Chapter 7 BRT for Gallatin Road

The MTA has done a significant amount of research regarding the potential for deployment of Bus Rapid Transit (BRT) technology in Nashville. The term BRT describes service provided with buses but with substantially upgraded quality of service. BRT is often seen as a more affordable alternative to light rail service. In fact, one of the alternatives being considered in the Northeast Corridor Mobility Study is a BRT route in the Gallatin Road right-of-way. BRT has the potential to influence land use development decisions by encouraging new development at stations along the route, and supporting higher density uses. There are many aspects of this increase in quality however, and these can be summed up as focusing on two main issues:

- Speed
- Image

There are a number of elements that can be incorporated in a BRT project as shown in Table 7-1. These contribute to the speed of the system or the image or both.

Table 7-1: BRT Elements

	Speed	Image
Innovative Vehicles		X
Dedicated Running Ways	X	
Signal Priority	X	
Real-time Passenger Info		X
Improved Fare Collection	X	
Reduced Stops/Enhanced Stops (Stations)	X	X
Improved Service	X	X
Branding & Marketing		X

Not every BRT project will incorporate all of these elements. Rather, this is a menu from which an agency can select elements most appropriate for a particular corridor or for particular segments of the corridor. It is also possible to introduce some elements as part of an initial package and subsequently add elements as funding and time permits.

MTA has identified the Gallatin Road Corridor now served by Route 26 Gallatin Road, the agency's heaviest route with over 80,000 rides per month, as its first priority for BRT implementation. This chapter describes options for phasing the implementation of the elements of BRT into the corridor. While BRT elements can be introduced at different times, the greatest promotional "bang" will result if a number are introduced when the service starts. It is also essential for significant and targeted promotional/informational efforts to accompany startup.

Each of the potential elements of BRT service are discussed in this chapter, including the analysis conducted by MTA and the options to be implemented based on analysis provided through the *Strategic Transit Master Plan*.

Background on Route 26 Gallatin Road

Route 26 Gallatin Road operates between the Sam's Club store on Gallatin Pike (beyond Rivergate) to the new Music City Central terminal. This is a 12.3 mile long route with scheduled running time of 45-50 minutes in each direction, depending on time of day. Typical weekday headways (frequencies) are 15 minutes in the peaks, 20 minutes in the midday, and 30 minutes in the evening. Saturday headways are 30 minutes during the day and hourly in the evening, and Sunday/Holiday headways are hourly. There are 49 weekday trips (requiring 8 buses in the peak), 30 Saturday trips (4 buses), and 17 Sunday/holiday trips (2 buses).

The route operates over Gallatin Pike/Gallatin Road/Main Street. This combination functions as an arterial roadway, generally with two travel lanes in each direction plus a continuous shared left turn lane. There are also generally fully paved shoulders, with no on-street parking, on the outer portion of the route. On the inner portion of the route there is a significant amount of on-street parking, some of it diagonal. There are 48 traffic signals over the length of route (an average spacing of 0.26 mile). Signal cycle times are long. Additional right turn lanes are not usually provided. The section of Main Street north of the I-24 interchange is frequently very congested during peak period, despite the use of a reversible center lane. Other parts of the route also seem to be congested, but only in peak periods. Congestion can take the form of tailbacks from traffic signals extending for multiple cycles. The MTA has identified six intersections as particularly congested. While posted speed limits are 35-45 mph, average bus scheduled bus speeds (including stops) are only about 15 mph. There are 104 posted stops in each direction, an average spacing of 625 feet. Almost all stops are located on the near side of intersections. Bus operators must, of course, be prepared to stop at each of these stops. Because it is a busy route, carrying both passengers to/from downtown Nashville and extensive local riding within the corridor, buses make many stops for passengers. Each stop takes a significant amount of time, this could due in part to MTA's policy of asking alighting passengers to remain seated until the bus stops, although not all passengers adhere to this request. Thus, slow bus speeds are a result of the combination of the pattern of congestion, frequent stops, and traffic signals. Route 26 Gallatin Road terminates at the newly constructed Music City Central station.

The following pages show photos of parts of the Gallatin corridor.

