the regional transit system. A simple, uniform policy would allow riders to navigate the system more easily by allowing for more transfers. The use of the region's SmartCard decreases the potential benefit of this strategy, as transfers and fare discounts are calculated automatically without demanding much attention from riders.

Case Examples:

- In the Twin Cities, regional transit providers worked together to develop of a regional fare structure, with uniform fares and fees across all buses in the region. As part of overall coordination package, this has helped to improve service quality by improving fare predictability.
- In the Phoenix Metro Area, the transit providers have created a unified fare system across all operators. Though this was part of a larger package of coordination activities along with joint branding across transit providers, it has helped make the system easier to understand and use, and has helped increase ridership and public support for public transportation in the region.

Shared Passenger Facilities/ Transit Hubs

What is it?

Transit hubs and other shared passenger facilities provide passengers with comfortable spaces to make transfers, information services, and other passenger amenities.

Benefits

Transit hubs facilitate transferring between buses, particularly between service providers. As a result, they can increase customer comfort and improve the overall rider experience. They promote the perception that the region's transit system is coordinated and comprehensive, thereby increasing customer confidence and satisfaction.

Case Examples:

- In the Metropolitan Washington region – Shared passenger facilities are common. These facilities provide accommodations for multiple bus service operators, allowing for seamless transfers. These include:
  - Metrorail Stations; Takoma/Langley Transit Center; Mark Center Transit Center; Pentagon Transit Center; Shirlington Transit Center; Seven Corners Transit Center; Lakeforest Transit Center; Westfield Montgomery Mall Transit Center; MARC train connections at Rockville and Silver Spring Metrorail stations; and other shared transfer nodes throughout the region that are coordinating locations for multiple providers (ex. Southern Towers in Alexandria)
- In the Twin Cities region – Regional transit providers coordinate extensively on passenger facilities to make the transit system in the region a more seamless experience for riders. For example, the Mall of America Intermodal Transit Station is one of the largest transit hubs in the country and serves multiple service providers and modes. Each year this station accommodates 1.2 million light rail trips, 900,000 bus trips, and additional paratransit and rideshare passengers at a single facility.

Shared Service Standards/MOEs

What is It?

When a region adopts shared service standards, multiple agencies agree on a set of shared performance metrics to achieve regional goals. These can reflect specific regional goals and objectives and can cover a wide array of performance and financial targets.

Benefits

Implementing shared service standards has multiple benefits to both transit passengers and operators. First, this can enhance service quality across providers by providing standards across all regional operators. Second, shared service standards create a process and a mechanism to achieve regional goals for transit operations and service delivery, in regions where operational responsibilities are diffuse. Working together to create and ensure compliance with such standards can create stronger relationships between transit agencies.

Case Examples:

- In response to budget shortfalls throughout the region in the San Francisco Metropolitan areas, MTC initiated the "Transit Sustainability Project" to address productivity challenges. This program tied the provision of future funds to meeting cost reduction targets of 5 percent over a 5-year period. The providers were given flexibility to choose whether to pursue this through reductions in service hours, costs per passenger, or cost per passenger mile. Other regional coordination recommendations of the project included: integration of bus/rail scheduling software; completion of multi-agency short range transit plans; enhancement of paratransit efficiency by introducing travel training and the creation of sub regional mobility manager; and the coordination of system schedules between BART and Caltrain. As a result, the Transit Sustainability Project illustrated a viable process that could be followed in other regions to achieve regional goals for transit operations and service delivery.

- In the Phoenix Metropolitan area, Valley Metro conducted the Service Efficiency and Effectiveness Study (SEES) in 2007 and created shared service standards and process for service development based on performance measures. These shared service standards and guidelines supported a system for service management and helped create consistency across all service providers in the region.

VII. IMPLEMENTATION AND NEXT STEPS

The strategies outlined in Chapter VI of this document offer transit operators and decision makers in the Metropolitan Washington region a wide array of potential options for improving efficiency in the provision of bus service through coordination and collaboration. Each of these has been presented in brief along with highlights of a high-level evaluation of the benefits that may be realized and the feasibility of implementation.

In presenting these strategies, the report includes an examination of many potential strategies that may be pursued. It is not anticipated that all strategies descried will be implemented. Instead, regional transit providers will select those that best serve their individual and collective goals and objectives.

Taking this into account, this section does not outline a path toward implementing all strategies as a comprehensive plan for the region. Rather, it estimates a timeframe to implement each strategy separately and highlights aspects that may make implementation either simple or difficult.

Timeframe Definitions

Though some of the regional strategies for efficiency are ambitious in scope, the region's transit providers and local jurisdictions have already proven their ability to effectively work together on big projects to improve the provision of bus services in the region, and can continue to do so moving forward. Though some strategies are relatively simple to pursue across at least two jurisdictions in the short term, implementing changes throughout the entire region is complex, but not impossible, as proven through the successes of peer regions.

For each of the proposed regional strategies, a potential timeframe for implementation is identified in Table 17. This timeframe is meant to present an approximation of how long each of the potential strategies would take to implement if they were to be pursued. In general, the timeframe is directly linked to the technological, legal, political, or administrative complexity of implementing each regional strategy. Specific steps toward implementing each strategy are highlighted in the "Next Steps" section that follows the table.

Definitions of Timeframes for Implementation:
Short Term: 1 to 2 years
Medium Term: 3 to 5 years
Long Term: 5 or more years

Implementation: Timeframe, Lead Agency and Next Steps

Table 17: Timeframe, Lead Agency, and Next Steps for Implementation

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
1. Transfer of Service Between Agencies	**Medium/Long** Transferring service from one agency to another takes a substantial amount of time and planning. Whereas transfers and mergers of service that are already planned may happen relatively quickly, identifying new ones and negotiating the administrative logistics can be a lengthy process.	**All** Any transit service provider in the region can initiate and lead a transfer of service with any other agency.	■ Determine service characteristics, including type of services and who should operate them as part of a regular performance evaluation and when updating Transit Development Plans (TDPs) or through other planning efforts. ■ Engage agencies with overlapping service areas to identify which service provider should take over operation of the route or service, or where two services can be merged. (See Appendix C for more information)
2. Shared Maintenance, Storage, and Parking Facilities	**Medium/Long** Building and managing maintenance, storage, and parking facilities to be able to accommodate the needs of multiple agencies is a medium to long-term endeavor. Agencies looking to coordinate on such facilities need to identify properties and design facilities to accommodate multiple transit providers.	**All** ■ Any transit service provider in the region can initiate negotiations to build a shared facility with other service providers in the region. ■ Agencies currently planning/designing facilities as identified in this report.	■ For planned facilities (included those identified in this report) agencies should explore the possibility of allowing other agencies to access the new facility. ■ When pursuing a new facility, transit agencies should assess the plans of bus service providers with proximal service areas. ■ When needs align, perform a feasibility study to explore whether a shared facility is possible, and whether the costs and benefits would make collaboration worthwhile.

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
3. Shared Infrastructure	**Medium/Long** Pursuing shared infrastructure projects is a medium to long-term endeavor. If projects are currently under construction, allowing multiple agencies to operate along it can be incorporated in the medium term. For projects still being planned, implementation time would be long-term.	**All** ■ Any transit service provider in the region can initiate negotiations to build shared infrastructure with any other service providers in the region. ■ Agencies currently planning/designing infrastructure as identified in this report.	■ For planned infrastructure, agencies should explore the possibility of allowing other agencies to operate on the new infrastructure. ■ When pursuing new projects, transit agencies should perform a feasibility study to explore if a sharing infrastructure is possible.
4a. Regional Procurement Contract for Buses	**Long** The legal and administrative challenges to implementing a regional procurement contract are significant. Maryland, Virginia, and DC have different legal procurement requirements, so getting all parties on the same page will be difficult and will take considerable time. Large assets, such as buses, can be some of the most complicated items to purchase due to technical specifications that each state and jurisdiction require, which also contributes to a longer timeframe for implementation.	**COG/ WMATA/State Agency** This effort will involve a prolonged coordination and negotiation process, and COG has led such endeavors in the past. COG and regional partners created a cooperative purchasing program that is used by jurisdictions throughout the region to purchase police and firefighting equipment.	■ Create a Regional Bus Procurement Committee, with representatives and decision makers from local, regional, and state agencies that meets on a regular basis. ■ Complete a survey of procurement laws and regulations in MD, VA, and DC, and identify areas of potential conflict. ■ If changes in state law and regulation are necessary, pursue these changes with state agencies/legislatures. ■ Plan out a scope and guidelines for developing a cooperative purchasing agreement for buses. ■ Using the scope and guidelines, develop a cooperative purchase agreement that all local agencies can use to acquire buses.

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
4b. Regional Procurement Contract for Other Purchases: Fuel, Parts, Services	**Medium/Long** As with buses and other large assets (4a), the legal and administrative hurdles to overcome for other joint purchases are also complicated. Maryland, Virginia, and DC all have different procurement requirements, so getting all parties on the same page will be difficult and take time. The procurement of fuel, parts, and services is generally not as complex as acquiring large assets, and may make the implementation of this strategy faster.	**COG/WMATA/State Agency** This effort will involve a prolonged coordination and negotiation process, and COG has led such endeavors in the past. As noted above, COG and regional partners created a similar cooperative purchasing program that is used by jurisdictions throughout the region to purchase police and firefighting equipment.	■ Create a Regional Bus Procurement Committee, with representatives and decision makers from local, regional, and state agencies that meets on a regular basis. ■ Complete a survey of procurement laws and regulations in MD, VA, and DC, and identify areas of potential conflict. ■ If changes in state law and regulation are necessary, pursue these changes with state agencies/ legislatures. ■ Plan out a scope and guidelines for developing a cooperative purchasing agreement for other purchases (fuel, parts, and services). ■ Using the scope and guidelines, develop a cooperative purchase agreement that all local agencies can use.
4c. Procurement Agreement for Buses between Two or More Jurisdictions	**Short** Creating a joint procurement agreement between two or more agencies is much less complicated than creating a regional contract, especially if the two agencies fall within the same state.	**All** Any individual agency can enter into an agreement with another without a central organizing party.	■ Identify immediate and long-term bus procurements needs. ■ Research the procurement requirements of other agencies, short term procurement needs, and existing procurement contracts. ■ Enter into negotiations to piggyback off an existing contract or to create a new collaborative contract with another agency.

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
4d. Procurement Agreement for Other Purchases between Two or More Jurisdictions	**Short** Creating a joint procurement agreement between two or more agencies is much less complicated than creating a regional contract, especially if the two agencies fall within the same state.	**All/Any** Any individual agency can enter into an agreement with another without a central organizing party.	■ Identify immediate and long-term bus procurements needs. ■ Research the procurement requirements of other agencies, short term procurement needs, and existing procurement contracts. ■ Enter into negotiations to piggyback off of an existing contract or to create a new collaborative contract with another agency.
5a. Regional Coordination and Promotion of Transit Information Resources	**Medium** All transit providers in the region maintain their own channels for communicating transit information to their customers. Building a system that satisfies the needs of all transit providers and users in the region – in other words, combining existing informational resources into a streamlined and centralized system – would take a moderate amount of time.	**COG/Arlington County** As the Metropolitan Planning Organization, COG has a regional perspective and experience building centralized information pages for regional services (i.e. CommuterConnections.com). In addition, Arlington County maintains one of the most robust transit information resources in the region (commuterpage.com) which can be used as a starting point for building a single, regional information source	■ Engage in a discussion of strategy value among participating/interested agencies through one of the regional forums for public transit agencies. ■ Review CommuterPage.com and other existing information resources for regional comprehensiveness and to identify gaps and needed improvements. ■ Consider logistical requirements and details of redirecting transit users to a new website, application, or phone number to receive information.

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
5b. Establish a Consistent Channel to Coordinate Communications regarding Construction and Service Disruptions	**Short** Currently, all transit providers in the region maintain their own channels for communicating service disruptions due to maintenance, construction, or emergencies. In general, interagency coordination to address service disruptions is done on an ad hoc basis, if at all.	**COG/ WMATA** As the Metropolitan Planning Organization (MPO), COG has a regional perspective and experience as a forum for regional communication. In addition, WMATA has developed strict and consistent guidelines for public outreach and information regarding services changes and disruptions in its Public Participation Plan.	■ Assess and document current practices for communicating service changes and disruptions and for helping customers identify alternative travel options. ■ Perform a feasibility study that identifies gaps in communications and coordination practices, as well as potential solutions to fill these gaps. ■ Implement a regional information outlet for service disruptions (i.e. website, email alerts, printed publication) and create a uniform standard for communication, including cross-agency coordination where appropriate.
5c. Joint Regional Call and Communication Center	**Long** All transit providers in the region currently maintain their own call and communication centers. Combining these into one, central, regional center will take a long time to implement, as agencies will need to overcome differences in communications/ customer service policies, capacity issues regarding the location of the center, and staffing issues regarding who will be employed (among other logistics). Staff are likely to resist the change due to the inconvenience of changing locations. Moving infrastructure will also require significant time and effort.	**COG/WMATA** As the Metropolitan Planning Organization, COG has a regional perspective and experience as a forum for regional communication. In addition, WMATA has the largest communications and customer service apparatus in the region, and can provide regional leadership in developing and guiding operation of a central communications and call center.	■ Form a task force to assess the need and feasibility. ■ Assess and document current communications and customer service practices and identify major differences and similarities. ■ Perform studies to assess issues surrounding location, employment, funding, and oversight.

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
5d. Shared Customer Service Studies	**Short** This strategy can be implemented in the short term because there are no major administrative, legal, or technological hurdles to overcome for regional transit providers to engage in shared customer services studies.	**All** Every transit agency in the region completes customer service studies and efforts such as mystery rider programs or surveys to gauge customer satisfaction	■ Identify ongoing and upcoming customer service studies and assess similarities. ■ Formulate and implement an agreement/MOU to jointly conduct or contract for customer service studies and surveys.
6a. One Agency Performs Bus Acceptance for Other Agencies	**Short** The administrative challenges of adopting this strategy would be relatively simply if the agency performing bus acceptance is in the same state as its partner agencies. If this were to be a broader, regional system for bus acceptance, implementation would take longer.	**All** Smaller agencies with fewer staff resources should look for opportunities to piggyback on the acceptance processes of larger ones. Agreements can be made between any two or more agencies. WMATA, Ride On, and Fairfax connector are the largest transit providers in the region, and have more staff than many of the other smaller; therefore, they would be the most likely agencies able to perform this.	■ Assess opportunities, current practices, and interest, as well as potential challenges that would need to be addressed. ■ Identify agencies with additional capacity, and implement an agreement/MOU that allows for one agency to perform acceptance for another.

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
6b. Regional Collaboration on Asset Disposal and Auction or Other Asset Management Functions	**Short** This strategy would be relatively simple to implement, despite potential administrative, legal, and technological challenges.	**All** Smaller agencies should seek larger ones that dispose and/or auction assets on a regular basis. Agreements can be made between any two or more agencies.	■ Assess opportunities and current practices. ■ Conduct a feasibility study of opportunities for merging asset management functions. ■ Formulate and implement an agreement/MOU to jointly share certain asset management functions.
6c. Merging of Governance, Staff, Operations, and/or Other Functions between Bus Service Providers in the Same State or Entire Region	**Long** Depending on the degree of administrative function merging, this strategy could involve complex administrative, legal, and political challenges that would likely take an extended period of time to overcome. Incremental sharing of administrative functions where it makes sense (for example, where two agencies' current practices are similar) is also possible.	**COG/ WMATA** As the MPO, COG has experience convening regional leaders to discuss and address complex regional challenges. WMATA, as the regional transit authority and largest transit provider in the region and would most likely play a large role in this process. Interested agencies could work together to identify appropriate lead agencies based on interest, capabilities, and capacity	■ Form of a task force to assess the need and feasibility of merging administrative functions. ■ Form a regular forum with local, regional, and state stakeholders for coordination between interested parties of the merger or merged functions.

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
6d. Information Sharing regarding Successful Practices in Administration	**Short** There are no administrative, legal, or political challenges to overcome to set up an information sharing structure. This could be done relatively quickly through existing coordination channels, such as the TPB Regional Public Transportation Subcommittee or Regional Bus Subcommittee.	**COG** As the MPO, COG has experience convening regional leaders to discuss regional challenges, and already oversees regional forums that enable transit providers in the region to actively coordinate. Agencies could coordinate to identify challenging administrative areas and identify the agencies most suited to shares its practices with others in the chosen forum.	■ Identify regional best practices for transit administration as well as existing administrative challenges, and ask agencies with greater experience and capabilities to present through a regional forum for transit providers. ■ Identify appropriate staff to participate in the forum to ensure the information reaches the right staff and that relationships for further coordination between peer staff are formed.
7a. Joint CDL Training	**Short** The administrative, legal, and technological complications are minimal, which could lead to short term implementation.	**WMATA** As the Regional Transit Authority with the largest team of operators and largest training programs, WMATA is a natural fit to coordinate or lead this effort. Key points of contact from each jurisdiction would also need to be identified.	■ Complete a survey of current CDL requirements in Maryland, Virginia, and the District of Columbia. ■ Identify the largest training programs in the region, with the greatest capacity to accommodate additional trainees. ■ Set up a fee structure that would be advantageous for both the agencies providing training and the agencies sending their staff to be trained.

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
7b. Joint Clever Device Training	**Short** The administrative challenges are minimal. Where multiple agencies have adopted similar technology in their bus fleets joint training can occur.	**WMATA** As the Regional Transit Authority, with the largest fleet and largest training programs, WMATA is a natural fit to lead this effort.	■ Identify which regional agencies use Clever Device technology platforms. ■ Set up a fee structure that would be advantageous for both the agencies providing training and the agencies sending their staff to be trained. ■ Identify opportunities and barriers for other agencies that do not currently use Clever Devices to adopt consistent technology platforms as time allows.
7c. Maintenance Trainings	**Short** The administrative challenges are minimal. While agencies use different bus vehicle makes and models and as a result, maintenance needs vary widely depending on the size and type of the vehicle fleet, where multiple agencies have fleet similarities joint training can occur.	**All** Any individual agency can enter into an agreement with another without a central organizing party.	■ Identify which regional agencies share a similar fleet makeup with similar maintenance needs. ■ Identify barriers to implementation based on agency-specific labor/union requirements. ■ Set up a fee structure that would be advantageous for both the agencies providing training and the agencies sending their staff to be trained.

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
7d. Safety and Security Training	**Short** Each agency uses different safety and security protocols, but opportunities may exist in the short term to identify areas of overlap, and perhaps even align some of these standards so that there are more opportunities for collaboration.	**All** Any individual agency can enter into an agreement with another without a central organizing party.	■ Identify which regional agencies share safety and security protocols. ■ Identify barriers to implementation based on agency-specific safety and security protocols. ■ Set up a fee structure that would be advantageous for both the agencies providing training and the agencies sending their staff to be trained.
7e. Regional Technician Training Program	**Long** This strategy would require a lead agency, significant coordination with multiple stakeholders (transit agency, educational institution, labor unions), and financial commitment to creating a sustainable program into the long term.	**COG/ WMATA** As the MPO, COG has experience convening regional leaders to discuss and address complex regional challenges. WMATA, as the regional transit authority, and largest transit provider in the region and would most likely play a large role in this process	■ Identify which regional agencies would be interested in participating. ■ Identify local program partners, including educational institution, non-profits, and other community stakeholders. ■ Develop a common curriculum based on agency needs and maintenance requirements. ■ Develop other programmatic details based on the needs of participating agencies. ■ Set up a fee structure that would be advantageous for participating agencies.

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
8a. Standardized Processes for the Collection and Dissemination of GTFS, APC, and AVL	**Medium** This strategy is likely not feasible until the medium term due to technological barriers and the necessary administrative cooperation. For this strategy to be successful, it would be necessary for a critical mass of agencies to align their information and technology systems into a consistent platform.	**COG/ WMATA** As the MPO, COG has experience convening regional leaders to discuss and address complex regional challenges. WMATA, as the regional transit authority, and largest transit provider in the region and would most likely play a large role in this process. WMATA has led previous efforts to standardize fare-payment and other data-sharing initiatives in the past.	■ Identify which regional agencies share compatible technology platforms. ■ Identify barriers to implementation based on technology and security constraints. ■ Define which data would be useful to share and create processes for data collection and dissemination.
8b. Transit Signal Priority Systems	**Long** This strategy requires significant capital investments, technology procurement, and coordination with many regional stakeholders.	**COG/ WMATA** As the MPO, COG has experience convening regional leaders to discuss and address complex regional challenges. WMATA, as the regional transit authority, and largest transit provider in the region and would most likely play a large role in this process. COG has led previous efforts to implement TSP in certain parts of the region.	■ Identify agencies, jurisdictions, and other stakeholders who are interested in participating in this program ■ Identify funding source for program

Strategy	Timeframe for Implementation	Lead Agency	Next Steps
8c. Flex Services	**Long** Flexible bus service as a service provision model has existed for many years, but recent technological developments have led some agencies across the country to consider new models of flexible bus service. In the long-term, as the technology and the industry change, this strategy will be an area for potential collaboration between agencies. Future flexible service will likely allow riders to cross jurisdictional boundaries, thereby requiring collaboration between agencies and jurisdictions.	**All** Each agency will have the opportunity to decide to what degree it would like to embrace new flexible service models. As such, any individual agency can enter into an agreement with another without a central organizing party.	■ Each agency should continue to monitor changes in technology and the transit industry ■ Identify opportunities to implement cross-jurisdictional flexible service when it can better serve riders ■ Create cost-sharing models that distribute the costs of cross-jurisdictional flexible service across multiple agencies

APPENDIX A: REFERENCES

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APPENDIX B: TECHNICAL ADVISORY COMMITTEE (TAC)

A Technical Advisory Committee (TAC) for this study provided oversight, guidance and information throughout the process of developing this report. The TAC has members from agencies at the state (Maryland, Virginia, and the District of Columbia), regional (MWCOG, WMATA), multi-jurisdictional (Potomac and Rappahannock Commission[24], Northern Virginia Transportation Commission), county (Arlington, Charles, Fairfax, Frederick, Loudoun, Montgomery, Prince George's), and city (Alexandria, District of Colombia, Fairfax City) levels. The TAC met four times throughout the study process, each time providing valuable insight and guidance to inform the contents and quality of this study. The input of the TAC was instrumental in the development of this report, and the research team would like to acknowledge and thank each member for participating.

List of TAC Participants

- Deana Archey - Montgomery County
- Jeffry Barnett - Charles County
- Erik Belmont - District Department of Transportation (DDOT)
- Stuart Boggs - Fairfax County
- Timothy Canan - Metropolitan Washington Council of Governments (MWCOG)
- Allison Davis - Washington Metropolitan Area Transit Authority (WMATA)
- Clinton Edwards - Virginia Department of Rail and Public Transportation (DRPT)
- Sean Egan - District Department of Transportation (DDOT)
- Gary Erenrich - Montgomery County
- Michael Felschow - Fairfax County
- Darlene Flynn, Montgomery County - RideOn
- Anthony Foster, Prince George's County - TheBus
- Mathew Gaskin - Metropolitan Washington Council of Governments (WMCOG)
- Dan Goldfarb - Northern Virginia Transportation Commission (NVTC)
- Scott Gross - Loudoun County
- Al Himes - Washington Metropolitan Area Transit Authority (WMATA)
- Todd Horsley - Virginia Department of Rail and Public Transportation (DRPT)
- William Jones, Arlington County - ART
- Megan Kanagy - District Department of Transportation (DDOT)
- Sarah Kleckner - Loudoun County
- Arianna Koudounas - Metropolitan Washington Council of Governments (MWCOG)
- Veronica D. Lowe - Frederick County
- Jim Maslanka - City of Alexandria

[24] The Potomac and Rappahannock Transportation Commission (PRTC) is a multi-jurisdictional agency in Virginia representing Prince William, Stafford and Spotsylvania Counties and the Cities of Manassas, Manassas Park and Fredericksburg.

