

# **Evaluation and Selection of the Locally Preferred Alternative Strategy**

## ***10.1 Introduction***

This report documents the development and identification of a proposed locally preferred alternative strategy (LPA) for addressing the transit needs of the southeast corridor. The alternative, a lower-cost, bus based strategy, was developed largely based on the results of the performance of the alternatives analyzed during the Phase I and II screening of alternatives. This analysis led the Steering Committee to combine the better performing elements of those alternatives to create a lower cost and more effective program. Implementation of the proposed LPA will allow for a transit travel market to be developed in the corridor via local and express bus service. The ultimate goal over a 25 year implementation period is for the region to build support and patronage for transit and for the region to develop strategies to pay for the capital investments and on-going operating costs. Ultimately the enhanced bus service proposed by the LPA could serve as a stepping stone to higher capacity service in the corridor like higher capacity Bus Rapid Transit, Light Rail, or Commuter Rail. However, the implementation of these higher capacity rail options is not a part of the LPA and most likely would occur beyond the 2030 time period.

## ***10.2 Alternatives Evaluation Process***

The evaluation process began with the development of six initial alternatives consisting of Commuter Rail, Light Rail, and Bus Rapid Transit (BRT) service options on the three main north-south corridors connecting Murfreesboro to Nashville via Smyrna and LaVergne: I-24, the CSX rail alignment, and Murfreesboro Road (US 41). These six alternatives were evaluated using both qualitative and quantitative measures related to the study's statement of purpose and need and project goals and objectives. The evaluation included identification of environmental red flags, comparison of station area population and employment, and concept-level estimates of capital or infrastructure costs. This analysis is documented in full detail in the Southeast Corridor Alternatives Analysis Final Report.

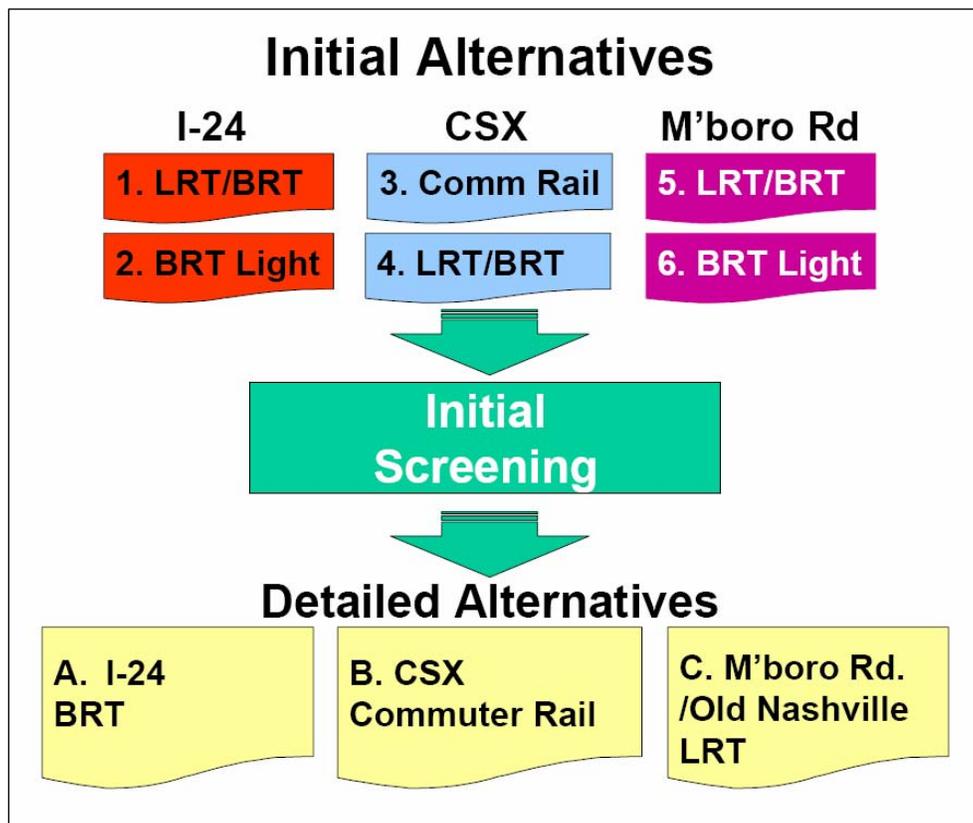
Based on the results of the initial screening, the Steering Committee determined that none of the proposed alignments (I-24, Murfreesboro Road and the CSX rail line) were clearly superior to the others. The initial screening indicated an alignment directly serving Nashville International Airport would add travel time and costs that far outweigh the potential benefits of the airport connection for users. Based on this finding, the options for alignments serving the airport that were considered as part of several alternatives were eliminated from consideration. Likewise, the committee found that the cost of developing a light rail system to operate the length of the corridor would be highly costly, and light rail was dropped from consideration as an alternative mode. However, while commuter rail clearly performed less well than BRT in the initial screening, the Steering Committee determined that it potentially provided sufficient benefits for it to be carried forward into the next round of alternatives screening. Based on public input, a fourth alignment option for providing service to the southern half of the corridor, Old Nashville Pike, was incorporated into one of the alternatives developed for detailed testing.

Based on the results of this initial screening and by incorporating the most promising elements of the six initial alternatives, the project's Steering Committee developed three alternatives, together with an enhanced bus or TSM alternative and a No-Build alternative to be carried

forward into detailed screening. Figure 10-1 illustrates this selection process. These alternatives were:

- Alternative A: BRT “Light” on I-24
- Alternative B: Commuter Rail on the CSX rail alignment
- Alternative C: BRT on Murfreesboro Road

The No-Build alternative consisted of the existing regional transit system together with planned and programmed improvements included in the regional transportation improvement program (TIP) and the financially constrained long range transportation plan (LRTP), which consisted of minimal changes to existing bus routes. To be implemented by 2030, the TSM alternative consisted of a system of bus routes similar to those proposed to operate under Alternative A (BRT on I-24) but without the support of the dedicated busway, which intended to allow the buses to bypass congested auto traffic in the corridor.



**Figure 10-1 Alternative Selection Process**

These alternatives were developed at a higher level of geographic and operational detail than the alternatives developed for the initial evaluation and received a more thorough and intensive analysis process. Capital cost estimates for these alternatives were developed at a higher level of detail, and operating cost estimates, as well as estimates of transit ridership, were performed for these alternatives.

### **10.3 Proposed Locally Preferred Alternative (LPA)**

The proposed LPA for the Southeast Corridor was developed based on the analysis of the three alternatives in the detailed evaluation phase. The Steering Committee examined the results of

the analysis, including the numbers of persons and jobs served, the capital and operating cost of the alternatives, and the ridership estimates, and combined the best performing and lowest cost elements of the alternatives into a single strategy. Cost and ridership estimates were prepared for two distinct versions of the alternative as it was developed and refined.

In addition, ridership estimates were prepared for the LPA in which the assumptions concerning future land use were changed to direct future growth in the corridor into areas around major transit stops and stations, since transit services and facilities can have a direct affect on surrounding land use and land use can have an effect on transit ridership. This was done to test the degree to which ridership would be improved if transit-supportive land use policies were enacted in the corridor. These land use changes would positively benefit transit, but their impacts on non-transit related systems are not evaluated in this study. Land use changes enacted by local government entities must also be evaluated for their impacts on water and sewerage systems, schools, roadway networks and other systems and services.

The elements of the proposed LPA represent a strategy to build transit demand in the corridor from the relatively modest current level to a level that could warrant significant financial investment in transit improvements. The proposed LPA represents the highest investment level that could be supported by the number of potential riders who are projected to exist in the corridor, and generates the other benefits of transit investment in the corridor such as potential environmental benefits and the ability to shape future development. A number of factors in the future, such as the performance of new RTA and MTA transit services, the price of fuel, future growth and distribution of population in the corridor, land use patterns, local transportation priorities, the availability of funding, and other factors, could change the potential for new transit services in the corridor. The study anticipates that at various stages, these factors will be revisited, and the recommendations will be potentially modified based on changing conditions in the corridor and in the region.

### **10.3.1 Summary of the Proposed LPA**

The proposed Locally Preferred Alternative strategy for the southeast corridor is an Enhanced Bus, or Transportation System Management (TSM) alternative. The strategy consists of a network of new and expanded bus services operating on Murfreesboro Road (US 41) and I-24 between Nashville and Murfreesboro and serving LaVergne, Smyrna, and Rutherford County gradually introduced over a period of more than 20 years. It differs from the TSM alternative tested in the Phase II screening of alternatives in that it includes bus services operating on both Murfreesboro Road and on I-24. These improvements would ultimately be supported by infrastructure improvements, including the development of improved bus stops to serve as stations along the route, improvements at intersections and the development of intersection “queue jump” facilities at congested intersections along the corridor to allow buses to bypass congested traffic conditions. Short sections of single lane, reversible bus lanes are proposed for specific congested areas of the corridor to allow buses to bypass the congested traffic conditions. Nashville-Davidson County is implementing an ITS system that would serve Murfreesboro Road from Nashville International Airport north. This ITS system is programmed and is not part of the Southeast Corridor project but would provide a basis for transit-supportive intersection improvements in the area. Partly on the basis of public recommendation, the proposed LPA also includes the addition of queue jump facilities at key I-24 interchanges as part of a regional ramp metering initiative. The improvements included in the full build-out of the LPA are shown in Figure 10-2. Figure 10-3 is a schematic diagram showing bus connections

and service frequencies. Figure 10-4 shows the sequence for short, medium, and long-term improvements.

The proposed LPA is recommended to be implemented in three phases. In the short-term, the improvements are largely limited to a significant increase in express and local bus service. The mid-term phase includes a further expansion of bus service and improvements to station stops and transit centers. Major infrastructure improvements are programmed for the long-term.