Figure 7-1: Typical Section of Outer Portion of Gallatin Pike with Route 26 Gallatin Road Buses

Figure 7-2 and Figure 7-3: Two Views of Bus Stop at Rivergate Mall

Figure 7-4: Bus Stop in Section with Diagonal Parking

Figure 7-5: Boarding at Music City Central Station

Potential Application of Specific BRT Elements to Proposed Gallatin BRT Service

BRT Vehicles (Image)

MTA plans: Six BRT 60 foot long articulated BRT vehicles were delivered in early 2009. This is the same design as used by the Los Angeles MTA on its pioneering, fully-dedicated right-of-way Orange Line BRT. MTA has deployed the buses on Route 26 Gallatin Road to provide an increase in capacity and begin the preliminary phasing of BRT. MTA plans to operate BRT service on Gallatin Road between the Sam's Club at the end of the line and MCC.

Analysis: Based on preliminary schedules prepared by MTA staff, between 7 and 12 buses are required to implement BRT service (plus maintenance spares) depending on the service pattern selected (see the discussion of Improved Service). Thus more buses will be required to fill all trips with BRT buses.

Cost/Lead time: Cost of current order was about $850,000/bus. Bus delivery typically requires 12-18 months.

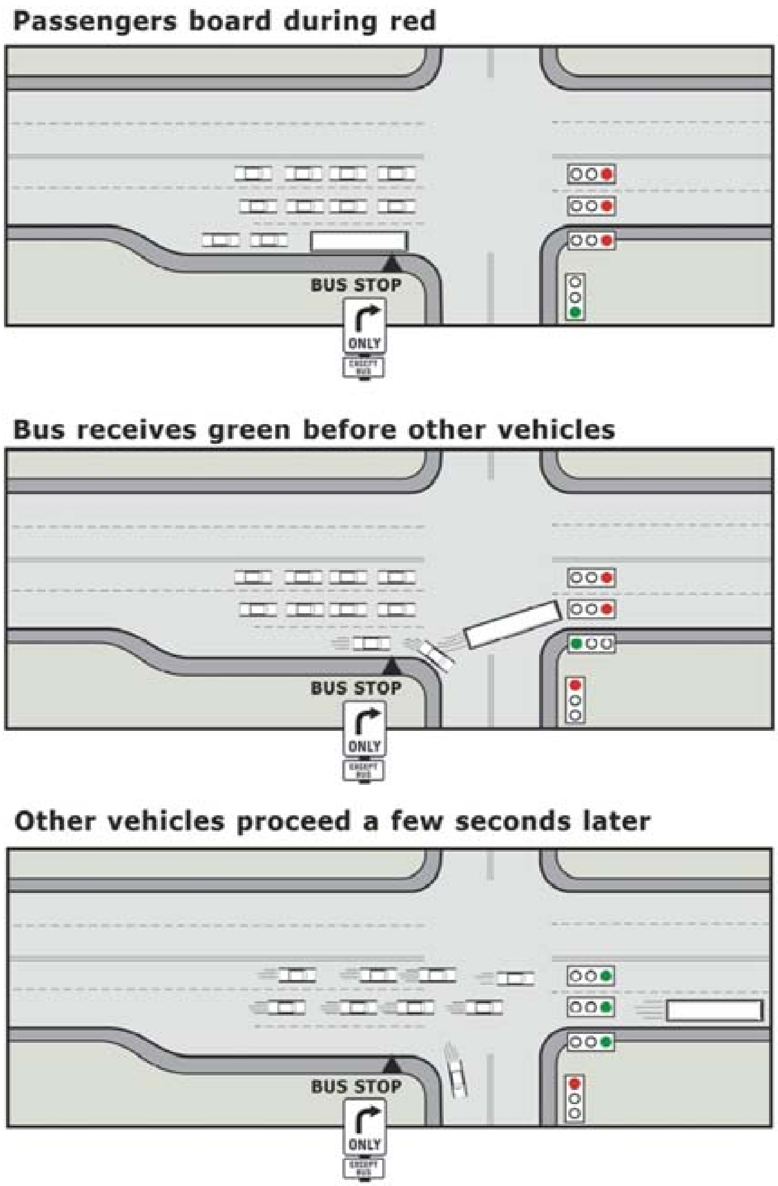
Action: Implmenetation of BRT will likely require an order of additional BRT buses to fully equip a route.