- Phillip Mclaughlin, Montgomery County - RideOn
- Heidi Mitter - Virginia Department of Transportation (VDOT)
- Raymond Mui, City of Alexandria - DASH
- Perrin Palistrant - Potomac and Rappahannock Transportation Commission (PRTC)
- Nick Perfili - Washington Metropolitan Area Transit Authority (WMATA)
- Eric Randall - Metropolitan Washington Council of Governments (WMCOG)
- Chloe Ritter, City of Fairfax - CUE
- Rich Roisman – Formerly of Metropolitan Washington Council of Governments (MWCOG)
- Kari Snyder - Maryland Department of Transportation (MDOT)
- Jennifer Vickery, Maryland Transit Administration - Locally Operated Transit Systems (MTA – LOTS)
- Carrie Watters - Frederick County
- Randy White - Fairfax County
- Steve Yaffe, Arlington County - ART

APPENDIX C: REGIONAL BUS SERVICE EVALUATION

The region's transit providers and their service areas were described and evaluated to identify opportunities for collaboration. There were limited challenges found due to the existing collaborations efforts of the member jurisdictions. The challenges that were identified were either: isolated incidents or had no clear actionable solution. The process and the challenges are documented below.

Regional Transit Supply and Demand

Each agency individually attempts to balance the demand for transit from its residents with their supply of transit service. The demand and supply were measured for all agencies within the MWCOG region to identify where services are not being provided consistently across the region.

The demand was measured by combining the 2016 employment and population to approximate the amount of activity happening with each census block. Typically, blocks with less than 1 job or person per acre are not active enough to support any level of transit service. Areas below 5 jobs or person per hour are best suited for limited stop, commuter, or other coverage service types. Areas above 5 jobs or person per acres can support local bus service with varying frequencies of service.

The supply was measured by the effective peak frequency of service through each census block. The level of service was captured from the GTFS feeds of each service provider. GTFS feeds were not available for Frederick (Transit), Loudoun (LCT), and Charles (Van-Go) Counties. GIS files were substituted for these agencies.

Density of Activity Trends

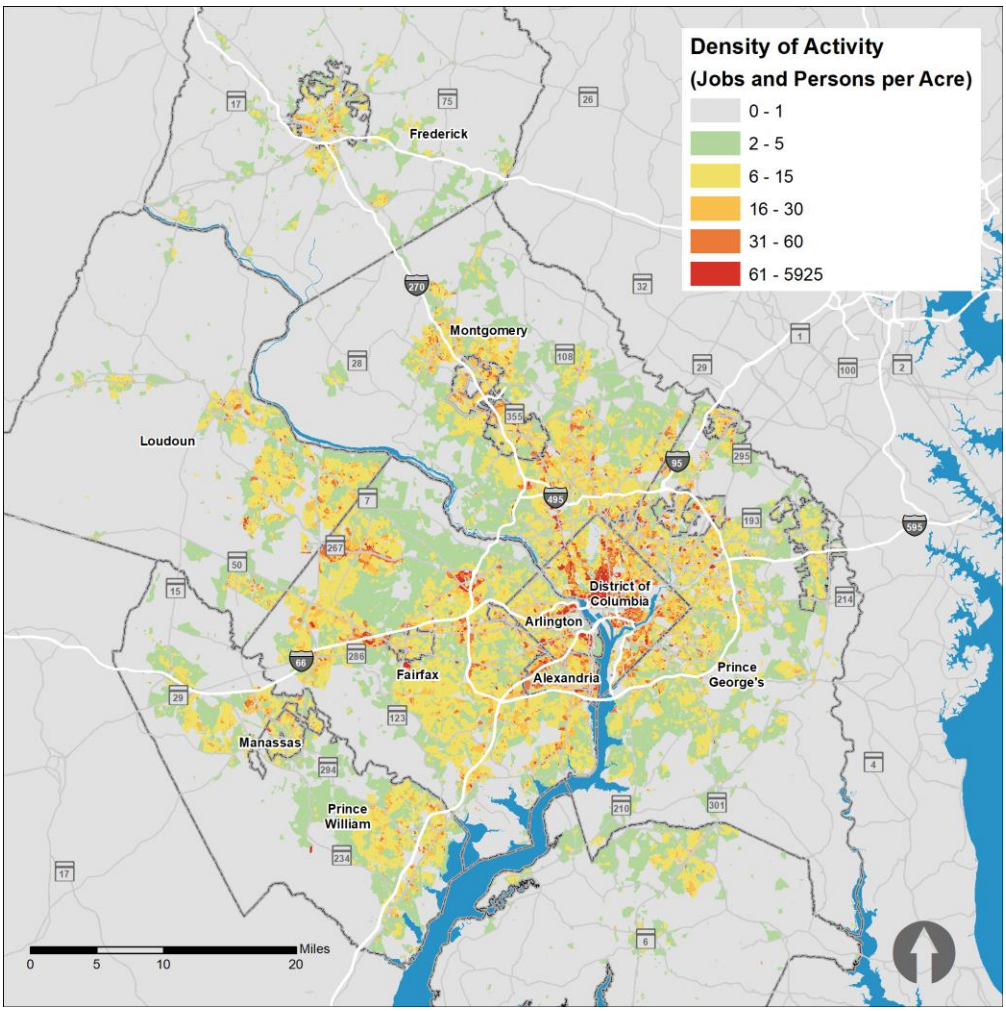
The density of activity within the region was centered around DC and diminished as the distance decreased from the District, see **Figure 8**. Within each jurisdiction, there tends to be hotspots of activity near to the jurisdictional boarder closest to DC. Only Fredrick County did not follow this trend. The activity in Frederick was instead focused in the center of the county. Between some of the outlying counties the amount of activity diminished below 1 job or person per acre suggesting breaks in the continuity of local bus service between these counties. The breaks in the continuity are located between:

- Charles and Prince Georges Counties;
- Frederick and Montgomery Counties; and
- Fairfax and Prince William's Counties.

Within some jurisdictions there are banded areas where the activity drops below 5 jobs or persons per acre. The breaks in the continuity are:

- Prince Georges County between I-495 and Bowie/Laurel; and
- Fairfax County between Tysons/Fairfax City and Centerville/Chantilly/Reston.

Figure 8: Regional Activity per Acre



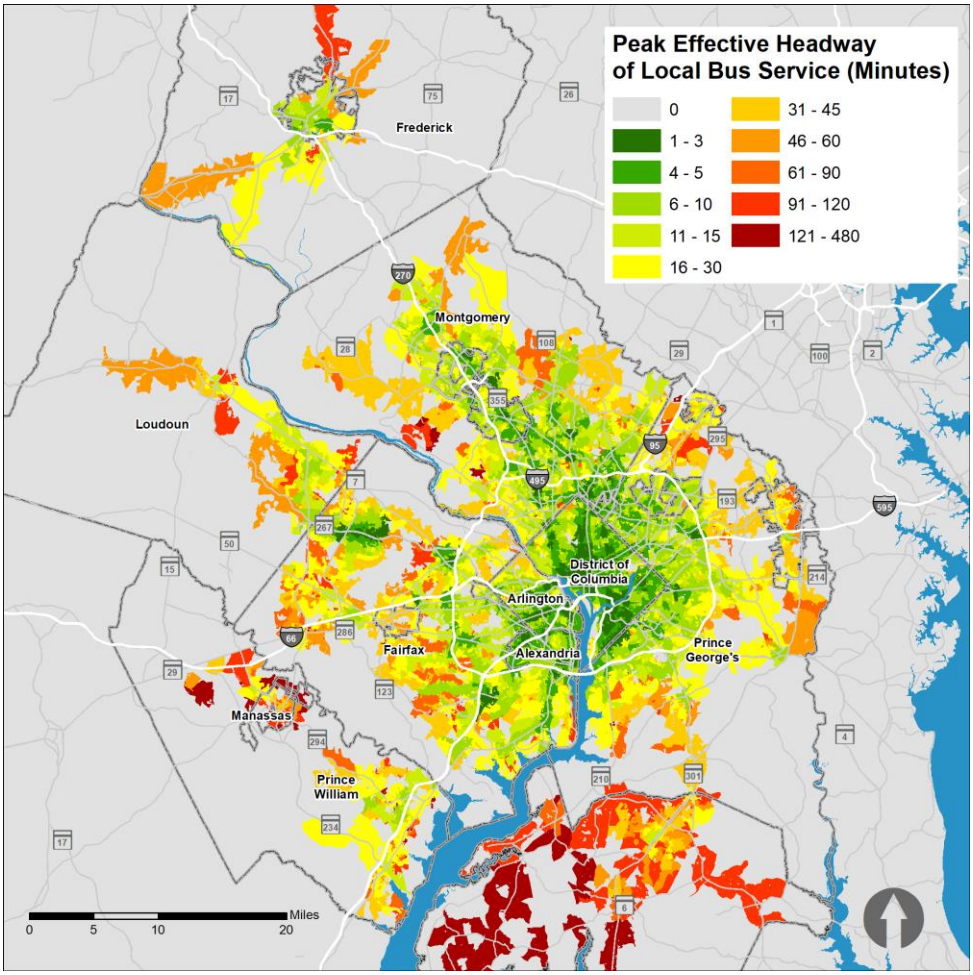
Frequency of Bus Service Trends

The effective headway of local bus service within the region follows similar patterns as the regions density of activity; the lowest headways centered on the District of Columbia and increase as the distance increase, see **Figure 9**. Similarly, the gaps in activity between jurisdictions are mirrored in the bus service provided. These gaps are located between:

- Charles and Prince Georges Counties;
- Frederick and Montgomery Counties; and
- Fairfax and Prince William's Counties.

Within the Fairfax County a gap can be found between the areas of Tysons/Fairfax City and Centerville/Chantilly/Reston. Within Prince George's County, the gap in activity is not mirrored in the headway of service provided. The areas of Bowie and Laurel have headways of 30 to 60 minutes while areas to the southwest have similar or better headways. This area is served by WMATA and TheBus, but is located far from the core of their service areas.

Figure 9: Effective Peak Frequency



Opportunities for Collaboration

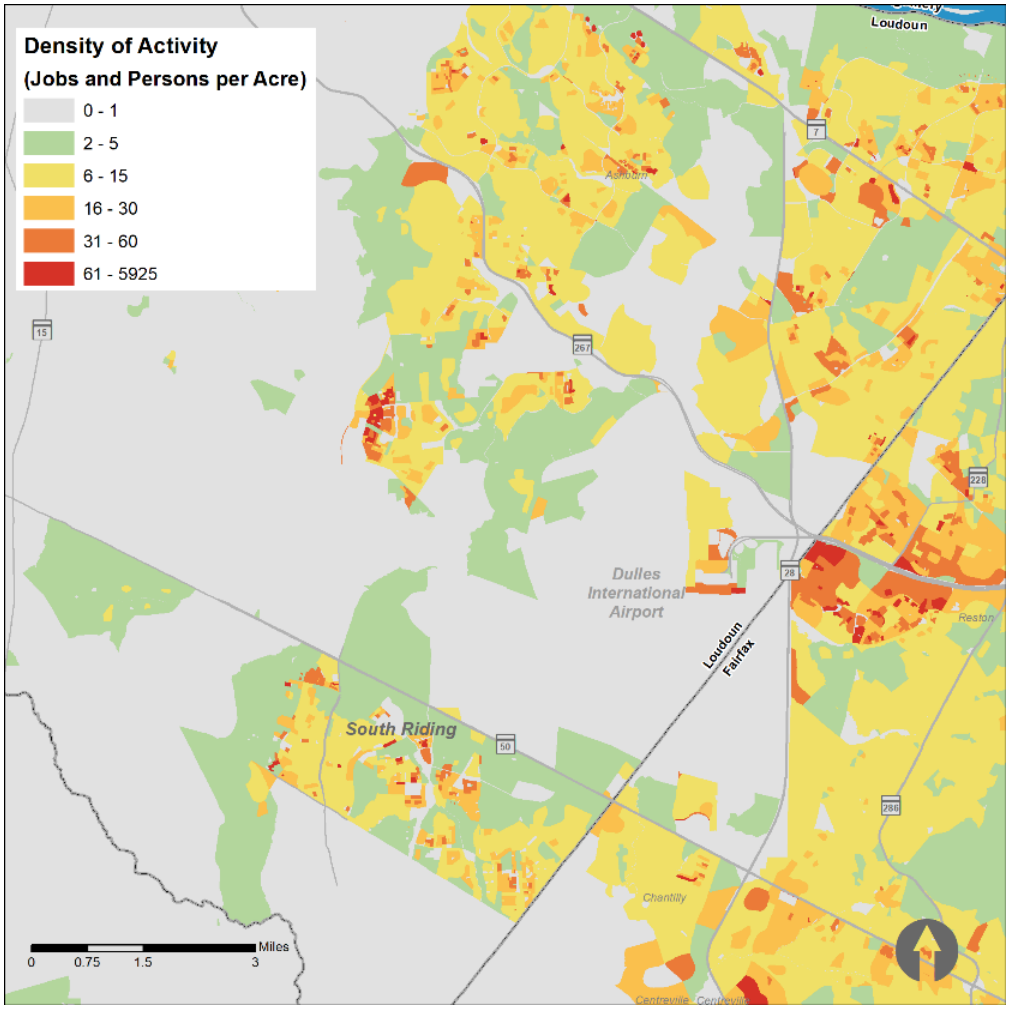
Active areas may go unserved because they are too far from the core of their agencies service area. When these areas fall near jurisdictional boundary neighboring agencies could assist in providing service. This arrangement for collaboration would be most easily implemented if:

- Neighboring jurisdictions currently provide local bus service up to the boarder of their service areas
- Member of the communities go back and forth between the jurisdictions.

Example

South Riding is an area of Loudoun County located along the border with Fairfax County, see **Figure 10**. Dulles International Airport separates it from the other areas currently served by Loudoun County Transit. Nearby in Chantilly, Fairfax County transit operates many local bus routes.

Figure 10: Regional Activity per Acre



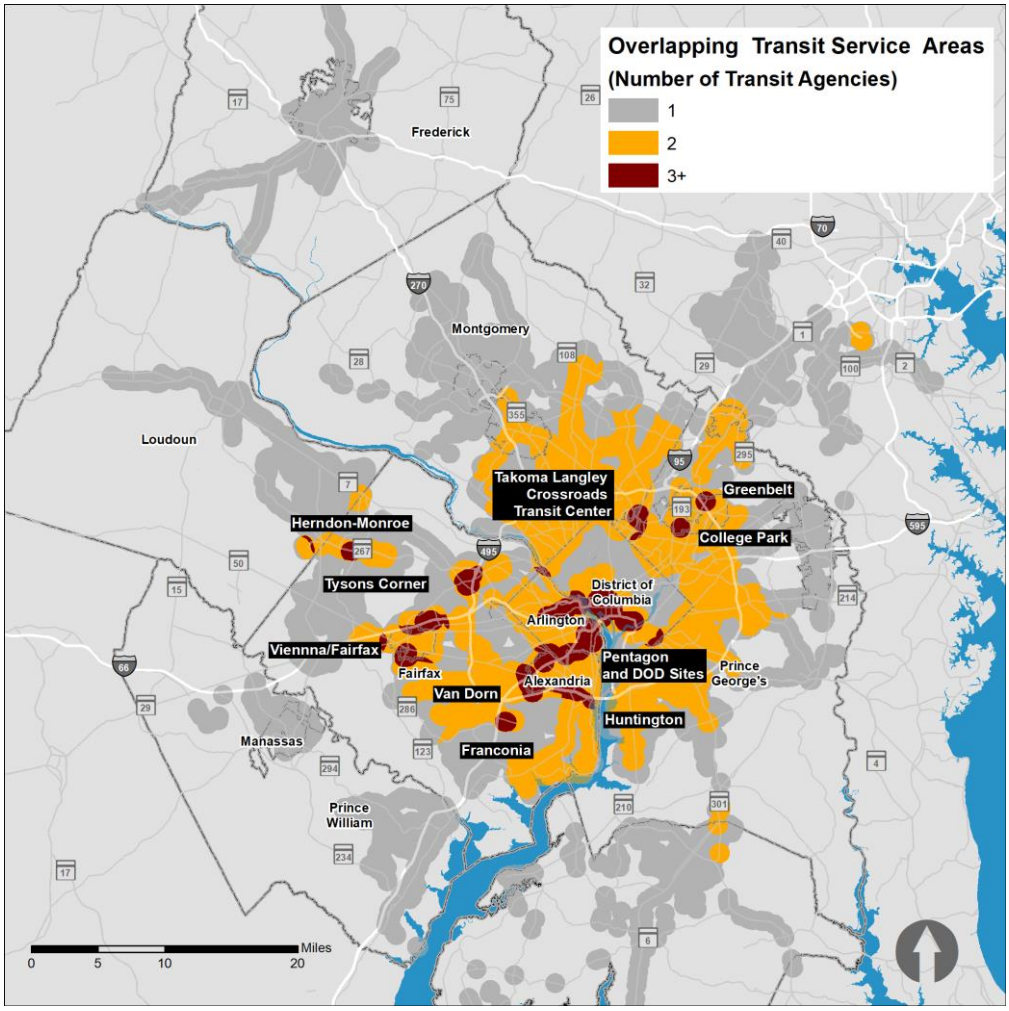
Transit System Interactions

Transit System Overlap

DC region is home to ten agencies that operate local bus service within their jurisdictions and one agency, WMATA, which operates regionally. WMATA operates any route that needs to cross a jurisdictional line in DC and the adjacent counties. Its service area overlaps the service area of the adjacent agencies, see **Figure 11**. Continued coordination between WMATA and the local transit agencies ensures that the needs of the people are met and prevents the creation of redundant services.

Due to their defined service areas, there are limited locations where the jurisdictional services intersect. Transit agencies have set up transit centers along the edge of their service areas to facilitate transfers between systems, see **Figure 11**. Additionally, the outlying agencies provide commuter services to Metro Rail stations and large employment centers, like the Pentagon, leading to more areas where transit systems intersect.

Figure 11: Transit System Overlap



APPENDIX D: TASK 2 TECHNICAL MEMORANDUM – INVENTORY OF REGIONAL BUS SERVICE COST COMPONENTS

AECOM

Regional Bus Service Provision Study

Metropolitan Washington Council of Governments

Task 2 Technical Memorandum:

Inventory of Regional Bus Service Cost Components

FINAL

Prepared May 2018

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1. INTRODUCTION

Bus service in the Washington Metropolitan region is provided by 12 separate operating agencies, ranging from the large region-wide Metrobus operations of WMATA, to smaller local and/or commuter systems operated by the counties and cities that comprise the region. Each operator is subject to a range of different conditions which affect both how service is provided and how much it costs to do so. Some of the characteristics that differ between operating entities include:

- Service types provided – i.e. local, express, commuter;
- Service area characteristics – i.e. density, mix of uses;
- Governance structures;
- Quality and quantity of service provided, including number of routes, frequency, span of service, etc.;
- Presence of existing labor agreements;
- Additional services provided, such as customer service, employer outreach, etc.;
- Whether service is operated directly or contracted/purchased; and
- Use of support services (i.e. legal, accounting) from other entities.

One of the main goals of this study was to identify the differences and similarities in costs between the operating agencies, and to the extent possible to quantify the true cost of operating bus service for each operating agency. The development of a common accounting of operating costs could be used by the region to better understand the costs of operating bus service in the region, and to help the region make better decisions moving forward about how to structure, provide, and operate bus service in the future. This technical memorandum outlines the process used to examine cost components for this study.

The second section describes the processes used for data collection, including the assembly of data from the National Transit Database and supplementary administrative data provided by the jurisdictions.

The third section describes the process used to derive O&M unit costs from the NTD data and examines the stability of the rates over time.

The fourth section compares these unit costs across jurisdictions, in addition to comparing with the contract rates paid by the jurisdictions for purchased transportation. The stability of the unit costs over time is also examined in this section.

Further analysis of these costs, and the cost implications of different bus service provision options in the region are discussed in the Task 3 technical memorandum.

2. O&M COST DATA COLLECTION

Due to the many differences between agencies outlined previously, significant variation in O&M costs is expected across the region. The first step in the analysis process was to gather all available information on O&M costs and operating characteristics from each of the operating agencies. To get a comprehensive understanding of the full range of costs associated with the provision of bus service at each operating agency, the study considered expense and level-of-service information gathered from three primary sources:

- **National Transit Database (NTD):** All federally-funded transit agencies report expense and service data to the NTD annually in a common format, which allows for the comparison of unit costs of service delivery across the various transit operators in the region.

  The NTD provides cost data ***by mode*** (e.g. bus or rail), ***method of operation*** (e.g. directly operated-DO vs. purchased transportation-PT), ***function*** (e.g. vehicle operations, vehicle maintenance, non-vehicle maintenance, and general administration), and ***object class*** (e.g., wages, fringe, fuel, parts, services). Using NTD data as the primary source also reduced the reporting burden on the agencies and sped up the data assembly process for this study. In addition, it allowed for the analysis of historic unit cost trends over time. This allows for a clearer understanding of and a higher level of confidence in the validity of the data used in the analysis.

- **Administrative expense data:** Participating agencies also provided detailed data on staffing headcounts and costs for various administrative functions. The data collection tool in Appendix D1 was provided to each operating agency to simplify the data collection process and ease the workload burden on agency staff. Unfortunately, not every agency was able to provide complete data, and it was therefore used only to supplement the NTD datasets. Where provided, this data was used to understand significant differences in costs between the operating agencies.

  The administrative expense data collected provided limited insights regarding the "back-office" functions provided by the local jurisdictions. While some jurisdictions provided great detail, some were not able to provide complete information, and some did not provide any administrative costs. For example, estimates of legal and information technology staffing headcounts were not available from any agency. Several jurisdictions provided sufficient staffing headcount information to suggest deep resources to support service planning functions which – if expanded - might be shared with (or sold to) neighboring jurisdictions. Because this information was not complete across all jurisdictions, this possibility was not pursued further in this study.

- **Contract Rates for Purchased Transportation**: Contract rates for purchased transportation services (i.e. when a jurisdiction contracts out for service operation) were requested Only four operating agencies were able to provide this information.

A summary of the data received from each operating agency is provided in Table 1. Historic NTD data for each operating agency dating back to 2006, where available, was obtained through the Florida Transit Information System – Integrated National Transit Database Analysis System[1] (FTIS/INTDAS) website. This database is operated by Florida International University and sponsored by the Florida Department of Transportation and FTA. The INTDAS provided data in a uniform structure, organized by year, mode, function and object class.

