01 Introduction

1.0 Introduction

This basis for evaluation allows the benefits and impacts of each alternative to be measured with an objective set of criteria that relate to the specific needs for this project. As the evaluation progresses with respect to these criteria, the most suitable options will emerge for more detailed analysis, traditionally leading to the adoption of the Locally Preferred Alternative (LPA) by local transportation decision makers. While the methodology offers an objective procedure for comparing potential transit solutions in this specific corridor, it also takes into consideration FTA's criteria for evaluating transit projects competing for New Starts funding to facilitate fully informed decision making.

Typically the evaluation methodology for an AA is a multi-step process, wherein increasingly detailed and comprehensive criteria and measures of effectiveness (MOEs) are applied to a decreasing number of alternatives. Each step in the evaluation process is thus designed to focus the analysis on progressively fewer alternatives with higher levels of scrutiny.

As the AA phase progresses more quantitative and less qualitative measures are implemented. Although each of the alternatives will be evaluated using the same criteria, all are not equally significant. Traditionally, the temptation has been to translate the qualitative and quantitative data into a ratio scale that can be arithmetically calculated and thus provide one number which can be used to compare the alternatives. However, this approach is not recommended because one must progressively weight the more significant criteria, which tends to become more subjective and less defensible.

Instead it is recommended to present the quantitative measures in numerical form and summarize the qualitative measures by comparison to one another. By translating the

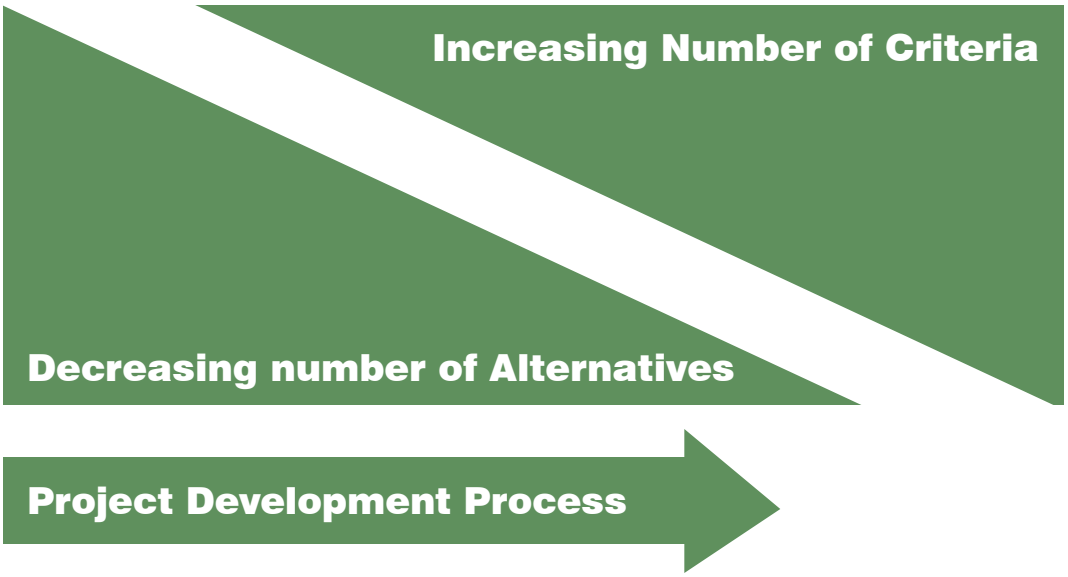


Figure 1 Alternatives Analysis Process

qualitative outcomes into an ordinal scale rating (i.e., Favorable, Neutral, Unfavorable), it allows for less precise judgments, and in this case recognizes positive and negative impacts. For ease of reference, key weaknesses which justify the elimination of alternatives are highlighted. The rational being that the alternatives advance unless there are compelling reasons to eliminate them.

Ultimately, the purpose of this memo is to describe the two-step process used to evaluate the transportation alternatives for the Northeast Corridor Mobility Study along with narratives describing the detailed findings of the measures applied in each step, with a discussion of key differentiators. This methodology is intended to achieve a balance between the economic, land use and transportation analysis in terms of project budgeting. This mobility study does not strictly follow all of the FTA guidelines for alternatives analysis. The two step process primarily consists of:

1. Preliminary screening of the alternatives
2. Detailed evaluation of alternatives (the next step)

Although the Northeast Corridor Mobility Study is not specifically oriented toward the identification of a Locally Preferred Alternative and/or a New Starts project, the planning process is intended to follow FTA guidelines to the extent feasible within the project's scope so as not to preclude the eventuality of a New Starts Project. With this in mind, we do recommend notifying the FTA of the project and providing them with periodical updates in order to avoid delays should the MPO decide to apply for New Starts funding in the future. Details of the proposed screening methods and associated criteria are provided below.

02 Purpose and Need

2.0 Introduction

The purpose of this section is to communicate the context of the study area by providing background information as it pertains to the history of the project and characteristics of existing infrastructure and demographics. This section also attempts to articulate the problems in the corridor, all of which influence the goals and objectives described in Section 2.3.

This study is predicated by the MPO's 2030 Long Range Transportation Plan, intended to help alleviate traffic congestion, provide more transportation choices, improve transportation system operations, and meet the region's air quality goals.

2.1 Project History

Nashville is a crossroads of three major interstate systems in the southeast: Interstate 65, Interstate 40, and Interstate 24. These interstates are used not only by travelers within the MPO, but also in large part by the nation's trucking industry. Historically, the five-county region which comprises Nashville's MPO has relied on widening roadways and transportation demand management strategies to alleviate congestion and reduce travel times for commuters. Within the past 15 years, however, population growth rates within the MPO have produced travel demands that strain the existing highway system and pose environmental concerns such as air quality.

Nashville's long range transportation plan serves as a guide for both land use planning and the transportation system in Nashville. The plan ensures that land use planning integrates all modes of transportation including driving, walking, bicycling, transit, and freight. The plan also seeks to ensure that each individual is provided with a means of movement from one place to another.

To reach these goals, the MPO has increased application of existing transit services, including shared ride systems, Metropolitan Transit Authority (MTA) bus routes, and paratransit services. The Tennessee Department of Transportation (TDOT) has established an Intelligent Transportation System for the Nashville area, which is used to quickly identify incidents and provide advance warning to motorists upstream. In 2006, the Music City Star was opened, providing commuter rail service from the City of Lebanon in Wilson County to downtown Nashville. Even with these increased services, increased travel demand has spurred the MPO to investigate alternative means of providing additional capacity.

According to the MPO, a Regional Commuter Evaluation Report was completed in 1996. This report identified the Southeast and Northeast corridors as areas that might favorably support high-speed transit. As a result, a study was completed in August 2007 which evaluated potential high-performance transit systems along the Southeast Corridor, from Nashville to Murfreesboro. The Southeast Corridor Study recommended a series of expansions to bus services along the corridor, including new express bus services, local circulators within communities along the corridor, and queue jump facilities at major interchanges on Interstate 24. The study also recommended that in the long term, infrastructure and land use plans be structured to accommodate future high capacity transit. Consistent with the recommendations of the Southeast Corridor Study, the MPO, in cooperation with the Regional Transit Authority (RTA) and the MTA, are now performing a similar study for the Northeast Corridor. The following demographics highlight the need for transportation improvements as well as land use planning, economic development and urban design in the corridor.

2.2 Project Demographics

Davidson and Sumner Counties display demographic trends that are common for metropolitan areas in the southeast. The population as a whole is aging and becoming more racially and ethnically diverse. Nashville's strong population growth between 2000 and 2007 can be attributed to a number of factors, including significant new job growth, relatively inexpensive housing, and an array of cultural attractions. Although central counties such as Davidson are continuing to see moderate population and housing growth, suburban counties such as Sumner are seeing a faster growth rate. Davidson's population includes more college graduates, while Sumner's population has a higher median income, perhaps reflecting lower rates of poverty in the county. Davidson County's housing is more diverse with a higher proportion of renters, while Sumner's housing is predominantly owner-occupied. These key findings, summarized below, characterize the demographic setting of the Northeast Corridor study area.

- The Nashville Metro Area and Sumner County have and will continue to see robust growth in population, households and incomes, while Davidson County will see more moderate growth;
- The Nashville Metro Area will see a significant increase in the numbers of persons holding bachelors or advanced degrees;
- Davidson County is growing much more slowly than outlying jurisdictions in the MSA such as Sumner County or Williamson County. In fact, over the past seven years, Davidson County's population increased by only 9,600 residents—an increase of less than two percent;
- By comparison, Sumner County has exhibited rapid population growth over the past 10 to 15 years. This reflects a growth rate of almost 16 percent;
- MPO forecasts suggest Davidson's current (2007) population estimate of 614,650 will increase by roughly 98,400, to 713,000 residents by 2030—a 16 percent increase;
- MPO forecasts for Sumner County suggest a population increase of 57,700 over the next 23 years, to 208,000 by 2030—a 38 percent increase;
- Sumner County's rapid population and household expansion spurred robust new residential development over the past seven years, with more than 9,400 new housing units added to the County's inventory between 2000 and 2007. Notably, the majority of these units (72 percent) are owner-occupied;
- By comparison, Davidson County's housing tenure is more diverse, reflecting its more urban development patterns, higher residential densities, population mix, and economic characteristics. Owner occupancies represent about 52 percent of units in Davidson County;
- Based on forecasts prepared by Scan US, all major racial and ethnic groups are projected to increase in size between 2007 and 2012 across all geographies examined. The greatest rate of growth is projected for Hispanics (by 30 percent) and Asians (by 27 percent);
- Davidson County has the greatest share of highly educated residents of any geography examined. In 2007, fully 35 percent of the working-age population of Davidson County possessed a college or graduate degree;
- The age cohort exhibiting the highest rate of growth between 2000 and 2007 occurred in those ages 65 years and above; and
- Sumner County currently has the highest median household income—$55,400. By comparison, median household income in Davidson is $48,500, which is below the median for the metropolitan area as a whole.

2.3 Goals and Objectives

Strong population and employment growth in the Northeast Corridor results in increased demand on the region's roadway networks. As industries thrive and grow, the availability of jobs and housing stock increase in addition to improved transportation accessibility if available. The intent of the purpose and need statement is to present the study area's existing conditions and underlying issues. In addition to examining existing transportation conditions, assessing existing demographic characteristics and current real estate market conditions within the study area are important in determining where the demand is located and where the most logical transportation investments can be placed. Understanding existing land use and economic conditions plays a key role in the Northeast Corridor study by presenting the various opportunities available within the study area that will promote or enhance potential transportation options for those who live and work in the study area.

Based on the needs established in Section 2.0, the following goals and supporting objectives for this project are outlined below. The goals and objectives also serve as the guiding principles in the development of the alternatives and help establish the evaluation criteria used to determine the most appropriate transportation and land use options.

2.3.1 Goal #1

Improve access and mobility within the study area through identifying mobility solutions and providing alternative transportation options along the corridor.

Related Objectives

- Reduce congestion on roadway network
- Provide alternative modes of transportation
- Reduce travel times along corridor(s)

2.3.2 Goal #2

Ensure adequate service is offered to accommodate zero-car households and other transit-dependent populations.

Related Objectives

- Provide transportation options to the transit-dependent, low income, and minority populations

2.3.3 Goal #3

Promote environmental sustainability through appropriate development patterns while integrating transportation and land use to reduce auto and truck trips. Additionally, attempt to reduce pollutant emissions to minimize impact on attainment status.

Related Objectives

- Improve or minimize adverse impacts on air quality
- Reduce or minimize adverse impacts on environmental and cultural resources
- Provide compatible land use and transportation options
- Provide transportation solutions and amenities which are compatible with envisioned land use character districts (i.e., complete streets as appropriate)

2.3.4 Goal #4

Steward transportation funds to incorporate market and economic analysis for a realistic plan, determine development potential, and recommend incentives for desired development patterns.

Related Objectives

- Invest in financially feasible transportation solutions
- Stimulate/enhance economic development opportunities along corridor
- Target travel markets and communities along corridor with the greatest needs

2.3.5 Goal #5

Improve safety and security in the corridor while considering the transit/pedestrian/auto interface.

Related Objectives

- Implement projects aimed at reducing traffic accidents
- Incorporate streetscapes and amenities designed to provide a safe environment for pedestrians and bicyclists as appropriate with the character districts

03 Preliminary Technology Screening

3.0 Definition of Candidate Technologies

The purpose of this section is to describe the alternative modal technologies under consideration for the Northeast Corridor Mobility Study. This section provides an overview of technologies and their guideways, and examples of where each technology currently operates, as well as typical performance characteristics of each transit technology. This is followed by photographs of the technology and/or its guideway, and a table of information related to system performance characteristics, including advantages and disadvantages.

The alternative technologies are evaluated qualitatively using criteria such as system characteristics (e.g., station spacing and speed), infrastructure compatibility, study purpose and goals, as well as costs. Appendix A shows example projects with capital costs adjusted to year 2009 dollars. Capital costs for each technology are based on FTA New Starts documents, planning studies and existing costs for example projects. The intent of the evaluation is to define a narrowed set of technology options. These are used in defining the initial range of alternatives (combinations of specific modes and alignments).

Eleven categories representing the range of technologies that operate in urban settings were identified as potential options in the study corridor. The public transportation technologies analyzed include:

- Bus
- Bus Rapid Transit (BRT)
- Light Rail Transit (LRT)
- Heavy Rail Transit (HRT)
- Commuter Rail
- Monorail
- Automated Guideway Transit (AGT)
- Personal Rapid Transit (PRT)
- Magnetic Levitation (Maglev)
- High Speed Rail
- Water Taxi/Bus

3.1.1 Bus

Buses are rubber-tired vehicles that operate on roadways in mixed traffic or in specially designated bus lanes or high-occupancy vehicle (HOV) lanes. Buses represent the most common and most flexible type of public transportation. Bus systems of some form exist in virtually every urban and suburban area of the country. Buses can operate on fixed routes according to published schedules, or may be dispatched individually to pick up passengers on a demand-responsive basis. Local bus route stops are typically as frequent as every one to two blocks, or every one-eighth mile. Express or limited service is characterized by fewer stops and higher average speeds.

In the past, the majority of buses in operation were diesel powered. However, vehicles powered by alternative fuels, such as clean diesel, biodiesel, and natural gas, are becoming more widespread as a means of reducing emissions. After participating in a successful pilot project to test a biodiesel blend in 18 of its buses, the Nashville MTA is seeking funding to convert all its buses to the biodiesel blend. Battery-powered electric buses have been implemented in several cities, primarily as short-haul, special use vehicles in activity centers because of their short operating range. New hybrid-electric buses have been tested and are being put into service. Fuel cell buses are in the evaluation and testing stage by manufacturers and transit agencies.

Although buses typically operate in mixed traffic, in several cities they operate in HOV lanes or in exclusive busways, providing faster service by by-passing roadway congestion. Other means to give priority treatment to buses include Intelligent Transportation System (ITS) components, such as bus signal priority or pre-emption (refer also to the next section, Bus Rapid Transit).

Bus transit encompasses a wide variety of vehicle types, ranging from converted vans to double-deck and articulated transit buses. Other technological innovations include low-floor buses, automatic vehicle location systems, automated demand responsive dispatching, transit operations software, electronic ticketing and automated fare payment.

Examples of bus service are present in most cities in the United States. In the corridor study area, the Nashville MTA provides bus service in Nashville-Davidson County, and operates regional bus service through contract with the RTA.

40′ Bus - Nashville

Articulated Bus – Minneapolis, Minnesota

Bus Characteristics	Descriptions
Person/Vehicle Capacity	40 to 60 seats; 50 to 80 passengers per vehicle
Vehicles per set	One
Guideway	Mixed traffic (or separate right-of-way - see BRT)
Speed (Maximum)	65 mph
Speed (Average)	Local: 10-20 mph; Express: 20-40 mph
Power Supply	Diesel or alternative fuels (CNG, biodiesel, hybrid)
Suspension	Rubber tire on pavement
Station/Stop Spacing	Local: One to two blocks; Express: 1+ mile
Capital Cost	$330,000 – $660,000 per vehicle + supporting facilities
Current revenue operations	Widespread
Advantages	· Can operate in mixed traffic or on its own guideway
	· Adaptable to a variety of fuels
	· Lower capital cost
	· Unequaled routing flexibility
Disadvantages	· Higher operating cost per passenger in very high-volume corridors
	· Travel times and reliability compromised in mixed traffic
	· Higher emissions with diesel engines

3.1.2 Bus Rapid Transit (BRT)

There is a broad range of perspectives as to what constitutes Bus Rapid Transit (BRT). BRT is difficult to define because it encompasses a wide variety of elements and applications. BRT emulates rail systems in many ways, but offers the flexibility of bus service. BRT encompasses a number of key elements, each with a range of options from which planners can select the most appropriate combination in designing a specific system for an area. The recent FTA publication, Characteristics of Bus Rapid Transit for Decision-Making (August 2004) explains six major element options and typical applications. The major elements and some of their typical options include:

- Running Ways: Options range from general traffic lanes to fully grade-separated BRT transitways. Bus priority running ways include queue-jump lanes, bus lanes, bus streets, and busways. Queue-jump lanes are installed at major intersections to allow buses to bypass traffic. A bus lane reserves a lane on an arterial or city street for the exclusive or near-exclusive use of buses. Bus streets or transit malls can be created in an urban center by dedicating all lanes of a city street to the exclusive use of buses. Busways physically separate buses from other vehicles.
- Stations: Options range from simple stops with basic shelters to complex intermodal terminals with many amenities. Station amenities provide for passenger safety, comfort, and convenience, including pedestrian-oriented improvements such as streetscaping.
- Vehicles: BRT systems can use a wide range of vehicles, from standard buses to specialized vehicles. Specialized vehicles can enhance the system's attractiveness by having a unique image and/or improving passenger comfort on the buses.
- Fare Collection: Options range from traditional pay-on-board methods to pre-payment with electronic fare media (e.g., smart cards).
- Intelligent Transportation Systems (ITS): ITS options include vehicle priority, operations and maintenance management, operator communications, real-time passenger information, and safety and security systems. Bus signal priority or pre-emption at intersections can involve the extension of green time or actuation of the green light at signalized intersections upon the detection of an approaching bus.
- Service and Operations Plan: Because BRT vehicles can travel anywhere there is pavement, BRT can be tailored to the unique origin and destination patterns of a corridor's travel market. For example, buses may exit exclusive busways and operate along streets to provide local area circulation and distribution.

