

Executive Summary:

Metrobus Network Evaluation and Future Fleet Needs

Presented to:

Washington Metropolitan Area
Transit Authority

Submitted by:



In Association with P²D Joint Venture

April 2007

Metrobus Network Evaluation and Future Fleet Needs Final Report – Executive Summary

Introduction

The Metrobus Network Evaluation and Future Fleet Needs (MNE) study was conducted to help WMATA identify its expanding fleet needs between the current period and 2010. Based on the evaluation, it is anticipated that the active fleet will grow from 1477 buses (spring 2006 baseline) to an estimated 1672 buses by 2010, an increase of 195 buses. The increased fleet needs are a product of WMATA's bus service plans and efforts to maintain quality of service in the face of increasing congestion and growth. The consultant team performed a comprehensive evaluation of the existing bus system to determine the existing and anticipated future performance of Metrobus services. Options to improve the efficiency and effectiveness of the existing network and short-term Metrobus service expansion plans were identified. A "planning agenda" of all service options and expansion plans was then compiled for each subregion in the Metrobus service area to identify the impacts on future fleet requirements and operating costs. This MNE report provides critical supporting input for the update of WMATA's 6-year Metrobus Revenue Vehicle Fleet Management Plan as well as serving as to confirm the need to expand the fleet in accordance with WMATA'S Metro Matters initiative.

Background

The Regional Bus Study Final Operating Plan (2003) included near-term and long-term service recommendations in each jurisdiction. The fleet requirements to implement the Near-Term bus service recommendations (from 2000 to 2010) were incorporated into the WMATA 10-Year Capital Improvement Plan (CIP). To accomplish all of the Regional Bus Study near-term service improvements, the study found that approximately 570 new buses would be needed in the region, with Metrobus operating 67%, local providers operating 10%, and the remaining 23% for new non-regional service that was not assigned to a specific operator.

The Metro Matters funding agreement approved by the WMATA Board of Directors in late 2003 covers the period from FY05 through FY10, funding only a portion of the System Access and Capacity Program contained in the CIP. The funding agreement called for 185 new expansion buses to be added to the fleet by FY10 with 95 allocated to the District of Columbia, and 45 each to Virginia and Maryland.

The Metro Matters funding agreement authorized the first 50 buses to be purchased and called for a subsequent determination to be made as to whether to purchase any of the additional 185 "Third Urgent Priority" buses beyond the first 50, noting the need for a new comprehensive bus network analysis. The intent of the Metro Matters language appeared to relate the need for more buses to the performance of the existing fleet. The presumption was that there may be network inefficiencies that, if corrected, could reduce the need for additional buses.

The Metrobus Revenue Vehicle Fleet Management Plan was last updated in January 2004. This document is a statement of the processes and practices by which WMATA establishes its current and projected revenue vehicle fleet size requirements and operating spare ratio. It includes a description of revenue service planned to accommodate growth in Metrobus ridership, as well as an assessment and projection of needs for bus vehicle maintenance over a six year time period. The current Metrobus Network Evaluation and Future Fleet Needs (MNE) Study provides input for updating the fleet management plan as well as

supporting documentation to confirm the need for the procurement of expansion buses as part of the Metro Matters program.

Study Methodology

WMATA's 6-Year Metrobus Revenue Vehicle Fleet Management Plan identifies the near term future fleet requirements by first determining the peak vehicles needed to operate the desired services (assuming they have been defined) and then determining the need for additional (i.e., spare vehicles) to 1) accommodate scheduled maintenance and 2) ensure reliability by responding to road-calls and change-offs and maintaining a strategic reserve fleet. The peak vehicle requirement is determined by assessing the impacts of ridership demand and changing operational characteristics on measures of service performance. Service quality goals are used to determine whether additional vehicles are needed to ensure service quality on existing services and whether any new (additional) services are needed.

The MNE Study was charged with identifying the peak vehicle requirements for the next six years to support an updating of the Fleet Management Plan and to determine whether the full 185 buses authorized by the Metro Matters agreement would still be needed. The MNE study was a comprehensive effort to examine fleet requirements conducted in coordination with Metrobus staff and representatives of the various jurisdictions. The study reflected a continuation of the Regional Bus Study (RBS) planning process by including a review of service performance measures as well as a review of progress toward implementation of the RBS recommendations.