For each agency, the following data were obtained:

- **Agency identification:** name, NTD number, year, mode, and service.

- **Operating expenses:** from NTD form F30 by function (vehicle operations, vehicle maintenance, non-vehicle maintenance, and general administration), and by object classes (operator wages, other wages and salaries, fringes, fuel, power, services, etc.).

- **Cost drivers:** from NTD form S10 (vehicles operated in maximum service, annual vehicle revenue hours, and annual vehicle revenue miles).

At the time of this study, only data through FY2016 had been published in the NTD. FY2017 NTD data was provided directly to the project team by the operating agencies. Supplemental data, including information on administrative costs and contract prices were also provided directly by some of the jurisdictions. The supplemental data provided by each jurisdiction is noted in Table 1; uniform data sources in this area were not available for all operating agencies. Where provided, the more detailed data regarding staffing headcounts, expenses, and contract rates are summarized in Appendix D3.

[1] Operation and maintenance costs data were retrieved from the INTDAS website: http://www.ftis.org/intdas.html (a free user account is required to access this site).

Table 1: Data Received from Operating Agencies

Agency	Historic NTD Data	2017 NTD Data	Supplemental Data
City of Alexandria	2006-2016	✓	None

Arlington County	2009-2016	✓	- Organizational charts:
			  - Transit Bureau
			  - Commuter Services
			  - Convention Store
			  - Dept. of Environment Services
			  - Destination Sales & Marketing Group
			- Contractor price for Purchased Transportation

Charles County	2006-2016	✓	- Staffing Headcounts for in-house general administration functions - Contractor price for Purchased Transportation
City of Fairfax CUE	2006-2016	✓	FY 2017 Budget by function
DDOT	2015-2016	✓	- 2017 Financial Report - Staff salaries - Revenue details - DDOT & WMATA MOU
Fairfax County	2006-2016	✓	- Org Chart - Expense Details
Frederick County	2006-2016	✓	- Transit Org Chart - Employee Time by Position - Manager Salaries - Staffing headcounts - Costs for directly operated services
Loudoun County	2006-2016	✓	- Org Chart - Descriptions and staffing headcounts for purchased transportation functions - Contractor price for Purchased Transportation
Montgomery County	2006-2016	✓	None
Prince George's County	2006-2016	✓	- Contractor price for Purchased Transportation - Staffing headcounts - FY17 costs for some purchased transportation functions
PRTC	2006-2016	✓	- Operating expenses by department
WMATA	2006 – 2014 (PT) 2006 – 2016 (DO)	✓	- Staffing headcounts - FY17 costs for directly operated functions

3. O&M UNIT COST DERIVATION

Because each operating agency provides a different quantity of transit service under different operating conditions, it is essential to derive unit costs for the purpose of cross agency comparison. In keeping with FTA and industry standards, several standard units and methods for calculating these costs are used, as defined in the section below. A detailed methodology for deriving these unit costs from the NTD data is also provided in Section 3.2. These unit costs will be used as part of Task 3 to evaluate the potential for cost savings through alternative service delivery options, such as transferring operations of a specific route to a different operator.

3.1. Definitions

Operations and maintenance unit costs were estimated using an O&M cost model that addresses the following types of costs and associated cost drivers:

- **Incremental Costs**: includes costs associated with vehicle operations (not including fuel and tires), represented as a function of vehicle revenue hours (cost/ Revenue Hour), and costs associated with vehicle maintenance (including fuel and tires), represented as a function of vehicle revenue miles (cost/ Revenue Mile).
- **Fully Allocated Costs**: includes incremental costs and additional costs associated with non-vehicle maintenance, as a function of peak-vehicles (cost/ Peak Vehicle), and costs associated with general administration as a function of vehicle revenue hours (cost/ Revenue Hour).

The cost drivers are defined by FTA[2] as follows:

- **Vehicle revenue hours:** The hours that vehicles travel while in revenue service. Vehicle revenue hours include layover and recovery time. Vehicle revenue hours exclude hours that a vehicle travels when out of revenue service including time spent leaving or returning to the garage, time spent changing routes, operator training hours, and vehicle maintenance testing hours, as well as school bus and charter services hours.

- **Vehicle revenue miles:** The miles that vehicles travel while in revenue service. Vehicle revenue miles exclude miles that a vehicle travels when out of revenue service including time spent leaving or returning to the garage, time spent changing routes, operator training miles, and vehicle maintenance testing miles, as well as and school bus and charter services miles.

- **Vehicles Operated in Annual Maximum Service (VOMS) - "Peak vehicles":** The number of vehicles operated to meet the annual maximum service requirement. This is the number of vehicles in revenue service during the week and day that maximum service is provided. Vehicles operated in maximum service (VOMS) excludes atypical days or one-time special events.

- **Deadhead hours and miles:** The hours or miles that a vehicle travels when out of revenue service, including for leaving or returning to the garage or yard facility, changing routes, and when there is no expectation of carrying revenue passengers.

Table 2 summarizes how cost drivers are associated with the functions defined in the NTD.

[2] https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary

Table 2: Functions and Their Associated Cost Drivers

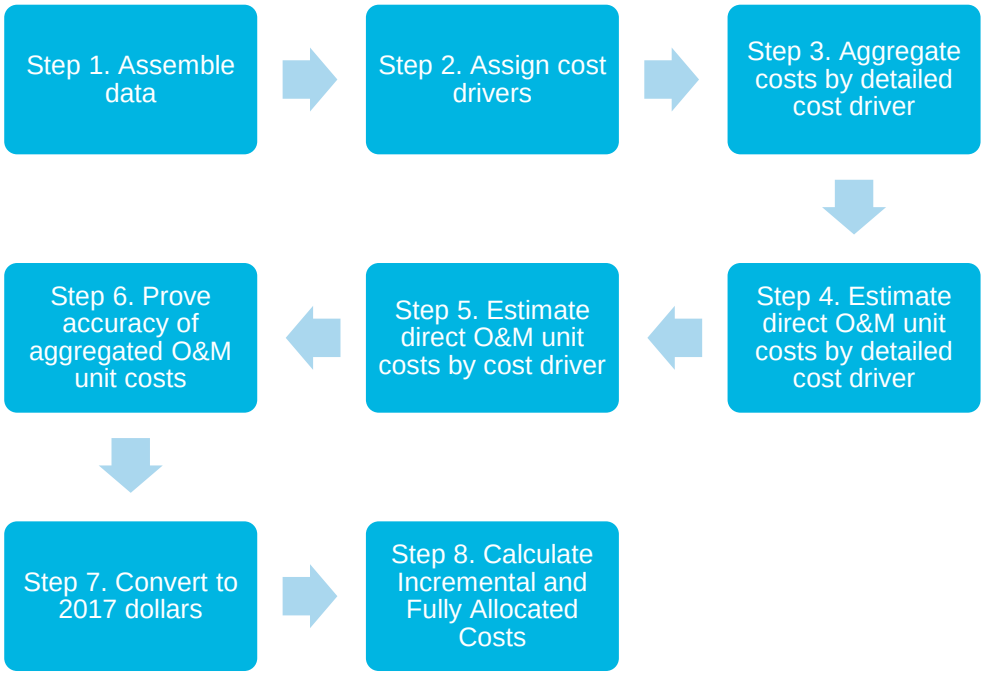
Function	NTD Definition	Cost Driver	Exception
Vehicle Operations	All activities associated with vehicle operations, including: • Transportation administration and support • Revenue vehicle movement control • Scheduling of transportation operations • Revenue vehicle operation • Ticketing and fare collection • System security	Vehicle revenue hours	Fuel/lubricants and tires/tubes applied in Vehicle Maintenance
Vehicle Maintenance	All activities associated with revenue and non-revenue (service) vehicle maintenance, including: • Administration • Inspection and maintenance • Servicing (cleaning, fuelling, etc.) vehicles In addition, vehicle maintenance includes repairs due to vandalism and accident repairs of revenue vehicles.	Vehicle Revenue Miles	Includes fuel/lubricants and tires/tubes from Vehicle Operations
Non-Vehicle Maintenance	All activities associated with facility maintenance, including: • Administration • Repair of buildings, grounds, and equipment as a result of accidents or vandalism • Operation of electric power facilities • Maintenance of: - Vehicle movement control systems - Fare collection and counting equipment - Structures, tunnels and subways - Roadway and track - Passenger stations, operating station buildings, grounds and equipment - Communication systems - General administration buildings, grounds and equipment - Electric power facilities	Peak Vehicles	Applied in fully-allocated costs only
General Administration	All activities associated with the general administration of the transit agency, including: • Transit service development • Injuries and damages • Safety • Personnel administration • Legal services • Insurance • Data processing • Finance and accounting • Purchasing and stores • Engineering • Real estate management • Office management and services • Customer services • Promotion • Market research • Planning	Vehicle revenue hours	Applied in fully-allocated costs only

Source: National Transit Database, https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary

3.2. Methodology

An eight-step methodology was applied to derive the O&M unit costs. Figure 1 provides an overview of the process adopted for the common cost calculator, and the subsections that follow describe each step in more detail.

Figure 1: Process for NTD Data Derivation of Unit Costs



Step 1: Assemble Data

Historic and current NTD data that had been obtained from INTDAS and directly from the operating agencies were assembled into a uniform structure, organized by year, mode, function and object class. This allows for ease of analysis and comparison across agencies. A snapshot of the data assembly is provided in Table 3 and Table B-1 in Appendix D2.

Step 2: Assign Detailed Cost Drivers

After the data was assembled, each cost element was associated with a detailed cost driver by function and by object class. Each object class was assigned to one of the following detailed cost drivers:

Vehicle operations: annual vehicle revenue hours (except for fuel/lubricants, tires/tubes):

- **VehRevHrs-Oper:** vehicle operations costs associated with operator wages.
- **VehRevHrs-Wages:** vehicle operations costs associated with other wages.
- **VehRevHrs-Fringe:** vehicle operations costs associated with fringe benefits.
- **Fuel/Elec:** vehicle operations costs associates with fuel and electricity used for revenue vehicles.
- **VehRevHrs:** other vehicle operations costs.

Vehicle maintenance: annual vehicle revenue miles (includes fuel/lubricants, tires/tubes):

- **Wages:** vehicle maintenance costs associated with wages.
- **Fringe:** vehicle maintenance costs associated with fringe benefits.
- **Fuel/Elec:** vehicle maintenance costs associated with fuel and electricity used for non-revenue vehicles.

- **VehRevMiles:** other vehicle maintenance costs.

Non-Vehicle maintenance: vehicles operated in maximum service (for fully-allocated costs only):

- **VehMaxSc-Wages:** non-vehicle maintenance costs associated with wages.
- **VehMaxSc-Fringe:** non-vehicle maintenance costs associated with fringe benefits.
- **VehMaxSc:** other non-vehicle maintenance costs.

General administrative costs: annual vehicle revenue hours (for fully-allocated costs only). This driver is the only one applied to total general administrative costs.

The assignment of detailed cost drivers to each object class is shown in Table 3 and Table B-5 in Appendix D2 provide additional detail.

Table 3: Detailed Cost Driver Assignment by Function (Step 2)

- Vehicle Operations		- Vehicle Maintenance		- Non-Vehicle Maintenance	
- Object Class	- Detailed Cost Driver	- Object Class	- Detailed Cost Driver	- Object Class	- Detailed Cost Driver
Vehicle Operations Operators' Salaries/Wages	VehRevHrs-Oper	Salaries/Wages	VehRevMiles-Wages	Salaries/Wages	VehMaxSc-Wages
Vehicle Operations Other Salaries/Wages	VehRevHrs-Wages	Salaries/Wages	VehRevMiles-Wages Wages	Salaries/Wages	VehMaxSc-Wages
Benefits	VehRevHrs-Fringe	Vehicle Maint. Fringe Benefits	VehRevMiles-Fringe	Non-Vehicle Maint. Fringe Benefits	VehMaxSc-Fringe
Vehicle Operations Services	VehRevHrs	Vehicle Maint. Services	VehRevMiles	Non-Vehicle Maint. Services	VehMaxSc
Vehicle Operations Fuel/Lube	VehRevMiles-Fuel/Elec	Vehicle Maint. Fuel/Lube	VehRevMile - Fuel/Elec	Non-Vehicle Maint. Fuel/Lube	VehMaxSc
Vehicle Operations Other Materials/Supplies	VehRevMiles	Vehicle Maint. Tires/Tubes	VehRevMiles	Non-Vehicle Maint. Tires/Tubes	VehMaxSc
Vehicle Operations Utilities	VehRevMiles-Fuel/Elec	Materials/Supplies	VehRevMiles	Materials/Supplies	VehMaxSc
Costs	VehRevHrs	Vehicle Maint. Utilities	VehRevMile - Fuel/Elec	Non-Vehicle Maint. Utilities	VehMaxSc
Vehicle Operations Taxes	VehRevHrs	Vehicle Maint. Casualty/Liability Costs	VehRevMiles	Costs	VehMaxSc
Vehicle Operations in Report	VehRevHrs	Vehicle Maint. Taxes	VehRevMiles	Non-Vehicle Maint. Taxes	VehMaxSc
Vehicle Operations Filing Separate Report	VehRevHrs	Vehicle Maint. In Report	VehRevMiles	Non-Vehicle Maint. In Report	VehMaxSc
Expenses	VehRevHrs	Report	VehRevMiles	Report	VehMaxSc
Transfers	VehRevHrs	Vehicle Maint. Misc Expenses	VehRevMiles	Non-Vehicle Maint. Expenses	VehMaxSc
		Vehicle Maint. Expense Transfers	VehRevMiles	Transfers	VehMaxSc

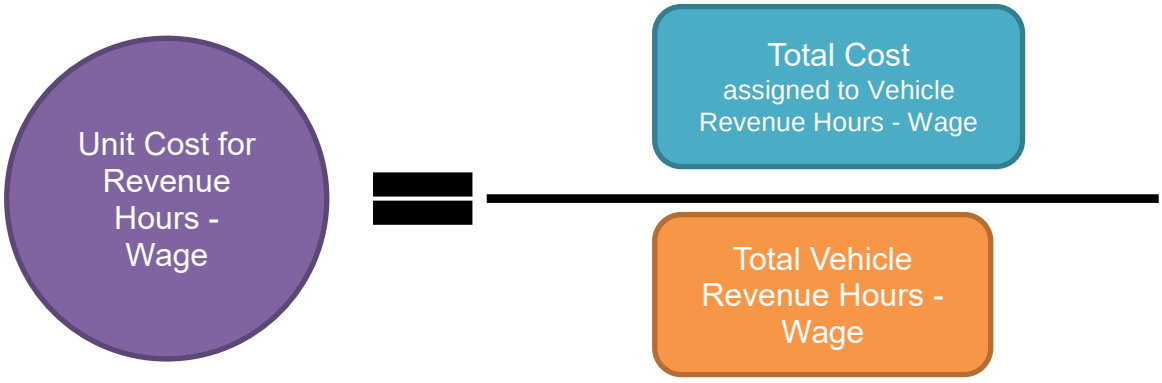
Step 3: Aggregate Costs by Detailed Cost Driver

Costs were then aggregated by detailed cost driver. **Table B-6** in Appendix D2 shows an example of this step which distinguishes the costs associated with each of the detailed cost drivers, (e.g., operator wages, other wages and salaries, fringes, and fuel & electricity).

Step 4: Estimate Direct O&M Unit Costs by Detailed Cost Driver

Direct O&M unit costs were then calculated by dividing the total aggregated costs for each detailed cost driver by the value of the associated detailed cost driver. For example, as shown in Figure 2, aggregated costs for vehicle revenue hours-wage were divided by annual vehicle revenue hours-wage. This step is shown in more detail in Table B-7 in Appendix D2 in lines 96-107.

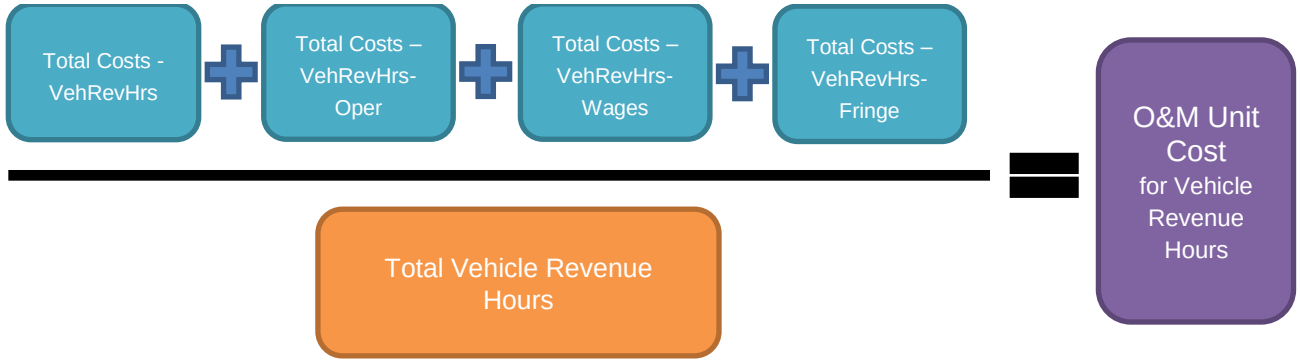
Figure 2: Sample Calculation for Step 4: Estimate Direct O&M Unit Costs by Detailed Cost Driver



Step 5: Estimate Direct O&M Unit Costs by Cost Driver

Direct O&M costs were summed for each cost driver across all object classes. For example, as shown in Figure 3, costs per vehicle revenue hour for operator wages, other wages and salaries, fringe benefits, and other costs were summed and divided by the total number of vehicle revenue hours to calculate a combined O&M unit cost per vehicle revenue hour. More detail is shown in Table B-7 in rows 110-112.

Figure 3: Sample Calculation for Step 5: Estimate Direct O&M Unit Costs by Cost Driver



Step 6: Prove Accuracy of Aggregated O&M Unit Costs

The aggregated O&M unit costs (excluding the general administration factor) were then applied to the cost drivers to compute O&M cost by cost driver. The resulting overall total was compared to the value reported in the NTD. This step is primarily undertaken to ensure the accuracy of the analysis and has been shown to be a vital exercise in developing a useful cost model. No variances between the two values for each agency, mode, and reporting year were found. This computation is shown in rows 123 – 127 of Table B-8.

Step 7: Convert Costs to 2017 Dollars

O&M unit costs were converted from the reported years to 2017 dollars by dividing the reported year dollar values by the change in the 2017 Washington-Baltimore Consumer Price Index (CPI) provided in Table B-9 for reference.

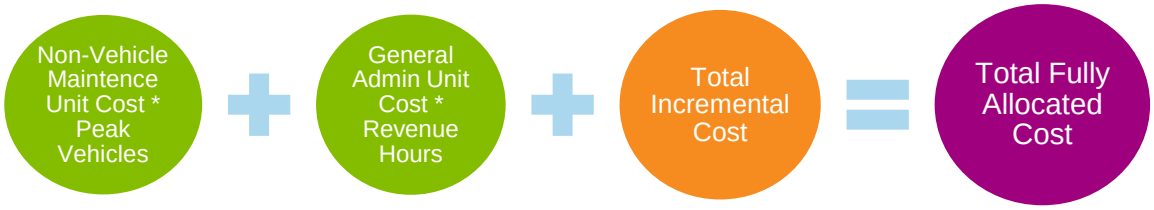
Step 8: Calculate Incremental and Fully Allocated Costs

Table B-10 summarizes O&M unit costs for vehicle operations (less fuel and tires) per vehicle revenue hour and for vehicle maintenance (including fuel and tires) per vehicle revenue mile. These two-unit costs multiplied by vehicle revenue hours and vehicle revenue miles, respectively, provide an estimate of incremental costs.

Figure 4: Incremental Cost Calculations

Table B-11 summarizes unit costs for non-vehicle maintenance per vehicle in maximum service and for general administration per vehicle revenue hour. These two-unit costs multiplied by vehicles in maximum service and vehicle revenue hours, respectively, plus the incremental costs described in the previous paragraph provide an estimate of fully allocated costs.

Figure 5: Fully Allocated Cost Calculations



4. ANALYSIS

The results of the process outlined in Section 3 is a set of total incremental and fully allocated costs for each operating agency for each year for which data was available (generally 2006-2017, with some exceptions). These unit costs vary through time and across operating agencies in the region. Some analysis was conducted across these variables to highlight major differences between the 12 operating agencies included in the study and to provide some insight into how unit costs have varied over the last decade.

4.1. O&M Unit Costs Across Jurisdictions

Table 4 presents unit costs for each operating agency in 2017. Details on unit costs for preceding years can be found in Tables B-10 and B-11.

Table 4: 2017 Unit Costs by Operating Agency

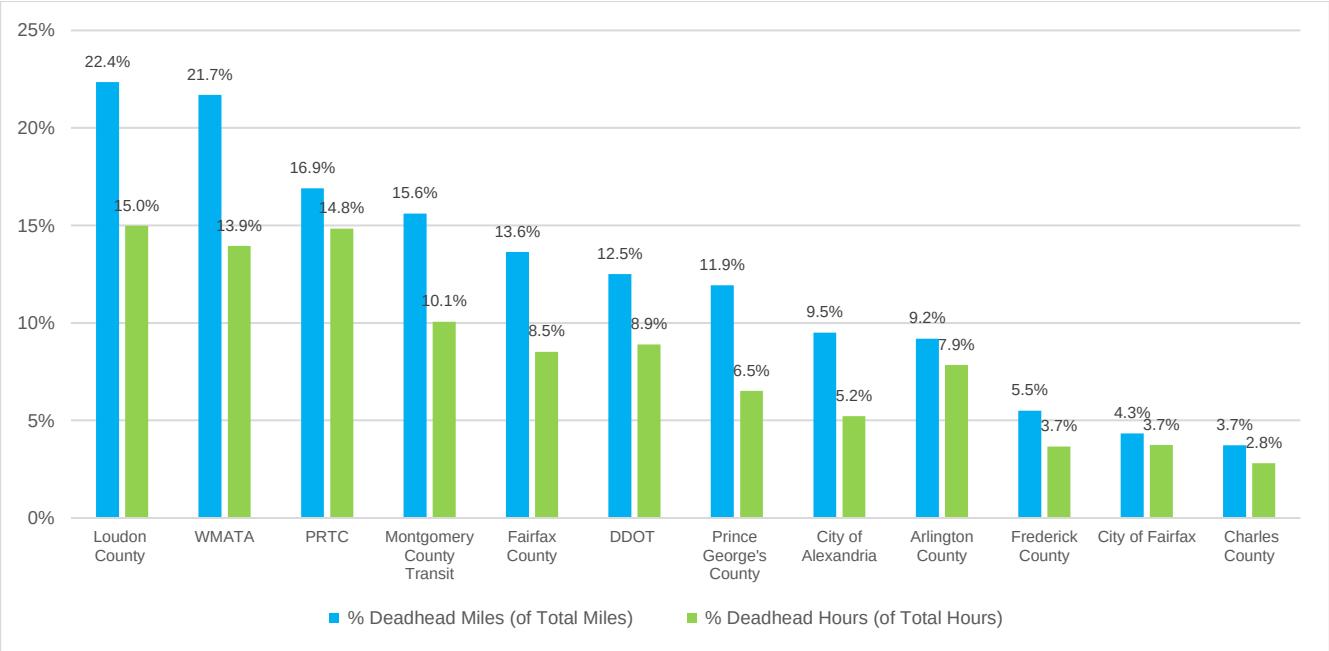
Agency	Vehicle Operations ($/hr)	Vehicle Maintenance ($/mile)	Non-Vehicle Maintenance ($/vehicle)	General Administration ($/hr)
City of Alexandria	$45.04	$1.92	$4,918.68	$15.06
Arlington County	$37.97	$1.97	$6,845.50	$20.11
Charles County	$33.06	$0.63	$295.75	$32.16
City of Fairfax	$61.78	$1.18	$2,937.75	$23.68
DDOT	$66.76	$3.90	$9,520.52	$13.07
Fairfax County	$62.56	$2.17	$3,898.65	$17.45
Frederick County	$45.95	$1.66	$722.28	$15.24
Loudoun County	$55.07	$1.44	$3,858.59	$21.39
Montgomery County	$60.96	$2.30	$18,061.87	$60.96
Prince George's County	$67.14	$2.50	$2,097.80	$15.91
PRTC	$108.18	$2.72	$14,761.39	$29.88
WMATA	$78.07	$4.67	$48,359.52	$18.65

A range of operating characteristics, contractual issues, and governance structures can dramatically impact these O&M unit costs. Further examination of the NTD expense and service data partially explains the significant range in unit costs across transit providers. Among the most important explanations of the differences are:

- Deadheading: the amount of time and distance that vehicles operate outside of regular revenue service.
- Labor contracts: including operator wages, union work rules, and service profile.
- Fringe benefits: all non-salary benefits, including pensions.

