NASHVILLE
NORTHEAST CORRIDOR
MOBILITY STUDY

JULY 2011

NASHVILLE AREA
Metropolitan Planning Organization

AECOM

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Executive Summary

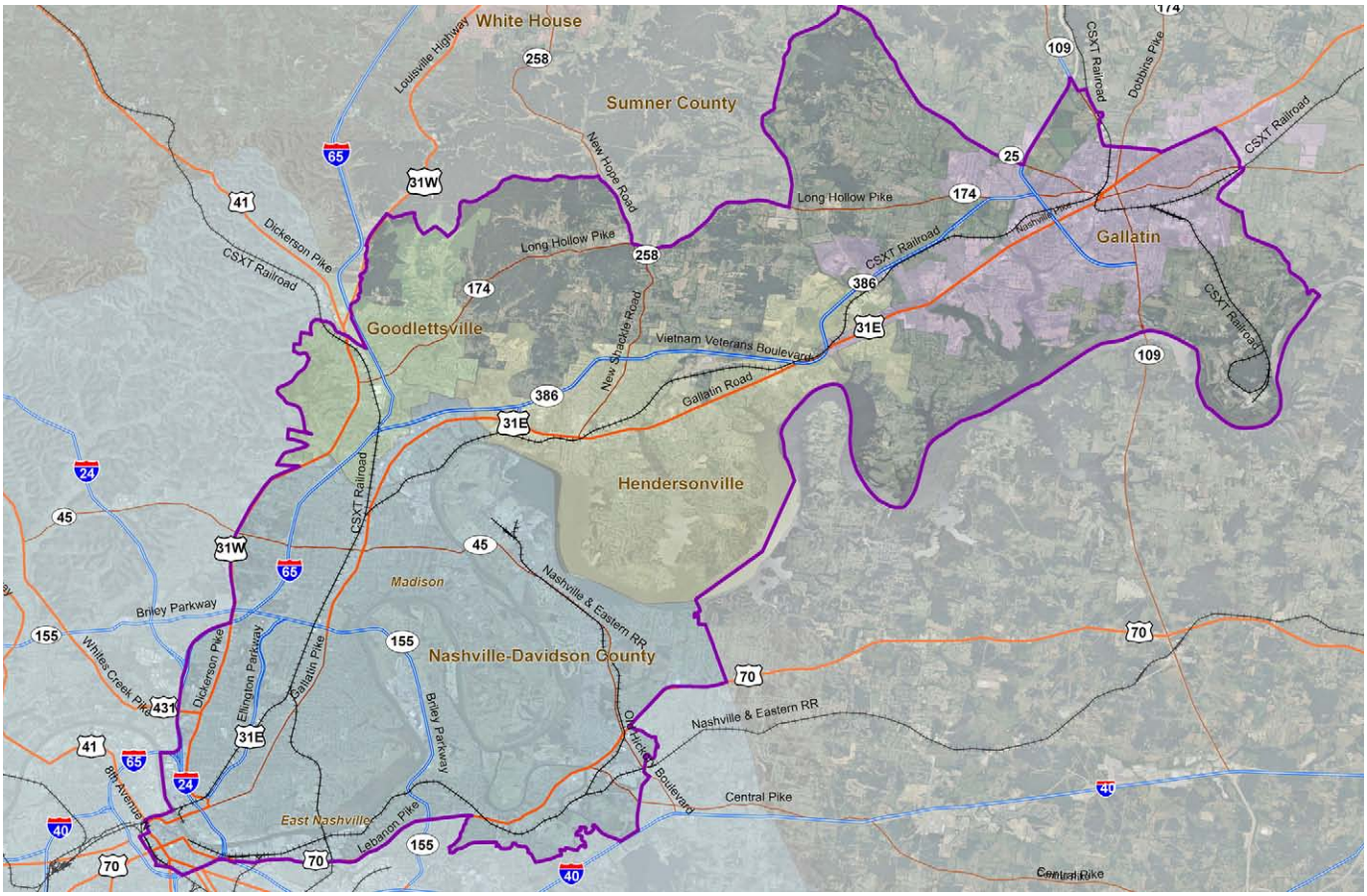


Figure E.1: *Northeast Corridor Study Area*

Figure E.2: *Music City Star, Nashville*

The Northeast Corridor Mobility Study reflects the vision of Northeast Corridor leaders and citizens about the future of their community. The Northeast Corridor of the future features a variety of housing choices, including mixed-use communities supported by transit, as well as more traditional suburban and small-town communities. Key to the realization of this future will be the development of a Light Rail Transit system that both encourages and is supported by walkable, mixed-use communities convenient to transit facilities and offering a range of housing, office, retail and entertainment opportunities. This report describes the recommended steps that the region and individual communities will take to make this vision a reality.