Figure 10-2 Proposed Locally Preferred Alternative Strategy

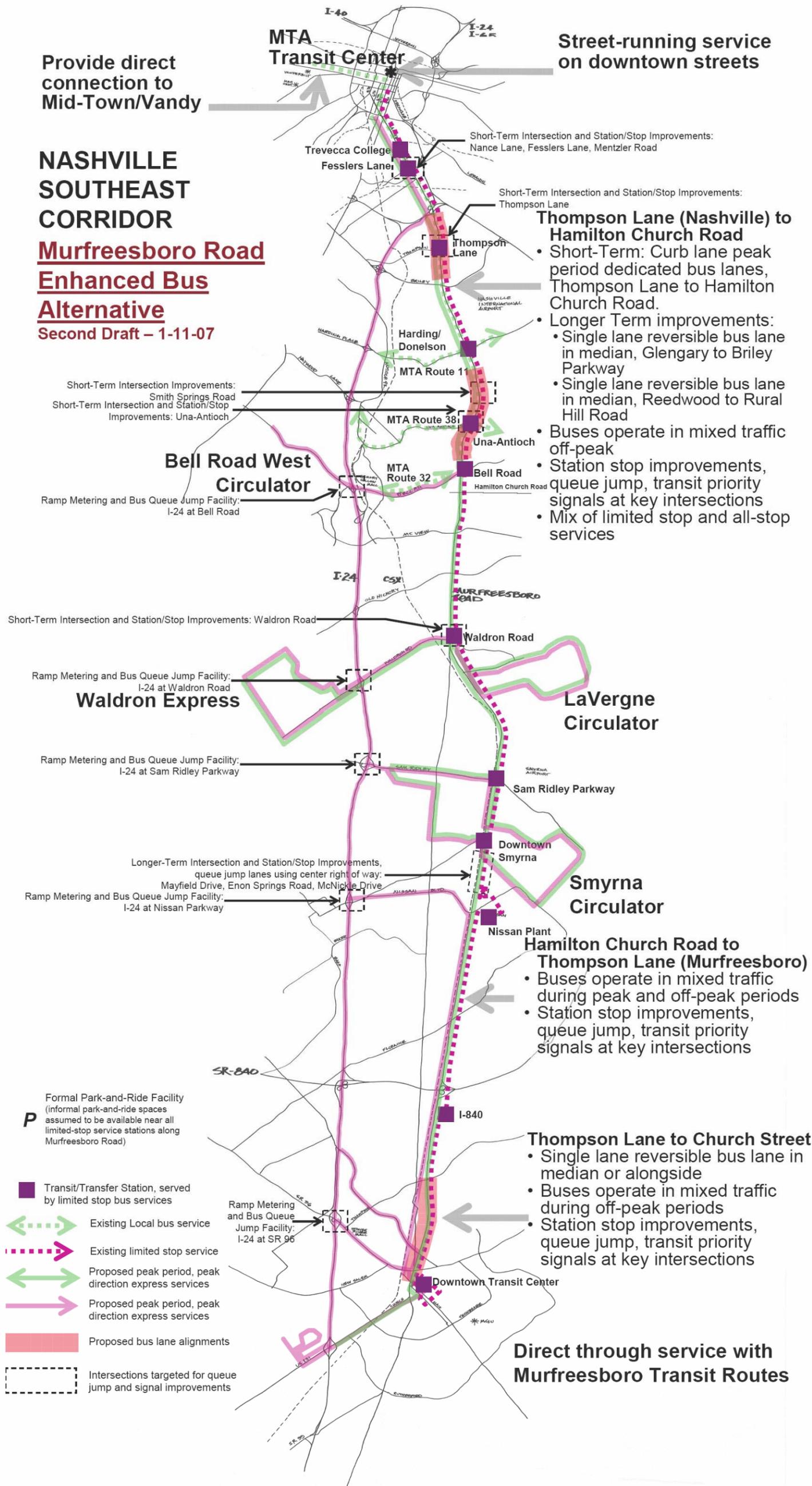


Figure 10-3 Proposed Locally Preferred Alternative Strategy-Bus Service Schematic Diagram

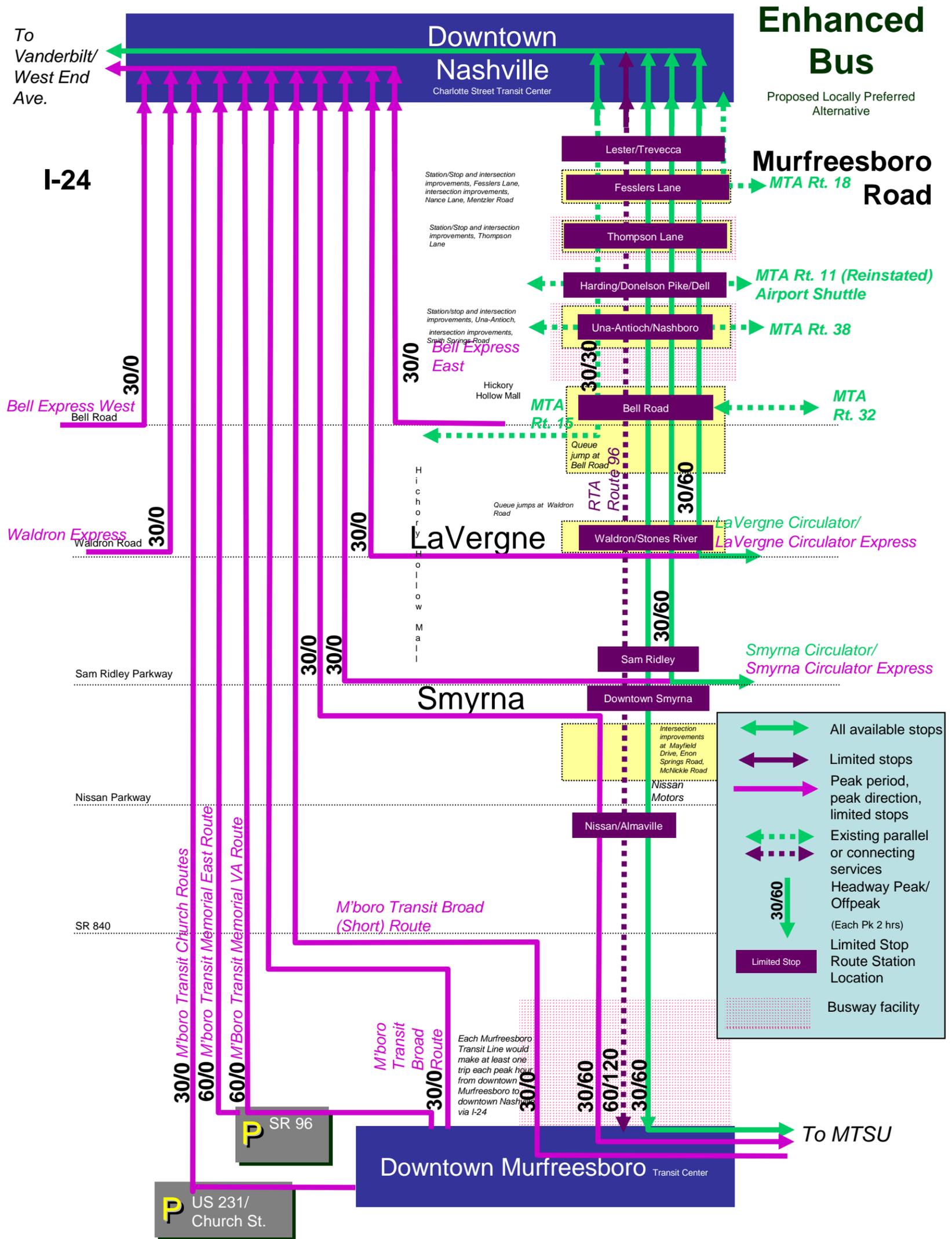
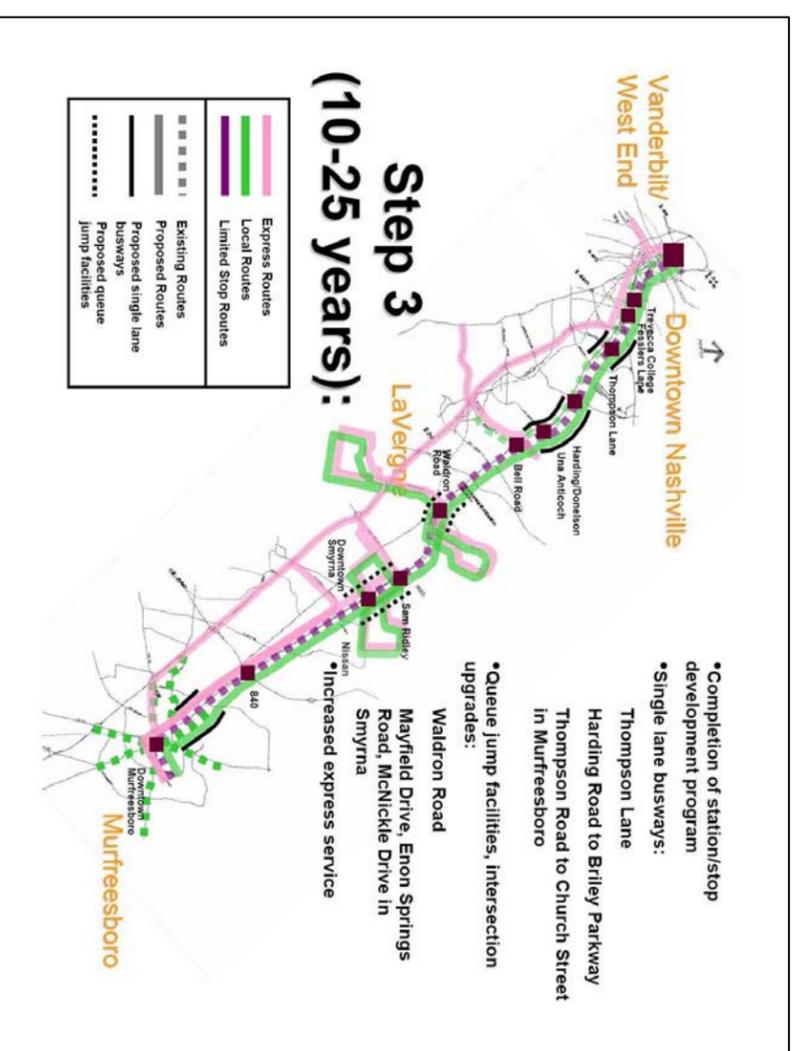
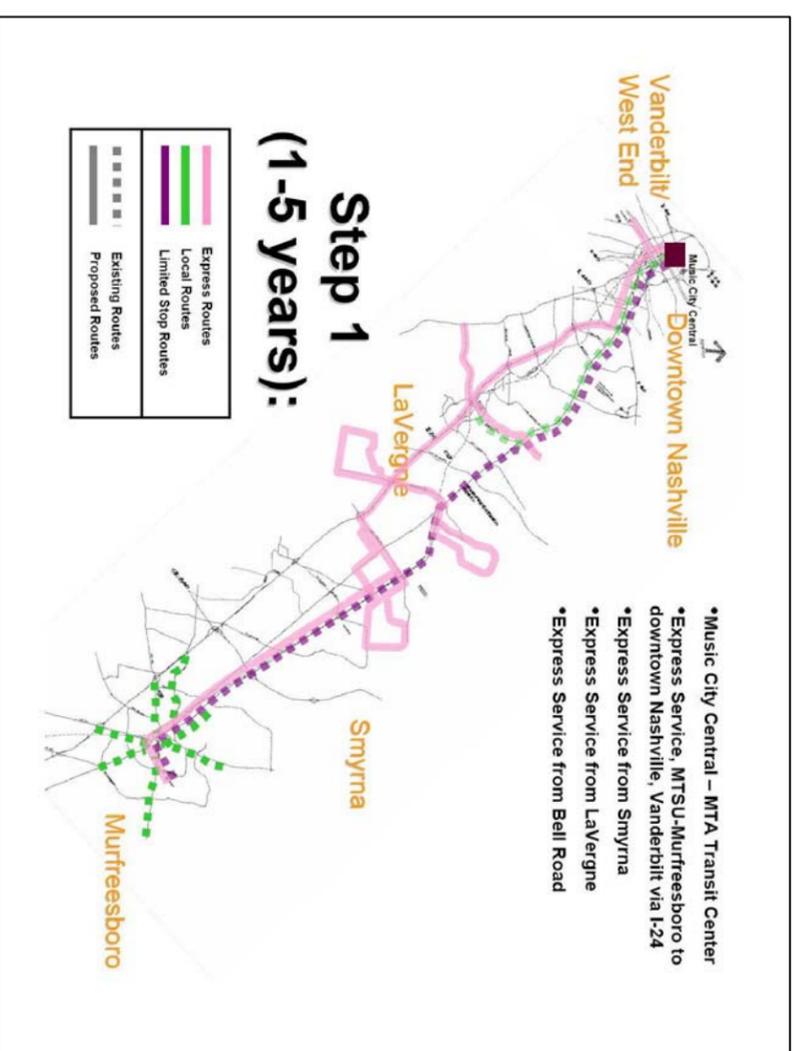
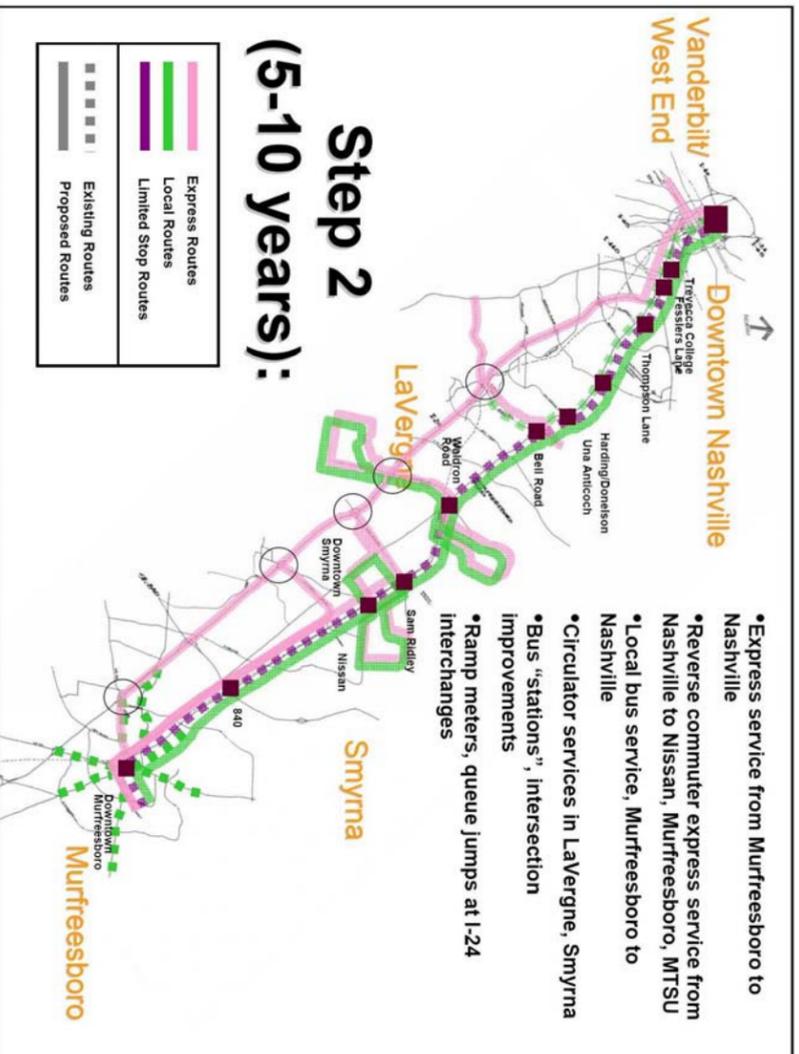
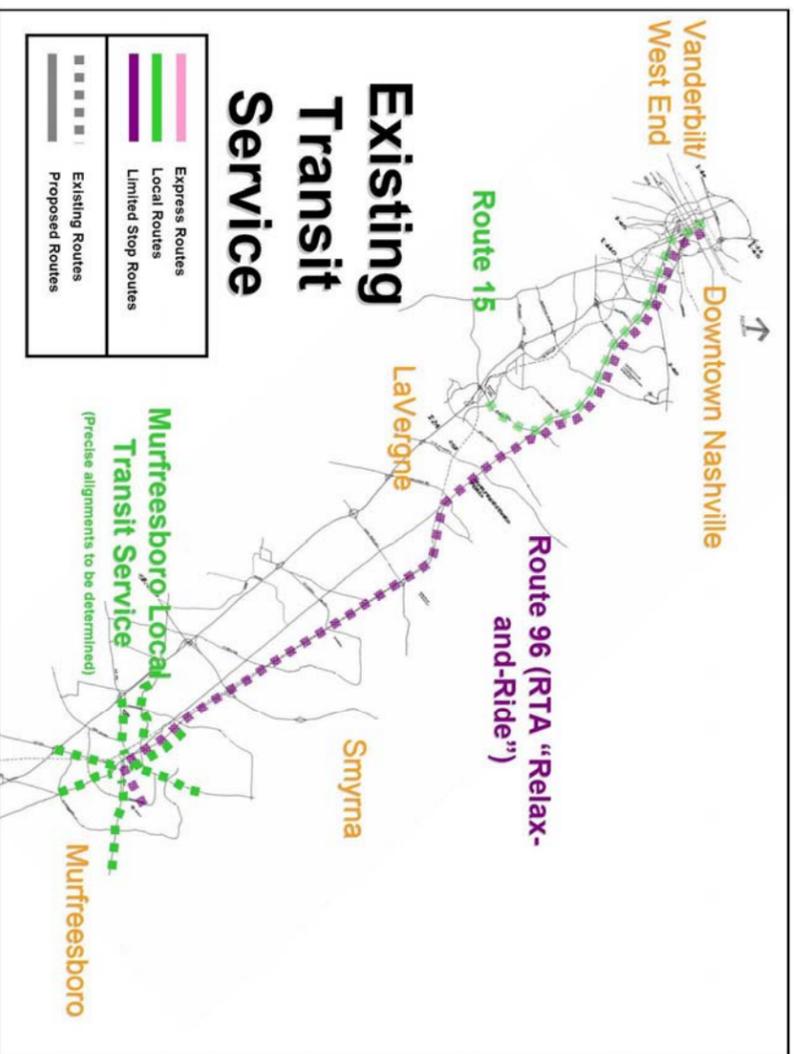