The location of bus garages where overnight storage, maintenance, cleaning, fueling, and driver dispatching occurs relative to the locations where buses enter revenue service on a route varies significantly from operator to operator. This is revealed in Figure 6 which examines deadhead miles and hours as a percentage of total miles and total hours. Loudoun County has the highest portion of deadhead miles of any of the operating agencies in the region, at least in part due to the long-distance commuter services that the agency operates. WMATA has a similarly high portion of deadhead miles, contributing to the agency's high Vehicle Operations Unit Cost.

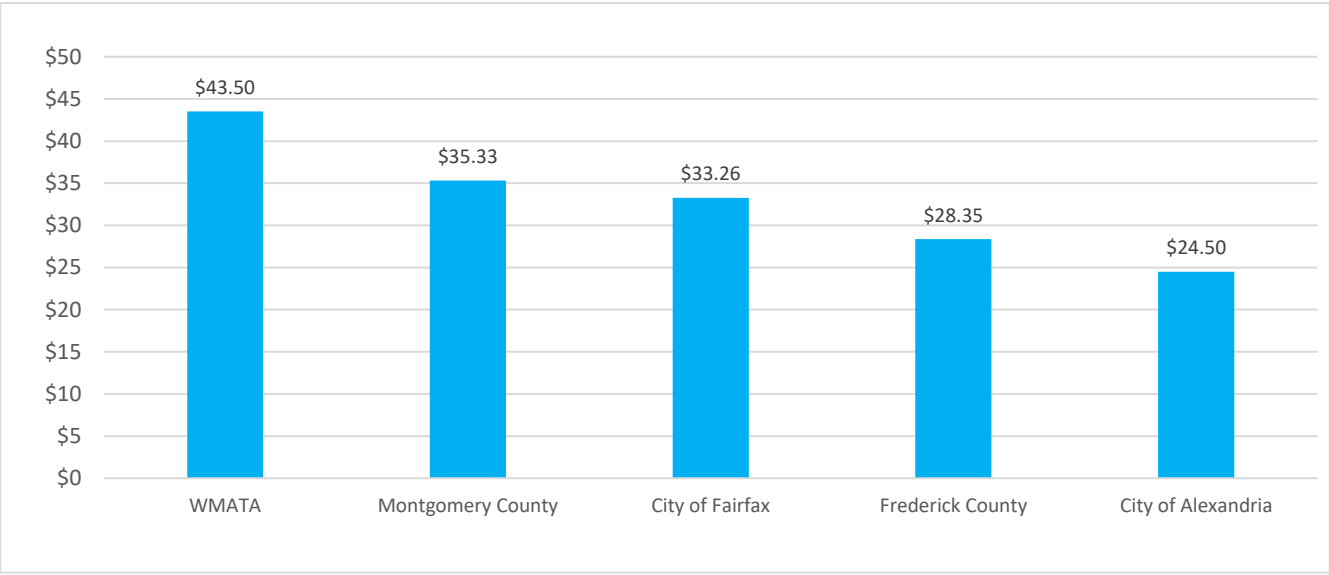
Figure 6: Deadhead Hours and Miles as a Percentage of Total Hours and Total Miles (FY17)



Source: 2017 NTD Data provided by operating agencies.

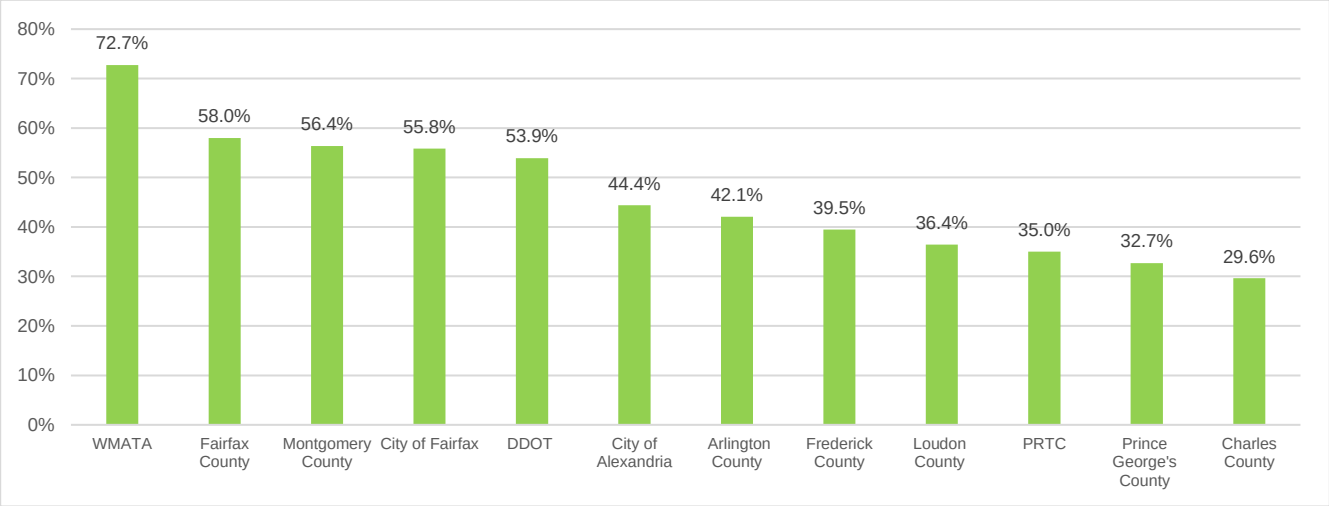
The average straight time wage rate for bus operators is not revealed in the NTD data, and only five agencies were able to provide that information for use in this study. Figure 7 illustrates the average wage rate per revenue hour at each of these agencies. The average wage rate incorporates not only regular wages but any labor contract provisions which affect payment, including overtime and other pay premiums, wage progression from entry level to top hourly wage, and the service profile (peak-to-base ratio) which can affect the amount of overtime and premiums paid. Of the agencies reporting this information, WMATA Operator wages are 23 percent, or approximately $8/revenue hour higher than the next highest operating agency.

Figure 7: Operator Wages per Revenue Hour (FY17)



The ratio of total fringe benefits paid to wages paid is shown in Figure 8. Note that this includes hourly and salaried employees, both represented (union) and non-represented. It is important to note that the high value for WMATA is partially explained by a large retired workforce receiving pension benefits. The other operators in the region have a smaller ratio of retired to working employees and fewer of both entitled to pension benefits.

Figure 8: Fringe Benefits as a Percentage of Total Wage and Salaries (FY17)



Some additional cost data was provided by a subset of operating agencies, which is highlighted in more detail in Appendix D3. This data provided some further insight into the differences in general administration costs between operating agencies. A review of this data revealed that it is important to consider the amount and quality of general administration services that are provided by the operating agencies when making any comparisons.

- General administration costs for the suburban operating agencies are generally a relatively smaller proportion of total expenses than for WMATA. This is partially explained by the broad set of administrative responsibilities that WMATA has in supporting a very large network of regional and non-regional services in two states and the District of Columbia.
- Fairfax County and Arlington County have relatively large service planning and customer service functions compared to the other suburban operating agencies. Arlington County includes their significant customer outreach efforts, including the Commuter Stores in these costs, which results in higher costs than most other providers in this category.

Table 5 compares the effective rate per revenue hour of contracted purchased bus service for those agencies that were able to report this information. Market prices drive much of the differences among the jurisdictions that purchase transportation services for the delivery of bus service.

Table 5: Contractor Price for Purchased Transportation

Agency	Contractor Price Per Hour
Arlington County	$ 62.25
Charles County	70.63
Loudoun County (MV)	$ 63.68
Loudoun County (TD)	$ 133.38
Prince George's County	$ 97.96

Note: the value for Arlington County includes the combination of hourly-, mileage-based, and fixed rate service.

4.2. O&M Unit Costs Over Time

As previously outlined, four-unit costs are calculated for each operating agency as part of this analysis:

- Vehicle operations per revenue hour (these costs exclude fuel and tires);
- Vehicle maintenance per revenue mile (these costs include fuel and tires);
- Non-vehicle maintenance per peak vehicle; and
- General administration cost per revenue hour.

This section examines the stability of the unit costs for each year for which NTD data was available (generally 2006-2017, with some exceptions as noted in Table 1). This analysis is important because it can reveal year-to-year fluctuations that might suggest that the most recent data are not representative of longer-term trends and application of the most recent year might yield misleading results. This may be the result of significant changes in operations, corrections of previous reporting errors, or introduction of new reporting errors. After confirmation with the operating agencies directly, no concerns were found in the reported NTD data.

Figure 9 highlights the changes in Vehicle Operations Unit Costs over time. As shown, there has been some variation in these costs, although the regional average has stayed relatively constant, showing a 2.6 percent increase to $60.14 in 2017. With the exception of Loudoun County which saw some changes due to an increase in annual revenue hours, unit costs across providers were fairly consistent with only slight variations over time.

Figure 9: Vehicle Operations Cost Per Vehicle Revenue Hour

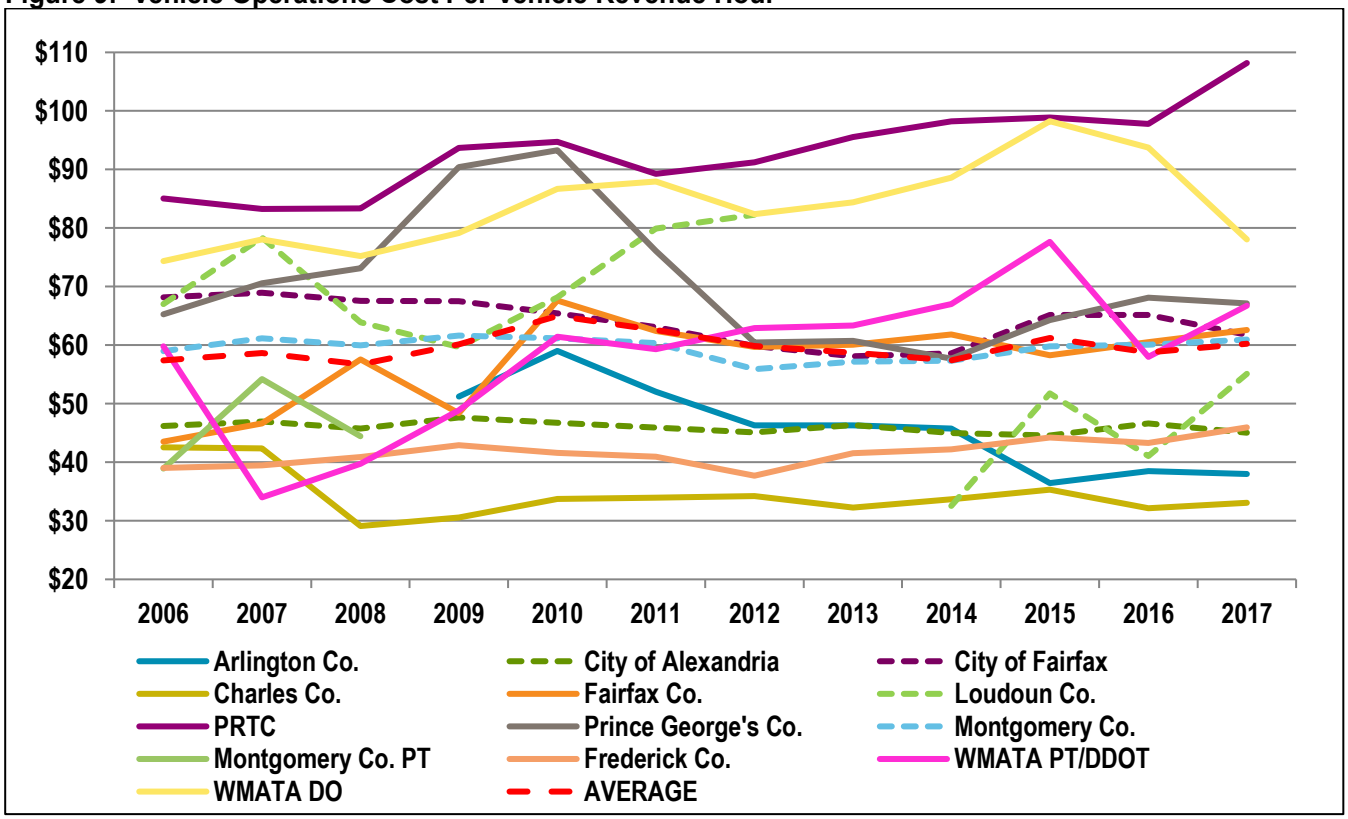


Figure 10 highlights the changes in Vehicle Maintenance Unit Costs over time. As shown, there is some year-by-year variation in these costs, although the regional average has stayed relatively constant, showing only a 2.2 percent decrease to $2.25/revenue mile in 2017. For most agencies, these unit costs were relatively consistent over the analysis period, recording only slight variations. Prince George's County had an increase in 2014 due to major maintenance undertaken in that year (maintenance services, tires, and fuel). Similarly, the decline in Loudoun County unit costs in 2014 was due to an increase in total annual revenue miles.

Figure 10: Vehicle Maintenance Cost per Vehicle Revenue Mile

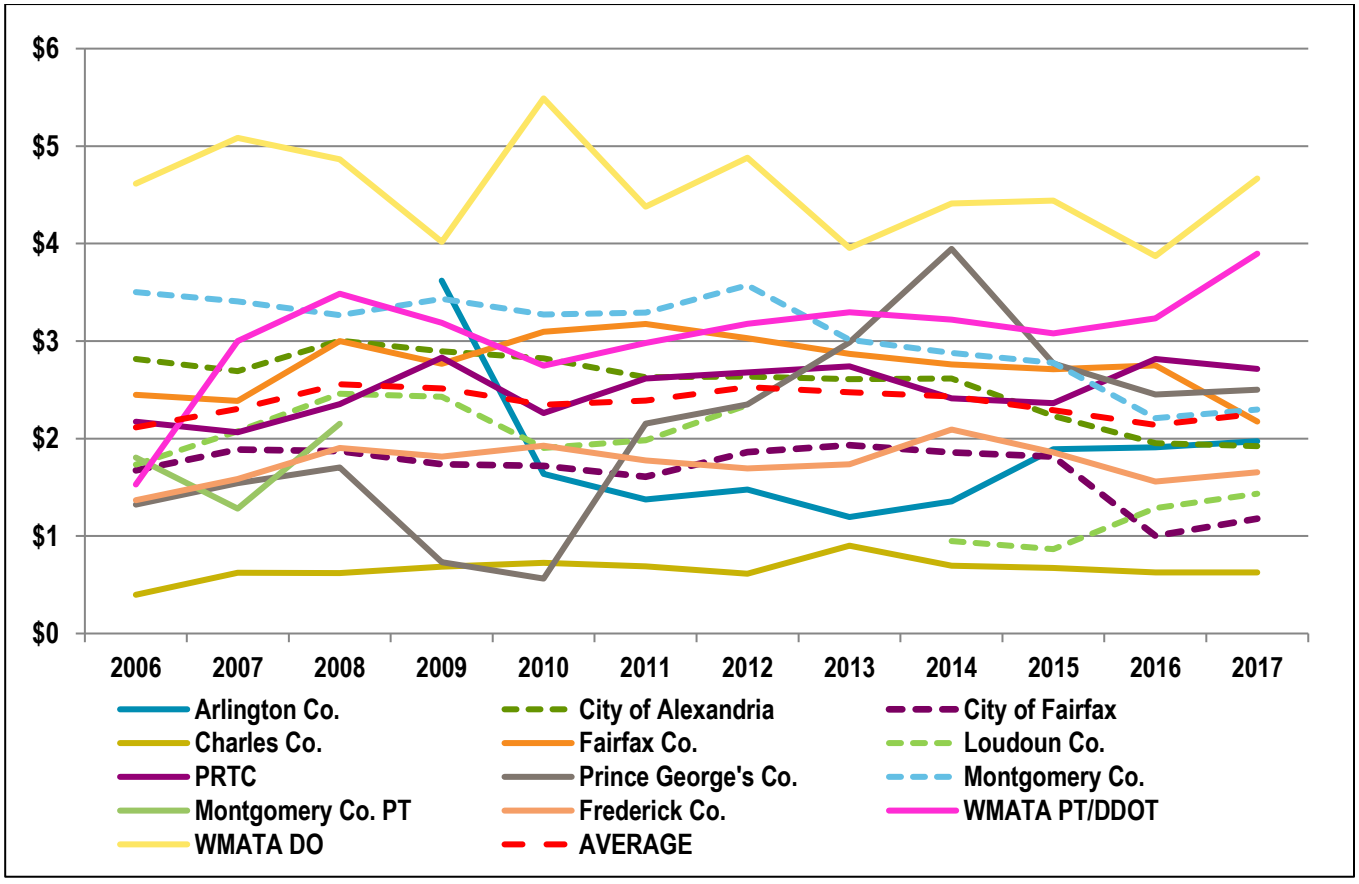


Figure 11 highlights the changes in Vehicle Maintenance Unit Costs over time. As shown, there is some year-by-year variation over time in these costs, although most agencies in the region have maintained a Non-Vehicle Maintenance Unit Cost under $10,000 per peak vehicle since 2006. The O&M unit costs varied widely over time, ranging from a low of $295.75/peak vehicle (Charles County) to a high of $48,359.52/peak vehicle (WMATA). The average annual unit cost was $8,928.77/peak vehicle.

The sharp increase in WMATA's 2017 costs was the result of a significant increase in wages and fringe benefit costs, compared to average costs in prior years. The sharp increase in DDOT's 2017 unit costs was also due to an unusually high but accurate non-vehicle maintenance cost. Unit costs for PRTC also saw a sharp increase in 2013 due to a reduction of peak vehicles to about a third of the average series value. A majority of PRTC's unit costs consisted of non-vehicle maintenance services and miscellaneous expenses, making up over 95% of total annual costs.

Figure 11: Non-Vehicle Maintenance Cost per Peak Vehicle

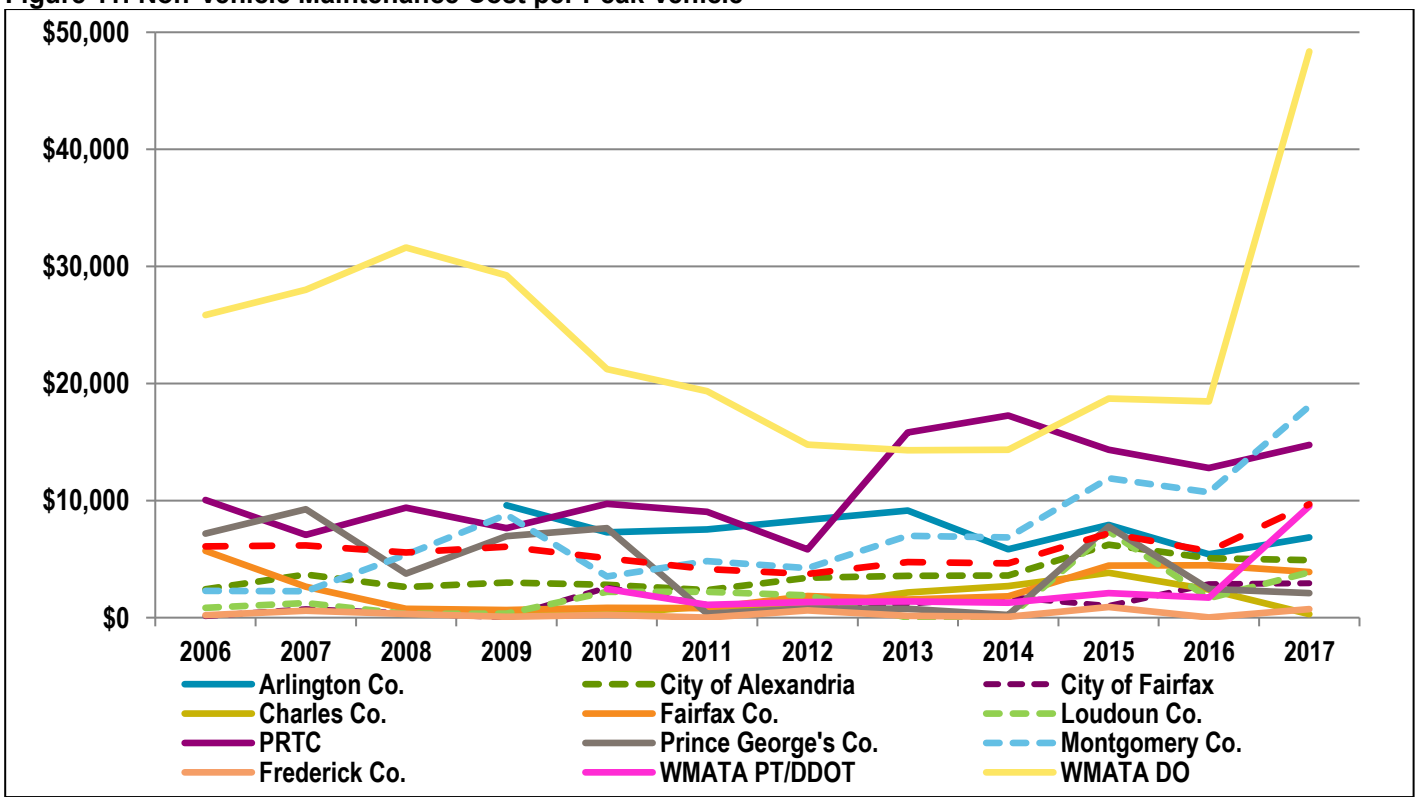
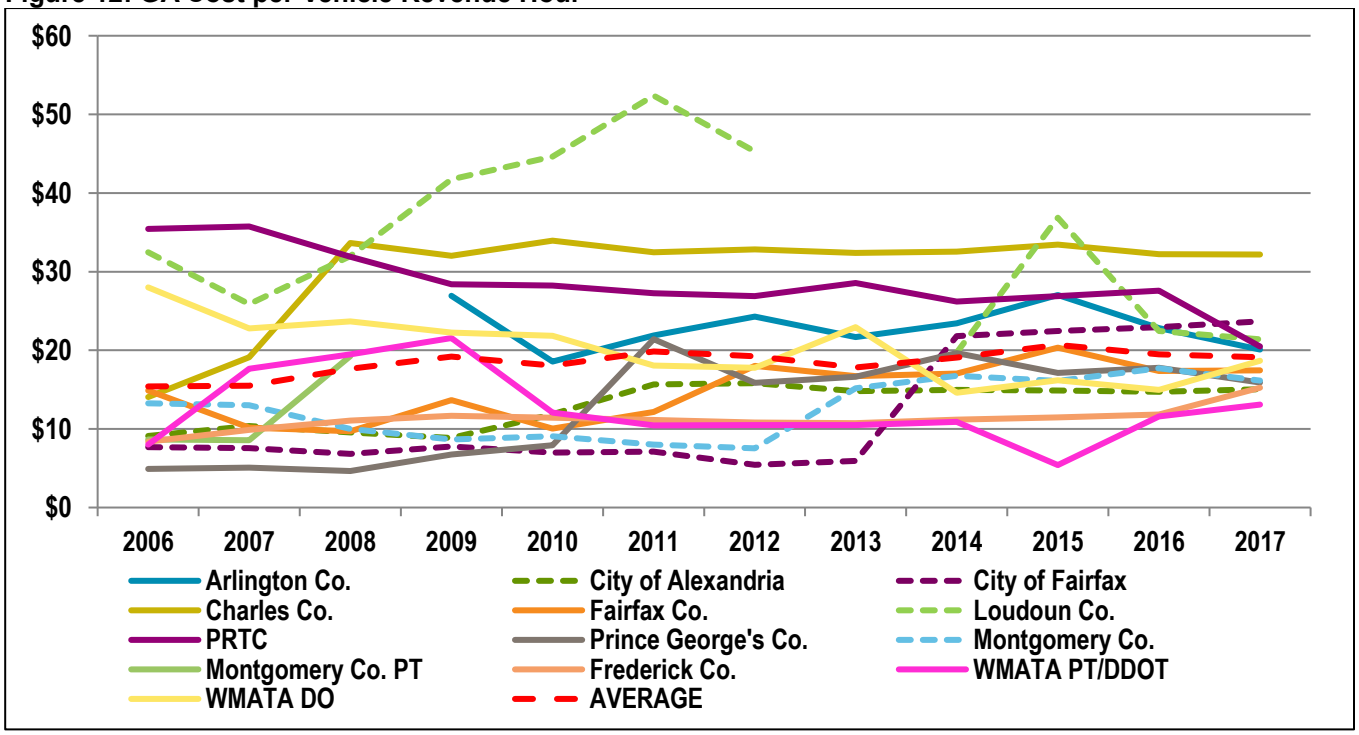