Figure 7-6: Future Nashville BRT Vehicle

Dedicated (Bus-Only) Running Ways (Speed)

Dedicated (Bus-Only) running ways provide one means of increasing the speed for BRT. These could consist of actual travel lanes dedicated to BRT operation or segments of “queue jump” lanes at intersections. Queue jump lanes provide the opportunity for buses to move in front of other traffic after stopping for red lights at intersections. Figure 7-7 below illustrates how a queue jump lane works.

Figure 7-7: Illustration of a Queue Jump Lane



Source: Kittleson Associates as illustrated in TCRP Report 118

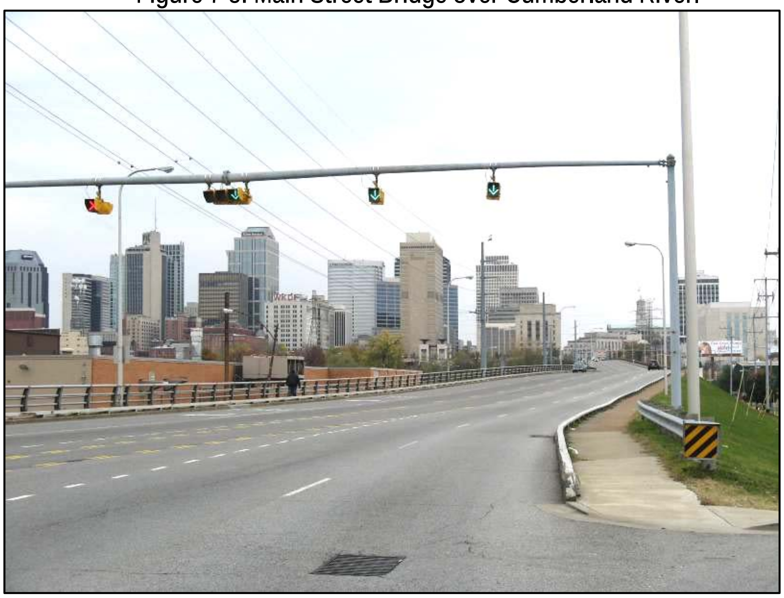
MTA plans: MTA has identified six intersections with peak period congestion which it has suggested could be considered for construction of queue jump lanes.

Analysis: Most intersections in the corridor do not have existing right turn lanes (which might be suitable for modification to also serve as queue jump lanes). Existing land use is often built to the lot line. Much of the benefit can be obtained with the implementation of transit signal priority. It will be very expensive, and time-consuming to construct queue jump lanes. One segment of dedicated lane that can be considered for near term implementation is the designation of the curb lane of the portion of Main Street south of I-24 (essentially, the Victory Memorial Bridge) in peak periods as a bus and High Occupancy Vehicle (HOV) lane.

Cost/Lead time: Cost for construction of queue jump lanes might be on the order of $1 million or more per intersection (including both directions), depending particularly on the cost of right-of-way acquisition. More than two years might be required to complete studies and design, acquire ROW, and construct queue jump lanes. Implementation of an HOV/bus lane on the Victory Memorial Bridge might be accomplished in a matter of months, at very reasonable cost.

Action: Defer implementation of queue jump lanes to a second phase of BRT implementation. The potential for conversion of the curb lane on the Victory Memorial Bridge in the peak direction to a combination of bus/HOV lane will be studied in conjunction with TDOT and the Public Works Department.

Figure 7-8: Main Street Bridge over Cumberland River.

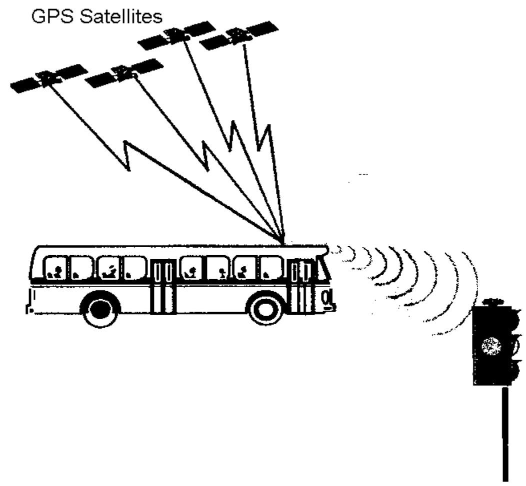


(Note the existing reversible center lane. Dedication of the curb lane in peak periods in the peak direction as a bus and HOV lane could be considered)

Transit Signal Priority (Speed)

MTA plans: MTA has identified Traffic Signal Priority (TSP) as an appropriate element for early implementation as part of a BRT implementation.