Examples of BRT and the wide variation in BRT characteristics are illustrated in the following examples:

- Orlando LYMMO – operates in a downtown environment in exclusive bus-lanes with standard buses, free fares, enhanced station amenities and includes ITS features.
- Los Angeles Wilshire – operates on arterial streets in mixed traffic, with conventional buses, on-board fare collection, enhanced station amenities and includes ITS features.
- Las Vegas MAX – operates on arterial streets, primarily in exclusive bus lanes, with specialized vehicle, off-vehicle fare collection (TVM's), enhanced station amenities and includes extensive ITS features.
- Cleveland Euclid Corridor – operates in exclusive busways transitioning curb lanes with signal priority, with unique, 62-foot aerodynamic vehicles, off-board fare collection, enhanced station amenities and ITS features.

Capital costs for BRT vary depending on the application. For the purpose of this study, three categories of BRT have been defined. Enhanced arterial BRT operates in shared roadways, and uses technology to help speed up service, including signal priority, queue jumpers, skip stop/express service and improved bus stations. Capital costs can range from $3 to $5 million per mile for enhanced arterial BRT. Premium arterial BRT and freeway/major BRT are similar in that they operate on exclusive guideways such as bus only lanes or busways that are separate from traffic with dedicated stations. Premium arterial BRT capital costs range from $11 to $14 million per mile and freeway/major BRT capital costs range from $27 to $49 million per mile.

BRT Characteristics	Descriptions
Person/Vehicle Capacity	40 to 60 seats; 50 to 80 passengers per vehicle
Vehicles per set	One
Guideway	Mixed traffic but separate right-of-way recommended
Speed (Maximum)	70 mph
Speed (Average)	15-45 mph (depends on application)
Power Supply	Diesel, CNG, hybrid; electric in some applications
Suspension	Rubber tire on pavement
Station/Stop Spacing	Half mile to several miles
Capital Cost	$3 to $49 million per mile
Current revenue operations	Yes
Advantages	· Can operate in mixed traffic or on its own guideway; this can reduce the number of transfers for many passengers
	· Moderate to high capacity system for less cost than LRT and other fixed guideway systems
	· Bus operating speed and reliability is improved by eliminating various types of delay
	· Can access both low- and high-density land uses
Disadvantages	· Higher operating cost in very high-volume corridors
	· Travel times compromised in mixed traffic
	· Wider guideway in station areas

Las Vegas MAX

Euclid Avenue HealthLine – Cleveland, Ohio

3.1.3 Light Rail Transit (LRT)

Light rail transit is primarily an at-grade rail mode with electrically powered vehicles receiving current from an overhead wire (catenary). This is in contrast to heavy rail vehicles that usually are powered from a track-level third contact rail. The overhead power collection feature allows LRT systems to be integrated with other at-grade transportation modes and pedestrians. The most recent LRT systems in the U.S. use articulated vehicles that are 90 feet long.

LRT operates primarily in an exclusive right-of-way, but it can also operate with other traffic along existing roadways. A light rail alignment may also be grade separated, either in tunnel or elevated. Station spacing can be as close as one-quarter mile in activity centers, but typically ranges between one-half to one mile in other areas, with total corridor lengths generally not exceeding 15 to 20 miles.

The maximum operating speed of modern LRT systems is 55 to 65 miles per hour making it suitable for medium distance trips in suburbs or between central business districts and other major activity centers. System operating speeds are a function of the exclusivity of the right-of-way and the number of stops. Streetcars are a subset of LRT; they have a smaller capacity and operate at slower speeds of 10-20 miles per hour. Streetcars are more suitable for high density urban applications with frequent stops.

Light rail operates as a single vehicle or in trains of up to four cars. The LRT train length is a function of the minimum length of a city block so that stopped vehicles do not block cross streets. LRT is currently operating in many North American cities including: Denver, Portland, Baltimore, St. Louis, Buffalo, Dallas, San Diego, Los Angeles and Minneapolis.

Dallas, Texas

Denver, Colorado

LRT Characteristics	Descriptions
Person/Vehicle Capacity	70 seats; 120 persons per vehicle
Vehicles per set	Typically, 2-3; can be single or up to four car trains
Guideway	Exclusive right-of-way or mixed traffic
Speed (Maximum)	65 mph
Speed (Average)	20-30 mph including stops
Power Supply	Electrically powered via overhead catenary wires
Suspension	Steel wheel on steel rail
Station/Stop Spacing	Half to one mile
Capital Cost	$45 to $85 million per mile
Current revenue operations	Widespread
Advantages	· May operate in mixed traffic, with cross traffic, or on exclusive right-of-way
	· Moderate to high capacity system
	· Can negotiate steeper grades and small radius curves than heavy rail
	· Less noise and emissions than buses
Disadvantages	· Cannot operate jointly with freight trains
	· Overhead catenary system may be visually intrusive
	· Moderately high capital cost
	· Routing not as flexible as buses or BRT

3.1.4 Heavy Rail

Heavy rail systems are at the upper end of the transit spectrum in terms of speed, capacity and reliability. Heavy rail is a fully grade separated rail mode with electrically powered vehicles receiving power from an electrified third rail. The alignment is required to be in an exclusive right-of-way and may be elevated, in a tunnel or at-grade. No crossings of the right-of-way are permitted in the same plane with heavy rail operations.

Station spacing can be as close as one-half mile in activity centers, but typically ranges between one to three miles in most areas. Train length can vary from two to ten cars.

Due to infrastructure costs, heavy rail is implemented where very high passenger capacity is required. Cities where heavy rail is currently operating include New York, Philadelphia, Atlanta, Washington D.C., Baltimore and San Francisco.

MARTA – Atlanta

Metrorail – Washington, DC

Heavy Rail Characteristics	Descriptions
Person/Vehicle Capacity	64 seats; 120-300 passengers
Vehicles per set	Two to ten
Guideway	Exclusive Fixed Guideway
Speed (Maximum)	70 mph
Speed (Average)	30-40 mph average including station stops
Power Supply	Electrified third rail
Suspension	Steel wheel on steel rail
Station/Stop Spacing	One-half mile to 3 miles
Capital Cost	$138 to $323 million per mile
Current revenue operations	In major cities
Advantages	· Very high capacity system
	· Lower O&M costs per passenger basis in very high-volume corridors
	· High capacity system good for both short and long distance travel
	· Higher speeds
Disadvantages	· Very high capital costs
	· No crossing of right-of-way permitted
	· Large grade-separated structures can have major impacts

3.1.5 Commuter Rail

Commuter rail is generally most applicable for longer-distance regional rail trips. Most commuter rail systems provide suburban to urban service with little CBD coverage. Station spacing typically ranges from 2 to 5 miles. Commuter rail systems usually provide more frequent service in the peak period/peak direction and may also offer limited midday, evening and weekend service.

A major advantage of commuter rail is its ability to share track with freight trains and other intercity passenger service (Amtrak). Commuter rail operations must meet Federal Railroad Administration (FRA) crash worthiness regulations when operating on freight trackage. Collision requirements are usually based on a crush load design of 2G or double the vehicle weight (e.g., about 200,000 lbs. buff strength).

Commuter rail operations in the United States typically consist of one to ten single or bi-level passenger cars that are pushed or pulled by a diesel or electrically-powered locomotive. In an electric system, power is supplied by a third rail or overhead catenary system.

Federal regulations require an automatic train control system for speeds in excess of 79 mph. Most commuter rail systems, however, operate below this maximum speed. Service headways usually range from 20 to 90 minutes at average operating speeds between 40 and 50 mph. Commuter rail systems tend to be grade-separated in dense urbanized areas and at grade in suburban areas. Due to its slower acceleration and longer braking distances compared with other rail technologies, commuter rail is best suited to longer distance trips with widely-spaced stations.

Commuter rail passenger cars can accommodate high or low platform boarding and up to 160 seated passengers, with a normal capacity of 300 passengers. Although individual trains have a high capacity (e.g., 10 to 12 cars), the total line capacity of commuter rail is typically less than heavy rail because headways are longer.

Commuter rail capital costs range between $1.4 million and $15 million per mile. Operating costs, largely dependent upon the rail system operating plan, vary considerably from system to system.

3.1.5.1 Locomotive-Hauled Commuter Rail

Locomotive-hauled trains can be diesel or electric-powered. Examples of conventional, diesel locomotive-hauled commuter rail systems include Metrolink in Los Angeles, Tri-Rail in South Florida, MARC in Baltimore, and commuter operations in New York and Chicago. Nashville's Music City Star, a 32-mile commuter rail line with 6 stations, opened in the east corridor in September 2006. Electric-powered locomotives haul commuter trains to and from New York, Chicago, and Philadelphia.

3.1.5.2 Self-Propelled Commuter Rail

Self-propelled rolling stock is an alternative to locomotive-powered trains for commuter rail service. Whether run as single cars or in trains, they are generally designed for one-person operation. Self-propelled railcars have been around almost as long as the internal combustion engine. Although they have seen only limited service in the U.S., new designs in Europe and Australia are performing reliably and economically in a wide range of regional passenger services.

Diesel multiple unit cars (DMUs) are self-propelled commuter rail cars that do not require a locomotive to push or pull them. Multiple unit cars can operate singly or as trains of up to 10 cars. These vehicles are typically 85 feet long and seat 60 to 100 passengers. They are capable of speeds from 80 to 120 miles per hour. DMUs are used widely in Europe for commuter service, rural branch lines, and cross-country express trains. In the U.S., the South Florida Regional Transportation Authority (Tri-Rail) is operating the latest DMU prototype with FRA's approval as part of a demonstration project. In a number of European and U.S. cities, including New York, Chicago, and Philadelphia, self-propelled electric multiple units (EMUs) operate as commuter trains.

Commuter Rail Characteristics	Descriptions
Person/Vehicle Capacity	Varies, up to 300 passengers
Vehicles per set	Varies, up to 12 vehicles
Guideway	Dedicated right-of-way
Speed (Maximum)	79 mph
Speed (Average)	40-50 mph
Power Supply	Varies: Diesel locomotive, electrically-powered third rail or overhead catenary system.
Suspension	Steel wheel on steel rail
Station/Stop Spacing	2-5 miles apart
Capital Cost	$1.4 to $15 million per mile
Current revenue operations	In major U.S. cities
Advantages	· Can share existing track with freight
	· Competitive peak hour travel times
Disadvantages	· Not suitable for short distances
	· Stations are further apart than other rail modes

Music City Star, Nashville

DMU Demonstration Project - Tri-Rail, South Florida

EMU - Metra, Chicago

3.1.6 Monorail

Monorail is a fixed guideway transit mode in which a series of electrically propelled vehicles straddle or suspend from a single guideway beam, rail, or tube. If fully automated, they are similar in operation to automated guideway transit systems but are classified separately due to their unique guideway configuration. The trains generally consist of permanently coupled cars where electric power is picked up by collectors on the vehicle in contact with a bar mounted on the side of the guideway beam.

Vehicles may travel in single units or may be linked together in train sets of one to six vehicles. A monorail must be grade separated from other traffic. The majority of monorail installations have been elevated; however, it could operate in tunnel or at-grade within in its own right-of-way. Station spacing is comparable to light rail, one-third to one-half mile in activity centers and one-half to one-mile or more in other areas. In the United States, monorail has been implemented in limited applications, such as recreational areas or amusement parks (Disneyland/Walt Disney World) and short (approximately 1 mile) systems in downtown Seattle and Newark International Airport. Recent monorail projects in the United States include the privately funded Las Vegas Monorail along the Las Vegas resort corridor (approximately 3 miles) and the JTA Skyway (2.5 miles) in downtown Jacksonville, Florida. Outside of the United States, straddle beam, large vehicle monorail systems are in operation in Sydney, Australia and Osaka, Kitakyushu, and Tokyo, Japan.

Las Vegas

Monorail Characteristics	Descriptions
Person/Vehicle Capacity	Varies
Vehicles per set	Varies
Guideway	Exclusive fixed guideway
Speed (Maximum)	55 mph
Speed (Average)	20-30 mph with station stops
Power Supply	Electric powered from separate rail
Suspension	Rubber tire on mono-beam, or suspended from elevated beam
Station/Stop Spacing	One-third to one mile
Capital Cost	$114-$132 million per mile
Current rev. operations	Yes (in Europe and Japan; limited operation in the U.S.)
Advantages	· Narrow width of beam is less visually intrusive than other elevated systems
	· Automated system can provide frequent service and lower labor costs
	· Serves low to medium passenger volumes
Disadvantages	· Complex guidance/switching systems leads to reduced operating flexibility
	· Right-of-Way must be grade separated. Emergency egress from vehicles on this elevated guideway has historically been a problem
	· Limited vehicle suppliers
	· High capital cost per mile
	· Limited experience in urban applications. Mostly amusement parks and airports in U.S.

3.1.7 Automated Guideway Transit (AGT)

AGT refers to a broad range of fixed guideway technology in which the most prominent feature is the automatic train operation. AGT can include steel-wheel/steel-rail or rubber tired vehicles which operate under automated control on an exclusive guideway, grade-separated from vehicular traffic. AGT may utilize conventional or alternative propulsion types such as magnetic levitation or linear induction.

AGT characteristics can vary considerably. Vehicles typically are smaller than other rail modes. However, the most significant operating standard for this technology is service at very short intervals. This frequent service mitigates the smaller vehicle size so that AGT hourly passenger capacity can be comparable to that of light rail. Station spacing is comparable to light or heavy rail, one-quarter to one-third mile in activity centers and one-half to one-mile or more in other areas. Train lengths vary between one and six vehicles. Depending on the AGT setting, the speed of the AGT vehicle ranges from 20 to 55 miles per hour.

AGT technology is in widespread use in airports such as Atlanta, which has a rubber-tired system, and amusement parks in the U.S. and other countries. There are also downtown circulator systems, such as the Miami MetroMover. Urban scale systems are found in Vancouver and several European cities.

Miami MetroMover

AGT Characteristics	Descriptions
Person/Vehicle Capacity	Varies; typical 40' car has 40 seats, 70-passengers
Vehicles per set	Varies
Guideway	Exclusive fixed guideway
Speed (Maximum)	55-62 mph
Speed (Average)	20-35 mph with station stops
Power Supply	Electrified third rail or linear induction
Suspension	Steel wheel on steel rail or rubber tired
Station/Stop Spacing	Between one quarter to one third miles in activity centers and one half to one mile in other areas
Capital Cost	$100-$219 million per mile
Current revenue operations	Many airport applications but few urban applications
Advantages	· Automated operations may reduce labor costs
	· More frequent service
	· Smaller stations
	· Hourly passenger capacities are comparable to light rail
	· Higher capacity system good for short distance travel in urban applications
Disadvantages	· Highest capital cost per mile except heavy rail
	· Grade separation required due to electrified third rail
	· Limited pool of vehicle suppliers

3.1.8 Personal Rapid Transit (PRT)

Personal Rapid Transit (PRT) systems are small typically low speed systems (25 mph or less) designed to provide personalized service, traveling to the desired stop without intermediate stops at other stations, and requiring an exclusive right-of-way. PRT is distinguished from other forms of AGT systems by two characteristics: vehicles sized like taxicabs and a non-stop ride from origin to destination by having passable or off-line stations. The capacity of PRT systems is approximately 5,000 pphpd or less.

PRTs are defined as having:

- Fully-automated vehicles capable of operation without humans
- Vehicles operating on small, grade-separated guideway
- Small vehicles with a capacity of one to six people
- Direct, origin-to-destination service, without the necessity of transfers or stops at intervening stations
- Service available on demand, rather than on fixed schedules

There are no PRT systems currently in operation in the world, although a pilot PRT system is under construction at London Heathrow Airport to test the systems for future expansion to other British Airports. The Morgantown, West Virginia system, connecting the University of West Virginia with the Morgantown CBD, probably comes closest to meeting PRT requirements, in so far as all the stations are off-line, allowing nonstop origin-to-destination travel. However, the vehicles are larger than true PRT, with a capacity of 20 passengers. Once vehicle capacity exceeds roughly 2 to 6 passengers the system becomes more a group rapid transit type system. These type systems generally resemble other rail operating systems, in that vehicles tend to stop at all or most stations as a result of multiple destinations of the larger group of riders.