Figure 12 highlights the changes in General Administration Unit Costs over time. As shown, there is some year-by-year variation in these costs, and the regional average shows an increase of 23 percent since 2006, to 19.11/ revenue hours in 2017. This is the only function in which WMATA's directly operated services are not among the highest unit costs, perhaps indicating some economies of scale in administrative functions.

Figure 12: GA Cost per Vehicle Revenue Hour



5. CONCLUSIONS

This technical memorandum focused on deriving O&M unit costs for each of the regional operating agencies based primarily on NTD data. This data was analyzed over the course of a twelve-year time period and used standardized definitions of object classes, cost drivers, and functions to ensure that the results are comparable across agencies. The results show that there are differences in the unit costs for each agency, and that for most functions, WMATA unit costs tend to be higher than the other operating agencies.

The NTD-based O&M unit costs are subject to year-to-year variation, which can sometimes lead to concerns over accuracy in reporting. The trend in unit costs was examined over a 12-year period, identifying stable trends and explainable variations that increased confidence that the FY17 unit costs were representative. This was the case except for WMATA, where there was significant change in non-vehicle maintenance and general administration costs in FY17. WMATA confirmed the accuracy of these data.

The unit costs derived from the NTD in this technical memorandum will be applied in the estimation of route-level costs in Task 3.

APPENDIX D1

Agency Data Request Form

MWCOG Analysis of Regional Bus Service Provision
DATA REQUEST

INTRODUCTION

The FTIP/AECOM team is assembling operating cost and service data from each of the bus service operators in the region to better understand cost structures and identify opportunities for containing costs.

In order to limit the burden in complying with this request, we will focus our efforts on the following National Transit Database Reports that you have already submitted:

Operating Expenses Form F-30: This form reports operating expenses by function by object class:

The entire form

Transit Agency Service Form S-10:

Vehicles in maximum service ("peak vehicles")
Annual Actual Vehicle Revenue Hours
Annual Actual Vehicle Revenue Miles
Annual Unlinked Trips

We have already assembled data for FY2016 and prior years from the NTD website.

WHAT WE NEED FROM YOUR AGENCY

1) FY 2017NTD Form F-30 and S-10 for Motor Bus. We are not addressing paratransit (Demand Response) services.
2) Complete the form on the following pages.

Please submit this information to the project FPT site as a zip file with your agency name in the file name: https://us1.hostedftp.com/~gbyala_fitp/ - the password is "mwcog".

If you have questions, please contact:

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M +1-301-305-9656
robert.peskin@aecom.com

Data Need	Detail	Action Requested				
NTD Reports	FY2016 and prior	Already assembled.	No action required			
	FY2017	Please download from your NTD account and provide in electronic form	Upload to project website			
Directly Operated Service	General Administration (functions may be performed by other City/ County/ State departments)	Budget excerpt	Provide for transit operation and for other functions if there is a clear indication of the portion of those functions supporting the transit operation			
		Organization chart	Provide for transit operation with a) an indication of headcounts and b) linkages to support by other governmental units			
		Describe responsibilities in these areas:	Narrative description	Head count (FTEs)	FY17 Cost	
					In-house	Purchased Services
		Customer service				
		Facilities/Capital Planning				
		Financial: including accounting, accounts payable, accounts receivable, treasury, payroll				
		Human Resources				
		Information Technology				
		Legal				
		Marketing				
		Planning				
		Policing				
		Purchasing				

Data Need	Detail	Action Requested				
Directly Operated Service	General Administration (functions may be performed by other City/ County/ State departments)	Describe responsibilities in these areas:	Narrative description		FY17 Cost	
				Head count (FTEs)	In-house	Purchased Services
		Runcutting				
		Service planning and scheduling				
		Street supervision				
		Other function				
		Other function				
		Other function				
Purchased Transport	Contractor Prices in FY17		Baseline Rate	Rate above this service limit	Rate below this service limit	
			Baseline price valid in this range>>			
		Price per hour				
		Price per mile				
		Price per vehicle				
		Fixed cost per month				
		Other pricing component				
		Other pricing component				
		Other pricing component				
		Budget excerpt	Provide for transit operation and for other functions if there is a clear indication of the portion of those functions supporting the transit operation			
		Organization chart	Provide for transit operation with a) an indication of headcounts and b) linkages to support by other governmental units			

Data Need	Detail	Action Requested					
Purchased Transport	Functions performed by public agency (functions may be performed by other City/ County/ State departments)	Describe responsibilities in these areas	Narrative description of function performed	Headcount (FTEs)		FY17 Cost	
				Public	Contractor	In-house	Contractor
		Contract administration					
		Customer service					
		Facilities/Capital Planning					
		Financial: including accounting, accounts payable, accounts receivable, treasury, payroll					
		Human Resources					
		Information Technology					
		Legal					
		Marketing					
		Planning					
		Policing					
		Purchasing					
		Runcutting					
		Service planning and scheduling					
		Street supervision					
		Other function					
		Other function					
		Other function					
	Ownership of Assets	Vehicles	Who owns the vehicles?				
			If contractor, is cost built into pricing (above) or separate?				
		Maintenance Facilities	Who owns the maintenance facilities				
			If contractor, is cost built into pricing (above) or separate?				

APPENDIX D2

Derivation of O&M Unit Common Costs for Directly Operated and Purchased Transportation Bus Service

Table B-2: Screenshot Showing NTD Data Assembly (a)

Year	NTD ID	Company Name	Location	State	Mode	Service	Total Modal Expenses for Operators' Salaries/Wages	Total Modal Expenses for Other Salaries/Wages	Total Modal Expenses for Fringe Benefits	Total Modal Expenses for Services	Total Modal Expenses for Fuel/Lube	Total Modal Expenses for Tires/Tubes
2009	3051	Ride-On Montgomery County Transit	Rockville	MD	MB	DO	$30,633,158	$13,711,331	$24,336,885	$2,704,849	$9,086,508	$6,978,814
2010	3051	Ride-On Montgomery County Transit	Rockville	MD	MB	DO	$30,874,468	$13,351,332	$24,901,215	$1,247,128	$8,354,976	$6,306,920
2011	3051	Ride-On Montgomery County Transit	Rockville	MD	MB	DO	$30,713,034	$11,989,807	$25,142,959	$1,866,923	$9,350,341	$5,655,864
2012	3051	Ride-On Montgomery County Transit	Rockville	MD	MB	DO	$29,860,568	$12,305,347	$23,269,965	$1,625,972	$10,559,499	$6,347,257
2013	3051	Ride-On Montgomery County Transit	Rockville	MD	MB	DO	$30,988,918	$16,150,414	$25,658,437	$2,125,489	$10,677,060	$6,343,417
2014	3051	Ride-On Montgomery County Transit	Rockville	MD	MB	DO	$31,688,779	$16,304,540	$28,523,903	$2,153,122	$10,629,505	$6,265,952
2015	3051	Ride-On Montgomery County Transit	Rockville	MD	MB	DO	$34,847,383	$15,946,038	$28,595,982	$3,798,168	$9,838,610	$6,042,014
2016	3052	Ride-On Montgomery County Transit	Rockville	MD	MB	DO	$35,053,144	$17,665,596	$30,196,007	$2,810,931	$7,225,539	$7,273,185
2006	3072	Transit Services of Frederick County	Frederick	MD	MB	DO	$1,237,139	$410,015	$588,416	$155,041	$443,766	
2007	3072	Transit Services of Frederick County	Frederick	MD	MB	DO	$1,334,958	$510,315	$635,438	$236,984	$455,778	
2008	3072	Transit Services of Frederick County	Frederick	MD	MB	DO	$1,340,351	$566,290	$655,756	$252,378	$598,557	
2009	3072	Transit Services of Frederick County	Frederick	MD	MB	DO	$1,139,299	$945,912	$722,699	$289,263	$501,294	$33,365
2010	3072	Transit Services of Frederick County	Frederick	MD	MB	DO	$1,414,756	$607,691	$723,929	$370,307	$453,004	$37,056
2011	3072	Transit Services of Frederick County	Frederick	MD	MB	DO	$1,410,898	$601,005	$752,589	$295,986	$512,926	$45,368
2012	3072	Transit Services of Frederick County	Frederick	MD	MB	DO	$1,278,269	$582,888	$726,662	$293,961	$539,296	$51,053
2013	3072	Transit Services of Frederick County	Frederick	MD	MB	DO	$1,392,194	$574,162	$774,668	$242,348	$558,142	$68,924
2014	3072	Transit Services of Frederick County	Frederick	MD	MB	DO	$1,386,666	$605,751	$839,835	$406,214	$553,119	$66,496
2015	3072	Transit Services of Frederick County	Frederick	MD	MB	DO	$1,454,520	$629,430	$887,090	$389,851	$436,490	$79,807
2016	3073	Transit Services of Frederick County	Frederick	MD	MB	DO	$1,444,543	$668,207	$907,530	$286,803	$340,904	$37,902

Table B-1: Screenshot Showing NTD Data Assembly (b)

Year	NTD ID	Company Name	Location	State	Mode	Service	Total Modal Expenses for Operators' Salaries/Wages	Total Modal Expenses for Other Salaries/Wages	Total Modal Expenses for Fringe Benefits	Total Modal Expenses for Services	Total Modal Expenses for Fuel/Lube	Total Modal Expenses for Tires/Tubes
2006	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	PT		$503,941	$128,383		$436,650	
2007	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	PT		$442,894	$109,204		$382,816	
2008	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	PT		$102,257	$26,141	$442,802	$697,760	
2009	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	PT		$550,670	$20,459			$690,952
2010	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	PT		$482,589	$86,293		$744,410	
2011	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	PT		$404,106	$70,273		$978,298	
2012	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	PT		$489,972	$79,789		$1,246,675	
2013	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	PT		$481,437	$81,311	$2,000	$1,352,003	
2014	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	PT		$475,624	$88,721	$2,000	$1,113,540	
2015	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	PT		$475,624	$88,721	$2,000	$1,113,540	
2016	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	PT		$475,624	$88,721	$2,000	$1,113,540	
2006	3030	Washington Metropolitan Area Transit Authority	Washington	DC	MB	DO	$116,219,948	$107,618,938	$122,231,293	$20,453,223	$36,172,997	$2,275,000
2007	3031	Washington Metropolitan Area Transit Authority	Washington	DC	MB	DO	$117,715,166	$114,151,162	$126,358,499	$17,582,476	$36,436,610	$2,364,735
2008	3032	Washington Metropolitan Area Transit Authority	Washington	DC	MB	DO	$125,340,419	$117,056,983	$138,381,208	$32,984,445	$31,361,133	$5,026,795
2009	3033	Washington Metropolitan Area Transit Authority	Washington	DC	MB	DO	$131,305,470	$102,602,776	$162,970,942	$31,178,478	$34,972,177	$4,723,509
2010	3034	Washington Metropolitan Area Transit Authority	Washington	DC	MB	DO	$131,117,301	$113,291,300	$168,887,048	$30,096,988	$33,359,484	$4,617,266
2011	3035	Washington Metropolitan Area Transit Authority	Washington	DC	MB	DO	$149,449,217	$108,155,453	$178,456,152	$19,226,972	$32,345,212	$5,436,394
2012	3036	Washington Metropolitan Area Transit Authority	Washington	DC	MB	DO	$147,169,963	$115,780,137	$164,318,652	$33,417,829	$38,894,142	$5,866,560
2013	3037	Washington Metropolitan Area Transit Authority	Washington	DC	MB	DO	$147,070,702	$113,401,310	$176,204,644	$35,305,700	$30,251,809	$5,278,686
2014	3038	Washington Metropolitan Area Transit Authority	Washington	DC	MB	DO	$156,223,901	$107,947,962	$185,412,771	$23,997,886	$38,994,957	$5,728,713
2015	3039	Washington Metropolitan Area Transit Authority	Washington	DC	MB	DO	$161,858,878	$114,656,631	$231,221,116	$34,763,364	$31,362,395	$5,695,275
2016	3040	Washington Metropolitan Area Transit Authority	Washington	DC	MB	DO	$167,178,286	$124,954,591	$194,358,725	$35,160,808	$21,289,399	$5,972,705

Table B-3: Cost Drivers for Vehicle Operations

Year		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NTD ID		3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071
Company Name	COST DRIVERS	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria
Location		Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria
State		VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA
Mode		MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
Service		DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO
Vehicle Operations Operators' Salaries/Wages	VehRevHrs-Oper	$2,629,619	$3,006,882	$3,273,872	$3,456,320	$3,653,929	$3,536,454	$3,928,810	$4,142,837	$4,467,210	$4,785,742	$5,173,821	$5,283,316
Vehicle Operations Other Salaries/Wages	VehRevHrs-Wages	$559,981	$640,319	$697,175	$736,028	$540,959	$608,328	$623,178	$853,263	$816,895	$1,067,335	$1,141,599	$1,444,501
Vehicle Operations Fringe Benefits	VehRevHrs-Fringe	$1,523,902	$1,860,038	$1,853,369	$2,245,667	$2,055,226	$2,245,763	$2,147,296	$2,259,809	$2,368,959	$2,717,393	$2,988,072	$2,875,026
Vehicle Operations Services	VehRevHrs	$18,444	$15,648	$12,968	$11,154	$15,290	$19,017	$17,273	$224,868	$163,223	$138,887	$120,212	$95,277
Vehicle Operations Fuel/Lube	VehRevMiles-Fuel/Elec	$849,077	$996,397	$1,413,484	$1,122,284	$1,077,804	$1,340,248	$1,621,942	$1,569,728	$1,614,567	$1,282,201	$780,125	$938,324
Vehicle Operations Tires/Tubes	VehRevMiles	$72,481	$82,572	$40,538	$57,969	$57,337	$91,791	$93,655	$21,963	$2,637	$102,033	$89,525	$103,388
Vehicle Operations Other Materials/Supplies	VehRevMiles	$35,727	$31,353	$42,272	$24,512	$22,948		$40,960	$19,551	$45,613	$64,235	$27,770	$33,441
Vehicle Operations Utilities	VehRevMiles-Fuel/Elec	$3,459	$0	$0	$0								
Vehicle Operations Casualty/Liab Costs	VehRevHrs												
Vehicle Operations Taxes	VehRevHrs												
Vehicle Operations In Report	VehRevHrs												
Vehicle Operations Filing Separate Report	VehRevHrs												
Vehicle Operations Misc Expenses	VehRevHrs	$928	$15,787	$63,799	$10,287	$25,376			$14,083	$49,052	$20,137	$22,980	$12,021
Vehicle Operations Expense Transfers	VehRevHrs												
Total Vehicle Operations Expenses	DirectExpense	**$5,693,618**	**$6,648,996**	**$7,397,477**	**$7,664,221**	**$7,448,869**	**$7,841,601**	**$8,473,114**	**$9,106,102**	**$9,528,156**	**$10,177,963**	**$10,344,104**	**$10,785,294**

Table B-4: Cost Drivers for Vehicle Maintenance

Year		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NTD ID		3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071
Company Name	COST DRIVERS	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria
Location		Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria
State		VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA
Mode		MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
Service		DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO
Vehicle Maint Operators' Salaries/Wages	VehRevMiles-Wages												
Vehicle Maint Other Salaries/Wages	VehRevMiles-Wages	$711,529	$813,610	$885,853	$935,220	$915,455	$970,468	$878,765	$917,620	$968,492	$1,002,041	$1,124,021	$1,189,610
Vehicle Maint Fringe Benefits	VehRevMiles-Fringe	$287,167	$350,510	$349,253	$423,178	$448,514	$525,828	$514,888	$444,932	$536,952	$540,179	$601,339	$609,200
Vehicle Maint Services	VehRevMiles	$79,979	$39,158	$77,931	$79,791	$89,704	$47,864	$56,487	$97,022	$169,911	$123,038	$153,219	$147,501
Vehicle Maint Fuel/Lube	VehRevMiles-Fuel/Elec	$28,548	$23,432	$20,004	$18,675	$23,351	$28,289	$34,910	$33,372	$33,346	$25,098	$16,494	$16,654
Vehicle Maint Tires/Tubes	VehRevMiles	$0	$0	$0		$0	$986	$2,090	$336	$83,913	$1,263	$2,943	$1,087
Vehicle Maint Other Materials/Supplies	VehRevMiles	$384,005	$342,534	$423,075	$678,553	$518,012	$374,954	$380,255	$578,149	$439,639	$529,041	$556,308	$491,730
Vehicle Maint Utilities	VehRevMiles-Fuel/Elec	$116,607	$0										
Vehicle Maint Casualty/Liab Costs	VehRevMiles	$222,781	$248,631	$274,215	$228,757	$311,211			$0				
Vehicle Maint Taxes	VehRevMiles	$0	$0	$0		$0							
Vehicle Maint In Report	VehRevMiles	$0	$0										
Vehicle Maint Filing Separate Report	VehRevMiles	$0	$0										
Vehicle Maint Misc Expenses	VehRevMiles	$2,023	$5,707	$16,624	$5,098	$8,400		$0	$1,138	$88	$7,377	$6,708	$7,953
Vehicle Maint Expense Transfers	VehRevMiles	$0	$0			$0							
Total Vehicle Maint Expenses	**DirectExpense**	**$1,832,639**	**$1,823,582**	**$2,046,955**	**$2,369,272**	**$2,314,647**	**$1,948,389**	**$1,867,395**	**$2,072,569**	**$2,232,341**	**$2,228,037**	**$2,461,032**	**$2,463,735**

Table B-5: Cost Drivers for Non-Vehicle Maintenance

Year		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NTD ID		3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071
Company Name	**COST DRIVERS**	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria
Location		Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria
State		VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA
Mode		MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
Service		DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO
Salaries/Wages	VehMaxSc-Wages												
Non-Vehicle Maint Other Salaries/Wages	VehMaxSc-Wages	$0	$0	$0		$0			$41,071	$48,209	$52,710	$55,489	$51,189
Non-Vehicle Maint Fringe Benefits	VehMaxSc-Fringe	$0	$0	$0		$0			$21,981	$19,536	$28,682	$27,399	$63,774
Non-Vehicle Maint Services	VehMaxSc	$91,773	$138,489	$109,923	$128,130	$121,062		$182,842	$116,002	$138,238	$300,499	$210,923	$237,808
Non-Vehicle Maint Fuel/Lube	VehMaxSc												
Non-Vehicle Maint Tires/Tubes	VehMaxSc												
Materials/Supplies	VehMaxSc	$0	$0	$0	$611	$1,553	$104,192	$448	$16,325	$3,248	$6,481	$36,143	$1,374
Non-Vehicle Maint Utilities	VehMaxSc												
Non-Vehicle Maint Casualty/Liab Costs	VehMaxSc												
Non-Vehicle Maint Taxes	VehMaxSc												
Non-Vehicle Maint In Report	VehMaxSc												
Non-Vehicle Maint Filing Separate Report	VehMaxSc												
Non-Vehicle Maint Misc Expenses	VehMaxSc	$0	$0	$0		$0			$60		$730		
Non-Vehicle Maint Expense Transfers	VehMaxSc												
Total Non-Vehicle Maint Expenses	**DirectExpense**	**$91,773**	**$138,489**	**$109,923**	**$128,741**	**$122,615**	**$104,192**	**$183,290**	**$195,439**	**$209,231**	**$389,102**	**$329,954**	**$354,145**