Figure 10-4 Sequential order of recommended improvements



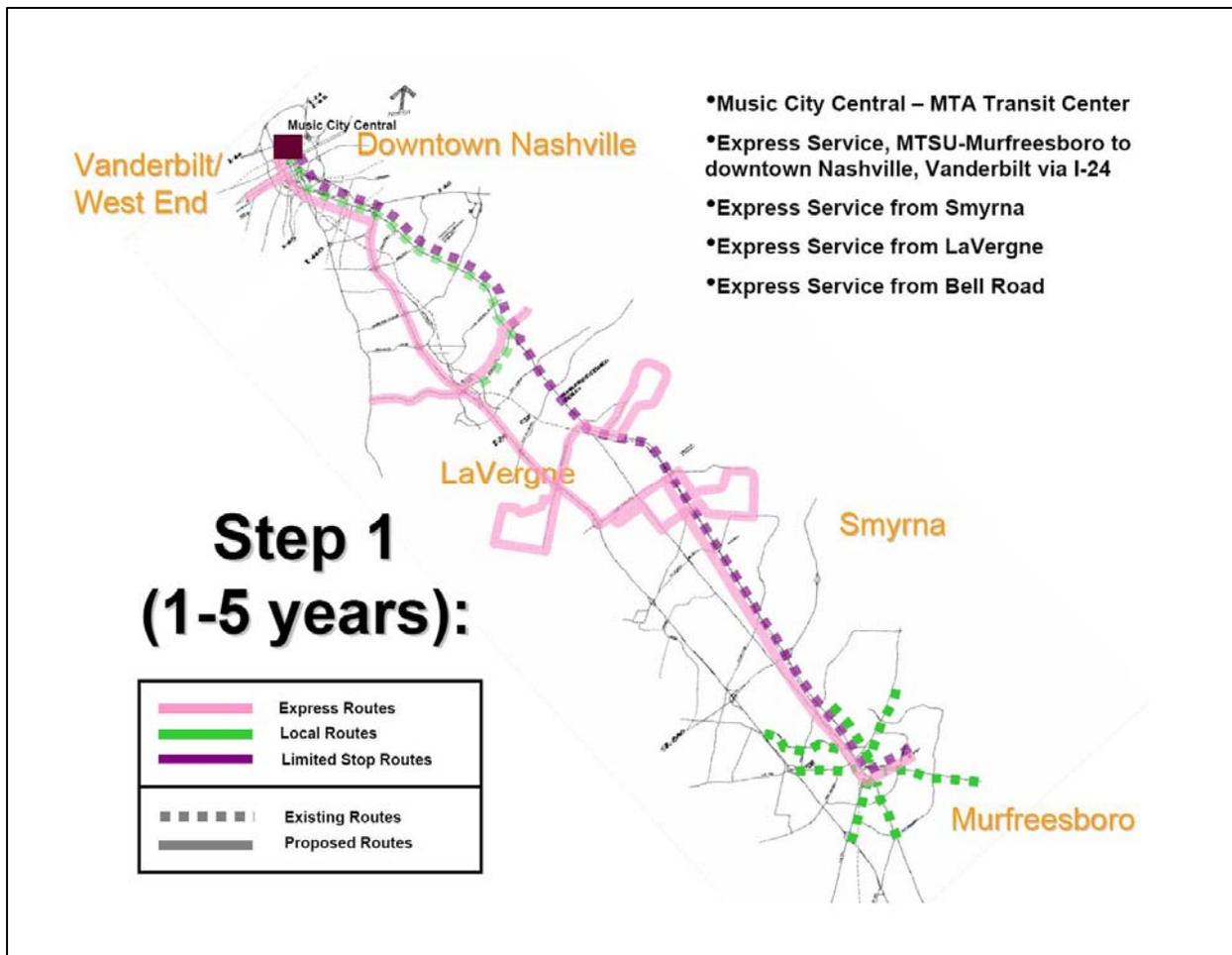
### **10.3.2 Short-Term Improvements (0-5 Years)**

Short-term improvements would begin building implementation immediately and would extend until completion, a period expected to take about five years. The short-term improvements are largely oriented to expanding bus service in the corridor. Improvements include the expansion of the express bus network to provide better service for commuters to downtown Nashville from Murfreesboro, Rutherford County, Smyrna and LaVergne. These services would primarily circulate through the communities they serve before transitioning to I-24 for the trip to downtown Nashville. The improvements also include more frequent service on RTA's 96 "Relax-and-Ride" service from Murfreesboro to Nashville via Murfreesboro Road. Infrastructure improvements in this phase are limited to the MTA's proposed Music City Central downtown transit transfer center, which is programmed and funded for construction and is to be completed in 2008 and is not formally a part of the Southeast Corridor study recommendations. The short-term improvements are shown graphically in Figure 10-5.

The short-term recommendations are designed to gradually build ridership to above its current level by providing a greater variety and frequency of service in the corridor.

Specific recommended improvements include:

- Implementation of an express bus route operating from Murfreesboro and Smyrna to downtown Nashville and the Vanderbilt-West End area via Murfreesboro Road, Sam Ridley Parkway and I-24.
- Express bus routes from Smyrna, LaVergne and the Bell Road-Hickory Hollow Mall area to downtown Nashville and Vanderbilt-West End. These routes would circulate through the communities on a route, the precise alignment of which has yet to be determined, and would be revisited prior to implementation. The routes would then enter the freeway to complete their trips to downtown Nashville, continuing on to the Vanderbilt-West End area of Nashville as a continuous route, most likely near interchange areas. The study assumes that park-and-ride spaces would be available for use by commuters at commercial parking lots along the off-freeway portion of the route. Formal park-and-ride lots have not been included in the proposed LPA.
- Connection of the regional transit network to the proposed circulator bus system being introduced in Murfreesboro. The City of Murfreesboro is in the process of implementing a local bus service to provide transit connections within their community. These routes would connect to an express bus service operating from Downtown Murfreesboro to downtown Nashville and Vanderbilt.
- Provision of bus service between Hickory Hollow Mall and Nashville International Airport to provide a local bus connection between the airport and the express and local bus services operating in the corridor between Nashville and Murfreesboro.
- Completion of the MTA downtown transfer center (MTA Central Station) at Charlotte Street.



**Figure 10-5 Short-Term Improvements**

### 10.3.3 Mid-Term Improvements (5-10 Years)

In the mid term, the number and types of bus routes will continue to increase during the gradual expansion of the transit market in the corridor. In addition, infrastructure improvements—in the form of transit stations at key intersections along Murfreesboro Road and the development of “queue jump” facilities at key intersections in the corridor—will provide improved amenities and travel speed for bus passengers in the corridor. The improvements recommended in the medium term are illustrated in Figure 10-6:

- Introduction of distinctive buses for operation in express and skip-stop service in the corridor. Buses with a distinctive look and with amenities that appeal to longer-distance travelers (padded seats, reading lights, tray tables, foot rests) and potentially alternative power (such as hybrid diesel-electric or natural gas powered buses) help to differentiate between corridor express services and more typical local bus service, which will help attract commuters to downtown Nashville and other riders who use the bus in spite of having access to an automobile. An example of a commuter or busway vehicle is shown in Figure 10-10. Such buses typically cost 1.5 to four times the cost of a standard diesel transit bus.
- Implementation of regular local bus service on Murfreesboro Road from Murfreesboro to downtown Nashville. Service would operate in both north-west and south-east directions at 30 minute intervals during rush hour periods and 60 minutes during midday and evening periods.