PRT on Test Track

PRT Characteristics	Descriptions
Person/Vehicle Capacity	3-6 seats
Vehicles per set	One
Guideway	Exclusive fixed guideway
Speed (Maximum)	25 mph
Speed (Average)	10-20 mph
Power Supply	Electric AC motor or linear induction
Suspension	Rubber tires on a guideway
Station/Stop Spacing	Very closely spaced
Capital Cost	No reliable estimates
Current revenue operations	None in operation
Advantages	· Automated operations may reduce labor costs
Disadvantages	· No existing systems in operation
	· Capacity is approximately 5,000 pphpd or less

3.1.9 Magnetic Levitation (Maglev)

Magnetic levitation (Maglev) is an advanced technology in which magnetic forces lift, propel, and guide a vehicle over a guideway. Utilizing state-of-the-art electric power and control systems, this configuration eliminates contact between vehicle and guideway and permits cruising speeds of up to 300 mph, or almost two times the speed of conventional high speed rail service. Because of its high speed, Maglev offers competitive trip-time savings to auto and aviation modes in the 40 to 600-mile travel markets. This technology can also be automated.

In these systems, the technology is analogous to that of an electric motor. Maglev trains are suspended over the fixed guideway by means of electro-magnetic suspension, creating "levitation." During movement there is no contact between the vehicle and guideway. Automatic electronic controls maintain a constant air gap of 5 to 15 mm (.2 to .6 inches) and compensate for variations in vertical loads. Levitating the train above the guideway eliminates most of the frictional drag inherent with other technologies, thus reducing the power required at high speeds and creating the opportunity for operating speeds at the high end of operations of up to 300 mph. Two basic types of Maglev technology exist: the electrodynamic suspension (repulsive forces) or EDS and electromagnetic suspension (attractive forces) or EMS.

Maglev technology is generally applied to high speed (100+ mph) travel needs (inter-city, longer distances), however; new permutations of maglev are being developed for use in slow speed (30-60 mph) applications. Shanghai, China has the only high speed maglev in revenue operation, which travels from downtown Shanghai to the Pudong International Airport. Low-speed maglev system line capacity ranges from 2,000 to 10,000 pphpd. Linimo is the first low-speed maglev, which opened in Japan in 2005 and serves the local community of Aichi and the Expo 2005 fair site. Maglev is in final planning stages in Munich, Germany.

Maglev has been proposed for several corridors in the U.S., such as Denver to Vail, Colorado; Baltimore to Washington, DC, and greater Los Angeles. Closer to home, the Tennessee Maglev Feasibility Study is researching possible routes and station locations for the maglev train between Chattanooga and Nashville. Currently, plans are to connect the major airports, downtown areas, and points in between.

Linimo, Japan

Maglev Characteristics	Descriptions
Person/Vehicle Capacity	Varies
Vehicles per set	Varies
Guideway	Exclusive fixed guideway
Speed (Maximum)	300 mph
Speed (Average)	· 60-100 mph in urban applications; · 250-300 mph for intercity routes
Power Supply	Magnetic forces lift, propel, and guide vehicle
Suspension	Concrete or steel guideway
Station/Stop Spacing	n/a
Capital Cost	No reliable estimates
Current revenue operations	None in U.S.
Advantages	· Competitive trip time
	· Can be automated
Disadvantages	· None operating in U.S.

3.1.10 High Speed Rail

High speed rail technology provides service between cities that are 100-500 miles apart. With speeds from 150-200 miles per hour, high speed rail is competitive to air travel. High speed rail uses a steel wheel on steel rail technology that is either turbine propelled or electric. High speed rail operates on new, dedicated right-of-way or upgraded existing tracks at slower speeds. Speeds are also limited by vertical and horizontal curves. Like commuter rail, high speed rail is subject to FRA regulation.

High speed trains are found throughout the world. The three most prominent high speed trains are the Japanese Shinkansen (Bullet Train), ICE (Germany) and TGV (France). Capacity for these three trains ranges between 850 passengers in 8 sections on the ICE; 1,090 passengers in 12 sections on the TGV; and 1,634 passengers in 15 sections on the Bullet Train. Three minute headways were demonstrated by TGV. Capital costs for high speed rail in the U.S. would vary, depending on the speed of the train and the track improvements.

While not truly high speed, the Amtrak Acela Express is the only comparable high speed rail service in the U.S. Operating between Washington DC, New York and Boston, the average speed is 72 miles per hour, with a maximum speed of 150 miles per hour. Other potential high speed rail corridors have been identified in the U.S., including the Florida High Speed Rail Project, the California High Speed Rail Authority and the Southeast High Speed Rail Corridor.

The American Recovery and Reinvestment Act of 2009 includes $8 billion in competitive grant funding for high speed rail projects, corridor programs, and planning.

Acels Express

High Speed Rail Characteristics	Descriptions
Person/Vehicle Capacity	Varies 850-634 passengers
Vehicles per set	Varies based on demand: 8-15 sections
Guideway	Dedicated right-of-way
Speed (Maximum)	200 mph (150 mph Acela Express)
Speed (Average)	150 mph (72 mph Acela Express)
Power Supply	Turbine or electric propelled
Suspension	Steel wheel on steel rail
Station/Stop Spacing	Intercity
Capital Cost	Unknown
Current revenue operations	Acela Express in U.S., several throughout the world
Advantages	· Competitive travel times for heavily traveled intercity corridors
Disadvantages	· High capital costs

3.1.11 Water Taxi

Water taxi/bus technology is a water based service that follows a fixed route between points or terminals on a waterfront. Vessels are 50 feet long or less and speeds can vary between 5 to 25 knots (5.8-28.8 mph). Water taxis/buses typically provide service for short to medium length trips with low passenger volumes at low to medium speeds. Terminal spacing is usually .5 to 1 mile apart. Water taxis typically provide service on demand; whereas, water buses operate on a fixed schedule. Service headways for water taxis/buses can be 5 minutes because of their small size.

Water taxis vary by technology, size and speed. Battery-powered electric monohull vessels are designed for short trips at slow speeds (5 knots), and hold around 25 passengers. Diesel-electric hybrid monohull vessels can make longer trips, operate at slow speeds (8 knots) and hold up to 72 passengers. Diesel monohulls operate at low to medium speeds (14-25 knots) and carry up to 80 passengers. Diesel catamarans operate at medium to high speeds (up to 28 knots), carry 150 passengers, and can accommodate long trips. Because diesel catamarans have two hulls, they are more costly to build and maintain. Hovercraft electric monohulls can operate at speeds of 37 knots with 50 passengers; however, they have limited maneuverability and are best for shorter trips.

Capital costs are determined by the type of vessel and amount of dock construction needed. These costs can range from $160,000 to $2.8 million. Operating and maintenance costs are high, due to staffing requirements, low fuel efficiency and other costs associated with water operations.

Examples of water taxi/bus service found in the U.S. that operate on fixed schedules include Long Beach Transit Aquabus, Fort Lauderdale Water Taxi, and Chicago Water Taxi (weather permitting).

(Sources: Sar Website, APTA Fact Book)

Ferry/Water Taxi Characteristics	Descriptions
Person/Vehicle Capacity	Varies by vessel: 25-150 passengers
Vehicles per set	One
Guideway	Exclusive right of way on navigable waterways
Speed (Maximum)	5-25 knots (5.8-28.8 mph)
Speed (Average)	Slow-varies by vessel size
Power Supply	Battery powered electric, diesel-electric or diesel engine
Suspension	Water vessel: Monohull or Catamaran
Station/Stop Spacing	.5-1 Mile apart
Capital Cost	Varies by type of vessel, $160,000 to $2.8 million
Current revenue operations	Yes. Public and private operations in U.S.
Advantages	· Can have low capital costs
	· Smaller vessels can have higher frequencies
Disadvantages	· High operating and maintenance costs
	· Slow speeds over a longer distance compared to other modes

Fort Lauderdale Water Taxi

3.2 Technology Screening

The Universe of Alternatives begins with a wide range of alternatives which may or may not be appropriate to satisfy the needs of the Northeast Corridor. At the pre-screening, transit modes may be eliminated for several reasons, including lack of demonstrated success in the US, high capital cost per mile, or clearly does not meet the project purpose and need. These determinations are made based upon the knowledge and experience of the consultant team, taking into account the distinctive requirements of the Northeast Corridor. The purpose of the pre-screening of transit technologies is to make an efficient use of study time and resources, and to avoid spending large amounts of time analyzing transit technologies that will clearly not be feasible or competitive in later stages of the alternative screening process.

The initial screening of alternatives for the Northeast Corridor Mobility Study includes a total of 11 technologies that are rated based on seven criteria that determine the suitability and applicability of each technology in the corridor. Each technology is rated based on these criteria with a positive (+) rating by comparison, a neutral (o) rating by comparison, or a negative (-) rating by comparison. The summary table of the preliminary technology screening results is shown in Table 1, with a discussion of: the suitability and applicability criteria and comparison rating methodologies; and the technologies that were eliminated and those that move forward for more detailed analysis.

3.2.1 Suitability Criteria

- **Average Operating Speed**

This evaluates the attractiveness of the technology from a passenger viewpoint. Average speeds (including station stops) may be affected by the inherent characteristics of the vehicle, the degree of separation from roadway traffic, and the station spacing. Technologies with average speeds of 30 miles per hour or greater have a positive rating, 20 to 35 miles per hour have a neutral rating, and technologies with less than 20 miles per hour average speed have a negative rating.

- **Average Station Spacing**

Average station spacing is rated based on suitability for the Northeast Corridor. Technologies that require closely spaced stations in dense areas or intercity stations across states have a negative rating. Technologies with station spacing at ¼ to 1 mile have a positive rating. The remaining technologies that require regional stations greater than one mile have a neutral rating.

- **Compatibility with Transportation System**

The introduction of other modes in the corridor will have capital and operating cost impacts, since new supporting facilities and staff will be required. Technologies that are consistent with current transportation systems in place in the Northeast Corridor have a positive rating. Technologies that require minor improvements to existing infrastructure have a neutral rating, and systems that required new exclusive guideways have a negative rating.

- **Satisfies Study Purpose and Goals**

Each technology that satisfies one or more ofthe study purpose and goals has a positive rating. If a technology has the potential to meet one or more goals, it is neutral. A negative rating means a technology does not meet the purpose and goals of the study.

- **Order of Magnitude Capital Costs per Mile (Millions)**

This assesses the overall capital costs of constructing and implementing a technology. Specific cost estimates are not being made during the prescreening step; this guideline will be evaluated based on average capital costs per mile in other urban applications. Total capital costs, adjusted to 2009 dollars, for each technology are based on FTA New Starts documents, planning studies, and existing costs for example projects, and are shown in Appendix A. Each technology has a positive rating if capital costs are low (up to $45 million per mile), a neutral rating if costs range between $45 and $90 million per mile, and a negative rating for costs greater than $90 million per mile.

3.2.2 Applicability Criteria

- **Proven Revenue Service in U.S**

Each technology is rated to determine if it can be applied to the Nashville Northeast Corridor. The system should be reliable and based on proven technology. The technology should be considered appropriate based on the number of active applications, especially those in urban settings, and the corresponding records for maintenance and reliability. Technologies in widespread use have positive ratings, and technologies with few to no applications in revenue service in the U.S. have negative ratings.

3.2.3 Summary of Findings

Eleven technologies are evaluated using the screening criteria listed above, and either chosen to carry forward for further analysis in the Northeast Corridor Mobility Study, or eliminated based on one or more factors. Table 1 displays the evaluation matrix with all technologies, criteria and ratings, as well as a brief summary of each characteristic. Technologies that are eliminated include heavy rail transit (HRT), monorail, automated guideway transit (AGT), personal rapid transit (PRT), magnetic levitation (Maglev), high speed rail, and water taxi/bus. Technologies selected to be carried forward are conventional bus, bus rapid transit (BRT), light rail transit (LRT), and commuter rail.

There are seven technologies eliminated from consideration based on characteristics that make them unsuitable or not applicable in the Northeast Corridor. These factors are highlighted in Table 1, as is the overriding factor that eliminates the technology. Eliminated technologies are listed below.

- HRT is likely not financially feasible for the Northeast Corridor, with high capital costs of $138-$323 million per mile. Heavy rail requires an exclusive guideway, which can be costly and visually intrusive. Additionally, the Northeast Corridor is not conducive to heavy rail, as heavy rail is a high capacity system designed for dense and highly congested areas.

- Monorail has high capital costs of $114-$132 million per mile, limiting the financial feasibility of this technology in the Northeast Corridor. Like HRT, monorails require new exclusive guideways, which can be visually intrusive and costly. Monorails are typically designed to serve local circulation needs, and there are few urban applications of monorails in the U.S. For these reasons, monorail is not suitable for the Northeast Corridor.

- AGT is eliminated for many of the same reasons as monorail. High capital costs of $100-$219 million per mile limit financial feasibility. AGT typically provides frequent service over a short distance, and requires a visually intrusive, exclusive guideway. A limited number of urban AGT systems exist in the U.S., making AGT not applicable in the Northeast Corridor.

- PRT is eliminated because it is not a feasible alternative for the Northeast Corridor. PRT is a low capacity system that does not reduce traffic congestion. The typical application of a PRT would be as a local circulator. Because there are no PRTs in existence, the feasibility and cost of the system is untested and, therefore, PRT is not suitable in the Northeast Corridor.

- Maglev is an untested system with no operational systems in U.S. and no reliable cost estimates. Additionally, Maglev is suitable for high speed intercity travel and does not support access and mobility needs in the Northeast Corridor.

- High Speed Rail operates through a chain of stops in cities across states and does not support access and mobility needs in the Northeast Corridor. High speed rail requires a new exclusive guideway or existing track upgrades to accommodate higher speeds, which increases capital costs. Therefore, high speed rail is eliminated from the alternatives in the Northeast Corridor.

- Water Taxi/Bus is eliminated because it fails to serve major activity centers and areas of high population density along the Northeast Corridor. Additionally, water taxi/bus technology in the Northeast Corridor would be less competitive than other modes because it travels at slow speeds along the river. Thus,

water taxi/bus fails to meet the study goals to reduce travel time in the corridor.

Four technologies were chosen for the pre-screening of alternatives based on the benefits they provide to the Northeast Corridor as they compare to the screening criteria. Technologies carried forward are listed below.

- Conventional Bus is carried forward as a fundamental element of all alternatives. For the Baseline and Build alternatives, conventional bus service will support the high-capacity investments, (e.g. feeding into stations).

- BRT offers the flexibility of bus and the travel time benefits of rail. BRT can operate in exclusive bus lanes or mixed traffic, which provides access to low and high density land uses. BRT has lower capital costs compared to rail technologies, at $3-$49 million per mile. Although BRT is a relatively new concept, it is successful in many U.S. cities. Therefore, BRT will be carried forward to the next screening.

- LRT is the most flexible of the rail modes, although it has significantly higher capital costs compared to BRT, at $45-$85 million per mile. LRT can operate on exclusive guideways or on-street with station spacing of ½ to 1 mile. This provides better access to land uses along the alignment than other rail modes. LRT also supports short to medium distance trips between suburbs, central business districts and major activity centers, which makes LRT suitable for the Northeast Corridor. For these reasons, LRT will be carried forward.

- Commuter Rail typically provides service between suburban park-and-ride lots and urban centers generally focused on peak period travel. Commuter rail is consistent with the Music City Star commuter rail. Capital costs can be low from $1-$15 million because commuter rail can operate on existing tracks. Commuter rail meets the study goals to reduce travel time along the corridor with faster speeds of 40 to 50 miles per hour. For these reasons, commuter rail will be carried forward.

Table 1: Technology Evaluation Matrix

Technology	Suitability					Applicability	Carry Forward?
	Average Operating Speed	Average Station Spacing	Compatibility with Transportation System	Satisfies Study Purpose & Goals	Order of Magnitude Capital Cost per Mile (Millions)	Proven Revenue Service in U.S.	
Conventional Bus	10-40 mph; depends on application	Local: 1-2 blocks Express: 1+ Miles	Consistent with Current Bus Operations	Meets Essential Mobility & Access Needs	Comparatively Low; Primarily Vehicle Related	Widespread Use	Yes
rating	=	=	+	+	+	+	
Bus Rapid Transit	10-50 mph; depends on application	1/2 to Several Miles	Requires Roadway Improvements	Provides Access to Low and High Density Land Uses	$3-49	Many Systems; Use is Expanding	Yes
rating	=	+	=	+	+	+	
Light Rail Transit	10-30 mph; depends on application	1/2 to 1 Mile	Substantial Infrastructure; Can Operate in-Street	Flexibility Allows Better Access to Land Uses	$45-85	Operates in Numerous Cities	Yes
rating	=	+	=	+	=	+	
Heavy Rail Transit	30-40 mph	CBD: >1 Mile Periphery: 1 to 3 Miles	Requires New Exclusive Guideway	High Capital Cost Limits Financial Feasibility	$138-323	Oeprates in High Density Cities	No
rating	+	=	-	-	-	+	
Commuter Rail	40-50 mph	2 to 5 Miles Serves Regional Travel	Can Operate on Existing Tracks; Consistent with Music City Star	Moderate Potential to Stimulate Economic Development	$1-15	Operates in Major Cities	Yes
rating	+	=	+	=	+	+	
Monorail	20-30 mph	1/3 to 1 Mile	Requires New Exclusive Guideway	High Capital Cost Limits Financial Feasibility	$114-132	Few Urban Applications; Some Theme Parks	No
rating	=	+	-	-	-	-	
Automated Guideway Transit	20-35 mph	1/4 to 1 Mile	Requires New Exclusive Guideway	High Capital Cost Limits Financial Feasibility	$100-219	Few Urban Applications; Many Airport	No
rating	=	+	-	-	-	-	
Personal Rapid Transit	10-20 mph	Closely Spaced Stations in Dense Area	Requires New Exclusive Guideway	Low Capacity Does Not Address Congestion Reduction	No Reliable Estimates	No Operational Systems - In Testing	No
rating	-	-	-	-	-	-	
Magnetic Levitation (Maglev)	100+ mph	Primarily Intercity	Requires New Exclusive Guideway	Does Not Support Access & Mobility Within Corridor	No Reliable Estimates	No Operational Systems - In Testing	No
rating	+	-	-	-	-	-	
High Speed Rail	70 mph	Chain of Stops in Cities Across States	Requires New Exclusive Guideway or Existing Track Improvements	Does Not Support Access & Mobility Within Corridor	Not Available	Washington to Boston (Amtrak)	No
rating	+	-	-	-	-	-	
Water Taxi/Bus	Slow - Varies by Vessel Size	Varies	Operates on Navigable Waterways	Does Not Meet Travel Market Needs of Corridor	Vessel and Terminal Costs	Many Large Cities	No
rating	-	=	=	-	+	+	

Rating scale:

- **+** **Positive Rating by Comparison**
- **=** **Neutral Rating by Comparison**
- **-** **Negative Rating by Comparison**

04 Preliminary Alternatives Screening

4.0 Introduction

The next step is to identify existing corridors within the study area and to combine the remaining technologies with suitable corridors. The pairing of technologies and corridors is a subjective process and a brief narrative will be provided to explain the rationale in the following section. Simple maps will be provided to illustrate the alignments and preliminary station locations. Station locations should not be considered as "final," but rather as provisional and solely for the purpose of preliminary screening. Route variations/deviations and feeder services will not be addressed in this step. The detailed criteria employed during preliminary screening are discussed in the paragraphs below, organized by the five project goals.