Table B-6: Aggregating Costs by Detailed Cost Driver

2	Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
3	NTD ID	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071
4	Company Name	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria
5	Location	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria
6	State	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA
7	Mode	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
8	Service	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO
76	**Non-EMP DIRECT EXPENSES BY DRIVER**												
77	VehRevHrs	$ 19,372	$ 31,435	$ 76,767	$ 21,441	$ 40,666	$ 19,017	$ 17,273	$ 238,951	$ 212,275	$ 159,024	$ 143,192	$ 107,298
78	VehRevHrs-Oper	$ 2,629,619	$ 3,006,882	$ 3,273,872	$ 3,456,320	$ 3,653,929	$ 3,536,454	$ 3,928,810	$ 4,142,837	$ 4,467,210	$ 4,785,742	$ 5,173,821	$ 5,283,316
79	VehRevHrs-Wages	$ 559,981	$ 640,319	$ 697,175	$ 736,028	$ 540,959	$ 608,328	$ 623,178	$ 853,263	$ 816,895	$ 1,067,335	$ 1,141,599	$ 1,444,501
80	VehRevHrs-Fringe	$ 1,523,902	$ 1,860,038	$ 1,853,369	$ 2,245,667	$ 2,055,226	$ 2,245,763	$ 2,147,296	$ 2,259,809	$ 2,368,959	$ 2,717,393	$ 2,988,072	$ 2,875,026
81	**VehRevHrs-TOTAL**	**$ 4,732,874**	**$ 5,538,674**	**$ 5,901,183**	**$ 6,459,456**	**$ 6,290,780**	**$ 6,409,562**	**$ 6,716,557**	**$ 7,494,860**	**$ 7,865,339**	**$ 8,729,494**	**$ 9,446,684**	**$ 9,710,141**
82	VehRevMiles	$ 796,996	$ 749,955	$ 874,655	$ 1,074,680	$ 1,007,612	$ 515,595	$ 573,447	$ 718,159	$ 741,801	$ 826,987	$ 836,473	$ 785,100
83	VehRevMiles-Wages	$ 711,529	$ 813,610	$ 885,853	$ 935,220	$ 915,455	$ 970,468	$ 878,765	$ 917,620	$ 968,492	$ 1,002,041	$ 1,124,021	$ 1,189,610
84	VehRevMiles-Fringe	$ 287,167	$ 350,510	$ 349,253	$ 423,178	$ 448,514	$ 525,828	$ 514,888	$ 444,932	$ 536,952	$ 540,179	$ 601,339	$ 609,200
85	VehRevMiles-Fuel/Elec	$ 997,691	$ 1,019,829	$ 1,433,488	$ 1,140,959	$ 1,101,155	$ 1,368,537	$ 1,656,852	$ 1,603,100	$ 1,647,913	$ 1,307,299	$ 796,619	$ 954,978
86	**VehRevMiles-TOTAL**	**$ 2,793,383**	**$ 2,933,904**	**$ 3,543,249**	**$ 3,574,037**	**$ 3,472,736**	**$ 3,380,428**	**$ 3,623,952**	**$ 3,683,811**	**$ 3,895,158**	**$ 3,676,506**	**$ 3,358,452**	**$ 3,538,888**
87	VehMaxSc	$ 91,773	$ 138,489	$ 109,923	$ 128,741	$ 122,615	$ 104,192	$ 183,290	$ 132,387	$ 141,486	$ 307,710	$ 247,066	$ 239,182
88	VehMaxSc-Wages	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 41,071	$ 48,209	$ 52,710	$ 55,489	$ 51,189
89	VehMaxSc-Fringe	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 21,981	$ 19,536	$ 28,682	$ 27,399	$ 63,774
90	**VehMaxSc-TOTAL**	**$ 91,773**	**$ 138,489**	**$ 109,923**	**$ 128,741**	**$ 122,615**	**$ 104,192**	**$ 183,290**	**$ 195,439**	**$ 209,231**	**$ 389,102**	**$ 329,954**	**$ 354,145**
91	**G&A**	**$ 933,354**	**$ 1,221,160**	**$ 1,234,128**	**$ 1,199,801**	**$ 1,598,347**	**$ 2,184,386**	**$ 2,354,461**	**$ 2,391,405**	**$ 2,615,629**	**$ 2,913,927**	**$ 2,983,945**	**$ 3,247,900**
92	**DirectExpense**	**$ 8,551,384**	**$ 9,832,227**	**$ 10,788,483**	**$ 11,362,035**	**$ 11,484,478**	**$ 12,078,568**	**$ 12,878,260**	**$ 13,765,515**	**$ 14,585,357**	**$ 15,709,029**	**$ 16,119,035**	**$ 16,851,074**
93	**Check Total DirectExpense**	**$ 8,551,384**	**$ 9,832,227**	**$ 10,788,483**	**$ 11,362,035**	**$ 11,484,478**	**$ 12,078,568**	**$ 12,878,260**	**$ 13,765,515**	**$ 14,585,357**	**$ 15,709,029**	**$ 16,119,035**	**$ 16,851,074**
94	**Variance**	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK

Table B-7: Estimating Direct O&M Costs

2	Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
3	NTD ID	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071
4	Company Name	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria
5	Location	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria
6	State	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA
7	Mode	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
8	Service	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO
96	**Direct Unit Costs per ...**												
97	VehRevHrs	$ 0.15	$ 0.22	$ 0.52	$ 0.14	$ 0.27	$ 0.13	$ 0.11	$ 1.42	$ 1.18	$ 0.79	$ 0.70	$ 0.50
98	VehRevHrs-Oper	$ 20.76	$ 21.36	$ 22.24	$ 22.39	$ 24.26	$ 23.40	$ 24.90	$ 24.54	$ 24.86	$ 23.84	$ 25.20	$ 24.50
99	VehRevHrs-Wages	$ 4.42	$ 4.55	$ 4.74	$ 4.77	$ 3.59	$ 4.02	$ 3.95	$ 5.05	$ 4.55	$ 5.32	$ 5.56	$ 6.70
100	VehRevHrs-Fringe	$ 12.03	$ 13.21	$ 12.59	$ 14.55	$ 13.64	$ 14.86	$ 13.61	$ 13.38	$ 13.18	$ 13.54	$ 14.55	$ 13.33
101	VehRevMiles	$ 0.65	$ 0.58	$ 0.65	$ 0.76	$ 0.73	$ 0.37	$ 0.39	$ 0.49	$ 0.48	$ 0.49	$ 0.48	$ 0.43
102	VehRevMiles-Wages	$ 0.58	$ 0.63	$ 0.66	$ 0.67	$ 0.67	$ 0.70	$ 0.60	$ 0.62	$ 0.63	$ 0.59	$ 0.65	$ 0.65
103	VehRevMiles-Fringe	$ 0.23	$ 0.27	$ 0.26	$ 0.30	$ 0.33	$ 0.38	$ 0.35	$ 0.30	$ 0.35	$ 0.32	$ 0.35	$ 0.33
104	VehRevMiles-Fuel/Elec	$ 0.81	$ 0.78	$ 1.07	$ 0.81	$ 0.80	$ 0.98	$ 1.14	$ 1.09	$ 1.08	$ 0.77	$ 0.46	$ 0.52
105	VehMaxSc	$ 1,952.62	$ 3,077.53	$ 2,290.06	$ 2,627.37	$ 2,502.35	$ 2,170.67	$ 3,215.61	$ 2,322.58	$ 2,358.10	$ 4,807.97	$ 3,743.42	$ 3,321.97
106	VehMaxSc-Wages	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 720.54	$ 803.48	$ 823.59	$ 840.74	$ 710.96
107	VehMaxSc-Fringe	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 385.63	$ 325.60	$ 448.16	$ 415.14	$ 885.75
108													
109	**AGGREGATED Direct Unit Costs (excl G&A) per ...**												
110	VehRevHrs	$ 37.36	$ 39.34	$ 40.10	$ 41.84	$ 41.76	$ 42.41	$ 42.56	$ 44.39	$ 43.77	$ 43.49	$ 46.01	$ 45.04
111	VehRevMiles	$ 2.28	$ 2.26	$ 2.63	$ 2.54	$ 2.52	$ 2.43	$ 2.49	$ 2.50	$ 2.54	$ 2.18	$ 1.93	$ 1.92
112	VehMaxSc	$ 1,952.62	$ 3,077.53	$ 2,290.06	$ 2,627.37	$ 2,502.35	$ 2,170.67	$ 3,215.61	$ 3,428.75	$ 3,487.18	$ 6,079.72	$ 4,999.30	$ 4,918.68

Table B-8: Proving Accuracy of Aggregated O&M Unit Costs

2	Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
3	NTD ID	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071	3071
4	Company Name	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria	City of Alexandria
5	Location	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria	Alexandria
6	State	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA
7	Mode	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
8	Service	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO	DO
109	AGGREGATED Direct Unit Costs (excl G&A) per ...												
110	VehRevHrs	$ 37.36	$ 39.34	$ 40.10	$ 41.84	$ 41.76	$ 42.41	$ 42.56	$ 44.39	$ 43.77	$ 43.49	$ 46.01	$ 45.04
111	VehRevMiles	$ 2.28	$ 2.26	$ 2.63	$ 2.54	$ 2.52	$ 2.43	$ 2.49	$ 2.50	$ 2.54	$ 2.18	$ 1.93	$ 1.92
112	VehMaxSc	$ 1,952.62	$ 3,077.53	$ 2,290.06	$ 2,627.37	$ 2,502.35	$ 2,170.67	$ 3,215.61	$ 3,428.75	$ 3,487.18	$ 6,079.72	$ 4,999.30	$ 4,918.68
122	PROOF												
123	VehRevHrs	$ 4,732,874	$ 5,538,674	$ 5,901,183	$ 6,459,456	$ 6,290,780	$ 6,409,562	$ 6,716,557	$ 7,494,860	$ 7,865,339	$ 8,729,494	$ 9,446,684	$ 9,710,141
124	VehRevMiles	$ 2,793,383	$ 2,933,904	$ 3,543,249	$ 3,574,037	$ 3,472,736	$ 3,380,428	$ 3,623,952	$ 3,683,811	$ 3,895,158	$ 3,676,506	$ 3,358,452	$ 3,538,888
125	VehMaxSc	$ 91,773	$ 138,489	$ 109,923	$ 128,741	$ 122,615	$ 104,192	$ 183,290	$ 195,439	$ 209,231	$ 389,102	$ 329,954	$ 354,145
126	**Total**	**$ 7,618,030**	**$ 8,611,067**	**$ 9,554,355**	**$ 10,162,234**	**$ 9,886,131**	**$ 9,894,182**	**$ 10,523,799**	**$ 11,374,110**	**$ 11,969,728**	**$ 12,795,102**	**$ 13,135,090**	**$ 13,603,174**
127	Variance	$ -	$ -	$ -	$ (0.00)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Table B-9: Summary of CPI Conversion Factors

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CPI	128.8	133.5	139.5	139.8	142.2	147.0	150.2	152.5	154.8	155.4	157.2	159.2
Conversion to 2017 $	0.8048	0.8319	0.8728	0.8746	0.8931	0.9218	0.9429	0.9567	0.9745	0.9762	0.9881	1.0000

Source: Bureau of Labor Statistics

Table B-10: O&M Unit Costs for Vehicle Operations (Cost per Veh Rev Hr) and Vehicle Maintenance (Cost per Veh Rev Miles) in 2017 Dollars

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Costs Excluding G&A												
Cost per Veh Rev Hrs												
Arlington Co.				$ 51.22	$ 59.01	$ 52.03	$ 46.29	$ 46.29	$ 45.77	$ 36.44	$ 38.48	$ 37.97
City of Alexandria	$ 46.18	$ 46.93	$ 45.76	$ 47.64	$ 46.75	$ 45.94	$ 45.11	$ 46.34	$ 45.00	$ 44.57	$ 46.60	$ 45.04
City of Fairfax	$ 68.14	$ 68.95	$ 67.56	$ 67.53	$ 65.43	$ 63.10	$ 59.86	$ 58.10	$ 58.61	$ 65.14	$ 65.14	$ 61.78
Charles Co.	$ 42.55	$ 42.39	$ 29.10	$ 30.57	$ 33.75	$ 33.93	$ 34.23	$ 32.24	$ 33.66	$ 35.33	$ 32.14	$ 33.06
Fairfax Co.	$ 43.52	$ 46.64	$ 57.55	$ 48.38	$ 67.62	$ 62.43	$ 59.66	$ 60.09	$ 61.83	$ 58.26	$ 60.49	$ 62.56
Loudoun Co.	$ 67.00	$ 78.40	$ 63.90	$ 59.71	$ 68.17	$ 79.88	$ 82.27		$ 32.54	$ 51.74	$ 41.07	$ 55.07
PRTC	$ 85.07	$ 83.25	$ 83.37	$ 93.69	$ 94.73	$ 89.25	$ 91.23	$ 95.57	$ 98.20	$ 98.88	$ 97.75	$ 108.18
Prince George's Co.	$ 65.28	$ 70.54	$ 73.13	$ 90.38	$ 93.28	$ 76.06	$ 60.44	$ 60.70	$ 57.70	$ 64.27	$ 68.13	$ 67.14
Montgomery Co.	$ 58.95	$ 61.16	$ 59.97	$ 61.63	$ 61.19	$ 60.33	$ 55.89	$ 57.16	$ 57.35	$ 59.80	$ 60.08	$ 60.96
Montgomery Co. PT	$ 38.92	$ 54.20	$ 44.44									
Frederick Co.	$ 39.01	$ 39.48	$ 40.89	$ 42.90	$ 41.58	$ 40.93	$ 37.70	$ 41.53	$ 42.20	$ 44.23	$ 43.30	$ 45.95
WMATA PT/DDOT	$ 59.80	$ 34.00	$ 39.74	$ 48.85	$ 61.46	$ 59.33	$ 62.93	$ 63.33	$ 67.04	$ 77.64	$ 58.02	$ 66.76
WMATA DO	$ 74.35	$ 78.06	$ 75.18	$ 79.14	$ 86.71	$ 87.96	$ 82.39	$ 84.41	$ 88.61	$ 98.24	$ 93.75	$ 78.07
AVERAGE	$ 57.40	$ 58.67	$ 56.72	$ 60.14	$ 64.97	$ 62.60	$ 59.84	$ 58.71	$ 57.38	$ 61.21	$ 58.75	$ 60.21
Cost per Veh Rev Miles												
Arlington Co.				$ 3.62	$ 1.64	$ 1.38	$ 1.48	$ 1.19	$ 1.36	$ 1.89	$ 1.91	$ 1.97
City of Alexandria	$ 2.82	$ 2.69	$ 3.00	$ 2.90	$ 2.82	$ 2.63	$ 2.64	$ 2.61	$ 2.62	$ 2.23	$ 1.95	$ 1.92
City of Fairfax	$ 1.67	$ 1.89	$ 1.87	$ 1.74	$ 1.72	$ 1.61	$ 1.86	$ 1.93	$ 1.86	$ 1.82	$ 1.00	$ 1.18
Charles Co.	$ 0.40	$ 0.62	$ 0.62	$ 0.69	$ 0.72	$ 0.69	$ 0.61	$ 0.90	$ 0.69	$ 0.67	$ 0.63	$ 0.63
Fairfax Co.	$ 2.45	$ 2.39	$ 3.00	$ 2.77	$ 3.10	$ 3.18	$ 3.03	$ 2.87	$ 2.76	$ 2.71	$ 2.75	$ 2.17
Loudoun Co.	$ 1.73	$ 2.08	$ 2.46	$ 2.43	$ 1.91	$ 1.98	$ 2.34		$ 0.95	$ 0.87	$ 1.29	$ 1.44
PRTC	$ 2.17	$ 2.06	$ 2.35	$ 2.83	$ 2.26	$ 2.61	$ 2.68	$ 2.74	$ 2.41	$ 2.36	$ 2.82	$ 2.72
Prince George's Co.	$ 1.32	$ 1.54	$ 1.70	$ 0.73	$ 0.56	$ 2.15	$ 2.35	$ 2.99	$ 3.95	$ 2.77	$ 2.45	$ 2.50
Montgomery Co.	$ 3.50	$ 3.41	$ 3.27	$ 3.43	$ 3.27	$ 3.29	$ 3.57	$ 3.01	$ 2.88	$ 2.78	$ 2.21	$ 2.30
Montgomery Co. PT	$ 1.80	$ 1.28	$ 2.15									
Frederick Co.	$ 1.37	$ 1.58	$ 1.90	$ 1.82	$ 1.93	$ 1.77	$ 1.69	$ 1.74	$ 2.09	$ 1.86	$ 1.56	$ 1.66
WMATA PT/DDOT	$ 1.53	$ 3.00	$ 3.49	$ 3.19	$ 2.75	$ 2.98	$ 3.18	$ 3.30	$ 3.22	$ 3.08	$ 3.23	$ 3.90
WMATA DO	$ 4.61	$ 5.08	$ 4.86	$ 4.02	$ 5.49	$ 4.38	$ 4.88	$ 3.96	$ 4.41	$ 4.44	$ 3.87	$ 4.67
AVERAGE	$ 2.11	$ 2.30	$ 2.56	$ 2.51	$ 2.35	$ 2.39	$ 2.53	$ 2.48	$ 2.43	$ 2.29	$ 2.14	$ 2.25

Table B-11: O&M Unit Cost for Non-Vehicle Maintenance (Cost per Veh in Max Service) and General Administration (Cost per Rev Hr) in 2017 Dollars

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Cost per Veh in Max Service												
Arlington Co.				$ 9,594.73	$ 7,290.87	$ 7,521.12	$ 8,354.16	$ 9,137.05	$ 5,851.48	$ 7,907.62	$ 5,412.15	$ 6,845.50
City of Alexandria	$ 2,413.51	$ 3,671.02	$ 2,613.51	$ 2,991.70	$ 2,801.18	$ 2,351.25	$ 3,408.06	$ 3,579.44	$ 3,585.26	$ 6,230.35	$ 5,063.62	$ 4,918.68
City of Fairfax	$ 121.44	$ 718.54	$ 366.05	$ 26.90	$ 2,547.95	$ 1,072.77	$ 742.69	$ 1,204.72	$ 1,757.06	$ 1,006.46	$ 2,850.07	$ 2,937.75
Charles Co.			$ 352.32	$ 385.11	$ 300.48	$ 970.39	950.97	$ 2,136.47	$ 2,705.75	$ 3,832.98	$ 2,408.02	$ 295.75
Fairfax Co.	$ 5,708.25	$ 2,653.01	$ 756.49	$ 651.00	$ 838.26	$ 805.67	$ 1,850.76	$ 1,536.43	$ 1,831.29	$ 4,453.51	$ 4,473.00	$ 3,898.65
Loudoun Co.	$ 845.69	$ 1,236.45	$ 312.09	$ 337.82	$ 2,196.36	$ 2,211.96	$ 1,898.98	$ -	$ -	$ 7,381.24	$ 1,655.79	$ 3,858.59
PRTC	$ 10,043.07	$ 7,064.55	$ 9,391.93	$ 7,654.46	$ 9,710.76	$ 9,041.23	$ 5,829.57	$ 15,822.72	$ 17,263.21	$ 14,336.27	$ 12,769.26	$ 14,761.39
Prince George's Co.	$ 7,190.50	$ 9,258.16	$ 3,773.89	$ 6,969.17	$ 7,630.38	$ 344.98	$ 795.13	$ 752.86	$ 226.21	$ 7,774.27	$ 2,461.55	$ 2,097.80
Montgomery Co.	$ 2,285.21	$ 2,256.72	$ 5,376.41	$ 8,789.58	$ 3,504.79	$ 4,833.40	$ 4,222.33	$ 6,973.99	$ 6,856.47	$ 11,904.77	$ 10,691.35	$ 18,061.87
Montgomery Co. PT			$ 6,493.96									
Frederick Co.	$ 210.99	$ 589.33	$ 307.56	$ 66.04	$ 249.13	$ 2.17	$ 622.78	$ 164.36	$ 75.63	$ 908.66	$ 23.46	$ 722.28
WMATA PT/DDOT					$ 2,442.61	$ 1,094.22	$ 1,319.14	$ 1,391.63	$ 1,285.16	$ 2,104.73	$ 1,710.16	$ 9,520.52
WMATA DO	$ 25,853.53	$ 28,002.36	$ 31,616.13	$ 29,226.65	$ 21,225.69	$ 19,355.37	$ 14,770.57	$ 14,296.06	$ 14,338.60	$ 18,702.82	$ 18,462.64	$ 48,359.52
AVERAGE	$ 6,074.69	$ 6,161.13	$ 5,578.21	$ 6,063.02	$ 5,061.54	$ 4,133.71	$ 3,730.43	$ 4,749.64	$ 4,648.01	$ 7,211.97	$ 5,665.09	$ 9,689.86
GA Cost per Rev Hrs												
Arlington Co.				$ 26.94	$ 18.56	$ 21.88	$ 24.29	$ 21.67	$ 23.44	$ 27.03	$ 22.80	$ 20.11
City of Alexandria	$ 9.11	$ 10.35	$ 9.57	$ 8.85	$ 11.88	$ 15.66	$ 15.81	$ 14.79	$ 14.97	$ 14.88	$ 14.72	$ 15.06
City of Fairfax	$ 7.68	$ 7.57	$ 6.84	$ 7.76	$ 6.98	$ 7.12	$ 5.43	$ 5.93	$ 21.79	$ 22.43	$ 22.94	$ 23.68
Charles Co.	$ 14.05	$ 19.12	$ 33.63	$ 32.02	$ 33.94	$ 32.46	$ 32.82	$ 32.37	$ 32.53	$ 33.45	$ 32.23	$ 32.16
Fairfax Co.	$ 14.89	$ 10.15	$ 9.70	$ 13.66	$ 10.04	$ 12.16	$ 18.03	$ 16.71	$ 17.04	$ 20.33	$ 17.35	$ 17.45
Loudoun Co.	$ 32.46	$ 25.87	$ 31.97	$ 41.75	$ 44.61	$ 52.39	$ 45.28		$ 19.71	$ 36.85	$ 22.47	$ 21.39
PRTC	$ 35.42	$ 35.74	$ 31.91	$ 28.38	$ 28.24	$ 27.24	$ 26.89	$ 28.57	$ 26.20	$ 26.89	$ 27.56	$ 20.48
Prince George's Co.	$ 4.91	$ 5.09	$ 4.64	$ 6.72	$ 7.91	$ 21.41	$ 15.86	$ 16.64	$ 19.64	$ 17.10	$ 17.77	$ 15.91
Montgomery Co.	$ 13.27	$ 13.03	$ 10.01	$ 8.64	$ 9.05	$ 8.00	$ 7.53	$ 15.17	$ 16.74	$ 16.12	$ 17.71	$ 16.13
Montgomery Co. PT	$ 8.65	$ 8.56	$ 19.26									
Frederick Co.	$ 8.38	$ 9.88	$ 11.04	$ 11.67	$ 11.43	$ 11.13	$ 10.81	$ 10.75	$ 11.18	$ 11.46	$ 11.85	$ 15.24
WMATA PT/DDOT	$ 8.01	$ 17.67	$ 19.47	$ 21.55	$ 12.09	$ 10.47	$ 10.49	$ 10.48	$ 10.91	$ 5.40	$ 11.57	$ 13.07
WMATA DO	$ 28.00	$ 22.79	$ 23.66	$ 22.24	$ 21.83	$ 18.06	$ 17.77	$ 22.93	$ 14.60	$ 16.19	$ 14.98	$ 18.65
AVERAGE	$ 15.40	$ 15.48	$ 17.64	$ 19.18	$ 18.05	$ 19.83	$ 19.25	$ 17.82	$ 19.06	$ 20.68	$ 19.50	$ 19.11