Analysis: There are several components that are common to all TSP systems.



- A device installed on the bus that requests priority which is typically controlled by the Computer Aided Dispatch (CAD) and Automatic Vehicle Location (AVL) onboard computer – the future Orbital/ACS computer in Nashville's case, so that priority is not requested when the bus is ahead of schedule, or under other locally-defined circumstances
- A sensor (or sensors), typically located at the wayside
- A priority server, normally installed in the same cabinet as the signal controller, that decodes and conditions the signal(s) from the bus
- The traffic signal controller (most modern controllers can be programmed to support TSP, to one degree or another)

Given the large number of traffic signals, bus operations in the Gallatin Corridor would benefit greatly from the installation of TSP, yet because of the relatively wide headways between buses, impact on other traffic would be expected to be very limited.

Cost/Lead time: MTA is currently coordinating with Public Works, the owner/operator of the traffic signal system, to acquire TSP technology for both the intersections and buses. It is convenient that the entire corridor is in a single jurisdiction. There are a number of technology choices for TSP and in cases of multiple jurisdictions, the technology selection can be difficult. Although there are open standards that have recently been defined for the interfaces between the TSP system components, to date, no system has been deployed based on those standards. Thus, all systems use interfaces that are essentially proprietary. Cost ranges will be on the order of $10-40,000 per intersection, depending particularly on whether or not the existing controllers have the capability to accommodate TSP. On-bus equipment cost should be on the order of $1000 per bus. Thus, total cost of TSP should be in the $500,000 to 1,000,000 range. Coordination between the agencies, design, and installation would take 9 -18 months.

Action: MTA is already working with Metro Public Works to define the equipment needs, quantities, and costs and should begin installation for implementation summer/fall 2009.

Real-Time Passenger Information - (Image)

Research has consistently shown that passenger satisfaction is greatly enhanced when people have accurate information regarding the number of minutes until their bus will arrive. There are two forms

- Dynamic Message Signs (DMS) at stops
- Internet access, from computers and wireless devices, including web-enabled cell phones

MTA plans: MTA will install DMS at BRT stops as an early phase of BRT implementation.

Analysis: The predicted time of bus arrivals at stops is typically calculated in a component of the central CAD/AVL system – the future Orbital/ACS system in Nashville's case. That data is then transmitted to the signs at stops and/or made available for customer access over the internet. MTA has received stimulus funding to acquire these components. Given the size of the MTA fleet, a single data radio channel should be adequate to provide the required communications with buses as well as with the DMS, avoiding any communication charges. Internet distribution has the advantage that information can be provided for all stops, not just those equipped with signs. Passengers can also consult this information before going to the bus stop. As in TSP, although open standard interfaces between a CAD/AVL central server and signs at stops have been defined, they are not commonly deployed. Most systems use proprietary standards defined by the system supplier making it difficult to utilize competitive procurement for wayside signs. A similar situation applies to internet distribution of bus arrival data.

Figure 7-9: Next Bus Sign at a Station

Figure 7-10: Mobile Unit with Bus Arrival Data

Cost/Lead time: Installation of DMS at 25 stops would cost on the order of $150,000. The additional cost of supporting internet access by customers should be fairly nominal. The Orbital system will support provision of such information. Design and installation could take 9-18 months.

Action: It would be very desirable to be able to procure DMS units competitively. his will require that a point of demarcation between the Orbital system and the signs, with defined interface standards, be established.