- Introduction of circulator bus services in Smyrna and LaVergne. These buses would operate as local circulator routes within neighborhoods in Smyrna and LaVergne before reaching Murfreesboro Road, on which they would continue to downtown Nashville using local transit routes, which would expand the volume of bus service on Murfreesboro Road.
- Development of queue jump facilities at the I-24 Interchanges at:
  - Bell Road
  - Waldron Road
  - Sam Ridley Parkway
  - Nissan Parkway
  - SR 96

These facilities would consist of a single lane, up to ¼ mile in length, in the inbound (northbound) interchange ramp that would allow buses to bypass auto traffic waiting to enter the traffic stream on I-24. The queue jump facilities are proposed to accompany the introduction of ramp metering at all I-24 interchanges in the corridor as an element of the implementation of a regional Intelligent Transportation System (ITS) system in the Nashville Region. Ramp meters have been recommended only at I-24 interchanges where express bus service is proposed to enter the freeway. These facilities would reduce travel time on inbound commuter express bus routes and would thus improve transit ridership in the corridor.

- Express service on I-24 from Murfreesboro to downtown Nashville and West End-Vanderbilt.
- Implementation of reverse-commute express service via I-24 from downtown Nashville to the Nissan Auto Plant, Murfreesboro and MTSU.
- Development of station “stops” at some major intersections along Murfreesboro Road and in downtown Nashville:
  - Church St., Broadway, Gateway Boulevard, and Lafayette Street in downtown Nashville
  - Trevecca Nazarene University
  - Fesslers Lane/Thompson Lane
  - Donelson Pike/Dell Manufacturing Facility
  - Una Antioch Pike
  - Bell Road Waldron Road
  - Sam Ridley Parkway
  - Downtown Smyrna
  - Nissan Boulevard
  - SR 840
  - Thompson Road Downtown Murfreesboro
  - Broad/Tennessee
  - MTSU

The plan assumes that up to 12 of these stations will be constructed within the five-to-ten year period, with the locations based on ridership on the existing transit system at that time. The remainder of the stations will be constructed in the longer term period as transit patronage increases. Some examples of the types of improvements proposed for stations are shown in the photos in Figure 10-12. Improvements could include shelters, or semi-climate controlled interior spaces, seating, upgraded landscaping, signage and lighting, paved connections to adjacent developments and parking, and crosswalk treatments to facilitate pedestrians crossing major roadways. Formal park-and-ride lots at stations have not been included in the recommendations and are assumed to be available at adjacent developments for use by commuters. Improvements would be sized and scaled appropriately to the surrounding development and the space available in the right of way. Thus, larger scale shelters and waiting areas would be constructed in areas outside

downtown Nashville, while more minimal facilities would be provided in the more constrained spaces available in downtown Nashville.

- Local bus services operating on Murfreesboro Road between LaVergne, Smyrna and downtown Nashville and West End-Vanderbilt.
- Conversion of RTA Route 96 to skip stop service, making stops only at selected intersections along Murfreesboro Road, and increasing service frequency on the route. The route would make stops only at the station stops identified above.

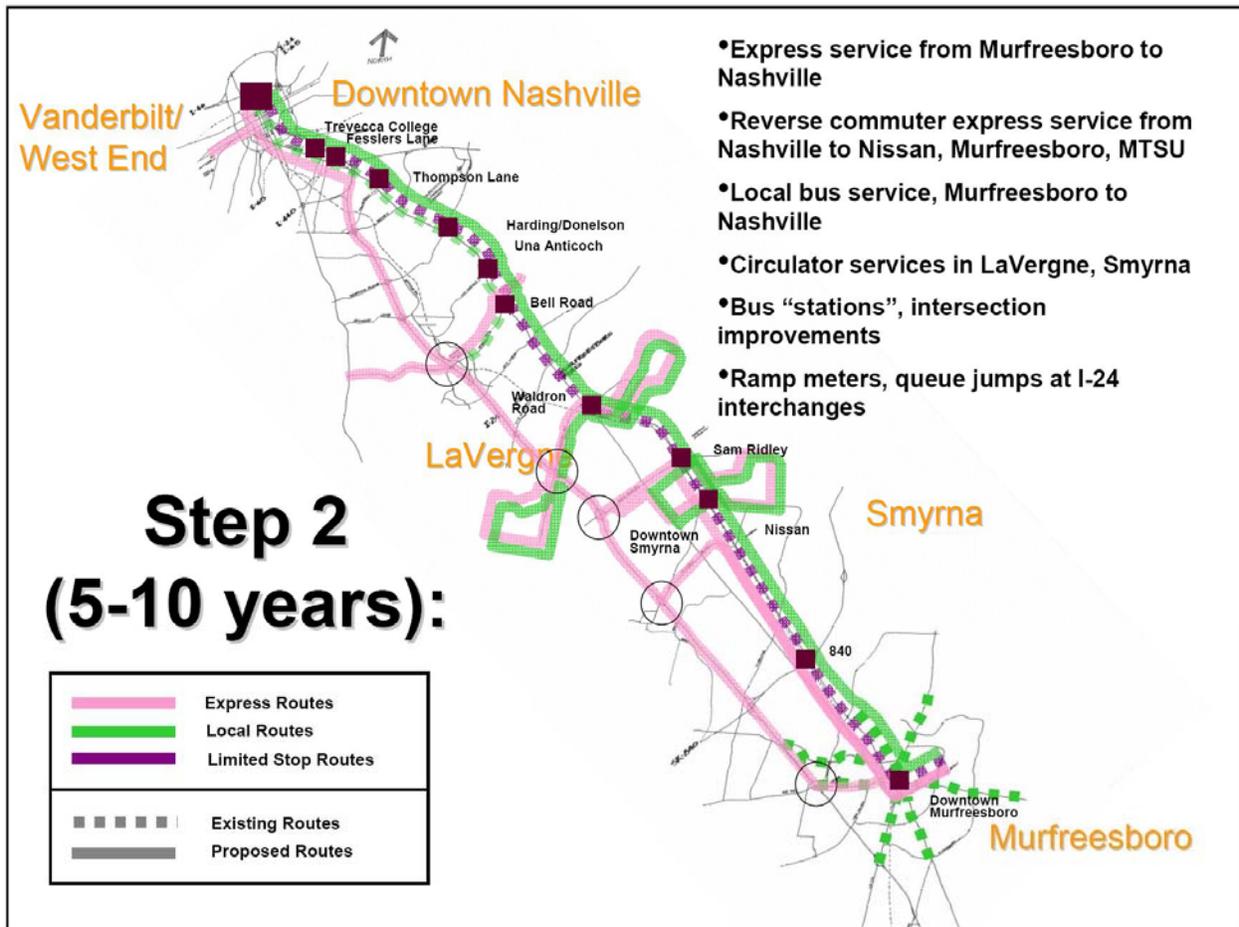


Figure 10-6 Medium Term Improvements

### 10.3.4 Long-Term Improvements (10-25 years)

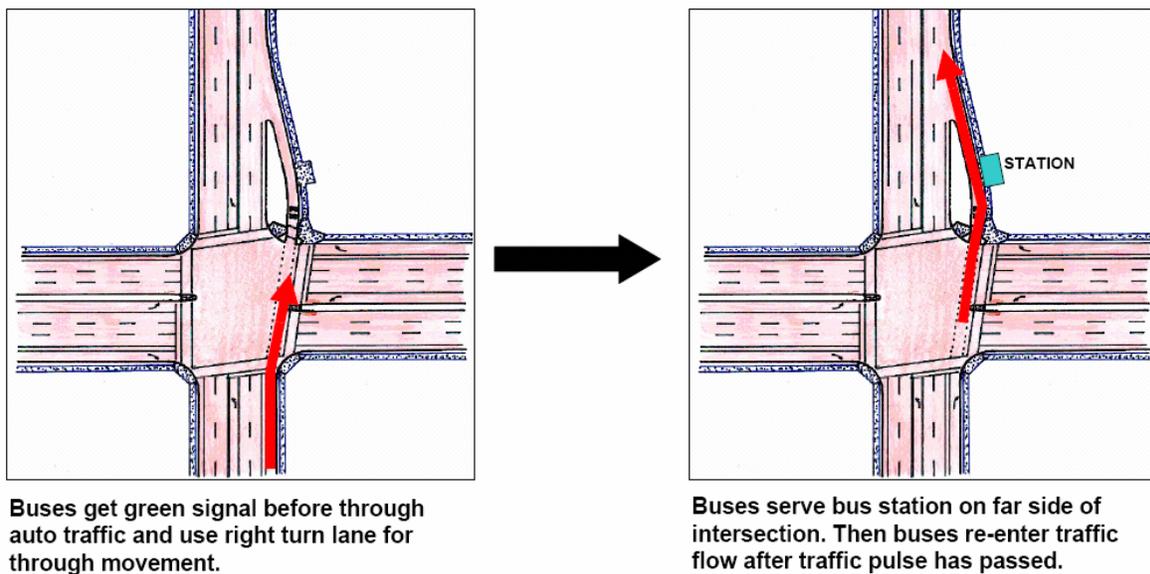
In the longer term, major infrastructure improvements would continue to improve transit conditions, while bus service would continue to cover more areas of the corridor and increase service frequency. In addition to the completion of the transit skip stop station program begun in the mid-term period, the main development in the long-term period would be the improvement of busways and intersections at selected congested intersections on Murfreesboro Road. These improvements would further benefit transit by allowing it to bypass congested traffic conditions. These improvements not only would continue building transit ridership in the corridor, but also could potentially serve as a precursor to some form of full length bus rapid transit or rail transit system. Some of the improvements to intersections or busway developments could be

developed during an earlier time period if their development could be programmed to coincide with roadway reconstruction projects in the selected areas.

The improvements identified for the long term period include the following:

- Increased frequency on express bus service from Murfreesboro to downtown Nashville and Vanderbilt-West End via I-24 and I-40.
- Development of intersection and signal improvements to allow transit to bypass congested traffic conditions at the following locations:
  - Thompson Lane,
  - Una-Antioch/Nashboro,
  - Waldron Road, in LaVergne
  - Mayfield Drive in Smyrna
  - Enon Springs Road in Smyrna
  - McNickle Road in Smyrna

Figure 10-7 illustrates an example of intersection bus queue jumping lanes.



**Figure 10-7 Example of a queue jumping lane intersection improvement**

- Completion of limited stop station improvements in downtown Murfreesboro and selected major stop locations along the corridor that were not completed in the mid-term phase of development.
- Development of single lane, reversible bus lanes in the median or along one side of Murfreesboro Road at the following locations:
  - North and south of Thompson Lane
  - South of Harding Road-Donelson Pike to north of Bell Road.
  - In Murfreesboro from Thompson Road south to Church Street.

The precise start and end points of the busways and their configuration (for example, whether they are located in the center of the roadway alignment or on the eastern or western sides of the roadway) will be determined at a later stage of development. A potential cross section of a single lane reversible busway shown in Figure 10-8. As the figure shows, the busway would be 12 feet in width and would be separated by landscaped

medians or barriers to prevent auto traffic from entering the lane. The lane would operate in the park direction (north in morning, south in the afternoon) and would be closed to traffic during the midday periods.