APPENDIX D3

Summary of Administrative Costs and Headcount Data

Table C-1: Summary of Administrative Costs and Headcount Data Provided

			City of Alexandria	City of Fairfax CUE Bus	Ride-On Montgomery County Transit	Transit Services of Frederick County	Washington Metropolitan Area Transit Authority	Arlington Transit - Arlington County	County Commissioners of Charles County	Fairfax Connector Bus System	Loudoun County Commuter Bus Service- Office of Transportation Services	Potomac and Rappahannock Transportation Commission	Prince George's County Transit	Ride-On Montgomery County Transit	DDOT - Progressive Transportation Services Administration
			Alexandria	Fairfax	Rockville	Frederick	Washington	Arlington	Port Tobacco	Fairfax	Leesburg	Woodbridge	Largo	Rockville	Washington
			VA	VA	MD	MD	DC	VA	MD	VA	VA	VA	MD	MD	DC
			MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
			DO	DO	DO	DO	DO	PT	PT	PT	PT	PT	PT	PT	PT
Directly Operated | General Administration Functions FY17 Costs & Purchased Transportation | Functions Performed by Public Agency (FY17 Costs)	Customer Service	Headcount (FTEs) - Public				1.2	36	0.2	4		0.9				
		Headcount (FTEs) - Contractor						6.7			3.25		12		
		In-house Cost				$ 45,973	$ 5,522,619								
		Purchased Services Cost						$ 382,654			-		$ 202,800		
	Contract Administration	Headcount (FTEs) - Public						1.2			3		1		
		Headcount (FTEs) - Contractor						0.5			4		9		
		In-House Cost									-		$ 87,213		
		Contractor Cost						$ 80,000			-		$ 3,174,423		
	Facilities/ Capital Planning	Headcount (FTEs) - Public		0.7		0.3		1.5	4	1			0.5		
		Headcount (FTEs) - Contractor											2		
		In-house Cost		$ 125,989		$ 44,548	$ 3,746,787						$ 38,818		
		Purchased Services Cost											$ 120,615		
	Financial	Headcount (FTEs) - Public		0.42		1.0	87	0.8	4						0.3
		Headcount (FTEs) - Contractor						1.0							
		In-house Cost		$ 54,900		82,966	27,321,783	$ 99,537							41,815
		Purchased Services Cost													
	Human Resources	Headcount (FTEs) - Public				0.6	55	0.2							
		Headcount (FTEs) - Contractor						0.8			2				
		In-house Cost				$ 14,668	$ 12,164,315								
		Purchased Services Cost													
	Information Technology	Headcount (FTEs) - Public		0.15			116								0.03
		Headcount (FTEs) - Contractor						1			0.05				
		In-house Cost		$ 35,607			$ 27,479,350	$ 152,714							$ 3,411
		Purchased Services Cost													
	Legal	Headcount (FTEs) - Public				0.01	19	0.1			0.01				0.09
		Headcount (FTEs) - Contractor									0.01				
		In-house Cost					$ 8,124,913								$ 16,052
		Purchased Services Cost													
	Marketing	Headcount (FTEs) - Public				0.21	8	0.2	4		1				0.1
		Headcount (FTEs) - Contractor						7							
		In-house Cost				$ 10,865	$ 2,688,201	$ 25,000							$ 14,220
		Purchased Services Cost						$ 382,654							
	Planning	Headcount (FTEs) - Public				0.3	12	3.4	4	17					0.92
		Headcount (FTEs) - Contractor													
		In-house Cost				$ 16,990	$ 1,427,549	$ 315,000							$ 122,560
		Purchased Services Cost													
	Policing	Headcount (FTEs) - Public					299	0.1							
		Headcount (FTEs) - Contractor													
		In-house Cost					$ 13,107,922	$ 7,500							
		Purchased Services Cost													

Table C-1: Summary of Administrative Costs and Headcount Data Provided (Continued)

			VA MB DO	VA MB DO	MD MB DO	MD MB DO	DC MB DO	VA MB PT	MD MB PT	VA MB PT	VA MB PT	VA MB PT	MD MB PT	MD MB PT	DC MB PT
Directly Operated | General Administration Functions FY17 Costs & Purchased Transportation | Functions Performed by Public Agency (FY17 Costs)	Purchasing	Headcount (FTEs) - Public				0.3	28	0.2			0.01				
		Headcount (FTEs) - Contractor						0.7							
		In-house Cost				$ 16,990	$ 2,719,749								
		Purchased Services Cost													
	Runcutting	Headcount (FTEs) - Public				0.3					0.06				
		Headcount (FTEs) - Contractor						0.2			0.05				
		In-house Cost				$ 16,990									
		Purchased Services Cost													
	Service Planning & Scheduling	Headcount (FTEs) - Public				0.3		0.8	4	10	0.05				1.7
		Headcount (FTEs) - Contractor									0.05				
		In-house Cost				$ 16,990									$ 159,605
		Purchased Services Cost						$ 85,000							
	Street Supervision	Headcount (FTEs) - Public													
		Headcount (FTEs) - Contractor						6.2			4				
		In-house Cost													
		Purchased Services Cost						$ 400,000							
	Other Admin	Headcount (FTEs) - Public		1.66		3	28			3					1.8
		Headcount (FTEs) - Contractor													
		In-house Cost		$ 368,281		$ 208,644	$ 20,714,924								$ 214,631
		Purchased Services Cost													
	Vehicle Maintenance - Custom	Headcount (FTEs) - Public											0.6		
		Headcount (FTEs) - Contractor											19		
		In-House Cost											$ 34,208		
		Contractor Cost											$ 5,668,910		
	Fuel - Custom	Headcount (FTEs) - Public													
		Headcount (FTEs) - Contractor													
		In-House Cost											$ 1,946,370		
		Contractor Cost													
	Vehicle operations - Custom	Headcount (FTEs) - Public											7.55		
		Headcount (FTEs) - Contractor											158		
		In-House Cost											$ 531,036		
		Contractor Cost											$ 14,956,272		

Table C-1: Summary of Administrative Costs and Headcount Data Provided (Continued)

		City of Alexandria	City of Fairfax CUE Bus	Ride-On Montgomery County Transit	Transit Services of Frederick County	Washington Metropolitan Area Transit Authority	Arlington Transit - Arlington County	County Commissioners of Charles County	Fairfax Connector Bus System	Loudoun County Commuter Bus Service- Office of Transportation Services	Potomac and Rappahannock Transportation Commission	Prince George's County Transit	Ride-On Montgomery County Transit	DDOT - Progressive Transportation Services Administration
		Alexandria	Fairfax	Rockville	Frederick	Washington	Arlington	Port Tobacco	Fairfax	Leesburg	Woodbridge	Largo	Rockville	Washington
		VA	VA	MD	MD	DC	VA	MD	VA	VA	VA	MD	MD	DC
		MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
		DO	DO	DO	DO	DO	PT	PT	PT	PT	PT	PT	PT	PT
Purchased Transportation | Contractor Prices FY17	**Price per Revenue hour (& Special Services)**													
	Baseline Rate/hour (MV)						$ 38.09	$ 70.63		$ 63.68		$ 97.96		
	Baseline Rate/hour (TD)									$ 133.38				
	Rate below this service limit													
	Price/Total Mile						$ 1.15							
	Price/Vehicle													
	Fixed Admin-Operating Cost/Month						$ 106,952.58							
	Fixed Admin-Maintenance Cost/Month						$ 35,680.13							
	Fixed Insurance Cost/Month					$ 65,576.00	$ 28,166.67							
	Pass-Throughs for Authorized Durable Equipment													
	Variable-direct charges											$ 80,000		
	Capital vehicle repair											$ 100,000		

Table C-2: Calculation of Aggregate Rate for Arlington County PT Contractor Cost

Item Description	Value
Price per Revenue hour (& Special Services)	$ 38.09
Price/Total Mile	$ 1.15
Fixed Admin-Operating Cost/Year	$1,283,430.96
Fixed Admin-Maintenance Cost/Year	$428,161.56
Fixed Insurance Cost/Year	$338,000.04
Annual Rev. Hours (FY17)	174,853
Annual Rev. Miles (FY17)	1,847,491
FY17 Cost ($ x Rev. Hour/ Rev. Mile)	$8,790,677.39
Total FY17 Cost Including Fixed Cost	$10,840,269.95
Hourly Aggregate Cost (Total $/ Rev. Hours)	**$62.25**

APPENDIX E: TASK 3 TECHNICAL MEMORANDUM – APPLICATION OF COST FACTORS

Regional Bus Service Provision Study

Metropolitan Washington Council of Governments

Task 3 Technical Memorandum:

Application of Cost Factors

DRAFT

Prepared May 2018

CONTENTS

LIST OF TABLES

INTRODUCTION

Bus service in the Washington Metropolitan region is provided by 12 separate operating entities, ranging from the large region-wide Metrobus operations of WMATA, to smaller local and/or commuter systems operated by the counties and cities that comprise the region. Task 2 of this study analyzed available cost data to develop unit costs for operations & maintenance (O&M) of each operating agency in the region. Based on the results of Task 2, this technical memorandum considers the cost implications of changing operators of specific routes and services.

Section 1 defines the several O&M costs that are explored and used in this analysis, leveraging the extensive data assembled in Task 2.

Section 2 discusses the initial application of the O&M unit costs to hypothetical test cases that could be operated in each of the jurisdictions to identify where cost efficiencies could be found.

Section 3 discusses the application of the O&M unit costs to a set of specific routes proposed for transferring service delivery between operating agencies.

Section 4 discusses the results of the analysis and its implications.

METHODOLOGY

Recognizing that relatively small, route-level changes in service are unlikely to cause significant changes in non-vehicle maintenance or general administration costs, cost implications in Task 3 will be estimated in two fundamental ways:

- **Incremental costs:** accounting for vehicle operations and vehicle maintenance costs only. This includes costs from the following sources:
    - NTD-derived incremental costs, including cost per vehicle revenue hour (for vehicle operations) and cost per vehicle revenue mile (for vehicle maintenance) as calculated in Task 2.
    - Contract rates for purchased transportation on a per vehicle revenue hour basis (and per vehicle revenue mile in the case of Arlington County). These rates were only provided by a select number of operating agencies, and therefore could only be included in the analysis for that subset.
    - WMATA non-regional rate per platform hour from WMATA's FY17 budget. These are the contract rates charged by WMATA to operate 'non-regional' service. (Note: these rates were applied to revenue hours because platform hour data was not available).
- **Fully-allocated costs:** accounting for incremental cost plus non-vehicle maintenance and general administration. This includes costs from the following sources:
    - NTD-derived fully allocated costs, including the incremental costs listed above as well as the cost per peak vehicle (for non-vehicle maintenance) and cost per vehicle revenue hour (for general administration) as calculated in Task 2.
    - WMATA rate per platform hour for Regional routes. (Note: these rates were applied to revenue hours because platform hour data was not available).

Operating scenarios for both a hypothetical test case and real bus routes that are being considered as potential candidates for transfer from one operator to another are compared using these different cost structures in the following sections.

TEST SCENARIO

Sample test scenarios were analyzed for the potential impacts of transferring route operations between different operating agencies. A hypothetical route, ten-miles long with an all-day 30-minute service frequency, was assumed as the test scenario for all jurisdictions. Other assumptions used in the test scenario include:

Weekday service (255 days/year) operating 5:00 am - 10:00 pm
Weekend service (110 days/year) operating 6:00 am – 10:00 pm
Layover time of 10 minutes

The average travel speed of the route was varied based on geography, with the understanding that bus services in more urbanized and congested areas tend to travel more slowly than services in more suburban or exurban areas where there is less congestion. Based on the operating characteristics highlighted in Table 1, the annual vehicle revenue hours and miles, and the number of vehicles required to operate this hypothetical route were calculated. Table 1 summarizes these assumed and derived parameters for the test scenario.

Table 1: Test Scenario Parameters

		DC		Inner Suburbs		Outer Suburbs		
Service Assumptions	Route Length (miles)	10	10	10	10	10	10	10
	Average In-Service Speed (miles per hour)	5	7.5	10	12	10	12	15
	Layover Time (minutes)	10	10	10	10	10	10	10
Derived Cost Drivers	Annual Revenue Hours	55,735	37,450	31,355	25,260	31,355	25,260	25,260
	Annual Revenue Miles	257,238	249,667	268,757	252,600	268,757	252,600	303,120
	Peak Vehicles	9	6	5	4	5	4	4

3.1 Test Scenario Results

Table 2 summarizes the 2017 O&M unit costs by jurisdiction for each operator for vehicle operations, vehicle maintenance, non-vehicle maintenance, and general administration (GA). The O&M unit costs are shown by jurisdiction and highlight all the potential operating agencies and cost options within each jurisdiction. Each jurisdiction therefore includes multiple potential operators, and O&M unit costs for each operator are calculated using up to three methods representing the range of possible operating costs for a service in that jurisdiction:

- ***NTD-Based Unit Costs*** - Derived costs from the National Transit Database calculated as part of Task 2 for each operating agency. This calculation provides a uniform basis for comparison.
- ***WMATA Regional/Non-Regional Routes*** - Metrobus flat rates for regional and non-regional service from the Approved FY17 budget[27]. These are average costs per platform hour for regional and non-regional routes. These rates represent the price WMATA would charge to operate the route studied. The cost per platform hour for non-regional routes has certain overhead and administrative expenses removed. Because platform hours (the basis for wages paid) were not available, for this study these rates are applied to revenue hours even though it is somewhat smaller than platform hours because it includes deadhead and other paid time. These rates may vary from those calculated from NTD data, as actual conditions often do not match budget forecasts.
- ***Contract*** - Contract rates per hour and per mile for jurisdictions which purchase transportation services from contractors and reported their purchase prices for this study.

[27] Regional routes are referred to as “All Routes” in WMATA budget documents.

For each jurisdiction, potential operators are identified and costs are estimated for each operator based on the derived cost drivers for the test scenario. These calculated rates for each jurisdiction are applied to the cost hour estimates for the test scenario from Table 1 (i.e. revenue hours, revenue miles, and peak vehicles). Tables 3 to 9 show the results of multiplying the derived cost drivers in Table 1 by the O&M unit costs in Table 2. All costs shown are in thousands of dollars and represent annual costs.

Tables 10 to 12 compare the O&M costs of the most expensive operator relative to the other operators in each jurisdiction. The most expensive operator's cost is indicated as "100%" and the other operator's costs are shown as a fraction of this amount. This is shown for each in-service speed assumption and in terms of incremental (vehicle operations and vehicle maintenance) and fully-allocate (including non-vehicle maintenance and general administration) costs.

Table 2: Summary of 2017 O&M Unit Costs for All Providers by Jurisdiction

Jurisdiction	Operator	Veh Ops (based on $/Rev Hr)	Veh Mnt (based on $/Rev Mi)	Non-Veh Mnt (based $/Peak Veh)	GA (based on $/Rev Hr)
District of Columbia	WMATA-NTD	78.07	4.67	48,359.52	18.65
	WMATA - All Routes	149.35	-	-	-
	WMATA - Non-Regional Routes	104.74	-	-	-
	Circulator - NTD	66.76	3.90	9,520.52	13.07
City of Alexandria/ Arlington County	WMATA-NTD	78.07	4.67	48,359.52	18.65
	WMATA - All Routes	149.35	-	-	-
	WMATA - Non-Regional Routes	104.74	-	-	-
	DASH - NTD	45.04	1.92	4,918.68	15.06
	ART - NTD	37.97	1.97	6,845.50	20.11
	Arlington Co. Contract Rate	38.09	1.15	-	-
Fairfax County	WMATA-NTD	78.07	4.67	48,359.52	18.65
	WMATA - All Routes	149.35	-	-	-
	WMATA - Non-Regional Routes	104.74	-	-	-
	Fairfax Connector	62.56	2.17	3,898.65	17.45
	CUE - NTD	61.78	1.18	2,937.75	23.68
	ART - NTD	37.97	1.97	6,845.50	20.11
	Arlington Co. Contract Rate	38.09	1.15	-	-
	DASH - NTD	45.04	1.92	4,918.68	15.06
Montgomery County	WMATA-NTD	78.07	4.67	48,359.52	18.65
	WMATA - All Routes	149.35	-	-	-
	WMATA - Non-Regional Routes	104.74	-	-	-
	RideOn - NTD	60.96	2.30	18,061.87	60.96
	TheBus - NTD	67.14	2.50	2,097.80	15.91
	Prince George's Co. Contract Rate	97.96	-	-	-
Prince George's County	WMATA-NTD	78.07	4.67	48,359.52	18.65
	WMATA - All Routes	149.35	-	-	-
	WMATA - Non-Regional Routes	104.74	-	-	-
	TheBus - NTD	67.14	2.50	2,097.80	15.91
	Prince George's Co. Contract Rate	97.96	-	-	-
	RideOn - NTD	60.96	2.30	18,061.87	60.96
City of Fairfax	WMATA-NTD	78.07	4.67	48,359.52	18.65
	WMATA - All Routes	149.35	-	-	-
	WMATA - Non-Regional Routes	104.74	-	-	-
	CUE - NTD	61.78	1.18	2,937.75	23.68
	Fairfax Connector - NTD	62.56	2.17	3,898.65	17.45
Loudoun County	Loudoun County - NTD	55.07	1.44	3,858.59	21.39
	Loudoun Co. Contract Rate (MV)	63.68	-	-	-
	Fairfax Connector - NTD	62.56	2.17	3,898.65	17.45
PRTC	PRTC - NTD	108.18	2.72	14,761.39	29.88
Frederick County	Frederick County - NTD	45.95	1.66	722.28	15.24
Charles County	Charles County - NTD	33.06	0.63	295.75	32.16
	Charles Co. Contract Rate	70.63	-	-	-

Table 3: DC Test Scenario Service Costs by Operator - 5mph ($000)

		5mph					
DC		Cost by Function				Total Cost	
Jurisdiction	Operator	Veh Ops (based on $/Rev Hr)	Veh Mnt (based on $/Rev Mi)	Non-Veh Mnt (based on $/Peak Veh)	GA (based on $/Rev Hr)	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)
District of Columbia	WMATA-NTD	$ 4,351	$ 1,201	$ 435	$ 1,039	$ 5,552	$ 7,026
	WMATA - All Routes	$ 8,324	$ -	$ -	$ -	$ -	$ 8,324
	WMATA - Non-Regional Routes	$ 5,838	$ -	$ -	$ -	$ 5,838	$ -
	Circulator - NTD	$ 3,721	$ 1,002	$ 86	$ 729	$ 4,723	$ 5,538

Table 4: DC Test Scenario Service Costs by Operator – 7.5mph ($000)

		7.5mph					
DC		Cost by Function				Total Cost	
Jurisdiction	Operator	Veh Ops (based on $/Rev Hr)	Veh Mnt (based on $/Rev Mi)	Non-Veh Mnt (based on $/Peak Veh)	GA (based on $/Rev Hr)	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)
District of Columbia	WMATA-NTD	$ 2,924	$ 1,201	$ 290	$ 698	$ 4,124	$ 5,113
	WMATA - All Routes	$ 5,593	$ -	$ -	$ -	$ -	$ 5,593
	WMATA - Non-Regional Routes	$ 3,923	$ -	$ -	$ -	$ 3,923	$ -
	Circulator - NTD	$ 2,500	$ 1,002	$ 57	$ 490	$ 3,503	$ 4,049

Table 5: Inner Suburbs Test Scenario Service Costs by Operator – 10mph ($000)

		10mph					
Inner Suburbs		Cost by Function				Total Cost	
Jurisdiction	Operator	Veh Ops (based on $/Rev Hr)	Veh Mnt (based on $/Rev Mi)	Non-Veh Mnt (based on $/Peak Veh)	GA (based on $/Rev Hr)	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)
City of Alexandria/ Arlington County	WMATA - NTD	$ 2,448	$ 1,254	$ 242	$ 585	$ 3,702	$ 4,529
	WMATA - All Routes	$ 4,683	$ -	$ -	$ -	$ -	$ 4,683
	WMATA - Non-Regional Routes	$ 3,284	$ -	$ -	$ -	$ 3,284	$ -
	DASH - NTD	$ 1,412	$ 516	$ 25	$ 472	$ 1,929	$ 2,426
	ART - NTD	$ 1,190	$ 530	$ 34	$ 631	$ 1,721	$ 2,385
	Arlington Co. Contract Rate	$ 1,194	$ 309	$ -	$ -	$ 1,503	$ -
Fairfax County	WMATA - NTD	$ 2,448	$ 1,254	$ 242	$ 585	$ 3,702	$ 4,529
	WMATA - All Routes	$ 4,683	$ -	$ -	$ -	$ -	$ 4,683
	WMATA - Non-Regional Routes	$ 3,284	$ -	$ -	$ -	$ 3,284	$ -
	Fairfax Connector - NTD	$ 1,962	$ 584	$ 19	$ 547	$ 2,546	$ 3,113
	CUE - NTD	$ 1,937	$ 316	$ 15	$ 742	$ 2,253	$ 3,010
	ART - NTD	$ 1,190	$ 530	$ 34	$ 631	$ 1,721	$ 2,385
	Arlington Co. Contract Rate	$ 1,194	$ 309	$ -	$ -	$ 1,503	$ -
	DASH - NTD	$ 1,412	$ 516	$ 25	$ 472	$ 1,929	$ 2,426
Montgomery County	WMATA - NTD	$ 2,448	$ 1,254	$ 242	$ 585	$ 3,702	$ 4,529
	WMATA - All Routes	$ 4,683	$ -	$ -	$ -	$ -	$ 4,683
	WMATA - Non-Regional Routes	$ 3,284	$ -	$ -	$ -	$ 3,284	$ -
	RideOn - NTD	$ 1,911	$ 617	$ 90	$ 1,911	$ 2,529	$ 4,530
	TheBus - NTD	$ 2,105	$ 672	$ 10	$ 499	$ 2,777	$ 3,287
	Prince George's Co. Contract Rate	$ 3,072	$ -	$ -	$ -	$ 3,072	$ -
City of Fairfax	WMATA - NTD	$ 2,448	$ 1,254	$ 242	$ 585	$ 3,702	$ 4,529
	WMATA - All Routes	$ 4,683	$ -	$ -	$ -	$ -	$ 4,683
	WMATA - Non-Regional Routes	$ 3,284	$ -	$ -	$ -	$ 3,284	$ -
	CUE - NTD	$ 1,937	$ 316	$ 15	$ 742	$ 2,253	$ 3,010
	Fairfax Connector - NTD	$ 1,962	$ 584	$ 19	$ 547	$ 2,546	$ 3,113

Table 6: Inner Suburbs Test Scenario Service Costs by Operator – 12mph ($000)