Improved Fare Collection - (speed)

Some U.S. BRT projects have adopted Proof of Payment (POP) fare collection, the system used on virtually all light rail systems. With such a system passengers that have some form of prepaid ticket to board at any door without stopping at the driver for inspection (ticket validators are installed at each doorway), greatly speeding boarding, a major portion of bus service delay. Those without a ticket can still pay the driver, who must give them a receipt. Teams of fare inspectors randomly check all passengers on a given bus for evidence of fare payment – POP (either a validated prepaid ticket or a receipt); those without POP are issued a citation, like a traffic ticket and are subject to a substantial fine. Research has shown that an inspection rate of about 20% is required to provide an adequate deterrence to violations (that is, passengers must perceive that they are asked for evidence of fare payment at least 1 trip out of every 5). POP does not have to be utilized during all periods of service; for example, some systems do not utilize it during evening and Sunday periods. It is not necessary to install fare vending machines at all stops along the route although this provides the greatest level of customer service and can improve the image of the BRT.

MTA plans: MTA has identified advanced fare collection as a potential element of a BRT implementation.

Analysis: With fare vending machines already deployed and 70% of MTA's passengers already carrying various forms of prepaid tickets, the foundation is in place for POP fare collection. Operation of POP could be limited to weekday daytime periods only. With BRT service stopping only at busy stops the dwell time at these stops could be extended. However, vehicles on the BRT route(s) would need to be equipped with ticket validators at all doorways. The MTA would need to deploy fare inspectors (using its own staff or contracting with another agency or private firm). The MTA's authority to levy fines for non-payment of fares would need to be confirmed.

Cost/Lead time: Ticket validators should be integrated with the MTA's farebox system. They are not an off-the shelf item; cost and development time is not known. It is anticipated that implementation would require the deployment of a single two person inspection team (i.e. two FTE positions) to provide an adequate deterrence to travel without fare payment.

Action: Further analysis of the capital cost of implementation is required. A comparison should be made between the operating cost savings from the estimated reduction on running time that would result from drivers no longer being involved in most fare collection transactions and passengers being able to board at both doors of the BRT vehicles vs. the cost of deploying fare inspectors. The increased ridership and revenue that would result from the faster travel times would also have to be considered. Implementation as part of the initial BRT rollout is not recommended.

Figure 7-11: Smart Card Reader Installed at Rear Door of Bus

Reduced Stops/Enhanced Stations - (Image and Speed)

Most bus stops are identified only with placement of a simple metal sign. Some stops along Gallatin road have passenger shelters, although these vary greatly in design and condition. Most BRT systems replace all-local service, with half mile or one mile stop spacing. This significantly reduced number of stops is then normally greatly enhanced, with such features as uniform, stylish passenger shelters, real-time and fixed passenger information, lighting, and benches. The station design is typically a key part of the BRT branding effort. A few BRT systems have installed raised sections of sidewalk, or "platforms, (like light rail) at stations.

MTA plans: MTA will install enhanced stations as part of the initial phases of BRT implementation.

Analysis: Stops along the Gallatin BRT should be spaced about ¾ mile apart. If practical, each of these should have features such as a boarding/alighting platform long enough for a BRT vehicle to be berthed with both doors on the platform. Shelters should provide protection from rain and configured to give shade from the summer sun. There should be lighting and information displays (including a DMS). Without designing the stations, a reasonable estimate of $60 - 80,000 each is suggested for a typical site. With the complex topography of the Gallatin corridor installation of near level boarding would be very challenging.

Cost/Lead time: Based on ¾ to 1 mile stop spacing, there would be about 28 stations. Thus, cost for the stations is estimated at $1.7M. Design and construction would take less than two years.

Action: An initial list of recommended BRT stops, based on ridership and spacing considerations, includes Sam's Club, Rivergate Mall, McHenry Shopping Cetner, One Mile Parkway, Old Hickory Blvd, Due West Plaza, Walton, Inglewood Library, Greenfield, Burchwood, Douglas, Eastland, and East Middle School, as well as key stops in the downtown area. This list includes several more stops in this segment than are included in the Northeast Corridor Alternatives Analysis which is focused on providing service all the way to Gallatin. Standard designs for shelters and markers must be developed as well as application to each site. Installation of near level boarding at BRT stations is not recommended.

Figure 7-12: Kansas City MAX Station, with Marker and Shelter

(Note: the marker incorporates map and schedule displays as well as a DMS)

Improved Service (Image)

Frequent service/Increased capacity is often considered a key element of BRT service.