4.1 Methodology

The preliminary alternatives screening takes the Northeast Corridor Mobility Study goals and objectives and translates them into quantitative measurements or qualitative assessments to evaluate each of the alternatives. The criteria for each goal are highlighted with an explanation of how that goal will be measured or assessed against specific criteria.

4.1.1 Criteria for Goal #1 – Improving Alternative Transportation Options

The first goal of the project is to improve access and mobility within the study area through identifying mobility solutions and providing alternative transportation options on the corridor. Four quantitative criteria are used to evaluate this goal:

- End to end travel time (order-of-magnitude) (Gallatin to Downtown Nashville)
- Number of major activity centers within 1/2 mile
- Forecast year 2035 population within 1/2 mile of station
- Forecast year 2035 employment within 1/2 mile of station

End to end travel time is estimated based upon the route length and the average speed for the transit technology. The other criteria are analyzed based upon GIS transportation analysis zone (TAZ) data of 2035 population and employment forecasts from the MPO and information on current major activity centers. The results illustrate the overall suitability of different alternatives for improving access and providing mobility solutions in the corridor.

4.1.2 Criteria for Goal #2 – Serve Transit Dependent Populations

The second goal of the project is to ensure adequate service is offered to accommodate zero-car households and other transit-dependent populations. Three quantitative criteria are used to evaluate this goal:

- Number of zero-car households within 1/2 mile of stations
- Number of low income households within 1/2 mile of stations
- Number of minority households within 1/2 mile of stations

These data are derived based upon US Census 2000 information available and proposed alternative routes and stations. The results illustrate the overall suitability of different alternatives in providing service to transit-dependent populations.

4.1.3 Criteria for Goal #3 – Promote Environmental Sustainability

The third goal of the project is to promote environmental sustainability through appropriate development patterns while integrating transportation and land use to reduce auto and truck trips, and to reduce pollutant emissions. Three quantitative and two qualitative criteria are used to evaluate this goal:

- Potential for promoting or connecting to TOD (transit-oriented development) (qualitative)
- Qualitative assessment of potential impacts to environmentally sensitive sites, infrastructure, and private property (qualitative)
- Acres of potentially affected parks and wetlands within 500 feet
- Number of potentially affected historic sites, cemeteries, and religious properties within 500 feet
- Number of potentially affected residences, schools, businesses, or churches within 500 feet

These data will be derived based upon GIS data provided by local governments or the MPO and information about each of the proposed alternative's routes. The potential for promoting and connecting to TOD (transit-oriented development) is based upon the subjective evaluation of the planning and economic development consultants. The consultant team will evaluate the feasibility of the proposed station locations for TOD for each alternative. This analysis takes into account market potential, availability of land, local jurisdictional planning efforts, and existing development patterns in the area. The assessment of potential impacts to the environment and infrastructure is based upon the transportation planner's subjective assessment of different routes and their disruption potential,

taking into account each route's intersection with known environmental or infrastructure features. All qualitative assessments are categorized as positive (+), neutral (o), or negative (-). The results illustrate the overall suitability of different alternatives in promoting environmental sustainability and fostering transit-oriented development patterns.

4.1.4 Criteria for Goal #4 – Steward Transportation Funds

The fourth goal of the project is to steward transportation funds to incorporate market and economic analysis for a realistic plan, determine development potential, and recommend incentives for desired development patterns. Two quantitative criteria are used to evaluate this goal:

- Average capital cost range based upon national comparisons and route length
- Acres of densely/intensely zoned land within 1/2 mile of stations

Average capital costs are provided as a range based upon national comparisons and route length. This provides a rough basis for estimating costs differences between alternatives and can be a potential basis for eliminating some alternatives, as the stewardship of transportation funds is a major stakeholder concern. Development potential is grossly estimated by the number of acres that are densely or intensely zoned within ½ mile of proposed station locations. This is analyzed by gathering zoning information in GIS from local governments. Each zoning category is identified as either densely/intensely zoned or not. Any single family zoning is considered as not densely/intensely zoned. The results illustrate the overall suitability of different alternatives in stewarding transportation funds and capitalizing on development potential.

It should be noted that one of the goals of the study is to help shape local government land use policy, including potential rezonings and/or overlays after a preferred alternative is identified.

4.1.5 Criteria for Goal #5 - Safety

The fifth goal of the project is to improve safety and security in the corridor while considering the transit/pedestrian/auto interface. No criteria have been developed for evaluating alternatives, because safety is more dependent upon the specific design and engineering solutions developed for each alternative in the engineering phase of the project, rather than on generic mode and/or route selection. All of the above forms of transit have proven historically to be safe, especially when compared with automobile travel. Transit also facilitates a pedestrian oriented investment and is likely to improve the safety of the pedestrian environment, particularily at transit stations. Site-specific safety issues cannot be addressed at this early stage of evaluation.

This preliminary screening of alternatives provides a basis for comparing alternatives without engaging in the more time-consuming and expensive methodologies employed in the later detailed evaluation of alternatives. Quantitative measures are employed wherever feasible in order to develop a more objective preliminary screening process. In some cases, particular alternatives have clear inherent weaknesses (by comparison), and each weakness is identified as the key reason or reasons to dismiss the alternative from further evaluation. A narrative will follow to explain which alternatives are eliminated and the criteria on which they "failed," and which alternatives should advance to the next phase of screening.

The three build alternatives that best meet the preliminary alternatives screening criteria discussed above will advance to the next step which employs more rigorous criteria and analytic evaluation methods.

4.2 Initial Range of Alternatives and Evaluation

In Table 1, the technology screening set aside certain transit technologies from consideration for the Northeast Corridor Mobility Study. However, there are still a number of potential combinations of technology and alignment that could be considered as part of the initial range of alternatives:

- There are three primary technologies to be considered for the high capacity transit corridor: BRT, LRT, and Commuter Rail;
- There are four roughly parallel north-south alignments extending the full length of the corridor (Downtown Nashville to Gallatin) that should be considered: a freeway corridor along I-24, I-65, and SR 386, an arterial corridor along Gallatin Pike and US 31E/SR 6, the railroad corridor along the CSX Railway, and a proposed railroad corridor partially along the CSX Railway that would connect with the Nashville & Eastern Railroad (N&E) in the Old Hickory area and the existing Music City Star commuter rail line at Donelson Station; and
- South of Briley Parkway, there are two additional roadways to be considered as alternates connecting to the freeway and arterial corridors: Ellington Parkway and Dickerson Pike.

4.2.1 Potential Alignments

This section describes the freeway, arterial, and railroad corridor alignments. Included is a discussion of the options south of Briley Parkway. The potential alignments are shown in Figure 2.

4.2.1.1 Freeway Corridor

This full length corridor connects Nashville, Goodlettsville, Henderson and Gallatin. It consists of three urban limited access freeways: I-24, I-65 and SR 386 (Vietnam Veterans Boulevard), and are briefly described here. I-24 runs from the northwest to the southwest and forms the eastern side of the interstate loop around Downtown Nashville. The downtown segment between I-65 and I-40, has no planned improvements for widening or adding HOV lanes.

Northeast of downtown, I-24 and I-65 merge and continue north, splitting again south of Ewing Drive. I-65 continues north to Goodlettsville and beyond. Reconstruction and widening of I-65 from SR 386 south to Trinity Lane has been underway since 2001. It is being widened from six to ten lanes, with two lanes being HOV. The segments from SR 386 to Dickerson Pike have been completed, including the rebuilding of the I-65/Briley Parkway/Ellington Parkway interchange. The interchange reconstruction allows a smooth transition from I-65 to Ellington Parkway without the need to enter and exit Briley Parkway. While not yet under construction, the final segment of the project from Dickerson Pike to Trinity Lane is programmed for construction in FY 2011 of the current TIP.

SR 386 (Vietnam Veterans Boulevard) splits off of I-65 in Goodlettsville in the vicinity of Rivergate Mall. Construction of this four-lane limited access freeway was completed in June of 2007. It passes through Hendersonville and ends in Gallatin where it joins with SR 174 (Long Hollow Pike). SR 174 (Long Hollow Pike and Red River Road) continues to US 31E/SR 6 (Nashville Pike) in downtown Gallatin, and is the final leg of the freeway corridor being considered for this project. This segment of SR 174 is in the LRTP to be relocated and widened from two to five lanes, but is not yet programmed in the TIP.

Ellington Parkway Option. Ellington Parkway is a four-lane limited access freeway connecting Downtown Nashville with Briley Parkway through the center of East Nashville. The rebuilding of the I-65/Briley Parkway/Ellington Parkway interchange as part of the I-65 project now provides a smooth transition from I-65 to Ellington Parkway without the need to enter and exit Briley Parkway.

Four MTA routes currently operate non-stop along Ellington Parkway, which provides quick access to the northern part of MTA's service area. Route 35X provides limited peak period express service to Rivergate Mall and, through contractual agreement with the RTA, continues into Sumner County via SR 386 to serve Hendersonville.

4.2.1.2 Arterial Corridor

This full length corridor also connects Nashville, Goodlettsville, Hendersonville and Gallatin. From the Cumberland River, this four-lane arterial corridor with a center turn lane begins as Main Street and Gallatin Pike in East Nashville to Briley Parkway, where it becomes US 31E/ SR 6. It continues through Madison, skirts the southern limits of Goodlettsville, and continues through Hendersonville and Gallatin with various name changes along the way. For the purposes of this study, the entire length of the corridor will generally be referred to as the Gallatin Pike Corridor. Segments of the corridor were reconstructed in 2005 and 2006. While there are no major improvements to the corridor programmed in the current TIP, the LRTP includes a project to widen it from five to seven lanes from the SR 386 Connector to Bonita Parkway in Hendersonville. Gallatin Pike is currently served by MTA's Route 26 from Downtown Nashville to the Wal-Mart and Sam's Club north of Rivergate Mall. This route has the highest ridership of all MTA routes, providing frequent weekday, as well as Saturday and Sunday, service.

Dickerson Pike Option. Dickerson Pike is a four-lane minor arterial connecting Downtown Nashville with Briley Parkway, which continues along the western edge of the Study Area into Goodlettsville. In East Nashville, Dickerson Pike runs parallel to, and in between, I-65 and Ellington Parkway. It is being considered as an alternate to Gallatin Pike south of Briley Parkway because the demographics along it are supportive of transit. It is currently served by MTA Route 23, which operates seven days a week and performs well. The transition from Gallatin Pike to Dickerson Pike (via Broadmoor Drive or Briley Parkway), however, would add distance and significant out of direction travel to the alignment.

4.2.1.3 Railroad Corridor

Within the Study Area, two CSX mainline tracks have been previously considered for commuter rail service. The Clement Landport intermodal transportation facility is located in downtown Nashville and was built in 1998 to provide boarding and transfer facilities for individuals using public transit and HOV or private vehicles. It has been identified as a potential site for a commuter rail station due to its proximity to the existing CSX line on Demonbreun Street (just southwest of the CBD). From Clement, heading north through the Maplewood Junction to the Amqui junction (near Gallatin Pike), the CSX Nashville-Chicago mainline consists of two tracks, with the exception of a single track bridge across the Cumberland River. At Amqui, and continuing northeast to Gallatin, the Northeast Corridor (CSX's mainline between Nashville and Louisville) is single track.

Previous studies identified a number of potential commuter rail station locations in Downtown Nashville, Madison, Hendersonville, and Gallatin along the corridor, with initial segment as well as longer-term terminus options. No stations were proposed within East Nashville. The corresponding spacing between stations would be between two and three miles.

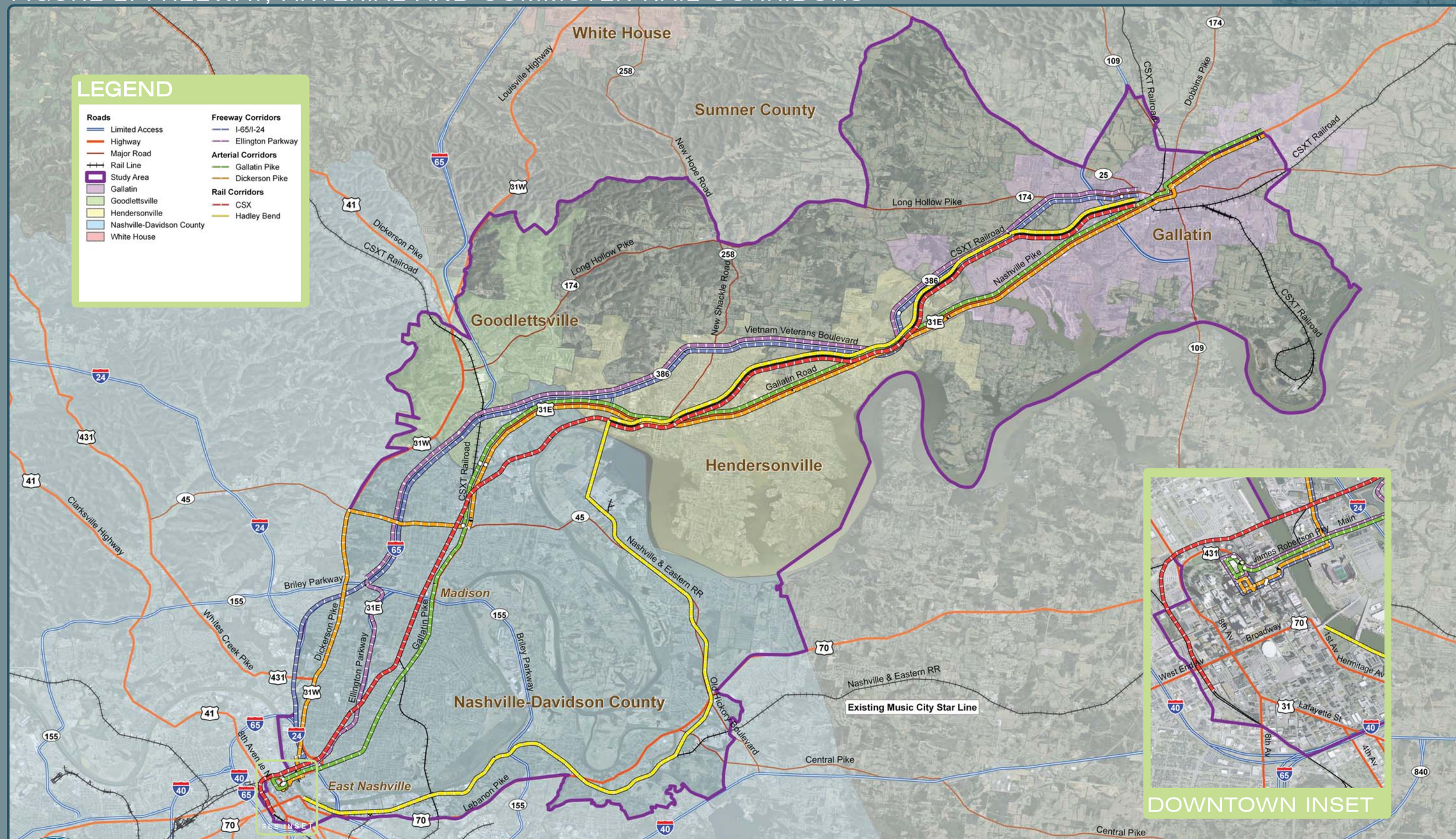
Nashville & Eastern Railroad (N&E) Option. The existing Music City Star commuter rail service operates on N&E short line tracks from downtown Nashville at the Riverfront Station east to Lebanon. An N&E spur line east of the Donelson Station extends north to the Old Hickory area and the DuPont plant. The Hadley Bend Connector is a new roadway in the MPO's Long Range Transportation Plan that would bridge the Cumberland River and connect SR 45 (Old Hickory Boulevard) and SR 386 (Vietnam Veterans Boulevard).