The RBS, completed in 2003, used a set of service design and service performance measures to evaluate existing services. It also included an assessment of future needs. The result of the study was a Draft Operating Plan for the near term as well as a longer range vision plan for the region's bus systems, including Metrobus and local jurisdiction bus services. Because the Draft Operating Plan was not cost-constrained, all the recommendations could not be implemented. However, over the past several years, some of the recommendations were implemented. In addition, new service needs have been identified and planning on several initiatives has progressed.

This MNE Final Report provides a performance evaluation of the existing Metrobus services, along with an update of the service plans for Metrobus in each jurisdiction in sufficient detail to determine fleet needs and provide Metrobus service planners with a road map for final service design and scheduling. This effort required consultation with jurisdictional representatives regarding the changing needs they have identified and assessment of the continued relevance and priority of unimplemented RBS recommendations.

Using the Metrobus spring 2006 timetable as the baseline conditions, the overall study approach was to:

- Apply performance measures to existing Metrobus lines to determine which ones are performing poorly and thus could be candidates for service cuts or restructuring.
- Identify existing lines that have crowding or running time deficiencies that would require additional peak vehicles.
- Plan service improvements in selected corridors that have been identified as deficient.
- Review recommendations of the Regional Bus Study to determine which ones have not yet been implemented, and whether they are still valid given current conditions.
- Consider transferring operations between Metrobus and local jurisdiction providers to improve network efficiency and effectiveness (a strategy that had been kept out of the discussion during the Regional Bus Study).
- Identify new programs initiated by others or jointly with WMATA that would require an increase in Metrobus services.

Service quality is key to the study process. Early in the study, service performance measures were discussed drawing on the existing Metrobus service evaluation process, the RBS measures and methodologies used in other areas. Data availability in the study time frame was a critical constraint in choosing measures for the evaluation. For example, while reliability measures are highly relevant to the customer experience, and were recommended by the APTA Peer Review commissioned by WMTA in 2005, the wealth of data that could be provided by the automatic vehicle location (AVL) system Metrobus has acquired has yet to be realized. Therefore reliability measures used in the evaluation were more limited, relying on the manual data sources (ride checks). The final sets of measures used in the evaluation were vetted with Metrobus and jurisdictional representatives and are summarized below.

- **Productivity**
 - Passengers per revenue-hour or revenue-trip
- **Travel Time and Reliability**
 - Schedule adherence, i.e., the percentage of trips “on-time” at key time points
 - Maintenance of headways for frequent routes
 - Match of scheduled and actual trip time
- **Duplication**
 - Route overlap where there is no functional difference between the routes
- **Crowding**
 - Load factor at peak load point
- **Frequency**
 - Policy headways (intervals between buses)

Specific thresholds used included:

Productivity Thresholds

Table ES-1 below shows the thresholds used for productivity by class of route and by time period.

TABLE ES-1: PRODUCTIVITY THRESHOLDS

Class	Peak Average	Peak Threshold (60% of Average)	Marginal Fail (Threshold - 10%)	Marginal Pass (Threshold + 10%)	Off-Peak Average	Off-Peak Threshold (60% of Average)
Express	23	14	13	15	15	9
Radial *	55	33	30	36	38	23
Small Bus	35	21	19	23	23	14
Suburban	37	22	20	24	28	17
Urban	55	33	30	36	38	23

* Productivity of articulated bus services (lines X2, Y5-9, & 70,71) not included in the average. Peak average would be 58 pass/rev-hr with these services.

Travel Time Thresholds

Lines for which 33% or more of peak-period trips ran at least 5 minutes longer than scheduled, or lines for which 10% or more of peak-period trips ran at least 10 minutes longer than scheduled, were deemed to have travel time “problems.”

Crowding Thresholds

The load factor is the number of people on the bus at the maximum load point divided by the number of seats. WMATA's load factor guideline is 1.2 in the peak period. Future crowding was projected by inflating current ridership by 2% annually and also taking into account the seating capacity effects of fleet replacement (where older buses with more seats are replaced by newer low-floor buses with fewer seats, dropping the average seat capacity for those lines served by with the standard 40' buses from 43 to 38).

Frequency Thresholds

Table ES-2 below shows the thresholds used for frequency (headway) by class of route and by time period.