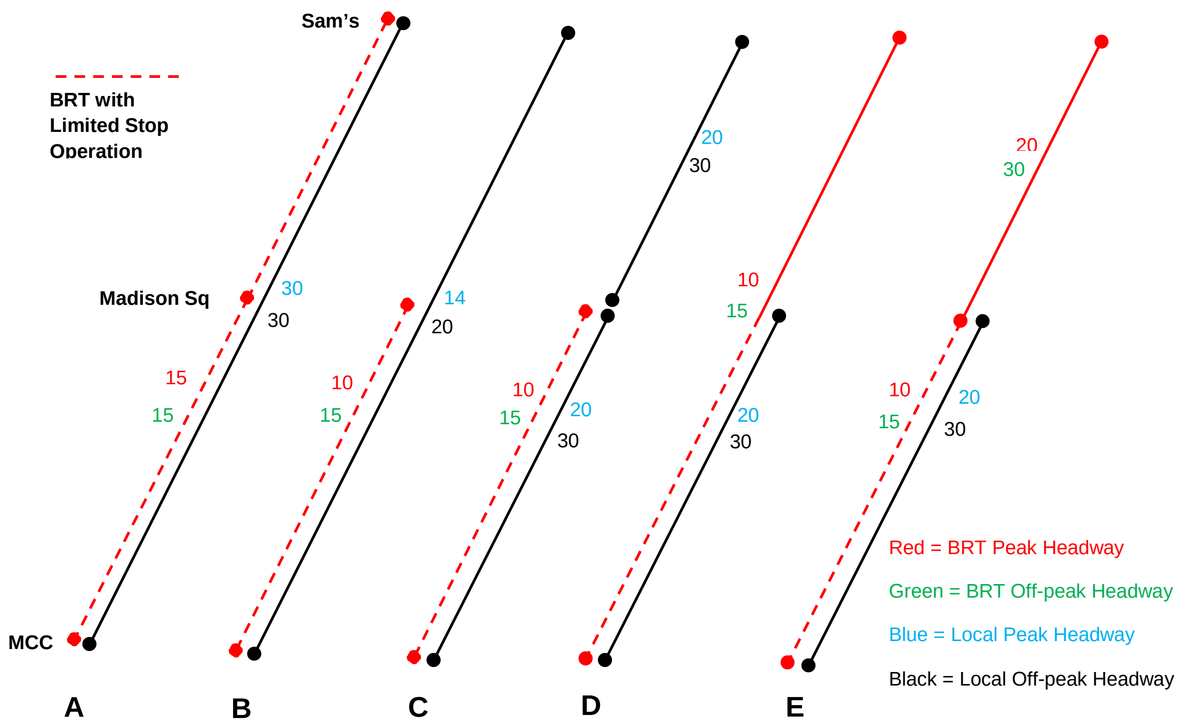
MTA plans: The MTA has indicated that it intends to provide 15 minute peak, 15 minute midday, 30 minute evening and Saturday service, and 50 minute Sunday service in the entire Gallatin Road corridor.

Analysis: Several service patterns were studied for the combined BRT and Local service. Five of these are illustrated schematically in the following figure.

Cost/Lead time: Estimated annual operating cost changes for these alternatives vary from about $2.35M to $3.2M (as calculated by MTA Service Planning), with the increase in peak period bus requirements varying from 6 to 8.

Action: Addendum 7-A (found at the end of this chapter) provides a more detailed description of these alternatives, with the advantages and disadvantages of each. Alternative A is recommended because it has the lowest operating costs and bus requirements while providing improvements in service to all users of the corridor. Under this alternative the BRT would operate through from Rivergate (Sam's). Operation would be simple due to the lack of short turn trips at Madison Square, as considered in all of the other alternatives. Ten BRT vehicles are required in peak periods and 6 in midday periods. The MTA has already purchased 6 BRT vehicles. Assuming that two vehicles are required as maintenance spares, then 6 additional units will be required. At the same price as paid for the recently received vehicles now on order, this will require an additional expenditure of about $5.1M.

Figure 7-13: Alternative Service Patterns for Gallatin Road BRT



Branding and Marketing

Key to the promotion of BRT service required to attract new riders is the careful attention to detail in branding the service. It should be very clear how the system and its service are different from the service that it replaces. They should look different and feel different to the passengers. The more dramatic the difference the better, as this will attract media buzz and conversation among the public. At a minimum, branding requires that all of the BRT elements (buses, stations, signs, etc.) should use colors and a logo different from the "regular" system.