This commuter rail option would utilize the existing N&E tracks from downtown Nashville to the DuPont plant, and the existing Riverfront and Donelson stations. Additional potential station locations along the N&E tracks have been identified near Hermitage Plaza and in Old Hickory. This option assumes the construction of tracks and structures parallel to the Hadley Bend Connector in order to cross the Cumberland River. North of the river, these new tracks would tie into the CSX tracks in the vicinity of the Rockland Recreation Area and continue northeast to Gallatin.

STUDY AREA CANDIDATE CORRIDORS

NORTHEAST CORRIDOR Mobility Study

FIGURE 2: FREEWAY, ARTERIAL AND COMMUTER RAIL CORRIDORS



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4.2.2 Combined Transit Technologies and Potential Alignments

The next step in the prescreening process is to combine the technologies carried forward and the alignments described in the previous section to determine which ones are applicable and suitable for the Northeast Corridor. Commuter rail is applicable in the two railroad corridors. Both BRT and LRT are applicable in the arterial corridor, as either could operate in exclusive lanes/guideways or in mixed-traffic. In the freeway corridor, both BRT and LRT are also applicable. BRT could operate either in an exclusive lane or in mixed traffic, while LRT would require an exclusive guideway in this corridor. It may be possible to operate BRT or LRT using the edge of the CSX rail right-of-way along most of its alignment. However, these mode options would be difficult to implement, given the need to maintain adequate separation from the CSX tracks for safety reasons. Additionally, there would be no real advantage to pursuing these mode options given the proximity of the arterial corridor.

This screening of technology and alignment combinations leaves the alternatives in Table 2 to be considered in the next step of screening. Nine of the ten alternatives serve Gallatin, Hendersonville, Madison, and East Nashville. However, the CSX/Hadley Bend/N&E Railroad Corridor alternative does not serve Madison or East Nashville, and neither commuter rail alternative directly serves Goodlettsville.

The general alignments of the ten initial alternatives are shown in Figures 3-8. The intent of the prescreening is to reduce the number of alternatives to no more than three build alternatives with characteristics that better address the study goals, objectives, and transportation needs.

The ten potential build alternatives include two Commuter Rail alignments and four alignments that could use either BRT or LRT. In the case of BRT, a wide range of operating characteristics is possible, ranging from mixed-traffic operations with conventional buses, fairly simple stations, and Intelligent Transportation Systems (ITS) options to exclusive bus-only lanes with specialized vehicles, enhanced station amenities, and extensive ITS features.

It should also be noted that the alignments identified to date are extremely general in nature, and do not denote specific rights-of-way or other alignment engineering considerations. Station locations have not been identified for the alternatives. However, the station spacing will likely be similar to the ranges cited for each alternative technology.

Two additional alternatives will be included, consistent with FTA planning guidance: a No-Build Alternative and a Baseline Alternative. These alternatives will be used as a basis for comparison in the detailed screening analysis, and are generally described as follows:

The **No-Build Alternative** will consist of the existing transportation network plus projects planned for and programmed for implementation in the short-term. These will include the projects in the MPO's current existing plus committed network (E+C) and additional projects local government are committed to implement.

A **Baseline Alternative** will be defined consistent with FTA New Starts planning guidance. FTA defines a baseline alternative as the "best that can be done" to improve transit service in the corridor without major capital investment in new infrastructure. It will likely emphasize transportation system upgrades, such as enhanced bus services, signal prioritization, transits hubs, real-time information systems, and off-board fare collection. The FTA uses the Baseline to isolate the costs and benefits of major capital investments.

Table 2: Initial Range of Alternatives

Alternative	From Gallatin via	Southern Segments Via	Mode	Distance
Freeway Corridor	SR 386/I-65	I-65/I-24	BRT or LRT	30
		Ellington Parkway	BRT or LRT	29
Arterial Corridor	US 31E/SR 6	Gallatin Pike	BRT or LRT	27
		Broadmoor/Dickerson Pike/1st St.	BRT or LRT	40
Railroad Corridor	CSX	CSX	Commuter Rail	28
		Hadley Bend Connector/N&E	Commuter Rail	33

4.3 Description of the Alternatives

4.3.1 Alternative #1 and Alternative #2 – I-65/I-24 Freeway Corridor Bus Rapid Transit (BRT) or Light Rail Transit (LRT)

The I-65/I-24 freeway corridor alternative with BRT or LRT technology runs from the City of Gallatin via SR386/I-65 to Briley Parkway, then south of Briley Parkway via I-65/I-24 exiting at Spring Street following North 1st Street/South 1st Street to Woodland and Union Streets looping around downtown Nashville via 5th Avenue North, Charlotte Avenue, and, 4th Avenue North. The Alternative #1 and Alternative #2 corridor is approximately 30 miles in length.

The general locations for proposed stations for Alternative #1 and Alternative #2 from northeast to southwest are: Maple Street, Harris/Greenlea, Saundersville, New Shackle Island, Rivergate Mall, Old Hickory, Ewing, Trinity and Music City Central in downtown Nashville.

Figure 3 shows the I-65/I-24 corridor for BRT and LRT technology.

4.3.2 Alternative #3 and Alternative #4 – Ellington Parkway Freeway Corridor Bus Rapid Transit (BRT) or Light Rail Transit (LRT)

The Ellington Parkway freeway corridor alternative with BRT or LRT technology runs from the City of Gallatin via SR386/I-65 to Briley Parkway, then south of Briley Parkway via Ellington Parkway to Main Street/James Robertson Parkway looping around downtown Nashville via 4th Avenue North, Charlotte Avenue, 5th Avenue North and Gay Street. The Alternative #3 and Alternative #4 corridor is approximately 29 miles in length.

The general locations for proposed stations for Alternative #3 and Alternative #4 from northeast to southwest are: Maple Street, Harris/Greenlea, Saundersville, New Shackle Island, Rivergate Mall, Old Hickory, Hart, Trinity and Music City Central in downtown Nashville.

Figure 4 shows the Ellington Parkway freeway corridor for BRT or LRT technology.

4.3.3 Alternative #5 and Alternative #6 - Gallatin Pike Arterial Corridor Bus Rapid Transit (BRT) or Light Rail Transit (LRT)

The Gallatin Pike arterial corridor alternative with BRT or LRT technology runs from the City of Gallatin via US31E/SR 6 to Briley Parkway, then south of Briley Parkway via Gallatin Pike to Main Street/James Robertson Parkway looping around downtown Nashville via 4th Avenue North, Charlotte Avenue, 5th Avenue North and Gay Street. The Alternative #5 and Alternative #6 corridor is approximately 27 miles in length.

The general locations for proposed stations for Alternative #5 and Alternative #6 from northeast to southwest are: Downtown Gallatin, Belvedere, Harris/Greenlea, New Station Camp, Saundersville, Indian Lake, Town Center, SR 386 Connector, Rivergate Mall, Madison, Briley Parkway, Trinity, Eastland Avenue, 7th Street, and Music City Central in downtown Nashville.

Figure 5 shows the Gallatin Pike arterial corridor for BRT and LRT technology.

STUDY AREA FREEWAY CORRIDOR

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FIGURE 3: ALTERNATIVES #1 AND #2 - I-65/I-24 BRT OR LRT

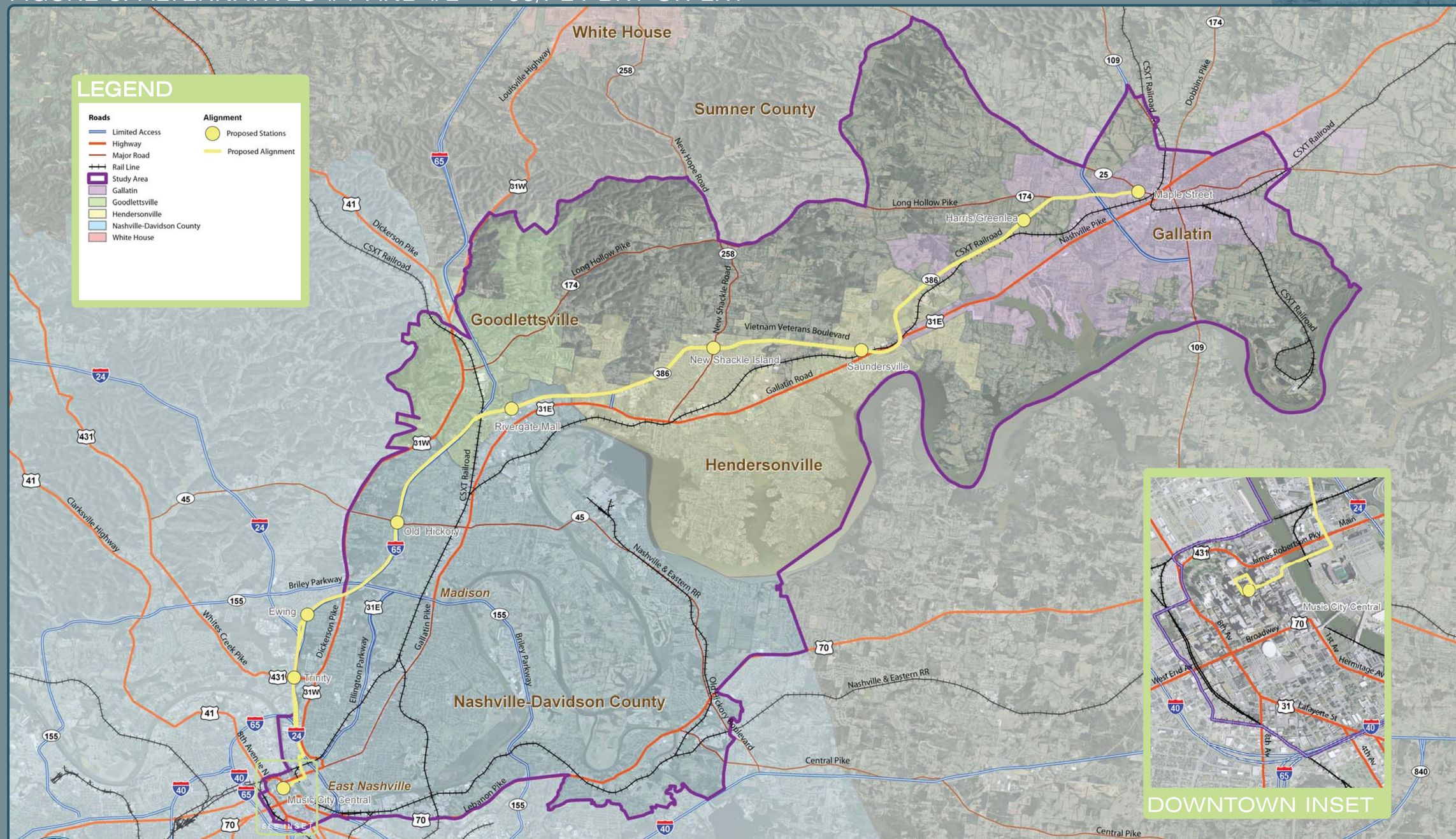

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FIGURE 4: ALTERNATIVES #3 AND #4 - ELLINGTON PARKWAY BRT OR LRT

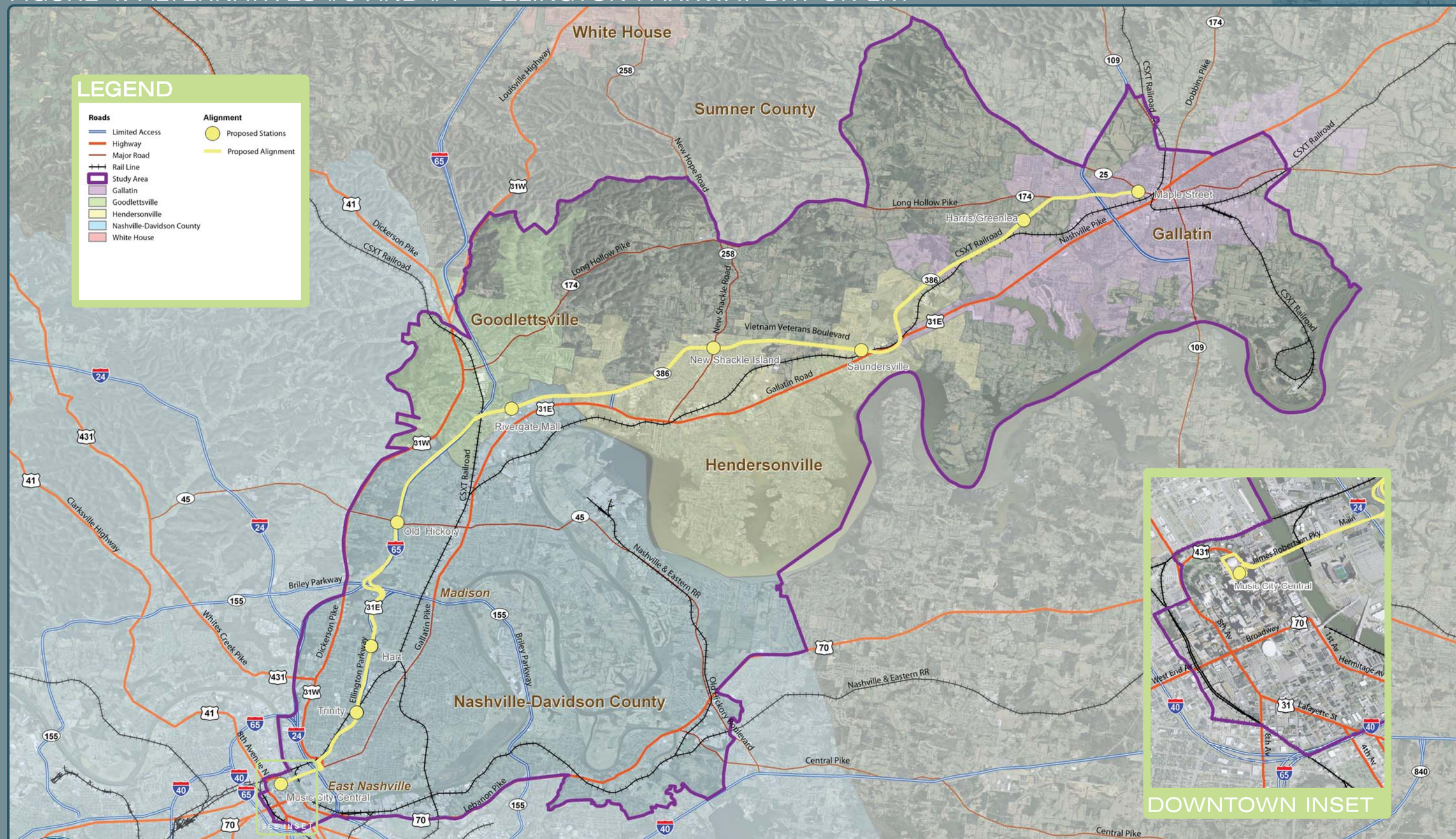

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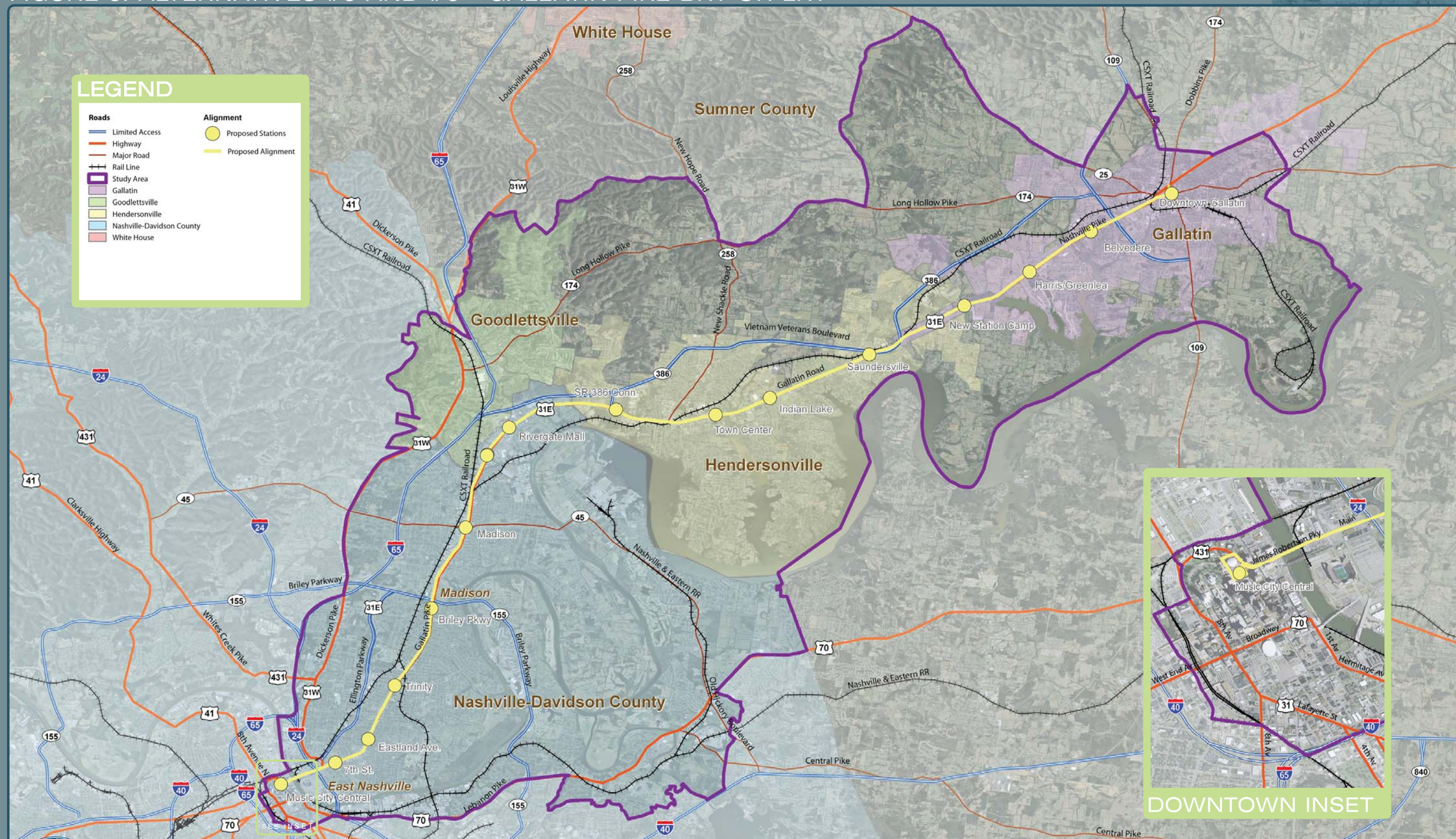
FIGURE 5: ALTERNATIVES #5 AND #6 - GALLATIN PIKE BRT OR LRT



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4.3.4 Alternative #7 and Alternative #8 - Dickerson Pike Arterial Corridor Bus Rapid Transit (BRT) or Light Rail Transit (LRT)

The Dickerson Pike arterial corridor alternative with BRT or LRT technology runs from the City of Gallatin via US31E/SR 6 to Briley Parkway, then south of Briley Parkway via Broadmoor/ Dickenson Pike following North 1st Street/South 1st Street to Woodland and Union Streets looping around downtown Nashville via 5th Avenue North, Charlotte Avenue, and, 4th Avenue North. The Alternative #7 and Alternative #8 corridor is approximately 40 miles in length.