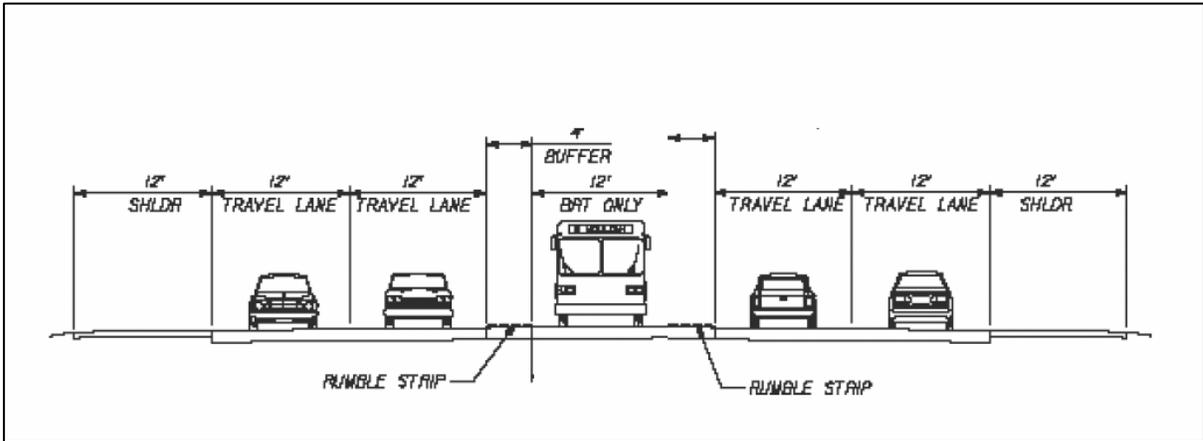


Figure 10-8 Potential bus lane cross section

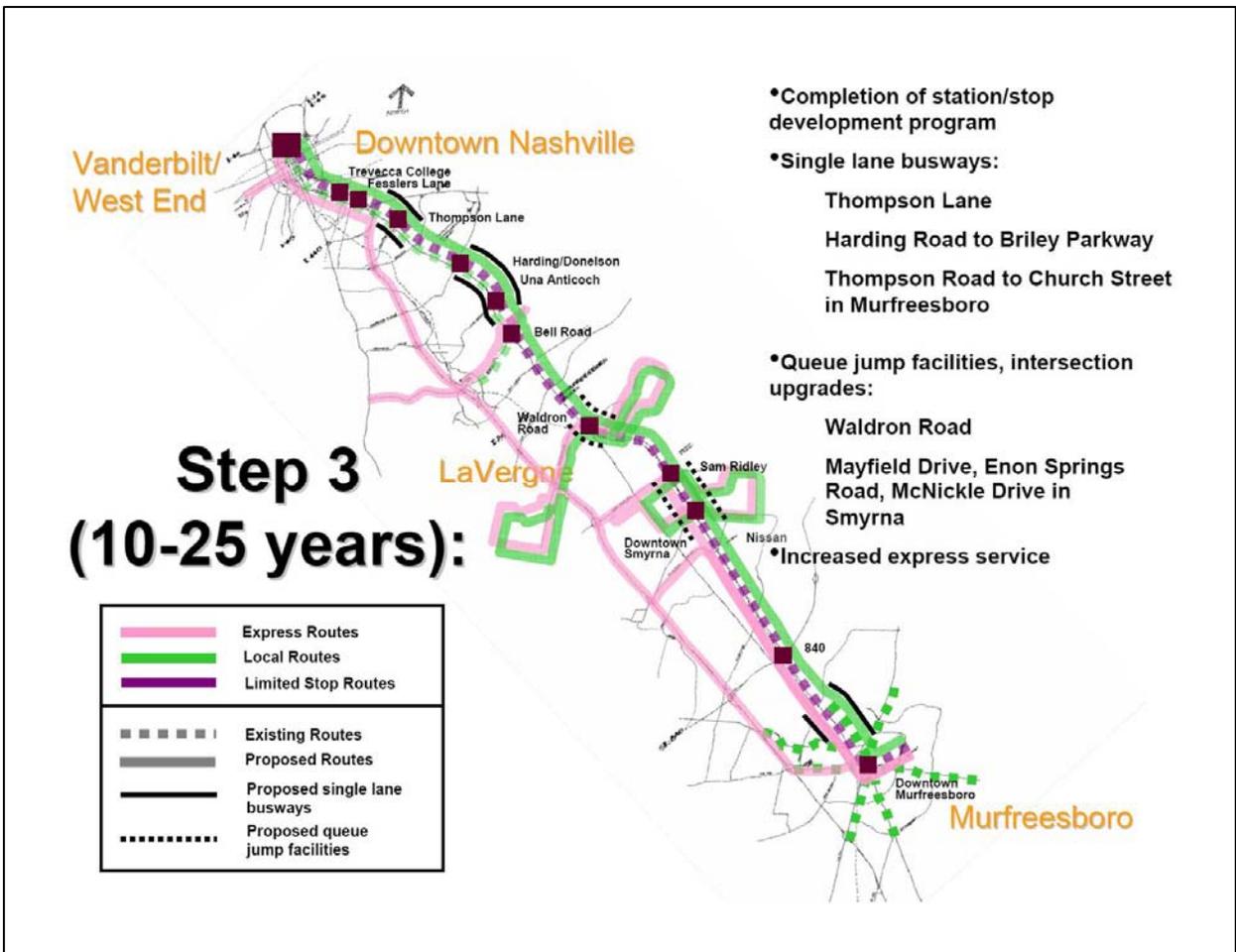


Figure 10-9 Long-Term

The configuration of a reversible lane facility along one side of the roadway, as opposed to in the center, would require significant signal and signage improvements over and above those required for a center lane facility to ensure, for example, that turning drivers in the intersection do not turn their vehicles into the busway or into the path of a crossing bus. Alleviating these and other potential driver and pedestrian safety concerns would add to the signal delays experienced by both buses and autos at effected intersections, leading this reversible lane facility to have a significant disadvantage to a side facility. Potential cross sections for the proposed bus lanes are shown in Figure 10-8. A diagram of the proposed long-term improvements for the corridor is shown in Figure 10-9.

### **10.3.5 Operating Plan for Proposed LPA**

The proposed LPA represents a dramatic increase in bus service in the corridor. The plan calls for the implementation of four new types of service in the corridor:

- Express bus services using I-24 to provide direct service between downtown Nashville and communities along the corridor including the Bell Road area, LaVergne, Smyrna, Rutherford County and Murfreesboro.
- Local bus service along the full length of Murfreesboro Road, to provide a basic level of bus service for travelers in the corridor and to support the wide variety of intra-corridor trips that do not end at the terminal areas of the corridor, downtown Nashville or Murfreesboro.
- Circulator services within corridor communities, to provide a basic level of transit service within the communities and to provide a direct connection between corridor neighborhoods, commercial developments and the longer-distance transit services operating on I-24 and Murfreesboro Road.
- Reverse-commute service to allow travelers from the city of Nashville and other corridors to travel to employment centers in the corridor, including employers in the Bell Road area and in LaVergne, Smyrna and Murfreesboro.

These new services are not meant to *replace* the existing local bus services operating in the northern (Nashville-Davidson County) portion of the corridor, the RTA Relax-and-Ride service operating throughout the corridor or the new bus system currently in development in Murfreesboro. They are, rather, intended to supplement and, in some cases, modify these existing services to create an integrated network which would provide transit services fitted to the diverse transportation markets existing in the southeast corridor.

#### **Express Bus Service on I-24**

The proposed express bus services would originate in neighborhoods in the central and southern areas of the corridor, including various areas of Murfreesboro and unincorporated Rutherford County, LaVergne, Smyrna and the Bell Road area in southern Nashville-Davidson County. The service would be oriented to serve commuters from throughout the corridor to downtown Nashville and the West End area. This market represents a small minority of trips that occur in the corridor. However, because the vast majority of these trips are destined to relatively small and walkable areas (downtown Nashville and the Vanderbilt-West End area), and occur within just a short span of time each day, they are one of the strongest markets for transit service and have the greatest potential impact on traffic congestion. The recommendations in the LPA would provide them with a high level of high quality transit service. Much of the express service was recommended for implementation in the short-term, while implementation of the local service was recommended for the mid-term period, primarily because no express service currently exists in the corridor.

In the short-term, express routes would originate at the following locations:

- MTSU and downtown Murfreesboro via Murfreesboro Road to Sam Ridley Parkway in Smyrna
- Smyrna (Sam Ridley Parkway)
- LaVergne (Waldron Road)
- Bell Road-Hickory Hollow Mall

In all, six express bus routes have been programmed to originate from various areas of Murfreesboro, with routes entering I-24 from the US 231, SR 96 and SR 840 interchanges and from the Sam Ridley Parkway interchange in Smyrna. The first of these, in the short-term, would originate at MTSU and operate north on Broad Street-Murfreesboro Road to Smyrna, from which it would operate west to I-24 via Sam Ridley Parkway. In the mid-term, a second express route would originate from Murfreesboro and a route originating in Nashville would operate a reverse-commute express service to the Nissan Motors factory in Smyrna and to Murfreesboro and MTSU. In the Long-Term, four additional routes originating in Murfreesboro and traveling to Nashville would be added as demand warrants their addition.



**Figure 10-10 Distinctive Vehicle for Commuter Express or Busway Services**

After operating a circulation route through their communities and making stops at park-and-ride sites located at existing commercial parking areas along their routes, the buses would enter I-24 and use the HOV lanes north to Harding Road before re-entering mixed traffic south of downtown Nashville. The buses would then exit and travel into downtown Nashville via Lafayette Street. In the mid-term, queue jump facilities would be added to the interchanges where the buses would enter the freeway to provide them with a speed and travel time advantage over other vehicles. However, no extension of the HOV lanes on I-24 is proposed as part of this LPA.

All of the express routes (other than the reverse commute route) would operate to downtown Nashville, operating through downtown Nashville north to the Music City Central transit center and dropping off passengers for transfer to MTA local bus routes and a circulator route. Then, the express route would continue as a through service to the Vanderbilt-West End area. Operating as a single through route to the West End would promote ridership that would likely be lost if passengers were forced to transfer to a local bus or circulator route. The reverse commute route would originate at the MTA's downtown transit center. The routes would stop at all local bus stops in the downtown area and in the West End.

The routes would use distinctive coaches to differentiate the proposed service from other bus service in the area and provide more comfortable padded seating, reading lights, footrests and other amenities appropriate for longer-distance trips. An example of this type of distinctive coach is shown in Figure 10-10. These coaches would have a seated capacity of 45 on a standard 40 foot sized vehicle to more than 50 for an articulated 60 foot vehicle. These services also would charge premium fares similar to those charged on the existing Relax-and-Ride service (full fare is currently \$2.50).