Introduction

Greater Nashville is "Music City USA," a thriving metropolitan area with approximately 1.8 million people in 2010 and projected population of 2.6 million by 2035. The Northeast Corridor stretches approximately 30 miles from downtown Nashville northeast to Gallatin, encompassing the cities of Hendersonville and Goodlettsville and surrounding unincorporated parts of Sumner County. The area is characterized by thriving urban neighborhoods, 20th century and newer suburban neighborhoods, and open spaces. Major transportation corridors include US 31E (called Gallatin Pike in the south and Nashville Pike in the north), Interstate 65, and State Road 386/Ellington Parkway. A 1996 Regional Commuter Evaluation Report identified the Northeast Corridor as an area that might favorably support high-speed transit. An analysis of existing conditions and future trends in the Northeast Corridor was conducted as part of this study in order to understand which characteristics of the area could potentially be leveraged to support this desired type of transit.

The intent of this study is to identify current mobility challenges within the Corridor and to investigate multimodal solutions to the increasing transportation demand created by locally preferred future land use patterns. This study is predicated by the MPO's 2035 Regional Transportation Plan. The three major policy initiatives of the Plan include ,1) a bold new vision for mass transit; 2) support for active transportation and walkable communities; and 3) preservation and enhancement of strategic roadway corridors. The first of these policies, a vision and strategy for transit, includes the Northeast Corridor as a priority corridor for transit improvements. The recommendations of this plan support that policy and provide specifics for the Northeast Corridor as it is outlined in the MPO's regional transit vision.

Need for Transportation Improvements

The Northeast Corridor Mobility Study is needed to address transportation issues in the corridor resulting from increasing population and employment, air quality challenges, and various additional mobility issues, including congestion and the number of transit-dependent citizens in the study area. In addition, the study provides the opportunity for the communities in the study area to assess land use, economic development, and quality-of-life goals, and provides a plan that cohesively addresses all of these elements.

Figure E.3: *Nashville's Music City Circuit currently operates in downtown*

Corridor Growth

Davidson and Sumner Counties have grown substantially in the last 10 to 15 years and are projected to continue strong growth through the year 2035. Sumner County and the City of Gallatin are also emerging as major employment centers. Growth in the Northeast Corridor will continue to have a noticeable impact on accessibility and mobility for those who live, work and shop in the corridor. It will also have a direct impact on land use and quality of life, which warrants the establishment of a preferred land use scenario to coincide with appropriate transportation improvements.

Transit Dependent Population

Improving transit options can provide increased mobility for the transit dependent. A 2006 On-Board Survey for the Nashville Metropolitan Transit Authority (MTA) revealed that 54% of those using transit had zero working vehicles and the vast majority of riders (74 percent) had incomes less than $15,000 a year. This depicts a heavily transit dependent customer base for the MTA.

Improving transit options in the corridor can also attract transit users who have a choice as to which mode of transportation to use. Increasing ridership can have positive impacts for the entire system and all who use transit. Efforts such as MTA's Easy Ride program, which encourages employers and workers to increase transit commuting, can help improve the region's overall ridership profile, making transit a more viable area for public expenditure.

Congestion and Mobility

Traffic volumes on Vietnam Veterans Boulevard have increased substantially since 1996. Vietnam Veterans Boulevard serves as a bypass to Hendersonville, pulling much of the traffic off of Gallatin Pike in this area. The extension of Vietnam Veterans Boulevard to the City of Gallatin draws additional traffic from Gallatin Pike, as well as traffic currently using Dickerson Pike. Through the implementation of the Existing and Committed (E+C) projects in the 2035 Regional Transportation Plan, congestion is expected to improve but not go away entirely.

Air Quality

In the Middle Tennessee region, a large portion of ozone-causing pollutants come from automobiles and trucks. The five counties included in the Nashville Area MPO were designated non-attainment in 1978 and declared maintenance areas in 1996 for the ozone precursor pollutants of NOx and VOC. In December 2004, the region entered into an Early Action Compact (EAC), and is has been on a "fast-track" towards air quality attainment. However, the EPA his revising its standards for 8-hour Ozone and it is likely that the Nashville region will remain in non-attainment under the new standards.