The general locations for proposed stations for Alternative #7 and Alternative #8 from northeast to southwest are: Downtown Gallatin, Belvedere, Harris/Greenlea, New Station Camp, Saundersville, Indian Lake, Town Center, SR 386 Connector, Rivergate Mall, Edenwold, Madison, Old Hickory, Skyline, Broadmoor, Trinity, Cleveland, and Music City Central in downtown Nashville.

Figure 6 shows the Dickerson Pike arterial corridor for BRT and LRT technology.

4.3.5 Alternative #9 - CSX Commuter Rail Corridor

The CSX commuter rail corridor alternative runs from the City of Gallatin via the existing CSX railway to downtown Nashville's Clement Landport. The Alternative #9 corridor is approximately 28 miles in length.

The general locations for proposed stations for Alternative #9 from northeast to southwest are: Maple Street, Harris/Greenlea, Saundersville, New Shackle Island, Myatt Drive, Madison, Briley Parkway, Capitol and Clement Landport.

Figure 7 shows the CSX commuter rail corridor.

4.3.6 Alternative #10 - Hadley Bend Commuter Rail Corridor

The Hadley Bend commuter rail corridor alternative runs from the City of Gallatin via the existing CSX railway across the Cumberland River (where new right-of-way is required, i.e. the Hadley Bend connector) to the Nashville and Eastern railway to downtown Nashville's Riverfront station via the existing Music City Star railway. The Alternative #10 corridor is approximately 33 miles in length.

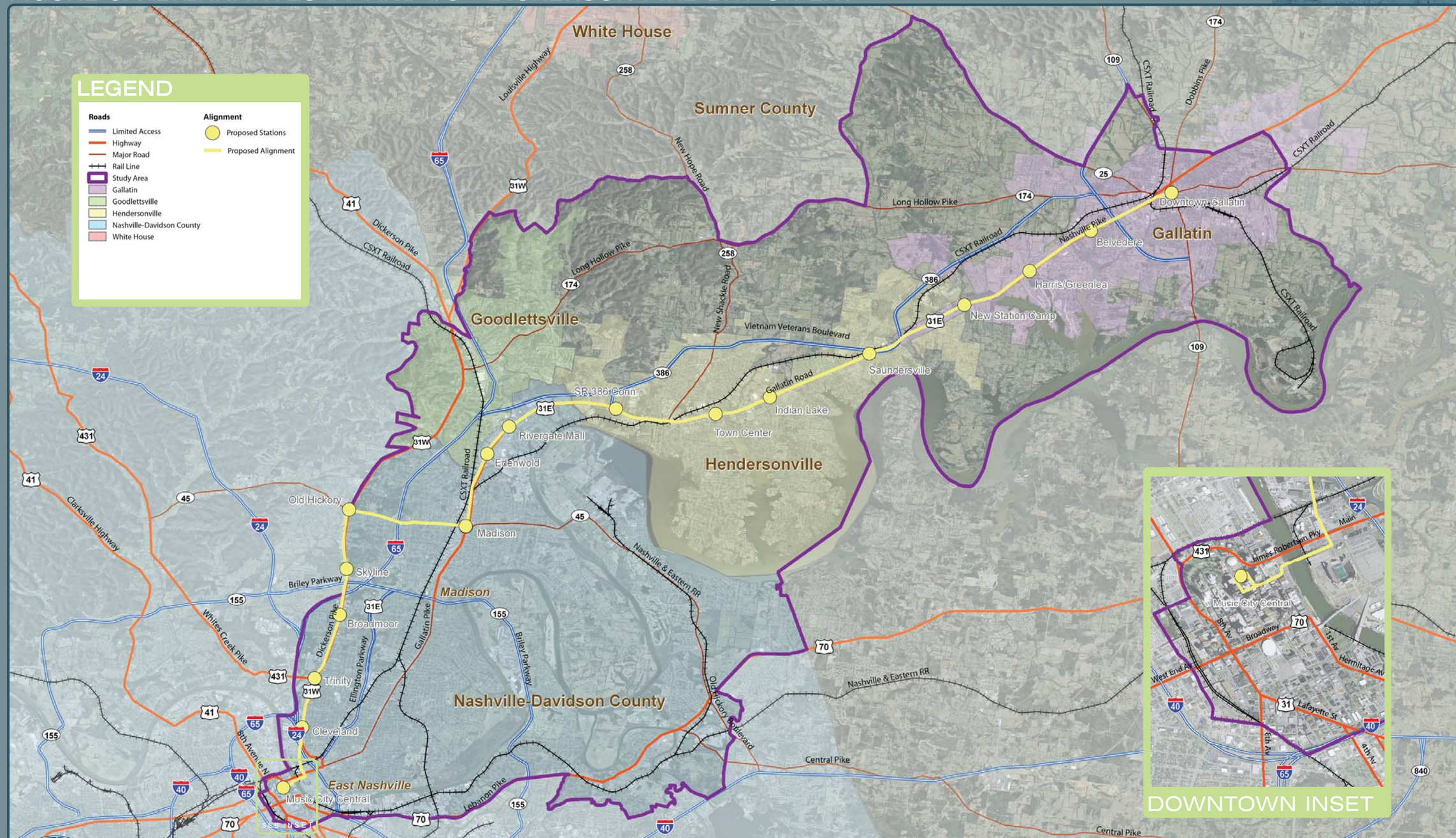
The general locations for proposed stations for Alternative #10 from northeast to southwest are: Maple Street, Harris/Greenlea, Saundersville, New Shackle Island, Old Hickory, Madison, Hermitage Plaza connecting to the Music City Star commuter rail stations of Donelson and Riverfront in Downtown Nashville.

Figure 8 shows the Hadley Bend commuter rail corridor.

STUDY AREA ARTERIAL CORRIDOR

NORTHEAST CORRIDOR Mobility Study

FIGURE 6: ALTERNATIVES #7 AND #8 - DICKERSON PIKE BRT OR LRT



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STUDY AREA COMMUTER RAILROAD CORRIDOR

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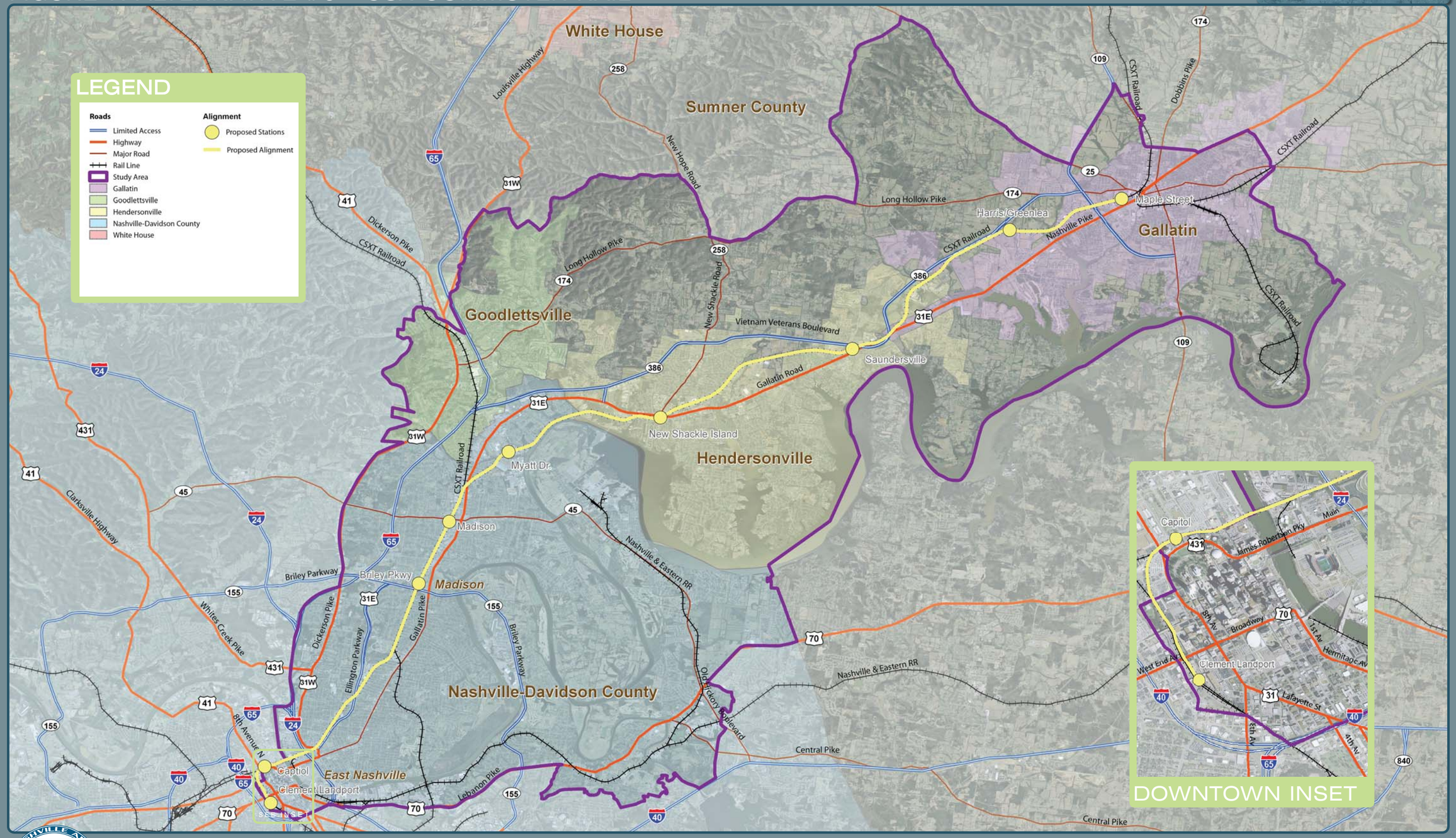
FIGURE 7: ALTERNATIVE #9 - CSX COMMUTER RAIL



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STUDY AREA COMMUTER RAILROAD CORRIDOR

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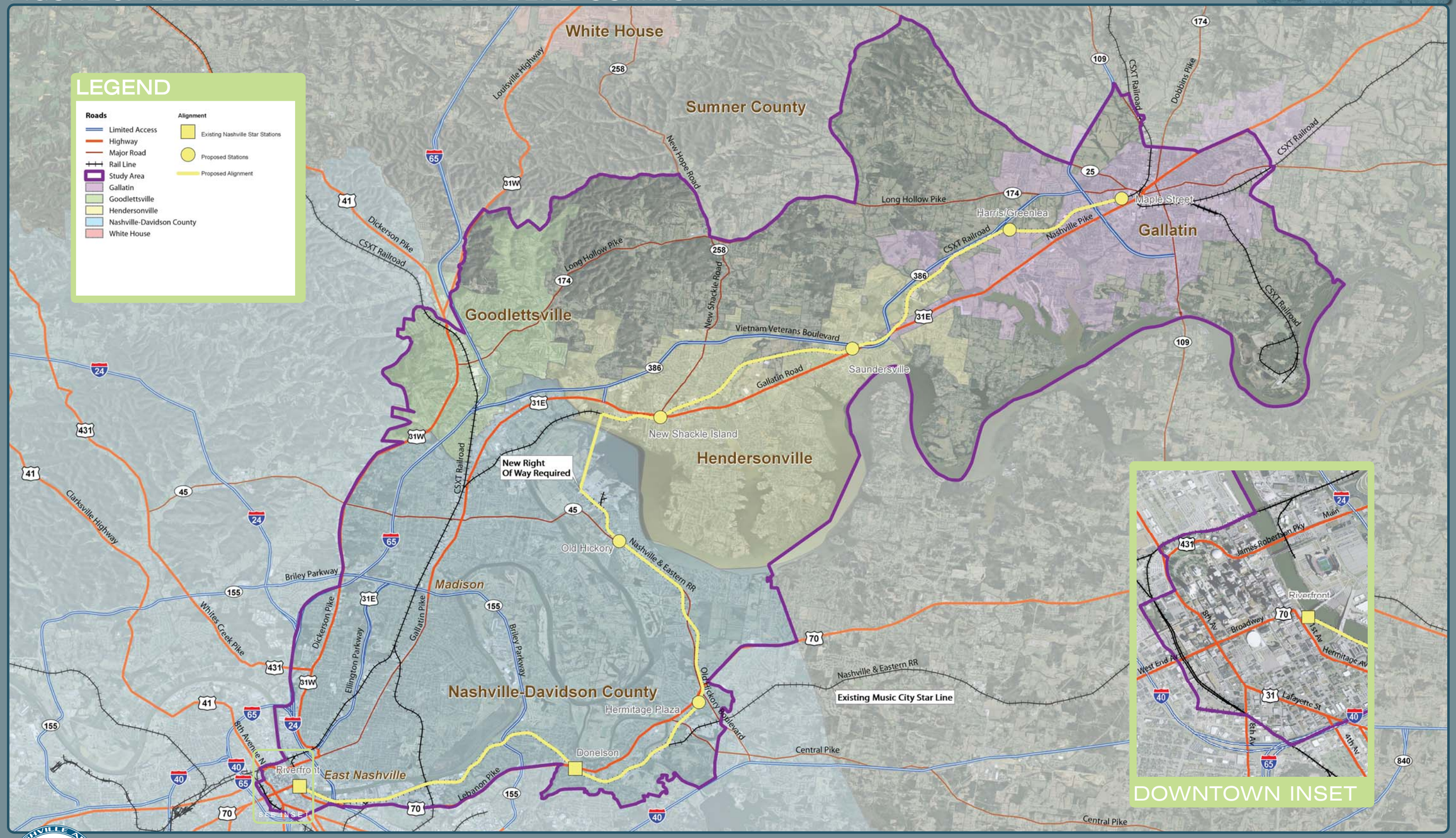
FIGURE 8: ALTERNATIVE #10 - HADLEY BEND COMMUTER RAIL



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4.4 Evaluation of Alternatives

The detailed criteria employed during preliminary screening are discussed below, organized by alternative corridor and technology and discussed in terms of project goals. Table 3 shows the raw numbers calculated for each criterion by alternative corridor.

4.4.1 Alternative #1 – I-65/I-24 Freeway Corridor Bus Rapid Transit (BRT)

Alternative #1 has one of the shortest estimated travel times from one end of the corridor to the other and contains the fewest number of residences, schools, businesses or religious facilities within 500 feet of the corridor.

For the Goal 1 criteria of improving access and mobility within the study area, the I-65/I-24 corridor proposed alignment with BRT technology ranks as one of the shortest estimated travel times from end to end at 46 minutes. The I-65/I-24 corridor has three major activity centers, Hendersonville Medical Center, Rivergate Mall and the Stadium located within 1/2 mile of the proposed stations; similar to the proposed Ellington Parkway and CSX rail corridors. Alternative #1's forecast year 2035 population is 62,300 and the forecast year 2035 employment is 123,714 jobs (see Table 3).

Regarding assessing adequate service for transit-dependent populations, the GIS analysis revealed that the I-65/I-24 corridor has 1,489 zero-car households within 1/2 mile of the proposed stations. Additionally, within 1/2 mile of the proposed stations, there are 2,344 low income households and 3,329 minority households (Table 3).