		12mph					
Inner Suburbs		Cost by Function				Total Cost	
Jurisdiction	Operator	Veh Ops (based on $/Rev Hr)	Veh Mnt (based on $/Rev Mi)	Non-Veh Mnt (based on $/Peak Veh)	GA (based on $/Rev Hr)	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)
City of Alexandria/ Arlington County	WMATA - NTD	$ 1,972	$ 1,179	$ 193	$ 471	$ 3,151	$ 3,815
	WMATA - All Routes	$ 3,773	$ -	$ -	$ -	$ -	$ 3,773
	WMATA - Non-Regional Routes	$ 2,646	$ -	$ -	$ -	$ 2,646	$ -
	DASH - NTD	$ 1,138	$ 485	$ 20	$ 381	$ 1,623	$ 2,023
	ART - NTD	$ 959	$ 498	$ 27	$ 508	$ 1,457	$ 1,993
	Arlington Co. Contract Rate	$ 962	$ 290	$ -	$ -	$ 1,253	$ -
Fairfax County	WMATA - NTD	$ 1,972	$ 1,179	$ 193	$ 471	$ 3,151	$ 3,815
	WMATA - All Routes	$ 3,773	$ -	$ -	$ -	$ -	$ 3,773
	WMATA - Non-Regional Routes	$ 2,646	$ -	$ -	$ -	$ 2,646	$ -
	Fairfax Connector - NTD	$ 1,580	$ 549	$ 16	$ 441	$ 2,130	$ 2,586
	CUE - NTD	$ 1,561	$ 297	$ 12	$ 598	$ 1,858	$ 2,468
	ART - NTD	$ 959	$ 498	$ 27	$ 508	$ 1,457	$ 1,993
	Arlington Co. Contract Rate	$ 962	$ 290	$ -	$ -	$ 1,253	$ -
	DASH - NTD	$ 1,138	$ 485	$ 20	$ 381	$ 1,623	$ 2,023
Montgomery County	WMATA - NTD	$ 1,972	$ 1,179	$ 193	$ 471	$ 3,151	$ 3,815
	WMATA - All Routes	$ 3,773	$ -	$ -	$ -	$ -	$ 3,773
	WMATA - Non-Regional Routes	$ 2,646	$ -	$ -	$ -	$ 2,646	$ -
	RideOn - NTD	$ 1,540	$ 580	$ 72	$ 1,540	$ 2,120	$ 3,732
	TheBus - NTD	$ 1,696	$ 632	$ 8	$ 402	$ 2,328	$ 2,738
	Prince George's Co. Contract Rate	$ 2,474	$ -	$ -	$ -	$ 2,474	$ -
City of Fairfax	WMATA - NTD	$ 1,972	$ 1,179	$ 193	$ 471	$ 3,151	$ 3,815
	WMATA - All Routes	$ 3,773	$ -	$ -	$ -	$ -	$ 3,773
	WMATA - Non-Regional Routes	$ 2,646	$ -	$ -	$ -	$ 2,646	$ -
	CUE - NTD	$ 1,561	$ 297	$ 12	$ 598	$ 1,858	$ 2,468
	Fairfax Connector - NTD	$ 1,580	$ 549	$ 16	$ 441	$ 2,130	$ 2,586

Table 7: Outer Suburbs Test Scenario Service Costs by Operator – 10mph ($000)

		10mph					
Outer Suburbs		Cost by Function				Total Cost	
Jurisdiction	Operator	Veh Ops (based on $/Rev Hr)	Veh Mnt (based on $/Rev Mi)	Non-Veh Mnt (based on $/Peak Veh)	GA (based on $/Rev Hr)	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)
Prince George's County	WMATA-NTD	$ 2,448	$ 1,254	$ 242	$ 585	$ 3,702	$ 4,529
	WMATA - All Routes	$ 4,683	$ -	$ -	$ -	$ -	$ 4,683
	WMATA - Non-Regional Routes	$ 3,284	$ -	$ -	$ -	$ 3,284	$ -
	TheBus - NTD	$ 2,105	$ 672	$ 10	$ 499	$ 2,777	$ 3,287
	Prince George's Co. Contract Rate	$ 3,072	$ -	$ -	$ -	$ 3,072	$ -
	RideOn - NTD	$ 1,911	$ 617	$ 90	$ 1,911	$ 2,529	$ 4,530
Loudoun County	Loudoun County - NTD	$ 1,727	$ 386	$ 19	$ 671	$ 2,112	$ 2,803
	Loudoun Co. Contract Rate (MV)	$ 1,997	$ -	$ -	$ -	$ 1,997	$ -
	Fairfax Connector - NTD	$ 1,962	$ 584	$ 19	$ 547	$ 2,546	$ 3,113
PRTC	PRTC - NTD	$ 3,392	$ 730	$ 74	$ 937	$ 4,122	$ 5,133
Frederick County	Frederick County - NTD	$ 1,441	$ 445	$ 4	$ 478	$ 1,886	$ 2,367
Charles County	Charles County - NTD	$ 1,037	$ 169	$ 1	$ 1,008	$ 1,205	$ 2,215
	Charles Co. Contract Rate	$ 2,215	$ -	$ -	$ -	$ 2,215	$ -

Table 8: Outer Suburbs Test Scenario Service Costs by Operator – 12mph ($000)

		12mph					
Outer Suburbs		Cost by Function				Total Cost	
Jurisdiction	Operator	Veh Ops (based on $/Rev Hr)	Veh Mnt (based on $/Rev Mi)	Non-Veh Mnt (based on $/Peak Veh)	GA (based on $/Rev Hr)	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)
Prince George's County	WMATA-NTD	$ 1,972	$ 1,179	$ 193	$ 471	$ 3,151	$ 3,815
	WMATA - All Routes	$ 3,773	$ -	$ -	$ -	$ -	$ 3,773
	WMATA - Non-Regional Routes	$ 2,646	$ -	$ -	$ -	$ 2,646	$ -
	TheBus - NTD	$ 1,696	$ 632	$ 8	$ 402	$ 2,328	$ 2,738
	Prince George's Co. Contract Rate	$ 2,474	$ -	$ -	$ -	$ 2,474	$ -
	RideOn - NTD	$ 1,540	$ 580	$ 72	$ 1,540	$ 2,120	$ 3,732
Loudoun County	Loudoun County - NTD	$ 1,391	$ 363	$ 15	$ 540	$ 1,754	$ 2,309
	Loudoun Co. Contract Rate (MV)	$ 1,609	$ -	$ -	$ -	$ 1,609	$ -
	Fairfax Connector - NTD	$ 1,580	$ 549	$ 16	$ 441	$ 2,130	$ 2,586
PRTC	PRTC - NTD	$ 2,733	$ 686	$ 59	$ 755	$ 3,419	$ 4,232
Frederick County	Frederick County - NTD	$ 1,161	$ 418	$ 3	$ 385	$ 1,579	$ 1,967
Charles County	Charles County - NTD	$ 835	$ 159	$ 1	$ 812	$ 994	$ 1,807
	Charles Co. Contract Rate	$ 1,784	$ -	$ -	$ -	$ 1,784	$ -

Table 9: Outer Suburbs Test Scenario Service Costs by Operator – 15mph ($000)

		15mph					
Outer Suburbs		Cost by Function				Total Cost	
Jurisdiction	Operator	Veh Ops (based on $/Rev Hr)	Veh Mnt (based on $/Rev Mi)	Non-Veh Mnt (based on $/Peak Veh)	GA (based on $/Rev Hr)	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)
Prince George's County	WMATA-NTD	$ 1,972	$ 1,415	$ 193	$ 471	$ 3,387	$ 4,051
	WMATA - All Routes	$ 3,773	$ -	$ -	$ -	$ -	$ 3,773
	WMATA - Non-Regional Routes	$ 2,646	$ -	$ -	$ -	$ 2,646	$ -
	TheBus - NTD	$ 1,696	$ 758	$ 8	$ 402	$ 2,454	$ 2,865
	Prince George's Co. Contract Rate	$ 2,474	$ -	$ -	$ -	$ 2,474	$ -
	RideOn - NTD	$ 1,540	$ 696	$ 72	$ 1,540	$ 2,236	$ 3,848
Loudoun County	Loudoun County - NTD	$ 1,391	$ 435	$ 15	$ 540	$ 1,826	$ 2,382
	Loudoun Co. Contract Rate (MV)	$ 1,609	$ -	$ -	$ -	$ 1,609	$ -
	Fairfax Connector - NTD	$ 1,580	$ 659	$ 16	$ 441	$ 2,239	$ 2,696
PRTC	PRTC - NTD	$ 2,733	$ 823	$ 59	$ 755	$ 3,556	$ 4,370
Frederick County	Frederick County - NTD	$ 1,161	$ 502	$ 3	$ 385	$ 1,663	$ 2,050
Charles County	Charles County - NTD	$ 835	$ 190	$ 1	$ 812	$ 1,025	$ 1,839
	Charles Co. Contract Rate	$ 1,784	$ -	$ -	$ -	$ 1,784	$ -

Table 10: Cost of Test Services of Most Expensive Operator Relative to other Operators within District of Columbia

DC		5mph		7.5mph	
Jurisdiction	Operator	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)
District of Columbia	WMATA-NTD	95%	84%	100%	91%
	WMATA - All Routes	-	100%	-	100%
	WMATA - Non-Regional Routes	100%	-	95%	-
	Circulator - NTD	81%	67%	85%	72%

Note: The most expensive operator is shown at 100%

Table 11: Cost of Test Services of Most Expensive Operator Relative to other Operators within Inner Suburbs

Inner Suburbs		10mph		12mph	
Jurisdiction	Operator	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)
City of Alexandria/ Arlington County	WMATA - NTD	100%	97%	100%	100%
	WMATA - All Routes	-	100%	-	99%
	WMATA - Non-Regional Routes	89%	-	84%	-
	DASH - NTD	52%	52%	52%	53%
	ART - NTD	46%	51%	46%	52%
	Arlington Co. Contract Rate	41%	-	40%	-
Fairfax County	WMATA - NTD	100%	97%	100%	100%
	WMATA - All Routes	-	100%	-	99%
	WMATA - Non-Regional Routes	89%	-	84%	-
	Fairfax Connector - NTD	69%	66%	68%	68%
	CUE - NTD	61%	64%	59%	65%
	ART - NTD	46%	51%	46%	52%
	Arlington Co. Contract Rate	41%	-	40%	-
	DASH - NTD	52%	52%	52%	53%
Montgomery County	WMATA - NTD	100%	97%	100%	100%
	WMATA - All Routes	-	100%	-	99%
	WMATA - Non-Regional Routes	89%	-	84%	-
	RideOn - NTD	68%	97%	67%	98%
	TheBus - NTD	75%	70%	74%	72%
	Prince George's Co. Contract Rate	83%	-	79%	-
City of Fairfax	WMATA - NTD	100%	97%	100%	100%
	WMATA - All Routes	-	100%	-	99%
	WMATA - Non-Regional Routes	89%	-	84%	-
	CUE - NTD	61%	64%	59%	65%
	Fairfax Connector - NTD	69%	66%	68%	68%

Note: The most expensive operator is shown at 100%

Table 12: Cost of Test Services of Most Expensive Operator Relative to other Operators within Outer Suburbs

Outer Suburbs		10mph		12mph		15mph	
Jurisdiction	Operator	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)	Incremental Cost (Veh Ops and Veh Maint Only)	Fully-Allocated Cost (Including Non-Veh Maint & GA)
Prince George's County	WMATA-NTD	100%	97%	100%	100%	100%	100%
	WMATA - All Routes	-	100%	-	99%	-	93%
	WMATA - Non-Regional Routes	89%	-	84%	-	78%	-
	TheBus - NTD	75%	70%	74%	72%	72%	71%
	Prince George's Co. Contract Rate	83%	-	79%	-	73%	-
	RideOn - NTD	68%	97%	67%	98%	66%	95%
Loudoun County	Loudoun County - NTD	83%	90%	82%	89%	82%	88%
	Loudoun Co. Contract Rate (MV)	78%	-	76%	-	72%	-
	Fairfax Connector - NTD	100%	100%	100%	100%	100%	100%
PRTC	PRTC - NTD	100%	100%	100%	100%	100%	100%
Frederick County	Frederick County - NTD	100%	100%	100%	100%	100%	100%
Charles County	Charles County - NTD	54%	100%	56%	100%	57%	100%
	Charles Co. Contract Rate	100%	-	100%	-	100%	-

Note: The most expensive operator is shown at 100%

3.2 Implications of Test Scenario Results

While these test scenarios are generally designed as proof-of-concept, some insights can be drawn from the results of the test scenarios. The results can be examined to support decision making within each jurisdiction.

- In most cases, both the incremental and fully-allocated cost estimates derived from the local jurisdictional operator NTD-based unit costs and contractor rates were lower than the incremental and fully-allocated cost estimates from the WMATA NTD-based unit costs and prices for regional and non-regional Metrobus services. For example, for the District of Columbia, Circulator O&M cost estimates calculated from the NTD were lower than the estimated O&M costs for all methods of deriving WMATA operating costs.
- Differences in vehicle operating speed have a significant impact on the cost estimates for the test scenario. Generally, to deliver the same headways, slower speeds mean that more vehicles are required and also drive up vehicle revenue hours. All of this results in higher costs on slower routes. To improve total O&M costs for bus services, the region may want to consider ways to increase operating speeds.

POTENTIAL CHANGES IN SERVICE DELIVERY

Derived unit costs were also applied to a set of 10 proposed route transfers from the current operator to a proposed new operator. The routes were selected from services provided by ART, TheBus, and Metrobus. Table 13 summarizes the routes and associated cost drivers for the potential route transfers.

Table 13: Potential Route Transfers by Agency

Convert From	Transfer To	Route	Direction	Revenue Hours	Revenue Miles	Peak Vehicles[28]
Metrobus	ART	22A	Pentagon/Ballston	9,451	67,335	-
Metrobus	ART	22B	Barcroft/Ballston	3,083	16,201	2
Metrobus	ART	22C	Pentagon/Ballston	9,694	59,218	5
Metrobus	ART	4B	Rosslyn/Seven Corners	13,791	113,226	3
Metrobus	TheBus	C12	Branch Ave Station/Naylor Rd Station	4,312	44,540	1.5
Metrobus	TheBus	C14	Branch Ave Station/Naylor Rd Station	5,523	57,269	1.5
TheBus	Metrobus	21	Upper Marlboro/New Carrollton Metrorail	12,619	227,407	5
Metrobus	TheBus	F12	New Carrollton/Cheverly Station	7,155	84,759	2
Metrobus	TheBus	F13	Washington Business Park/Cheverly Station	9,465	95,154	4
TheBus[29]	Metrobus	20	Upper Marlboro/Addison Road Metrorail	14,331	193,583	6
*Metrobus	Metrobus	J12	Forestville/Addison Rd Station	11,222	146,113	3

Estimated route costs for current and proposed service were then compared on the following basis:

- WMATA Metrobus service:
  - NTD-based unit costs for incremental costs including vehicle operations and vehicle maintenance only.
  - NTD-based fully allocated unit costs for vehicle operations, vehicle maintenance, non-vehicle maintenance, and general administration.
  - Metrobus regional or non-regional rates, as appropriate.

[28] For routes 22 A, B, and C, routes enter service as 22A. Vehicle requirement has been ignored. Additionally, routes C12 and 14 operated together in the peak period

[29] In the case of TheBus route 20 and Metrobus J12, the proposed transfer was to eliminate route 20 and extend the current Metrobus route J12. The route would therefore begin in Forestville and end at Addison Rd. Station via Upper Marlboro.

- Local jurisdictional service
    - NTD-based unit costs for incremental costs including vehicle operations and vehicle maintenance only.
    - NTD-based fully allocated unit costs for vehicle operations, vehicle maintenance, non-vehicle maintenance, and general administration.
    - Contractor rates for local service, where available.

The analysis results are summarized in Tables 14 and 15. Table 14 shows the cost breakdown by cost driver for current and proposed costs, based on NTD data only. Table 15 then compares the NTD-based route costs to purchased transportation contract costs and WMATA regional or non-regional rates as appropriate.

4.1 Implications of Planned Route Transfer Results

Table 16 summarizes the results of Table 14 and 15. For five of the seven proposed route transfers (all transfers from Metrobus to a local operator), the proposed costs were lower than the current costs when considering:

- NTD-based incremental costs for vehicle operations and vehicle maintenance;
- NTD-based fully allocated costs (including non-vehicle maintenance and general administration); and Contractor rates.

For each of those five routes, application of Metrobus regional or non-regional rates (as appropriate) resulted in higher costs for the proposed transfers.

Table 14: Estimated O&M Costs for Current and Proposed Service Delivery by Cost Driver ($000)

		Current NTD-Based Cost				Proposed NTD-Cost			
Planned Transfer	Route	$/Rev Hr	$/Rev Mi	$/Peak Veh	GA$/Rev Hr	$/Rev Hr	$/Rev Mi	$/Peak Veh	GA$/Rev Hr
Metrobus 22 A,B,C	22A	$ 738	$ 314	-	$ 176	$ 359	$ 133	-	$ 190
to	22B	$ 241	$ 76	$ 97	$ 57	$ 117	$ 32	$ 14	$ 62
ART service	22C	$ 757	$ 276	$ 242	$ 181	$ 368	$ 117	$ 34	$ 195
Metrobus 4B to the new ART 31	4B	$ 1,077	$ 528	$ 145	$ 257	$ 524	$ 223	$ 21	$ 277
Metrobus C12, 14	C12	$ 337	$ 208	$ 73	$ 80	$ 290	$ 111	$ 3	$ 69
to TheBus	C14	$ 431	$ 267	$ 73	$ 103	$ 371	$ 143	$ 3	$ 88
TheBus Route 21 to *Metrobus	21	$ 847	$ 569	$ 10	$ 201	$ 985	$ 1,061	$ 242	$ 235
*Metrobus F12 to TheBus	F12	$ 559	$ 396	$ 97	$ 133	$ 480	$ 212	$ 4	$ 114
*Metrobus F13 to TheBus	F13	$ 739	$ 444	$ 193	$ 176	$ 635	$ 238	$ 8	$ 151
Eliminate TheBus Route 20; replace	20	$ 962	$ 484	$ 13	$ 228	-	-	-	-
with an extended *Metrobus Route	J12	-	-	-	-	$ 876	$ 682	$ 145	$ 209

Table 15: O&M Cost Comparison for Current and Proposed Service Delivery by Cost Type Routes

Planned Transfer	Route	Incremental Cost - NTD-Based Veh Ops and Veh Maint		Fully Allocated Cost - NTD-Based Including Non-Veh Maint & GA		PT Contract Cost		WMATA - Regional and Non-Regional Rate as approp.	
		Current	Proposed	Current	Proposed	Current	Proposed	Current	Proposed
Metrobus 22 A,B,C	22A	$ 1,052	$ 492	$ 1,228	$ 682	-	$ 438	$ 1,411	-
to	22B	$ 316	$ 149	$ 470	$ 225	-	$ 136	$ 460	-
ART service	22C	$ 1,033	$ 485	$ 1,456	$ 714	-	$ 438	$ 1,448	-
Metrobus 4B to the new ART 31	4B	$ 1,605	$ 747	$ 2,007	$ 1,045	-	$ 656	$ 2,060	-
Metrobus C12, 14	C12	$ 545	$ 401	$ 697	$ 473	-	$ 422	$ 644	-
to TheBus	C14	$ 698	$ 514	$ 874	$ 605	-	$ 541	$ 825	-
TheBus Route 21 to *Metrobus	21	$ 1,416	$ 2,046	$ 1,627	$ 2,524	$ 1,236	-	-	$ 1,322
*Metrobus F12 to TheBus	F12	$ 954	$ 692	$ 1,184	$ 810	-	$ 701	$ 749	-
*Metrobus F13 to TheBus	F13	$ 1,183	$ 874	$ 1,553	$ 1,032	-	$ 927	$ 991	-
Eliminate TheBus Route 20; replace	20	$ 1,446	$ -	$ 1,687	$ -	$ 1,404	-	-	-
with an extended *Metrobus Route	J12	-	$ 1,558	$ -	$ 1,912	-	-	-	$ 1,175

Table 16: Summary of Cost Comparison between Proposed and Current Service

Route Transfer	NTD-Based Incremental Costs (Veh Ops & Veh Maint)	NTD-Based Fully Allocated Costs (Including Non-Veh Maint & Gen Admin)	Contractor Rate	Metrobus Regional or Non-Regional Rate as appropriate.
Metrobus 22 A, B, C to ART service	Lower than current	Lower than current	Lower than Metrobus	Higher than contractor
Metrobus 4B to the new ART 31	Lower than current	Lower than current	Lower than Metrobus	Higher than contractor
Metrobus C12, 14 to TheBus	Lower than current	Lower than current	Lower than Metrobus	Higher than contractor
TheBus Route 21 to *Metrobus	Higher than current	Higher than current	Higher than Metrobus	Lower than contractor
*Metrobus F12 to TheBus	Lower than current	Lower than current	Lower than Metrobus	Higher than contractor
*Metrobus F13 to TheBus	Lower than current	Lower than current	Lower than Metrobus	Higher than contractor
Eliminate TheBus Route 20; replace with an extended *Metrobus Route J12	Higher than current	Higher than current	Higher than Metrobus	Lower than Contractor

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CONCLUSIONS

Application of the O&M unit costs to a test scenario across all jurisdictions and to specific potential route transfers demonstrated the potential outcomes of providing the same service by different operators. Differences in service costs among operators may be explained by the differences in in-route service speed (revealed in the estimation of vehicle revenue hours, vehicle revenue hours, and peak vehicles) and in differences in deadheading, productivity, wage rates, and fringe benefits (revealed in Task 2). Application of these findings should consider the following:

- **Scale of service change:** Incremental costs are more appropriate to consider when comparing the cost of alternative providers for relatively small service changes. Fully-allocated costs are more appropriate for larger service changes, particularly if there are changes in the requirements for passenger and maintenance facilities.
- **Planning horizon:** Shorter-term impacts are more likely to be reflected by incremental costs; longer-term impacts (particularly in the context of a significant change in scale) are more likely to be reflected by fully-allocated costs.
- **Cost vs price basis:** This is different for the three types of O&M unit costs applied:
- **Costs estimated from NTD-based unit costs:** The NTD provides a uniform basis for cost comparison because of the standard accounting definitions applied to costs by function (e.g., vehicle operations, vehicle maintenance) and by object class (e.g., wages, fringe benefits, fuel). NTD definitions also apply these costs to cost drivers (i.e., vehicle revenue hours, vehicle revenue miles, and vehicle operated in maximum service) in a standardized way. Some variation in year-to-year reporting was observed in the development of the unit costs, particularly for WMATA in FY17, and this might affect the validity of the comparisons.
- **Costs estimated from contractor prices:** For jurisdictions that purchase transportation, direct costs for vehicle operations and vehicle maintenance are based on the contract prices, which are expressed per vehicle revenue hour (and per vehicle revenue mile and fixed monthly prices for Arlington County). Generally, contractors limit the applicability of the offered prices to a range of total quantity of service delivered. For the individual routes considered for transfer of service delivery, the incremental changes were relatively small compared to the total service purchased from any particular contractor, so this limitation may not be at issue.
- **Costs estimated for WMATA regional and non-regional rates:** These rates are intended to be applied per platform hour, which includes vehicle revenue hours plus paid time for deadheading and other driver time “behind the wheel”. In application in this technical memorandum, the rates were applied only to vehicle revenue hours, so these costs are somewhat under-estimated. There is no single factor for converting vehicle revenue hours to platform hours because deadheading varies from route to route, depending on the location of the garage where the buses are dispatched and the location of route terminals.

The existence of multiple methods for calculating O&M costs in the region can lead to some confusion, but should all be considered when making service delivery decisions in the region, along with the other non-O&M cost related impacts.