TABLE ES-2: Frequency Thresholds

Frequency (Minutes between buses)	Peak Period	Off-Peak/ Weekend
Urban/Radial	15	30
Suburban	30	60
Express	4 trips	none

The evaluation of performance of existing routes (i.e., lines) using these measures provided a means to target some routes for more intensive investigation. The approach taken was as follows:

- 1) Determine which existing high ridership lines have overcrowding problems that are best solved by adding buses to the lines
- 2) Determine which existing high ridership lines have inadequate travel time that is best solved by adding time to schedules which will require more buses
- 3) Determine which low productivity lines should be addressed with service cuts that would reduce fleet requirements
- 4) Determine which low productivity lines also duplicate service of other lines or providers that could be addressed through restructuring and therefore reduce peak bus requirements.
- 5) Determine which lines with inadequate service frequency (based on the thresholds) should be allocated additional peak buses so as to meet the thresholds.

Based on the evaluation, a number of candidate lines were identified for service changes. For the whole Metrobus systems, a total of 35 additional buses are needed to address travel time, frequency, or crowding problems. None of these "needed" vehicles is associated with a line that fails to meet the productivity threshold.

Planning Agenda and Proposed Future Service Needs

Before final service recommendations could be made, the study addressed the unimplemented RBS recommendations and other newly identified needs. Some of the unimplemented recommendations addressed the same problem lines identified in the current service evaluation. Others were largely new services to meet changing needs and opportunities that had not yet been implemented due to funding constraints. The new services included RapidBus services in high volume corridors and new connections to address changing travel patterns. These recommendations were reviewed with jurisdiction representatives and Metrobus service planning staff to determine if they were still relevant and desirable in the six year time frame. The result of this analysis combined with the service evaluation was a "planning agenda" that led to specific service recommendations in each sub-region. Table ES-3 presents an

overview of the planning agendas developed for each subregion identifying the estimated resource requirements needed to implement the list of proposed service modifications.

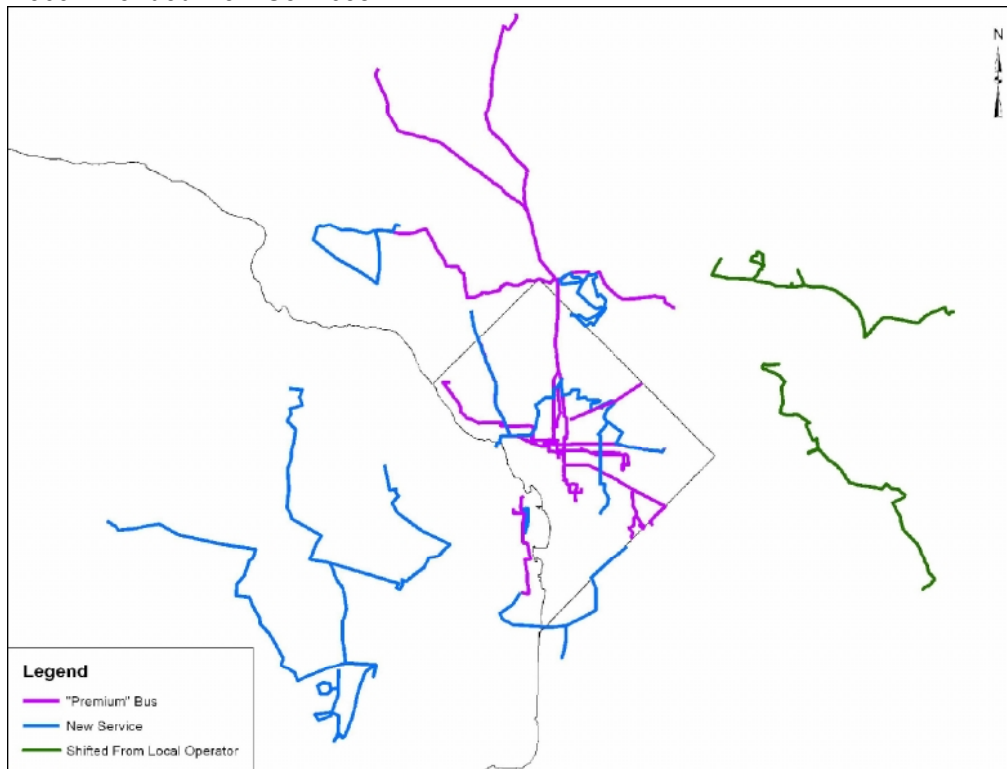
TABLE ES-3: OVERVIEW OF PLANNING AGENDA -- METROBUS ESTIMATED RESOURCE REQUIREMENTS