For the Goal 3 criteria, Alternative #1 is generally neutral on potential for promoting or connecting transit-oriented design (TOD) development in comparison to the other alternatives and generally favorable in terms of potential impacts to environmentally sensitive sites, infrastructure and private property. The GIS analysis of parks and wetlands yielded a total of 44.8 acres (39.3 acres of parks and 5.5 acres of wetlands) within 500 feet of Alternative #1 (see Table 3). Also, one cemetery and four historic sites lie within 500 feet of Alternative #1. Additionally, 990 residences, 12 schools, 275 businesses and 23 religious facilities (1,300 total) may be potentially disrupted by the proposed alignment of Alternative #1, rendering it on the lower side of the number of facilities affected among the ten alternatives considered.

Regarding the stewardship of transportation funds, the estimated average capital cost range for Alternative #1 is $745.3 million. Concerning desired development patterns for transit-supportive land use, the analysis of densely or intensely zoned acres within 1/2 mile of all proposed stations for Alternative #1 yielded a total of 3,310 acres (see Table 3).

Figure 3 shows the proposed I-65/I-24 BRT alignment and stations.

4.4.2 Alternative #2 - I-65/I-24 Freeway Corridor Light Rail Transit (LRT)

Alternative #2 has the fewest number of residences, schools, businesses or religious facilities within 500 feet of the proposed corridor.

For the Goal 1 criteria of improving access and mobility within the study area, the I-65/I-24 corridor proposed alignment with LRT technology has an estimated travel time from end to end of 41 minutes, slightly longer than with BRT technology. The I-65/I-24 corridor has three major activity centers, Hendersonville Medical Center, Rivergate Mall and the Stadium located within 1/2 mile of the proposed stations; similar to the proposed Ellington Parkway and CSX rail corridors. Alternative #2's forecast year 2035 population is 62,300 and the forecast year 2035 employment is 123,714 jobs (see Table 3).

Regarding assessing adequate service for transit-dependent populations, the GIS analysis revealed that the I-65/I-24 corridor has 1,489 zero-car households within 1/2 mile of the proposed stations. Additionally, within 1/2 mile of the proposed stations, there are 2,344 low income households and 3,329 minority households (Table 3).

For the Goal 3 criteria, Alternative #2 is generally neutral on potential for promoting or connecting transit-oriented development (TOD) in comparison to the other alternatives and generally favorable in terms of potential impacts to environmentally sensitive sites, infrastructure and private property. The GIS analysis of parks and wetlands yielded a total of 44.8 acres (39.3 acres of parks and 5.5 acres of wetlands) within 500 feet of Alternative #2 (see Table 3). Also, one cemetery and four historic sites lie within 500 feet of Alternative #2. Additionally, 990 residences, 12 schools, 275 businesses and 23 religious facilities (1,300 total) may be potentially disrupted by the proposed alignment of Alternative #2, rendering it on the lower side of the number of facilities affected among the ten alternatives considered.

Regarding the stewardship of transportation funds, the estimated average capital cost range for Alternative #2 is $1,848.2 million, higher than BRT technology for the same corridor.

Concerning desired development patterns for transit-supportive land use, the analysis of densely or intensely zoned acres within 1/2 mile of all proposed stations for Alternative #2 yielded a total of 3,310 acres (see Table 3).

Figure 3 shows the proposed I-65/I-24 LRT alignment and stations. Note that for this analysis, the proposed alignment and stations remain the same whether BRT or LRT technology is used.

4.4.3 Alternative #3 – Ellington Parkway Freeway Corridor Bus Rapid Transit (BRT)

Alternative #3 has one of the shortest estimated travel times from one end of the corridor to the other and has the least number of historic sites and cemeteries within 500 feet of the proposed corridor.

For the Goal 1 criteria of improving access and mobility within the study area, the Ellington Parkway corridor proposed alignment with BRT technology ranks as one of the shortest estimated travel times from end to end at 44 minutes. The Ellington Parkway corridor has three major activity centers, Hendersonville Medical Center, Rivergate Mall and the Stadium located within 1/2 mile of the proposed stations; similar to the proposed I-65/I-24 and CSX rail corridors. Alternative #3's forecast year 2035 population is 62,013 and the forecast year 2035 employment is 111,637 jobs (see Table 3).

Regarding assessing adequate service for transit-dependent populations, the GIS analysis revealed that the Ellington Parkway corridor has 1,839 zero-car households within 1/2 mile of the proposed stations. Additionally, within 1/2 mile of the proposed stations, there are 2,763 low income households and 5,236 minority households (Table 3).

For the Goal 3 criteria, Alternative #3 is generally neutral on potential for promoting or connecting transit-oriented development (TOD) in comparison to the other alternatives and generally favorable in terms of potential impacts to environmentally sensitive sites, infrastructure and private property. The GIS analysis of parks and wetlands yielded a total of 34.5 acres (28.6 acres of parks and 5.9 acres of wetlands) within 500 feet of Alternative #3. Also, one cemetery and one historic site lie within 500 feet (see Table 3). Of the proposed alignments considered, Alternative #3 has the fewest cemeteries and historic sites near the corridor that could be potentially affected. Additionally, 1,529 residences, 19 schools, 119 businesses and 26 religious facilities (1,693 total) may be potentially disrupted by the proposed alignment of Alternative #3.

Regarding the stewardship of transportation funds, the estimated average capital cost range for Alternative #3 is $734.8 million. Concerning desired development patterns for transit-supportive land use, the analysis of densely or intensely zoned acres within 1/2 mile of all proposed stations for Alternative #3 yielded a total of 4,332 acres (see Table 3).

Figure 4 shows the proposed Ellington Parkway arterial corridor BRT alignment and stations.

4.4.4 Alternative #4 - Ellington Parkway Freeway Corridor Light Rail Transit (LRT)

Alternative #4 has the fewest number of historic sites and cemeteries within 500 feet of the proposed corridor.

For the Goal 1 criteria of improving access and mobility within the study area, the Ellington Parkway corridor proposed alignment with LRT technology has an estimated travel times from end to end of 40 minutes slightly shorter than with BRT technology. The Ellington Parkway corridor has three major activity centers, Hendersonville Medical Center, Rivergate Mall and the Stadium located within 1/2 mile of the proposed stations; similar to the proposed I-65/I-24 and CSX rail corridors. Alternative #4's forecast year 2035 population is 62,013 and the forecast year 2035 employment is 111,637 jobs (see Table 3).

Regarding assessing adequate service for transit-dependent populations, the GIS analysis revealed that the Ellington Parkway corridor has 1,839 zero-car households within 1/2 mile of the proposed stations. Additionally, within 1/2 mile of the proposed stations, there are 2,763 low income households and 5,236 minority households (Table 3).

For the Goal 3 criteria, Alternative #4 is generally neutral on potential for promoting or connecting transit-oriented development (TOD) in comparison to the other alternatives and generally favorable in terms of potential impacts to environmentally sensitive sites, infrastructure and private property. The GIS analysis of parks and wetlands yielded a total of 34.5 acres (28.6 acres of parks and 5.9 acres of wetlands) within 500 feet of Alternative #4. Also, one cemetery and one historic site lie within 500 feet (see Table 3). Of the proposed alignments considered, Alternative #4 has the fewest cemeteries and historic sites near the corridor that could potentially be affected. Additionally, 1,529 residences, 19 schools, 119 businesses and 26 religious facilities (1,693 total) may be potentially disrupted by the proposed alignment of Alternative #4.

Regarding the stewardship of transportation funds, the estimated average capital cost range for Alternative #4 is $1,822.3 million, higher than BRT technology on the same corridor. Concerning desired development patterns for transit-supportive land use, the analysis of densely or intensely zoned acres within 1/2 mile of all proposed stations for Alternative #4 yielded a total of 4,332 acres (see Table 3).

Figure 4 shows the proposed Ellington Parkway arterial corridor LRT alignment and stations. Note that for this analysis, the proposed alignment and stations remain the same whether BRT or LRT technology is used.

4.4.5 Alternative #5 - Gallatin Pike Arterial Corridor Bus Rapid Transit (BRT)

Alternative #5 has the greatest number of activity centers within 1/2 mile of the proposed corridor, along with the largest projected 2035 population within 1/2 mile of the proposed stations. Alternative #5 also has the greatest number of transit-dependent populations and acres of densely or intensely zone land within 1/2 mile of all the proposed stations. Conversely, Alternative #5 has the greatest number of historic sites, cemeteries, residences, schools, businesses and religious facilities within 500 feet of the proposed corridor.

For the Goal 1 criteria of improving access and mobility within the study area, the Gallatin Pike corridor proposed alignment with BRT technology has an estimated travel time from end to end of 83 minutes. The Gallatin Pike corridor has seven major activity centers located within 1/2 mile of all proposed stations, the most among the ten alternatives analyzed. These activity centers include: Volunteer State Community College, Rivergate Mall, City of Madison, the National Cemetery, Nashville Auto Diesel College, East Nashville and the Stadium. Alternative #5's forecast year 2035 population is 118,491 (the largest among the proposed alignments considered) and the forecast year 2035 employment is 149,291 jobs (see Table 3).

Regarding assessing adequate service for transit-dependent populations, the GIS analysis revealed that the Gallatin Pike corridor has 5,088 zero-car households, 6,453 low income households and 10,752 minority households within 1/2 mile of all proposed stations, each the greatest among the proposed alignments analyzed (Table 3).

For the Goal 3 criteria, Alternative #5 is generally favorable on potential for promoting or connecting TOD in comparison to the other alternatives and generally unfavorable in terms of potential impacts to environmentally sensitive sites, infrastructure and private property. The GIS analysis of parks and wetlands yielded a total of 44.0 acres (32.2 acres of parks and 11.8 acres of wetlands) within 500 feet of Alternative #5. Ten cemeteries and four historic sites also lie within 500 feet of Alternative #5, the greatest number among the proposed alignments analyzed. Additionally, Alternative #5 has the greatest number of residences, schools, businesses and religious facilities near the corridor that could be potentially affected. A total of 2,699 facilities (1,228 residences, 38 schools, 1,299 businesses and 134 religious facilities) may be potentially disrupted by the proposed alignment of Alternative #5.

Regarding the stewardship of transportation funds, the estimated average capital cost range for Alternative #5 is $713.9 million. Concerning desired development patterns for transit-supportive land use, the analysis of densely or intensely zoned acres within 1/2 mile of all proposed stations for Alternative #5 yielded a total of 7,833 acres, the most among the proposed alignments analyzed (see Table 3).

Figure 5 shows the proposed Gallatin Pike arterial corridor BRT alignment and stations.

4.4.6 Alternative #6 - Gallatin Pike Arterial Corridor Light Rail Transit (LRT)

Alternative #6 has the greatest number of activity centers within 1/2 mile of the proposed corridor, along with the largest projected 2035 population within 1/2 mile of the proposed stations. Alternative #6 also has the greatest number of transit-dependent populations and acres of densely or intensely zone land within 1/2 mile of all the proposed stations. Conversely, Alternative #6 has the greatest number of historic sites, cemeteries, residences, schools, businesses and religious facilities within 500 feet of the proposed corridor.

For the Goal 1 criteria of improving access and mobility within the study area, the Gallatin Pike corridor proposed alignment with LRT technology has an estimated travel time from end to end of 69 minutes. The Gallatin Pike corridor has seven major activity centers located within 1/2 mile of all proposed stations, the most among the ten alternatives analyzed. These activity centers include: Volunteer State Community College, Rivergate Mall, City of Madison, the National Cemetery, Nashville Auto Diesel College, East Nashville and the Stadium. Alternative #6's forecast year 2035 population is 118,491 (the largest among the proposed alignments considered) and the forecast year 2035 employment is 149,291 jobs (see Table 3).

Regarding assessing adequate service for transit-dependent populations, the GIS analysis revealed that the Gallatin Pike corridor has 5,088 zero-car households, 6,453 low income households and 10,752 minority households within 1/2 mile of all proposed stations, each the greatest among the proposed alignments analyzed (Table 3).

For the Goal 3 criteria, Alternative #6 is generally favorable on potential for promoting or connecting TOD in comparison to the other alternatives and generally unfavorable in terms of potential impacts to environmentally sensitive sites, infrastructure and private property. The GIS analysis of parks and wetlands yielded a total of 44.0 acres (32.2 acres of parks and 11.8 acres of wetlands) within 500 feet of Alternative #6. Ten cemeteries and four historic sites also lie within 500 feet of Alternative #6, the greatest number among the proposed alignments analyzed. Additionally, Alternative #6 has the greatest number of residences, schools, businesses and religious facilities near the corridor that could be potentially affected. A total of 2,699 facilities (1,228 residences, 38 schools, 1,299 businesses and 134 religious facilities) may be potentially disrupted by the proposed alignment of Alternative #6.

Regarding the stewardship of transportation funds, the estimated average capital cost range for Alternative #6 is $1,770.4 million, higher than BRT technology for the same corridor. Concerning desired development patterns for transit-supportive land use, the analysis of densely or intensely zoned acres within 1/2 mile of all proposed stations for Alternative #6 yielded a total of 7,833 acres, the most among the proposed alignments analyzed (see Table 3).

Figure 5 shows the proposed Gallatin Pike arterial corridor LRT alignment and stations. Note that for this analysis, the proposed alignment and stations remain the same whether BRT or LRT technology is used.

4.4.7 Alternative #7 - Dickerson Pike Arterial Corridor Bus Rapid Transit (BRT)

Alternative #7 has the longest estimated travel times from one end of the corridor to the other and the largest projected 2035 employment within 1/2 mile of all proposed stations.

For the Goal 1 criteria of improving access and mobility within the study area, the Dickerson Pike corridor proposed alignment with BRT technology ranks as one of the longest estimated travel times from end to end at 99 minutes. The Dickerson Pike corridor has four major activity centers, Volunteer State Community College, Rivergate Mall, City of Madison and the Stadium located within 1/2 mile of the proposed stations. Alternative #7's forecast year 2035 population is 112,509 and the forecast year 2035 employment is 173,268 jobs, the greatest number of all the alternative alignments considered (see Table 3).

Regarding assessing adequate service for transit-dependent populations, the GIS analysis revealed that the Dickerson Pike corridor has 2,850 zero-car households within 1/2 mile of the proposed stations. Additionally, within 1/2 mile of the proposed stations, there are 4,580 low income households and 7,479 minority households (Table 3).

For the Goal 3 criteria, Alternative #7 is generally favorable on potential for promoting or connecting TOD in comparison to the other alternatives and generally unfavorable in terms of potential impacts to environmentally sensitive sites, infrastructure and private property. The GIS analysis of parks and wetlands yielded a total of 273.9 acres (262.1 acres of parks and 11.8 acres of wetlands) within 500 feet of Alternative #7. Four cemeteries and six historic sites also lie within 500 feet of Alternative #7. Additionally, 913 residences, 13 schools, 1,178 businesses and 107 religious facilities (2,211 total) may be potentially disrupted by the alignment of Alternative #7.

Regarding the stewardship of transportation funds, the estimated average capital cost range for Alternative #7 is $768.8 million. Concerning desired development patterns for transit-supportive land use, the analysis of densely or intensely zoned acres within 1/2 mile of all proposed stations for Alternative #7 yielded a total of 5,887 acres (see Table 3).

Figure 6 shows the proposed Dickerson Pike arterial corridor BRT alignment and stations.

4.4.8 Alternative #8 - Dickerson Pike Arterial Corridor Light Rail Transit (LRT)

Alternative #8 has the longest estimated travel times from one end of the corridor to the other and the largest average capital cost range. Alternative #8 also has the greatest projected 2035 employment within 1/2 mile of all proposed stations.

For the Goal 1 criteria of improving access and mobility within the study area, the Dickerson Pike corridor proposed alignment with LRT technology ranks as one of the longest estimated travel times from end to end at 76 minutes. The Dickerson Pike corridor has four major activity centers, Volunteer State Community College, Rivergate Mall, City of Madison and the Stadium located within 1/2 mile of the proposed stations. Alternative #8's forecast year 2035 population is 112,509 and the forecast year 2035 employment is 173,268 jobs, the greatest number of all the alternative alignments considered (see Table 3).

Regarding assessing adequate service for transit-dependent populations, the GIS analysis revealed that the Dickerson Pike corridor has 2,850 zero-car households within 1/2 mile of the proposed stations. Additionally, within 1/2 mile of the proposed stations, there are 4,580 low income households and 7,479 minority households (Table 3).

For the Goal 3 criteria, Alternative #8 is generally favorable on potential for promoting or connecting TOD in comparison to the other alternatives and generally unfavorable in terms of potential impacts to environmentally sensitive sites, infrastructure and private property. The GIS analysis of parks and wetlands yielded a total of 273.9 acres (262.1 acres of parks and 11.8 acres of wetlands) within 500 feet of Alternative #8. Four cemeteries and six historic sites also lie within 500 feet of Alternative #8. Additionally, 913 residences, 13 schools, 1,178 businesses and 107 religious facilities (2,211 total) may be potentially disrupted by the alignment of Alternative #8.

Regarding the stewardship of transportation funds, the estimated average capital cost range for Alternative #8 is $1,906.6 million, the highest of the alternatives considered. Concerning desired development patterns for transit-supportive land use, the analysis of densely or intensely zoned acres within 1/2 mile of all proposed stations for Alternative #8 yielded a total of 5,887 acres (see Table 3).

Figure 6 shows the proposed Dickerson Pike arterial corridor LRT alignment and stations. Note that for this analysis, the proposed alignment and stations remain the same whether BRT or LRT technology is used.