Summary of Implementation Actions for Gallatin BRT:

The readiness of the various elements for early installation should be considered and a package prepared for simultaneous implementation, based on what is realistically possible. The table below proposes elements that could realistically rolled out within about 18 months of the availability of funding and would have the greatest impact. Development of dedicated lanes or queue jump lanes must be considered a long term goal; design and right-of-way acquisition will be extremely time-consuming and expensive. Implementation of POP fare collection may require establishment of a legal framework and would requirement deployment of fare inspectors (either MTA employees, law enforcement personnel from another agency, or contractor employees). Without POP fare collection, which allows rear door boarding, the value of near level boarding platforms at stations is quite limited

Following in Table 7-2 is a summary of projected BRT costs with the recommended options.

Table 7-2: BRT Cost Summary

BRT Capital Cost Item	Cost
6 Additional BRT Buses	$5.1M
Victory Memorial Bridge Lane	nominal
Signal Priority	$0.5M
Real-Time Info	$0.2M
Enhanced Stations	$2M
Branding & Marketing	$50,000
Contingency (20%)	$1.6M
Total	**$9.4M**

Before BRT can be implemented some decisions must be made and some design is required, as outlined in this report. A reasonable timeframe for implementation is within 24 months, assuming that funding for the elements is in place.

Potential Extension of BRT from MCC to Vanderbilt

Some preliminary consideration has been given to the potential for operating a Gallatin Road BRT route beyond the Music City Central (MCC) through to the West End / Vanderbilt area. A routing via Charlotte, Union, Church, and 21st Street is being considered by MTA and this routing is already utilized by Route 35X Rivergate Express. Such an extension would appear to be logical since it would provide distribution/collection through much of the downtown area as well as providing a direct link for passengers travelling to/from the Baptist Hospital, Vanderbilt University, and the Vanderbilt Medical Center. These are some of the strongest trip generators in Middle Tennessee. Providing through service would attract more riders to transit as well as provide more capacity in the segment between downtown and Vanderbilt. This is primarily served by Route 7 Hillsboro whose buses sometimes have standing-room-only due to the short distance passengers.

There would be an increase in BRT capital and operating costs as a result of this extension: Capital costs are estimated at $5 million and include:

- 3-4 additional peak period vehicles
- TSP (about 24 additional signalized intersections are involved)
- Branded BRT stations, with DMS units (an estimated 12 locations).