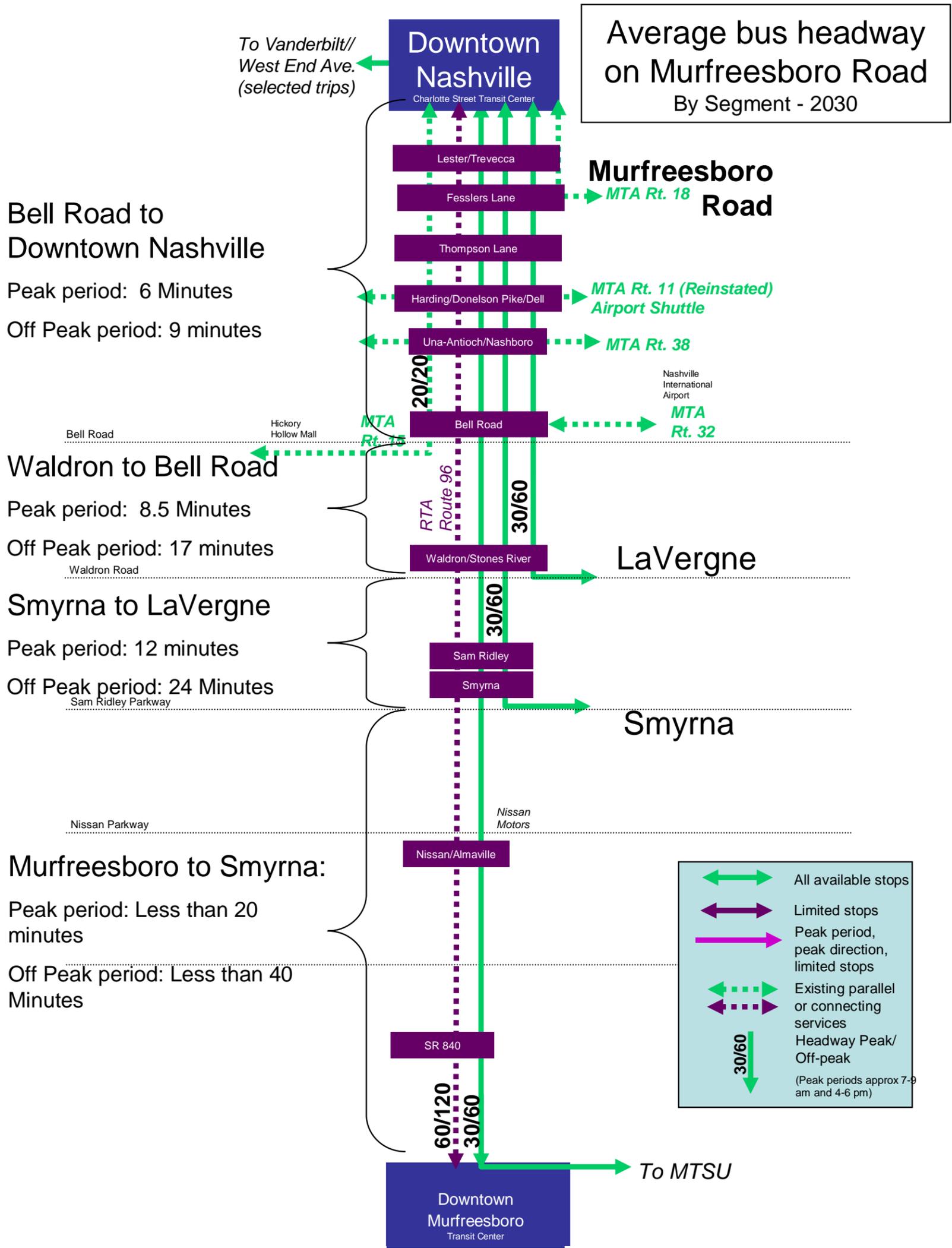
Service frequencies for the bus services that would operate under the full implementation of the LPA (at the end of the Long-Term phase) are shown in Figure 10-3 on page LPA-6. Most of the express routes would operate in the peak direction (northbound in the morning, southbound in the afternoon) and during the peak period (terminating downtown between approximately 7:00 and 9:00 a.m., leaving downtown between approximately 4:00 and 6:00 p.m.), with no mid-day, evening, night or weekend-holiday service. Most of the routes would operate at a 30 minute frequency during the periods in which they operate, thus operating 4-5 trips per day in each direction. The MTSU/Murfreesboro-to-Nashville via Sam Ridley express route is assumed to offer bi-directional off-peak service at a 60-minute headway during the off-peak period and 30 minutes during the peak in order to allow passengers who need to travel off-peak and in the evenings an express option between downtown Nashville, Smyrna and Murfreesboro. MTSU students and workers in industries that do not work a typical nine-to-five workday would likely require such a service. The route serving Nissan Motors would operate on Nissan's shift schedule. Two of the Murfreesboro express routes, the Memorial East and Memorial VA routes, would each operate on a 60 minute frequency during the peak periods, but cover some of the same alignment.

#### **Local and Skip Stop Bus Routes on Murfreesboro Road (US 41)**

Bus services in the corridor are now essentially local bus routes. MTA's Route 15 provides a relatively high frequency of bus service between Hickory Hollow Mall and downtown Nashville via Bell Road and Murfreesboro Road. MTA provides no service outside Nashville-Davidson County. The service operates on weekdays during peak, mid-day and evening periods in both directions and provides a basic level of service on weekends and holidays. RTA's Route 96 "Relax and Ride" service operates on Murfreesboro Road from Murfreesboro to Nashville, providing service and making stops at all locations along the length of the corridor. Currently, however, the route operates only during the peak travel periods (from approximately 6:00 to 9:00 a.m. and from 3:30 to 6:30 p.m) on weekdays. The proposed City of Murfreesboro transit service will serve only the portion of US 41 (Broad Street in Murfreesboro) that lies within the city.

The Southeast Corridor study's analysis of travel patterns in the corridor indicated that travel patterns in the corridor are complex, with many trips of varying length occurring between locations within the corridor and only a small percentage of commuter trips to downtown Nashville. In addition to the rapid growth in Rutherford County and the relative lack of existing service, this pattern suggested that there was a strong need for transit services that provided a basic level of bus transit service throughout the corridor, operating on its main north-south arterial roadway, Murfreesboro Road. The diagram in Figure 10-11 (which supplements the information in Figure 10-3) shows the headways of the local bus services proposed for implementation through the short-, medium-, and long-term periods and provides calculations of

Figure 10-11 Proposed Composite Local and Skip-Stop Bus Headways on Murfreesboro Road (US 41)



the combined (or composite) headways for the local service for each segment of Murfreesboro Road.

The goal for development of local service on Murfreesboro Road was to make service as frequent, fast and convenient as possible, so as to make it competitive with driving and to support the corridor as a focus for transit oriented development in the region.



**Figure 10-12 Examples of skip stop station improvements**

As Figure 10-11 shows, the existing Route 15 service operates at a headway of approximate 20 minutes all day, providing frequent basic service on Murfreesboro Road from Bell Road north to downtown Nashville. The planned City of Murfreesboro service will provide service at a 30 minute frequency on the portion of Murfreesboro Road (Broad Street) within Murfreesboro. While the short-term priority is to provide express service for commuters (which currently does not exist), expansion of the local service begins in the medium term with the addition of three new routes:

- A local bus route operating at a 30 minute headway between MTSU and Murfreesboro to Downtown Nashville and the Vanderbilt-West End area via Murfreesboro Road and the extension of the Smyrna Circulator bus route. Each trip on this and other community circulator routes would begin as a community circulator, serving local streets within each community. The route would then follow Sam Ridley Parkway to Murfreesboro Road, stopping at the intersection to allow transfers to other bus routes before continuing north on Murfreesboro Road to downtown Nashville and the Vanderbilt-West End area, operating as a local bus route along Murfreesboro Road.
- Operation of the LaVergne circulator route in the same manner as the Smyrna route, with through service to downtown Nashville and the Vanderbilt-West end area.

Operating the circulator routes as extensions of the local bus routes means that they can serve as feeder-distribution routes for express and skip stop service operating on Murfreesboro Road, and also provide local passengers within the neighborhoods with a “one-seat ride” between their homes and downtown Nashville. Transit riders, particularly suburban “choice” riders, strongly resist transferring between services. The routes would make all stops along Murfreesboro Road and throughout its alignments in downtown Nashville and in the West End area.

In addition, the RTA Route 96 “Relax-and-Ride” service would be recast at this point as a skip stop service from MTSU and downtown Murfreesboro to downtown Nashville and the West End area. This service, similar to an express service, would stop only 12 times between Murfreesboro and Nashville at the following locations:

- Downtown Murfreesboro
- SR 840
- Almadale Road/Nissan Boulevard
- Downtown Smyrna
- Sam Ridley Parkway
- Waldron/Stones River Boulevard
- Bell Road
- Una Antioch Nashboro Pike
- Harding Road/Donelson Pike (Dell)
- Thompson Lane
- Fesslers Lane
- Lester Road/Trevecca Nazarene University

The precise locations of these stops and the locations of downtown stops would be determined at future stages of development based on ridership property ownership, engineering constraints and other considerations. The route would terminate in downtown Nashville at the Music City Central Transit Center. Some trips would continue west to the Vanderbilt/West End area via Charlotte Street or West End Avenue. These services would use 40 foot suburban style vehicles with a capacity of 45, or articulated vehicles with a capacity of more than 50.

The limited stop pattern would allow the buses to operate at a faster speed and would provide improved travel times for longer-distance travelers in the corridor. Passengers could transfer from the limited stop station locations along the corridor to local bus service for access to areas between stops or to local communities served by community circulator services. The skip stop service would provide an express trip once an hour in each direction during peak periods and once every two hours during the off-peak and evening periods. All of the local services are assumed to operate from 5 a.m. to midnight five days a week, with a lower level of service on weekends and holidays. The skip stop locations would also be served by the local bus service and thus would have the highest frequency of bus service of any location along the corridor. The skip stop locations are often located within areas where busway improvements would be located, areas which are expected to become the focus of transit oriented development in the corridor.

Generally, the individual bus services would operate at a headway of 30 minutes during the peak period and at 60 minutes during the off-peak. The services would combine with existing bus routes serving the corridor, and the service frequency would “accumulate” as it proceeds northward into the more densely populated areas of the corridor to provide increasingly frequent services to areas approaching Nashville. As the diagram in Figure 10-11 shows, the combined headways of service between downtown Murfreesboro and Smyrna would be about 20 minutes (the level would be lower on Broad Street within Murfreesboro, where the City of Murfreesboro would also provide service at a headway of 30 minutes). Between Smyrna and LaVergne the headway would fall to 12 minutes during the rush hour periods and 24 minutes off-peak, with the introduction of the Smyrna circulator bus. North of Waldron Road, with the introduction of the LaVergne circulator route, the headways would fall to 8.5 minutes during the peak period and 17 minutes during the off-peak. With the addition of the MTA Route 15, peak period service on Murfreesboro Road would fall to 6 minutes during the peak and 9 minutes during the off-peak periods. At this frequency in the area from Bell Road north, service would come so frequently that service schedules would be unnecessary during peak periods; a bus would arrive within a few moments of the arrival of a bus passenger at the stops. Such service levels have been found to promote high transit use in other cities.

The local and skip stop services would benefit from intersection improvements and would be the primary users of the short sections of busway at congested locations, both improvements proposed in the long-term. These improvements would provide travel speed advantages over driving, reducing travel time between Murfreesboro and Nashville by up to 10 minutes, an advantage that would provide a significant benefit to travelers, resulting in higher ridership.

### **Community Circulator Services**

The community circulator services are generally not so much separate bus services as they are the southern end of the various local and express bus services, which comprise the bulk of the new services proposed in the LPA. The express and local bus routes originating in LaVergne and Smyrna and on Bell Road would operate as circulators within their local area, connecting residential and employment areas east and west of Murfreesboro Road to each other and to destinations along Murfreesboro Road. As noted above, these routes would then continue north, either as express buses operating on I-24 or as local buses operating on Murfreesboro Road. In both cases, this would provide through service to downtown Nashville and the Vanderbilt-West End area. In Smyrna and LaVergne, these services would constitute the only proposed local bus service in these communities and would provide the basic level of service for all transit users, including the transit dependent populations who live and work in those communities.

Approximate alignments for these services were identified for the purposes of transportation modeling and are shown in the figures describing the alignments. However, more detailed analysis of the communities and their needs would be required before implementation. The express services would be implemented in LaVergne, Smyrna and along Bell Road during the short-term period, while the local services would be in place during the mid-term. By combining these two services, the communities would enjoy 15 minute service frequencies on their circulator services during the peak period (combining the 30 minute frequencies for the express and local services) and 60 minutes headways off-peak. The circulator services presumably would be operated with standard local and suburban style transit buses up to 40 feet in length. Articulated vehicles could not be used for the circulator services due to constraints on operating these large vehicles on local streets.