Jurisdiction	Change in Daily Passengers	Est. Incremental Annual Operating Cost (\$000)	Additional Bus Needs – 2011		
			AM Peak	PM Peak	2011 Requirement (without spares)
District of Columbia	19,817	\$33,365	83	87	83
Montgomery County	5,800	\$9,685	13	18	18
Prince George's County	6,530	\$6,593	21	22	22
Total Maryland	12,330	\$16,278	34	40	40
Inner Virginia	6931	\$13,026	41	42	42
Outer Virginia	1363	\$3,096	1	0	1
Total Virginia	8294	\$16,122	42	42	43
Grand Total	40,441	\$65,765	159	169	166

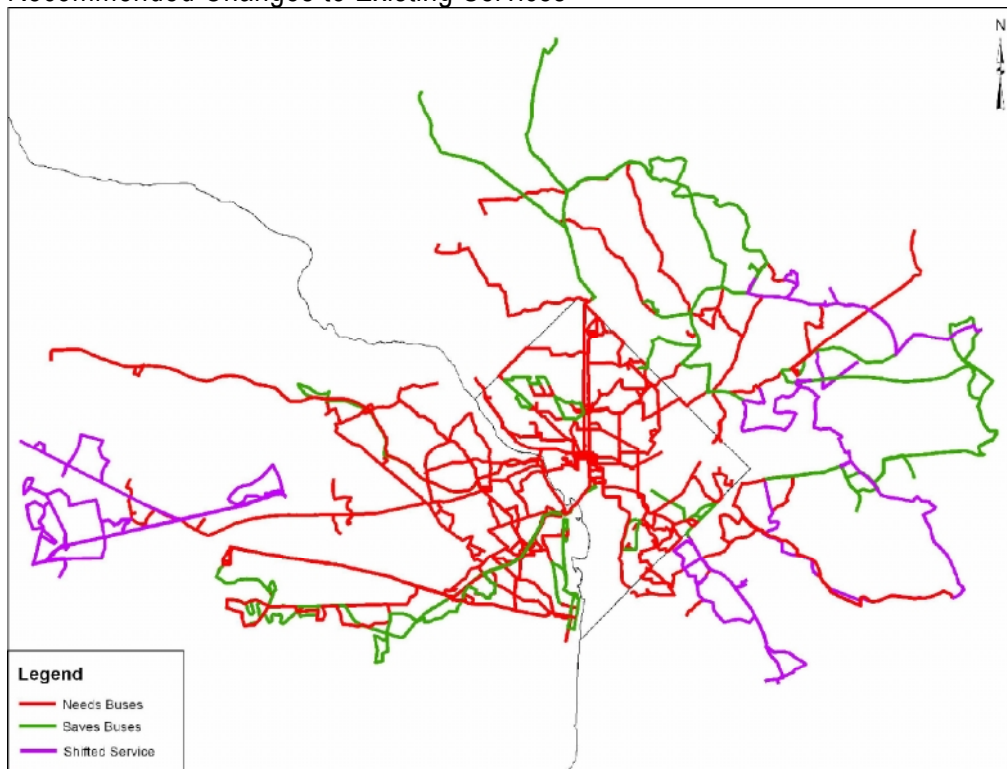
The RBS study identified Metrobus and local jurisdiction bus service needs, as well as needs for new non-regional service to be provided by either Metrobus or local providers at the discretion of the jurisdictions. While these decisions remain at the jurisdiction's discretion at the time of implementation, the MNE study had to provide Metrobus fleet requirements for the Fleet Management Plan update based on some assumption regarding who would operate the new non-regional service. These assumptions were discussed with the jurisdictional representatives and WMATA staff for the purposes of these fleet estimates. Furthermore, to address duplication of service, some restructuring proposals involved logical shifting of responsibility for certain lines from Metrobus to local providers or vice versa. In some cases, such as Fairfax Connector assumption of responsibility for Metrobus 12's, 20's and 2W lines, these shifts have already been agreed upon.

The resulting service recommendations included adding buses to existing lines to meet increasing ridership demand and to address growing traffic congestion impacts on travel time and reliability, restructuring service and/or shifting service between operators to optimize efficiency and level of service, new services to address unmet needs or changing travel patterns and cutting service where productivity falls below minimum requirements. The following maps show where these types of changes are recommended.

Recommended New Services



Recommended Changes to Existing Services



The first part of the MNE presented the findings of the bus service evaluation for Metrobus services detailing recommended service modifications and enhancements for each of five subregions. As noted, this evaluation was performed in large part to comply with the Metro Matters Agreement directing WMATA and the contributing jurisdictions to reassess the non-regional bus routes and the number of buses needed for the bus fleet expansion element of the Metro Matters Program. The results of the bus service evaluation were used to determine the impacts on the 2011 fleet and garaging requirements. The procurement of 195 buses, ten more than the 185 buses originally designated under the Metro Matters program, is recommended with minor modifications to the jurisdictional allocation and the acquisition schedule. The needs that the expansion buses are required to address are summarized in Table ES-4 which follows.