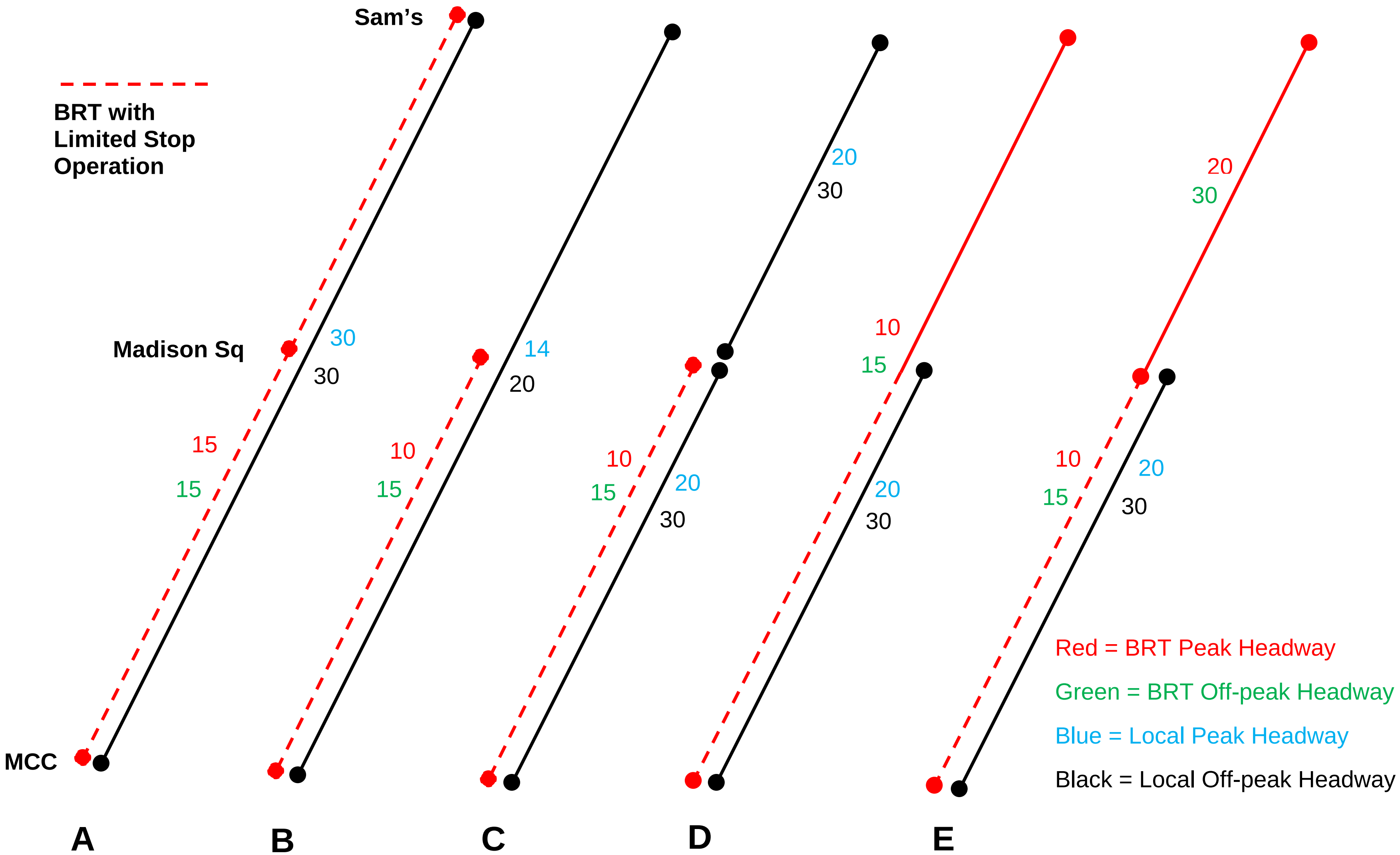
Operating cost assumptions:

- 4 buses in the peak period for BRT
- 3 buses in the off peak for BRT
- 2 buses evenings for BRT
- 2 buses Saturday for BRT
- 1 bus Sunday for BRT
- Reduction of 1 bus on Route 7 Hillsboro weekdays daytime

With these assumptions, the annual additional operating cost for a BRT extension would be about $925,000. Further analysis of this concept is required and implementation of this improvement is included as one of the mid-term *Strategic Transit Master Plan* actions.

Addendum 7-A: Alternative Service Patterns (these two pages provide support for operating plan decisions described earlier in the chapter)

Alt.				Increase in Buses Required						Net Increase in Annual Oper. Cost $
	Description	Pros	Cons	AM rush	Midday	PM rush	Evening	Saturday	Sunday	
A	BRT added with all trips operated to Sam's Club; Local headways widened to 30 in peak and midday; 60 minutes nights and weekends	Significant service increase on outer portion of route. Least expensive.	Least frequent local service	8	6	7	7	2	2	$2.3M
B	BRT added south of Madison Sq.; no change in local service	Simplest service pattern	Riders on outer portion of #26 receive no benefit from BRT service. Expensive.	8	6	7	7	7	NC	$3.20M
C	BRT added south of Madison Sq.; Local headways widened to 20 in peak and 30 in midday with outer end converted to shuttle when BRT service is running	Simple service plan	Riders on outer portion of #26 may use BRT service (timed transfers would be provided), but would be forced to transfer	6	5	5	6	6	NC	$2.55M
D	BRT service operated, with all trips running through to Sam's; local service cut back to Madison Sq. with BRT making local stops north of Madison Sq.	Simple service plan, outer end riders benefit greatly	Expensive	9	8	8	7	7	NC	$3.04M
E	Same as D, but with half of BRT trips terminating at Madison Sq.	Outer end riders receive faster service, but less frequent.		6	5	5	6	6	NC	$2.35M


Sam's
BRT with
Limited Stop
Operation
Madison Sq
MCC
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Red = BRT Peak Headway
Green = BRT Off-peak Headway
Blue = Local Peak Headway
Black = Local Off-peak Headway