Existing MTA transit routes provide circulator services in the Nashville area, including the distribution of passengers transferring in the downtown area from routes originating in the corridor. A circulator route that currently connects the Nashville Star commuter rail service to downtown Nashville and the West End area is assumed to continue operation and would supplement the distribution of passengers in the downtown area. All routes connecting to downtown Nashville would operate through downtown and some trips on each route would connect to the West End via Charlotte Street.

### **Reverse Commute Services**

The fourth market targeted by the proposed LPA is reverse commuters, commuters from Nashville-Davidson County who travel primarily in the southbound direction in the corridor for employment or educational opportunities. This includes employees and potential employees in the Nashville region who desire transit connections to Dell, Nissan, and other major employers in the corridor, as well as students and potential students of MTSU, Trevecca Nazarene University, and other educational centers in the corridor. The proposed LPA includes a number of local, skip stop and express service opportunities to support reverse commute trips in the corridor. These include:

- The local services proposed for Murfreesboro Road, all of which are bi-directional services that operate a balanced schedule in the peak (northbound) and reverse peak (southbound) directions. These services would provide a minimum of 30 minute frequency service (in most cases, much more frequent service) between all areas of the corridor along Murfreesboro Road.
- Skip stop service operates a balanced schedule in both the northbound and southbound directions along Murfreesboro Road between Nashville and Murfreesboro-MTSU, stopping at 12 key locations at a headway of one hour during peak periods and two hours during off-peak periods.
- Express Service operating a balanced schedule in both the northbound and southbound directions between downtown Nashville, Smyrna, and Murfreesboro MTSU, during traditional peak travel periods only.
- A reverse-directional service connecting Nissan Motors in Smyrna, downtown Murfreesboro and MTSU, operating at the schedule of shift changes at Nissan Motors.

This package of services would provide reverse commuters with a high volume of services and a semblance of the convenient mix of services that exists for commuters. The result is greatly increased opportunities for Nashville residents to take advantage of the employment and educational opportunities of the southeast corridor.

### **10.4 Ridership Estimates for Proposed LPA**

Ridership estimates were prepared for the ultimate build-out of the proposed services and not for the increments of service developed in the short- and mid-term periods.

The methodology employed for preparing the ridership forecasts for the LPA used the same underlying assumptions as those employed for Alternatives A, B, and C and for the No-Build and original TSM/Enhanced Bus alternatives. The Nashville area MPO's regional model was used to estimate ridership. This model was adjusted to account for the performance of new types of service, including Commuter Rail and busway-BRT services, and for changes in the environment (principally recent changes in the cost of fuel). A second estimate of ridership was prepared for the LPA to simulate the probable effect of changes in land use on transit ridership. Specifically, these adjustments simulated the effect of the projected growth in the corridor between the years 2000 and 2030 being concentrated within ½ mile of the skip stop station locations identified in Figure 10-1, which presumably would make transit more attractive and increase ridership.

The estimates of ridership results for the three earlier "build" alternatives and for the LPA with and without the concentrated land use assumption are shown in Table 10-1. Estimates of 2030 transit boardings for the corridor are shown in Table 10-2. Both of these tables are illustrated in charts in Figures 13 and 14 respectively. These tables show the estimated increase in ridership

between the no-build system (consisting of the existing MTA and RTA bus and rail systems, with minor modifications) and the various build alternatives. The estimates are prepared on a system-wide basis to include all of the existing and proposed services in the Nashville region in order to ensure that all of the new ridership generated by the new service (including travelers from outside the corridor who transfer to services in the corridor) are counted and also ensure that the corridor service does not take credit for riders already using the existing system (such as those using the current MTA Route 15 or RTA Route 96). As the table shows, the combination of express service on I-24 and frequent local and skip stop service on Murfreesboro Road generates more ridership than busway service on either facility (or, indeed, on both facilities combined).

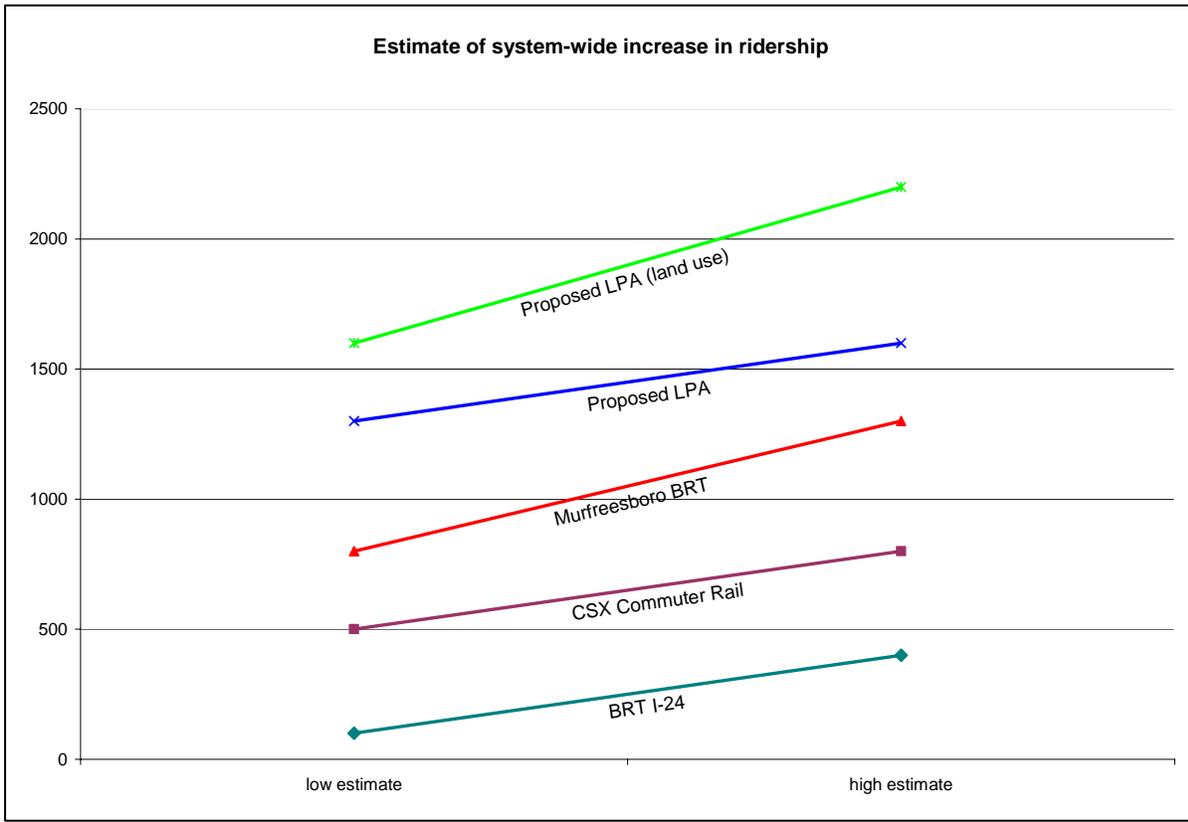
**Table 10-1 Increase in System Wide Ridership Generated by Alternatives A, B and C, Proposed LPA, and Proposed LPA with Concentrated Land Use**

Alternative	Estimated Increase in System-Wide Transit Ridership (Riders per Day)
A. BRT I-24	100-400
B. Commuter Rail CSX	500-800
C. BRT M'Boro Road	800-1,300
Proposed LPA (Enhanced Bus I-24 and Murfreesboro Road)	1,300-1,600
Proposed LPA With Improved Land Use	1,600-2,200

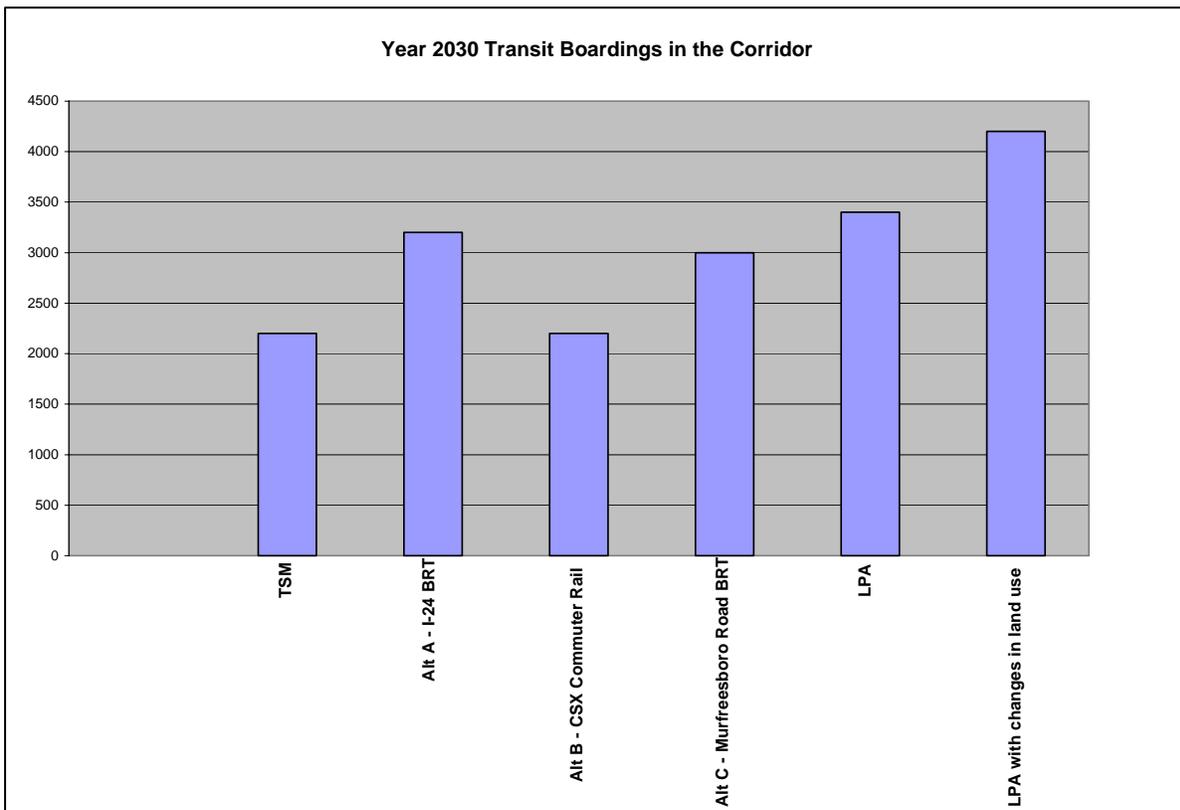
**Table 10-2 Year 2030 Transit Boardings in the Corridor**

Year 2030 Transit Boardings in the Corridor			
Alternative	Total Boardings	Change from NB	Change from TSM
No-Build	3,100		-1,900
TSM	5,200	2,200	
Alt A (BRT on I-24)	6,300	3,200	1,100
Alt B CSX Commuter Rail	5,200	2,200	0
Alt C Murfreesboro/Old Nashville BRT	6,100	3,000	900
Enhanced Bus	6,500	3,400	1,300
Enhanced Bus with Modified Land Use	7,300	4,200	2,100
Corridor Routes include:			
15, 32, 96(relax & ride), All corridor Guideway routes, all			
Total boardings based on upper limit of range in Table 4.1			

**Figure 10-13 Estimate of System-Wide increase in ridership**



**Figure 10-14 Year 2030 Transit Boardings in the corridor**



**Table 10-3 Comparison of change in Vehicle Miles Traveled (VMT) and Vehicles Hours Traveled (VHT) for Detailed Alternatives and Locally Preferred Alternatives**