TABLE ES-4: REASONS FOR ADDITIONAL BUSES BY SUBREGION

	Rapid/BRT	New Service	Crowding	Travel Time	Policy Frequency	Shift between Operators or Mode	Restructuring	Low Productivity/Discontinue	TOTAL PEAK BUSES	Spares	TOTAL WITH SPARES
District of Columbia	43	33	8	5	4	(10)	8	(8)	83	15	98
Inner Virginia	19	0	1	0	10	0	14	(2)	42	7	49
Outer Virginia	0	24	0	0	4	(19)	(2)	(6)	1	0	1
Total Virginia	19	24	1	0	14	(19)	12	(8)	43	7	50
Montgomery County	12	6	3	3	1	0	(7)	0	18	3	21
Prince George's County	5	6	3	0	4	3	1	0	22	4	26
Total Maryland	17	12	6	3	5	3	(6)	0	40	7	47
Total Region	79	69	15	8	23	(26)	14	(16)	166	29	195

(-) indicates a reduction in bus requirements

Metrobus Fleet Composition with Future Expansion and Replacement

The active Metrobus fleet is expected to grow from 1477 buses (spring 2006 baseline) to a total of 1672 buses by 2010 with the procurement of 195 Metro Matters expansion buses as shown in Table ES-5. In addition, WMATA plans to replace aging buses at a rate of 100 equivalent 40' standard buses each year beginning in 2008. At this point WMATA intends to move to a Diesel Hybrid propulsion system for its standard 30' and 40' transit buses, selecting this clean emission technology to replace the older more polluting diesel buses in the existing fleet. Also, all new buses will be low-floor construction to support full accessibility. It is expected that by 2012, after the completion of the current five year replacement program and the procurement of the Metro Matters expansion buses, the standard diesel bus fleet will decrease from 945 buses to an estimated 432 buses with the Hybrid fleet growing from 50 buses to approximately 610 buses. The fleet totals also assume a slight reduction in the small bus fleet and the expansion of the articulated bus fleet (likely also to deploy hybrid technology) with the conversion of several routes from standard 40' bus operations recommended in the MNE report. Table ES-5 below shows the expected fleet distribution in both 2010 and 2012 compared to the 2006 baseline.

TABLE ES-5: WMATA METROBUS ACTIVE FLEET AND PROPOSED ACQUISITION PLAN SUMMARY

	Fleet Distribution by Type		
	2006	2010	2012
Small Bus			
30' CNG	35	35	35
30' Diesel	55	0	0
26' Diesel	15	0	0
Cut-A-Way	4	4	4
30' Hybrid	<u>0</u>	<u>59</u>	<u>59</u>
sub-total	109	98	98
Standard 40 'Bus			
CNG	379	429	429
Hybrid	50	495	551
Diesel	<u>875</u>	<u>586</u>	<u>432</u>
sub-total	1304	1510	1412
Articulated 60' bus			
Neoplan	21	21	21
Ikarus	43	43	0
New (tbd)	<u>0</u>	<u>0</u>	<u>109</u>
sub-total	64	64	130
Total Fleet	1477	1672	1640

Notes: 2006 – baseline conditions
2010 – Metro Matters procurement complete with 3 years of fleet replacement
2012 – Five year bus replacement program completed

Revised Metro Matters Expansion Bus Acquisition Plan

The recommended timeline and allocation for the acquisition and distribution of the 195 Metro Matters expansion buses is shown in Table ES-6. The proposed acquisition rate is slightly delayed compared to the original plans while the ultimate allocation to each jurisdiction is increased slightly.