4.4.9 Alternative #9 - CSX Commuter Rail Corridor

Alternative #9 has one of the shortest estimated travel times from one end of the corridor to the other. The CSX commuter rail proposed alignment is generally neutral on potential for promoting or connecting TOD in comparison to the other alternatives and generally neutral in terms of potential impacts to environmentally sensitive sites, infrastructure and private property.

For the Goal 1 criteria of improving access and mobility within the study area, the CSX commuter rail corridor proposed alignment ranks as one of the shortest estimated travel times from end to end at 48 minutes. The CSX rail corridor has three major activity centers, the City of Madison, National Cemetery and Nashville Auto Diesel College located within 1/2 mile of the proposed stations; similar to the proposed I-65/I-24 and Ellington Parkway corridors. The Stadium is just barely outside the 1/2 mile range. Alternative #9's forecast year 2035 population is 49,991 and the forecast year 2035 employment is 121,548 jobs (see Table 3).

Regarding assessing adequate service for transit-dependent populations, the GIS analysis revealed that the CSX rail corridor has 1,796 zero-car households within 1/2 mile of the proposed stations. Additionally, within 1/2 mile of the proposed stations, there are 2,302 low income households and 2,873 minority households (Table 3).

For the Goal 3 criteria, Alternative #9 is generally neutral on potential for promoting or connecting TOD in comparison to the other alternatives and generally favorable in terms of potential impacts to environmentally sensitive sites, infrastructure and private property. The GIS analysis of parks and wetlands yielded a total of 42.6 acres (21.9 acres of parks and 20.7 acres of wetlands) within 500 feet of Alternative #9. Seven cemeteries and three historic sites also lie within 500 feet of Alternative #9. Additionally, 1,792 residences, 14 schools, 263 businesses and 38 religious facilities (2,107 total) may be potentially disrupted by the alignment of Alternative #9.

Regarding the stewardship of transportation funds, the estimated average capital cost range for Alternative #9 is $224.4 million, slightly more than the Hadley Bend commuter rail proposed alignment. Concerning desired development patterns for transit-supportive land use, the analysis of densely or intensely zoned acres within 1/2 mile of all proposed stations for Alternative #9 yielded a total of 3,451 acres (see Table 3).

Figure 7 shows the proposed CSX commuter rail corridor alignment and stations.

4.4.10 Alternative #10 - Hadley Bend Commuter Rail Corridor

Alternative #10 has the lowest estimated capital cost range among the ten alternatives considered in this pre-screening analysis. On the other hand, Alternative #10 touches the fewest activity centers, the least population and employment projected for 2035, the fewest transit-dependent populations, the least densely or intensely zoned land and the most parks and wetlands.

For the Goal 1 criteria of improving access and mobility within the study area, the Hadley Bend commuter rail corridor proposed alignment has an estimated travel time from end to end of 60 minutes. The Hadley Bend commuter rail corridor comes closest to only one major activity center—the Stadium in Downtown. Alternative #10's forecast year 2035 population is 44,310 and the forecast year 2035 employment is 51,483 jobs, both the lowest of all the alternatives analyzed (see Table 3).

Regarding assessing adequate service for transit-dependent populations, the GIS analysis revealed that the Hadley Bend commuter rail corridor has 1,237 zero-car households, 1,960 low income households and 2,363 minority households (Table 3), the lowest number of all the alternatives considered in this analysis.

For the Goal 3 criteria, Alternative #10 is generally negative on potential for promoting or connecting TOD in comparison to the other alternatives and generally negative in terms of potential impacts to environmentally sensitive sites, infrastructure and private property. The GIS analysis of parks and wetlands yielded a total of 308.2 acres (258.5 acres of parks and 49.7 acres of wetlands) within 500 feet of Alternative #10, ranking this alignment last in this criterion. Three cemeteries and five historic sites also lie within 500 feet of Alternative #10. Additionally, 1,615 residences, 15 schools, 353 businesses and 46 religious facilities (2,029 total) may be potentially disrupted by the alignment of Alternative #10.

Regarding the stewardship of transportation funds, the estimated average capital cost range for Alternative #10 is $213.5 million, the lowest of all the technologies and alignments. Note that the proposed alignment's average capital costs exclude the portion of the alignment already existing and in use by the Music City Star line assuming little improvements would be required to accommodate both lines between the Riverfront and Donelson Stations; the overall result is a low average capital cost. Concerning desired development patterns for transit-supportive land use, the analysis of densely or intensely zoned acres within 1/2 mile of all proposed stations for Alternative #10 yielded a total of 3,235 acres, last among all the alternatives considered (see Table 3).

Figure 8 shows the proposed Hadley Bend commuter rail corridor alignment and stations.

Table 3: Prescreening Evaluation Scores

Criteria	Measure	Alternatives									
		1	2	3	4	5	6	7	8	9	10
		BRT	LRT	BRT	LRT	BRT	LRT	BRT	LRT	Commuter Rail	
		I-65/I-24		Ellington Parkway		Gallatin Pike		Dickerson Pike		CSX	Hadley
Goal 1: Improve access and mobility within the study area through identifying mobility solutions and providing alternative transportation options on the corridor.											
End to end travel time (order-of-magnitude) (Gallatin to Nashville)	minutes	46	41	44	40	83	69	99	76	48	60
Number to Major Activity Centers within 1/2 mile	number	3	3	3	3	7	7	4	4	3	1
Forecast year 2035 population within 1/2 mile of station	population	62,300	62,300	62,013	62,013	118,491	118,491	112,509	112,509	49,991	44,310
Forecast year 2035 employment within 1/2 mile of station	employment	123,714	123,714	111,637	111,637	149,291	149,291	173,268	173,268	121,548	51,483
Goal 2: Ensure adequate service is offered to accommodate zero-car households and other transit-dependent populations											
Number of zero-car households within 1/2 mile of stations	households	1,489	1,489	1,839	1,839	5,088	5,088	2,850	2,850	1,796	1,237
Number of low income households within 1/2 mile of stations	households	2,344	2,344	2,763	2,763	6,453	6,453	4,580	4,580	2,302	1,960
Number of minority households within 1/2 mile of stations	households	3,329	3,329	5,236	5,236	10,752	10,752	7,479	7,479	2,873	2,363
Goal 3: Promote environmental sustainability through appropriate development patterns while integrating transportation and land use to reduce auto and truck trips. Additionally, attempt to reduce pollutant emissions to minimize impact on attainment status.											
Potential for promoting or connecting to TOD developments	+ / o / -	o	o	o	o	+	+	+	+	o	-
Qualitative assessment of potential impacts to environmentally sensitive sites, infrastructure, and private property	+ / o / -	+	+	+	+	-	-	-	-	o	-
Acres of potentially affected parks and wetlands within 500 feet.	acres	44.8	44.8	34.5	34.5	44.0	44.0	273.9	273.9	42.6	308.2
Number of potentially affected historic sites and cemeteries within 500 feet.	number	5	5	2	2	14	14	10	10	10	8
Number of potentially affected residences, schools, businesses, or religious facilities within 500 feet	number	1,300	1,300	1,693	1,693	2,699	2,699	2,211	2,211	2,107	2,029
Goal 4: Steward transportation funds to incorporate market and economic analysis for a realistic plan, determine development potential, and recommend incentives for desired development patterns.											
Relative cost to each other as indexed to the average capital cost of all 10 options*	Indexed	0.7	1.7	0.7	1.7	0.7	1.6	0.7	1.8	0.2	0.2
Acres of densely/intensely zoned land within 1/2 mile of stations	acres	3,310.2	3,310.2	4,332.2	4,332.2	7,832.6	7,832.6	5,886.6	5,886.6	3,451.3	3,235.5
Goal 5: Improve safety and security in the corridor while considering the transit/pedestrian/auto interface.											
No evaluation criteria	N/A	o	o	o	o	o	o	o	o	o	o
RESULT	Advance/Do Not Advance										

Qualitative Ratings by Comparison

+ Favorable
o Neutral
- Unfavorable

*Estimated capital costs are presented as an index based upon cost averages typical for each technology and can vary substantially depending upon the design constraints in any particular corridor.

05 Next Steps

5.0 Introduction

The next step is the detailed evaluation of the three alternatives that move forward from the preliminary screening stage. This evaluation will consist of a detailed, mostly quantitative analysis inclusive of cost estimating and travel demand forecasting. To conduct a thorough evaluation, each of the alternatives will need to be well defined in terms of operating plans, concept drawings, and a written description of the physical characteristics. The definitions would also include specific modifications to the underlying bus network to eliminate competing service and/or to provide complementary feeder service as warranted. In addition to the build alternatives, a No-build and a TSM (Baseline) alternative will need to be defined and evaluated.

Table 5 shows the detailed alternatives evaluation criteria summary table that will be completed with the results discussed in a future memorandum.

At the same time, three future land use scenarios for the study area will be developed. Each land use scenario will be depicted by a future land use map covering the entire study area. Each land use scenario will also be associated with future population and future employment quantities that will be derived from the future land use data. The three future land use scenarios will be substantially different in character. One will represent an extrapolation based upon current trends; a second will reflect community feedback on desirable land use patterns; and a third will reflect recommended transit-supportive land use patterns.

Following the establishment of a preferred transportation alternative, the preferred transportation alternative and the baseline will be evaluated both upon the "trend" and upon the "transit-supportive" land use scenarios. This will allow an evaluation of the costs and benefits of the preferred transportation alternative, and it will also allow a prospective view of how transit might be better supported through amendments to current land use policy. As a result, both transportation and land use recommendations will result from the study's analysis.

Table 5: Detailed Evaluation Criteria

Criteria	Measure	No-Build	TSM	Build Alternatives		
				1	2	3
Goal 1: Improve access and mobility within the study area through identifying mobility solutions and providing alternative transportation options on the corridor.						
Total Population Served	Total #					
Total Employment Served	Total #					
Total Households Served (HH)	Total #					
Regional Vehicle Hours Traveled (VHT)	Total #					
# of New Traffic Impediments	Total #					
Estimated Impacts to Level of Service	+ / o / -					
Annual Transit Boardings on New Service	Total #					
Ave. Annual User Benefits	Total #					
Goal 2: Ensure adequate service is offered to accommodate zero-car households and other transit-dependent populations						
Percentage of 0-Car Households	% of Total					
Percent of Low Income Households	% of Total					
Percentage of Minority Population	% of Total					
Goal 3: Promote environmental sustainability through appropriate development patterns while integrating transportation and land use to reduce auto and truck trips. Additionally, attempt to reduce pollutant emissions to minimize impact on attainment status.						
Estimated Regional Emission Reduction	Total #					
Regional Vehicle Miles Traveled (VMT)	Total #					
# of On-Street Parking Spaces Displaced	Total #					
# of Parks and Recreation Areas w/ Likely Impacts	Total #					
# of Wildlife and Waterfowl Habitats w/ Likely Impacts	Total #					
# of Historic and Archeological Sites w/ Likely Impacts	Total #					
# of Residential Units Displaced	Total #					
# of Commercial Units Displaced	Total #					
Goal 4: Steward transportation funds to incorporate market and economic analysis for a realistic plan, determine development potential, and recommend incentives for desired development patterns.						
Total Capital Cost	Total $					
Annual Operating Cost	Total $					
Total Annualized Cost	Total $					
Cost-Effectiveness (Cost/User Benefit)	Total $					
Goal 5: Improve safety and security in the corridor while considering the transit/pedestrian/auto interface.						
Estimated Impacts to Safety	+ / o / -					
Public/Stakeholder Involvement						
Public and Stakeholder Preference	+ / o / -					
RESULT	Advance/ Do Not Advance	**Do Not Advance**	**Do Not Advance**	**Advance**	**Do Not Advance**	**Do Not Advance**

Qualitative Ratings by Comparison

+ Favorable
o Neutral
- Unfavorable

Indicates a Cause for Elimination by Comparison

06 Appendices

Order-of-Magnitude Capital Cost Data for Modes

ORDER-OF-MAGNITUDE COST DATA

Mode	City	Project	Mileage	Stations	Year of Exp. Cost	Year of $	2009 Cost/Mile
HRT	Atlanta	MARTA - North Line Ext.	2.3	2	$463,180,000	1998	$312,919,016
	Los Angeles	Metro - N. Hollywood Ext.	6.3	3	$1,310,000,000	1998	$323,102,814
	San Francisco	BART-SFO	8.7	4	$1,510,000,000	2000	$255,283,148
	Washington	Largo Metrorail Ext.	3.1	2	$433,900,000	2000	$205,869,689
	Miami	North Corridor Extension	9.5	7	$1,372,190,000	2010	$138,885,628
	N. Virginia	Dulles Corridor Ext.-Wiehle Ave.	11.6	5	$2,065,000,000	2010	$171,170,424
HRT Order-of-Magnitude Costs:					**Min. Cost/Mile**		$138,885,628
					Avg. Cost/Mile		$234,538,453
					Max. Cost/Mile		$323,102,814
LRT	Denver	West Corridor	11	14	$624,300,000	2006	$65,700,481
	Houston	Downtown to Astrodome	7.5	16	$300,000,000	2002	$56,284,017
	Los Angeles	Mid-City Exposition	9.6	10	$640,000,000	2010	$63,492,063
	Minneapolis	Hiawatha	11.6	17	$675,400,000	2002	$81,927,209
	Portland	Interstate MAX	5.8	10	$350,000,000	2002	$84,911,232
	Sacramento	South LRT	6.3	7	$222,000,000	2001	$52,062,716
	Salt Lake City	CBD to University	2.5	4	$105,800,000	2000	$62,245,808
	Salt Lake City	Medical Center Ext.	1.5	3	$89,400,000	2002	$83,863,185
	San Diego	Mid Coast Corridor	3.4	3	$131,500,000	2006	$44,772,849
	Phoenix	East Valley Corridor	19.6	27	$1,412,120,000	2007	$77,925,969
	Denver	Southeast	19.1	13	$879,270,000	2007	$49,791,541
	Portland	S. Corridor I-205/Portland Mall	8.3	15	$557,400,000	2007	$72,636,607
	Dallas	Northwest/Southeast MOS	21	16	$1,406,220,000	2009	$66,962,857
	Sacramento	S. Corridor Extension	4.3	4	$226,250,000	2008	$54,720,930
	St. Paul-Minneap.	Central Corridor	11	16	$932,300,000	2012	$75,346,482
LRT Order-of-Magnitude Costs:					**Min. Cost/Mile**		$44,772,849
					Avg. Cost/Mile		$66,176,263
					Max. Cost/Mile		$84,911,232
Comm. Rail	Kansas City	Johnson County I-35	23	5	$30,900,000	2004	$1,714,657
	Lowell	Lowell-Nashua Ext.	12	1	$40,700,000	2004	$4,328,722
	Seattle	Everett to Seattle Line	35	6	$104,000,000	2004	$3,792,380
	Seattle	Lakewood to Tacoma Line	8	3	$86,000,000	2002	$15,126,330
	Wash. Cty, OR	Wilsonville-Beaverton Line	15.3	5	$82,800,000	2005	$6,578,034
	Salt Lake	Weber Co. to Salt Lake City	44	8	$611,680,000	2007	$15,036,207
	Minneapolis	Northstar Corridor Rail	40.5	5	$307,320,000	2007	$8,207,341
	Nashville	Music City Star	32	6	$41,000,000	2006	$1,441,232
	Albuquerque	Rail Runner Phase I	47	9	$135,000,000	2007	$3,106,723
Commuter Rail Order-of-Magnitude Costs:					**Min. Cost/Mile**		$1,441,232
					Avg. Cost/Mile		$6,592,403
					Max. Cost/Mile		$15,126,330
Frwy/ Major BRT	Cleveland, Ohio	Euclid Corridor	9.8	30	$228,600,000	2004	$29,771,221
	Honolulu	Primary Corridor	32.2	31	$683,400,000	2004	$27,087,293
	Pittsburgh	MLK East Busway Extension	2.3	?	$62,800,000	2002	$38,419,959
	Los Angeles	San Fernando Valley E-W Cor.	14.4	13	$314,000,000	2003	$29,221,530
	Hartford	New Britain-Hartford Busway	9.4	11	$458,780,000	2010	$46,929,214
	Houston	North Corridor BRT	5.4	8	$275,340,000	2010	$49,027,778
	Houston	Southeast Corridor BRT	6	11	$169,840,000	2010	$27,217,949
Frwy/Major BRT Order-of-Magnitude Costs:					**Min. Cost/Mile**		$27,087,293
					Avg. Cost/Mile		$35,382,135
					Max. Cost/Mile		$49,027,778
Enhanced Arterial BRT	Kansas City	Troost Corridor BRT	9	25	$30,730,000	2010	$3,283,120
	Springfield	Pioneer Parkway EmX BRT	7.8	14	$36,990,000	2010	$4,559,911
	Grand Rapids	The Rapid	10	n/a	$33,600,000	2007	$3,634,176
Enhanced Arterial BRT Order-of-Magnitude Costs:							$3,825,736
Premium Arterial BRT	Atlanta	SR 120	39	n/a	$311,468,000	2002	$11,237,609
	Atlanta	SR 92/SR 140	45.3	n/a	$327,538,000	2002	$10,173,926
	Atlanta	Camp Creek Pkwy	15.1	n/a	$111,452,000	2002	$10,385,706
Premium Arterial BRT Order-of-Magnitude Costs:					**Avg. Cost/Mile**		$10,599,080