Alternative	VMT	VHT	VMT Change (from No-Build)	VMT % Change (from No-Build)	VHT Change (from No-Build)	VHT % change (from No-Build)
No-Build	30,160,420	1,052,491	0	0.00%	0	0.00%
TSM	30,149,191	1,052,128	-11,229	-0.04%	-363	-0.03%
1. I-24 BRT	30,144,716	1,052,050	-15,704	-0.05%	-441	-0.04%
2. CSX Commuter Rail	30,145,286	1,052,044	-15,134	-0.05%	-447	-0.04%
3. M'Boro/Old Nashville BRT	30,139,361	1,051,874	-21,059	-0.07%	-617	-0.06%
LPA	30,142,546	1,051,944	-17874.00	-0.06%	-547	-0.05%
LPA with Land Use Changes	30,138,541	1,051,796	-21879.00	-0.07%	-695	-0.07%

Identifying ridership on individual services within a transit network is difficult under a bus-based system. However, approximate estimates of ridership generated by specific areas were estimated as follows (these numbers exceed the number of new riders, as some of these riders are currently using existing MTA or RTA services):

- Smyrna Area: 440 daily riders (480 under Improved Land Use)
- LaVergne Area: 350 daily riders (390 under Improved Land Use)
- Murfreesboro Area: 1,140 daily riders (1,250 under Improved Land Use)
- Bell Road Express: 130 daily riders (130 under Improved Land Use)
- Existing Route 96: 150 daily riders (180 under Improved Land Use)
- Nissan Express : 170 daily riders (190 under Improved Land Use)

The estimates of ridership show that the proposed investment in transit service and infrastructure in the corridor will provide transportation benefits to thousands of people and will increase the transit market in the corridor dramatically. However, the ridership estimates remain relatively low, causing the Steering Committee to recommend an incremental enhanced bus alternative instead of a rail or busway-based system. The estimates remain as accurate as possible given the existing local transit model and the relatively little experience in the community with express bus and rail transit services. The Steering Committee anticipates revisiting these results as further refinements are made to the region's travel demand model and as new data inputs from rail and express bus transit services in other corridors provide a clearer picture of the propensity for area residents to use premium transit services when they are made available.

### **10.5 Cost Estimates for Proposed LPA**

Estimates of costs were prepared for capital cost items (including transit infrastructure such as stations and busways, additional buses and other improvements) and for the operating costs of the additional transit service that make up the LPA. These cost estimates were prepared using standard cost estimating methodologies typically used for FTA New Starts Alternatives Analysis projects. A summary of the operating and capital cost estimates for the full build-out of the LPA and for each of the phases (short-term, mid-term and long-term) is listed in Table 10-3.

**Table 10-4 Operating and Capital Costs for Proposed LPA, by Development Phase (in millions of 2005\$)**

Cost Summary	Capital					Annual Operating
	Stations	Busway/ Streetscape Miles	Infrastructure Costs	Vehicle Costs	Total Capital	Incremental Cost (over No Build) (\$million)
1-5 Years	4	0	4.7	23.0	27.7	3.9
5-10 Years	12	0	22.5	17.5	40.0	11.1
10-25 Years	4	13.2	65.8	12.5	78.3	13.0
Total	20	13.2	93.0	53.0	146.0	

### 10.5.1 Operating Cost

The operating cost estimates were based on a fully-burdened resource build-up cost model as recommended by FTA. The estimates disaggregated costs as reported in the FTA's National Transit Database (NTD) for transit operations in the Nashville area. Costs were averaged for the three most recent years (2003-2005) for which NTD data is available, with each of the past years inflated to a common (2005) level. The costs account in part for the increase in fuel costs that occurred in 2004 and 2005. The modeling technique assigns the costs of operating fixed route bus service into four categories:

- Costs that vary according to the miles of service operated,
- Costs that vary according to the hours of service operated,
- Costs that vary according to the number of vehicles operated, and
- Administrative costs

Costs assigned to the miles, hours or number of vehicles operated are divided by the number of hours, miles and vehicles operated to develop a cost factor for each of these categories. Costs associated with administration are divided by the total operating cost for fixed route bus service to identify an administrative markup percentage.

The cost drivers that generate the cost estimates are taken from the travel demand forecasts, which provide for each alternative an estimate of the number of miles, hours of service and the number of buses that would be required to operate each route. FTA requires that cost estimates be developed on a system-wide basis to ensure that all of the costs associated with an alternative are captured. For each alternative tested, including the LPA, the total number of hours, miles and vehicles were estimated and subtracted from the number of hours, miles and vehicles required under the no-build system (a system similar to the existing operation). The remaining number of hours, miles and vehicles under each alternative was then multiplied by their respective cost factors and added together. This number was then multiplied by the administrative cost percentage factor to determine the administrative costs associated with the alternatives. The costs generated by the service cost drivers (the hours, miles and number of vehicles) were then added to the administrative costs to establish the total costs. The process was repeated for each phase of development to isolate costs associated with the improvements recommended for implementation in that phase.

As Table 10-4 shows, operating costs of the services (primarily express routes) initiated in the first five years would be about \$4 million per year. With the addition of significant local bus service in the mid-term period, the cost increases to \$11 million per year. With slight increases in service, primarily the implementation of a few new express routes, the costs in the long term increase to about \$13 million per year. These costs do not include the operation of existing or programmed bus services, including MTA, RTA and the proposed Murfreesboro City services,

which would be in operation whether or not the recommendations of this study were implemented.

### **10.5.2 Capital Costs**

Capital costs include the cost of all real property, vehicles and structures, including buses, transit stations, streetscape materials, the construction of busways and queue jumps, roadway widening, signal systems and other items that support the proposed LPA. These costs were developed on a unit cost basis using a standard capital costing model, with unit costs updated to 2005 levels using inputs from TDOT's records of recent projects. These costs take into account the recent increases in fuel, steel, and concrete costs that occurred in 2004 and 2005. Table 10-5 shows the cost estimating worksheet for the infrastructure elements of the full build-out of the LPA, while Table 10-2 shows the estimates for each interim stage. The estimates take into account costs of purchasing land and building stations. The MTA's Music City Central station is not included in the cost estimates as its development is not driven by this project, and thus, it is part of the "no-build" system.

The estimated number of buses generated by the model, which were used in the operating cost estimates, is subtracted from the no-build to generate the incremental number of buses needed. This number is multiplied by a cost factor of \$500,000 per vehicle to derive the total cost for vehicles in each development phase.

As Table 10-4 shows, the estimated total capital cost of the proposed LPA is \$146 million. Of this, about \$93 million would cover the infrastructure, including the busway sections, skip stop transit stations, and intersection and queue jump improvements, and about \$53 million would be required for additional buses. More than 100 additional buses would be required to operate the proposed services in the full implementation of the LPA (including spare vehicles, which comprise 15% of the vehicle fleet). The bulk of these vehicles (about 46) would be required in the short term to provide the new express services proposed in the short term, while each following increment of service would require additional vehicles in smaller numbers. This estimate assumes only the cost of the initial purchase of buses for each new route and does not include the replacement of buses, which must be replaced at 12 year intervals. As the estimates indicate, relatively little capital costs occur in the short-and mid-terms, with the majority of capital costs (about half) occurring in the long-term period. This pattern of investment will ensure that major high cost investments will not go forward until the new services have had the opportunity to increase ridership in the corridor.

## **10.6 Conclusion**

The Southeast Corridor study Steering Committee identified and evaluated a range of transit options to provide service to this fast growing corridor. The analysis of these transit options found that, barring unforeseen changes in conditions, the most feasible strategy is a phased approach in which new transit services would be incrementally added. Supporting infrastructure would be added later and more slowly as ridership grows and the corridor and the region's capacity to financially support the improvements increases, as land use in the corridor gradually focuses on the transit corridors and on transit oriented development patterns, and as ridership on the existing Music City Star rail system and other RTA corridor transit services continues to grow and is reflected in regional modeling estimates. The incremental approach is beneficial in two distinct ways: it immediately provides services to meet the pressing transportation needs of the corridor and it gives service providers, government officials, and the public time to resolve some of the issues in the corridor regarding land use, ridership, and funding while building transit ridership in the corridor to support the future development of expanded service.

**Table 10-5 Infrastructure Cost Worksheet for Proposed LPA (2005\$)**

<b>PREFERRED ALTERNATIVE: Partial Busway and Stations on Murfreesboro Road</b>				
<b>Description</b>	<b>Miles</b>	<b>Const Type</b>	<b>BRT Cost PerMile</b>	<b>BRT Cost Per Segment</b>
<b>Streetscape-Stop Improvements, downtown areas (Lump Sum)</b>				
<i>Nashville Downtown Area</i>	2.70	Lump	\$ 500,000	\$ 1,350,000
<i>Murfreesboro Downtown Area</i>	3.00	Lump	\$ 250,000	\$ 750,000
<b>Stations</b>				
<i>MTA Transfer Center Station (Downtown Station Stop)</i>		STA. 1	\$ 150,000	\$ 150,000
<i>Church St. Station (Downtown Station Stop)</i>		STA. 1	\$ 150,000	\$ 150,000
<i>Broadway Station (Downtown Station Stop)</i>		STA. 1	\$ 150,000	\$ 150,000
<i>Gateway Blvd. Station (Downtown Station Stop)</i>		STA. 1	\$ 150,000	\$ 150,000
<i>Lafayette Street (Downtown Station Stop)</i>		STA. 1	\$ 150,000	\$ 150,000
<i>Trevecca College (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>Fesslers Lane (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>Thompson Lane (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>Donelson Pike/Dell (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>Una Antioch Pike (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>Bell Road (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>Waldron Road (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>Sam Ridley Parkway (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>Downtown Smyrna (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>Nissan Boulevard (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>SR 840 (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>Thompson Road (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<i>Downtown Murfreesboro (Downtown Station Stop)</i>		STA. 1	\$ 150,000	\$ 150,000
<i>Broad/Tennessee (Downtown Station Stop)</i>		STA. 1	\$ 150,000	\$ 150,000
<i>MTSU (Limited Stop Route Station)</i>		STA. 2	\$ 200,000	\$ 200,000
<b>Subtotal</b>				<b>\$ 3,650,000</b>
<b>Mainline Construction (Single Lane Reversible Busway, Murfreesboro Road)</b>				
<i>North of Thompson Lane to Briley Parkway</i>	0.90	NC-5	\$ 6,223,109	\$ 5,600,798
<i>Reedwood (south of Harding/Donelson) to Rural Hill</i>	2.90	NC-4	\$ 6,223,109	\$ 18,047,016
<i>Queue Jump, Enon Springs, McNickle Drive</i>	0.70	NC-5	\$ 6,223,109	\$ 4,356,176
<i>Thompson Lane to Church Street (Murfreesboro)</i>	3.00	NC-7	\$ 6,223,109	\$ 18,669,327
<b>Mainline Construction (Queue Jump Facilities at I-24 Interchanges)</b>				
<i>Bell Road</i>	0.25	NC-4	\$ 6,223,109	\$ 1,555,777
<i>Waldron Road</i>	0.25	NC-4	\$ 6,223,109	\$ 1,555,777
<i>Sam Ridley Parkway</i>	0.25	NC-4	\$ 6,223,109	\$ 1,555,777
<i>Nissan Boulevard (Limited Stop Route Station)</i>	0.25	NC-4	\$ 6,223,109	\$ 1,555,777
<i>SR 96</i>	0.25	NC-4	\$ 6,223,109	\$ 1,555,777
<b>Subtotal</b>				<b>\$ 54,452,204</b>
<b>OTHER CONSRUCTION ITEMS</b>				
<i>Facility</i>				\$ -
<i>Traffic Engineering Improvements</i>				\$ 10,500,000
<b>RIGHT-OF-WAY</b>				
<i>Station Land</i>			\$ 125,000	\$ 5,000,000
<i>Mainline ROW</i>			\$ 2,000,000	\$ 17,340,000
<b>TOTALS FOR ALTERNATIVE</b>	<b>14.45</b>		<b>---</b>	<b>\$ 93,042,204</b>