TABLE ES-6: METRO MATTERS PROPOSED FLEET PROCUREMENT AND ALLOCATION

STATE	THROUGH FY08	FY09	FY10	Revised Recommended Bus Needs Requirement	METRO MATTERS Original Allocation Plan
District of Columbia	25	18	55	98	95
Virginia	18	0	32	50	45
Maryland	11	19	17	47	45
Revised Recommended Procurement Timeline	54	37	104	195	185
METRO MATTERS Original Procurement Timeline	80	40	65	185	

Impacts on Metrobus Garages and Required Actions

Growth in the active bus fleet, in turn, presents challenges to WMATA to increase its bus storage and maintenance capacity. First, Metrobus garages are largely old facilities that require considerable investment to be better able to service the newer bus types with advanced propulsion systems (e.g. CNG or hybrid/electric) and other advanced technologies. Further, WMATA policy requires that new buses be low-floor with ramp systems to improve accessibility for persons with disabilities. Due to the low-floor design, newly manufactured buses specify the placement of several components on the roof, making buses taller and requiring changes in maintenance practices and equipment to reach these components. In fact, buses with these modifications cannot be serviced at several facilities due to height constraints. Second, most of the older garages have already been assigned buses in numbers at or near the practical storage capacity for these facilities. As reflected in the 2003 Regional Bus Study Garage Plan, WMATA is fully cognizant of the critical constraints that its garages place not only on servicing newer buses but also on providing sufficient capacity to house an expanded fleet.

Table ES-7 provides an overview of the garage capacity constraints. Although the spare capacity currently available is approximately the same as the recommended Metro Matters expansion bus totals, most of this free capacity is concentrated in two Maryland garages. The existing garages in the District of Columbia and Virginia cannot adequately support the new buses expected to be assigned to the routes in these two jurisdictions between now and 2011 as currently planned. The total storage deficit in the District and Virginia is currently estimated at 94 spaces just to meet the 2011 needs without consideration of growth requirements. The following actions are therefore recommended to provide adequate capacity for the expected fleet in 2011.

- The capacity of the Bladensburg garage in the District should be increased from 257 to 300 through the planned relocation of the SVMT car shop along with a small reduction in employee and non-revenue vehicle parking.
- A new Southeastern garage in the District is required to replace the current facility and should be constructed to service up to 250 buses including at least 25 percent articulated buses.

- Future garage expansion or replacement plans should take into consideration possible future use of articulated buses on Virginia lines. The new West Ox garage under construction in Virginia with an expected completion of late 2008 will provide WMATA with capacity to service only 100 standard buses.
- WMATA should immediately pursue phase II of the West Ox (VA) garage to increase the total capacity of this facility by 50 buses

TABLE ES-7: OVERVIEW OF GARAGE CAPACITY ISSUES

STATE	2006 Capacity	2006 Assigned	2006 Spaces Available	Recommended Revised METRO MATTERS Procurement	2011 Assigned	2011 Spaces Available	Future Planned Capacity	Spaces Available For Future Growth
District of Columbia	691	656	35	98	754	(63)	863	109
Maryland	583	441	142	47	488	95	583	95
Virginia	399	380	19	50	430	(31)	449	19
TOTAL	1673	1477	196	195	1672	1	1895	223

The proposed service expansion detailed in this report should be implemented essentially as capacity allows within each jurisdiction minimizing non-revenue operating costs and the training costs associated with shifting routes between garages. The recommended allocation of buses by state is presented in Table ES-6.

In addition, WMATA should expand its use of articulated buses to achieve transportation operating cost savings while enhancing service reliability on several of the most frequent lines such as the S2,4 16th Street Line among others recommended. The articulated bus fleet should increase from the present 64 buses to 130 buses. This will require minor modifications at Bladensburg, appropriate designs for the new Southeastern replacement garage and an increase in 60-foot bus lifts at the Montgomery and Landover garages. The fleet distribution by type anticipated in 2012 upon the completion of the Metro Matters fleet expansion program and the five-year bus replacement program was presented in Table ES-5.

Summary

The Metrobus Network Evaluation and Future Fleet Needs (MNE) study was commissioned by WMATA to confirm the Metro Matters expansion bus plans and was designed to serve two purposes:

- Provide a comprehensive review of the existing Metrobus system offering recommendations to improve the efficiency and effectiveness of the existing network. In addition, short-term service expansion plans that may have potential to be implemented by 2010 were identified. The final "Planning Agenda" presented in the study highlights future fleet requirements as well as the ridership and operating costs impacts.
- Provide supporting input for WMATA's updated 6-year Metrobus Revenue Vehicle Fleet Management Plan including estimates for expansion and replacement bus requirements noting the expected change in the fleet mix and the associated garage capacity impacts.

This Final Report details the requirements for an increase in the Metrobus fleet of 195 buses by FY2010, ten more than the 185 buses approved by the WMATA Board of Directors in its Metro Matters initiative. On an annual basis, prior to seeking Board authorization to procure new buses to meet the expansion requirements for the upcoming year, WMATA staff should review progress in implementing the service changes listed in the "Planning Agenda" and update the request accordingly.