Project Goals and Vision

To ensure that the mobility needs of the community are addressed, the project team focused on the following issues:

- ***How do various growth scenarios inform demand for specific land uses such as residential, office, commercial and retail?***
- ***What mix of transportation investments will most effectively meet the demand resulting from potential growth scenarios?***
- ***What is the most appropriate mix of future land uses in the study area that encourage (and maximize the use of) specific transportation modes like bus rapid transit or commuter rail?***
- ***What potential benefits and costs are there to local, state, and federal governmental entities including transit service providers?***
- ***What are the fundamental economic connections among, and associated advantages of, land use planning, real estate development and various transportation-related initiatives such as joint development, transit-oriented development (TOD), transit-adjacent development (TAD), and other mechanisms?***

Discussions with the public as well as local government officials led to the development of the evaluation criteria and methodology aimed at analyzing the array of transportation options available to the study area. The criteria were based on current understanding of issues within the study area and throughout the region, and the transportation needs expressed by local decision-makers and representatives of local transit agencies. Additionally, a corridor vision was developed that reflects the ideas proposed by stakeholders, public participants, and planning agencies. Reaching a broad consensus among key stakeholders is an essential element to ensuring a successful outcome. It was important that all stakeholders who live, work and have an interest in the corridor were kept informed during the project, given opportunities to provide input, and made aware that the project team is mindful of their issues. Providing continuous opportunities for meaningful dialogue with stakeholders, agencies, decision-makers and the public allowed for collaboration and interaction between all entities. These discussions led to the formulation of the following guiding principles for the project:

Guiding Principles
1 PROTECT VALUABLE RESOURCES
Historic Buildings and Landmarks; Natural Resources; Open Space; Agricultural Lands; Air & Water Quality; Community Character & Identity
2 IMPROVE ACCESS TO ECONOMIC OPPORTUNITIES
More Options to Commute to Jobs and Schools; Better Accessibility to Local Businesses
3 IMPROVE ACCESS TO GOODS & SERVICES
Protect Local Businesses; Encourage More Diversity in the Local Marketplace; Plan for Mixed-Use Developments
4 INCREASE HOUSING CHOICES
Preserve Low Density Options; Increase Higher Density Options
5 IMPROVE AESTHETICS THROUGHOUT THE CORRIDOR

These principles are expressed in the overarching project vision:

> ***Expand and promote alternative transportation options to reduce congestion, protect air quality, and facilitate desired walkable development patterns.***

Public Outreach

The Northeast Corridor Mobility Study was conducted in coordination with an extensive public outreach program that was intended to offer a wide range of venues for the project team to obtain direct public input and for the public to have numerous opportunities to review, comment and help guide the development and evaluation of the identified mobility options. The Public Involvement Plan (included as Appendix A of this report) was designed to educate the public on the basis of the study and the planning process while creating the forum to address the stated public involvement objectives.

This process included a wide range of outreach tools to establish and maintain a healthy and interactive exchange of ideas and information between the project team and the stakeholders and general public participants. Character Preference Surveys were conducted using images of transportation and development types, “before and after” renderings and 3-D simulation to reflect the relationships between buildings, open spaces, streets and the human scale. Multi-media video was incorporated to express the unique elements of the study area. News releases, fact sheets and project bulletins were developed and disseminated to offer information and project status. As a primary element of the community outreach, Corridor Workshops were organized and held in the major communities along the corridor.

The results of the public workshops were used in developing the preferred land use scenarios in the corridor, as well as the final recommendation of working toward making light rail feasible in the corridor. The routes of the alternatives studied were also modified as a result of input received from the public and community officials.

Figure E.4: *Public meetings and workshops*

Transportation Alternatives

The team identified a wide range of potential alternatives, which are illustrated in Table E.1. Figures E-8 illustrates the alternatives originally considered. Following an in-depth analysis of the alternatives and discussions with the public and community officials, three alternatives were selected for detailed evaluation:

#1 - Commuter Rail along the CSX Corridor

#2 - LRT along Ellington Parkway/SR-386 Corridor

#3 - BRT along the Gallatin Pike (US – 31E) Corridor

Figures E-9, E-10 and E-11 illustrate the locations of these alternatives.

Figure E.6: *Denver, Colorado, an example of LRT*

Figure E.5: *Las Vegas MAX, an example of BRT*

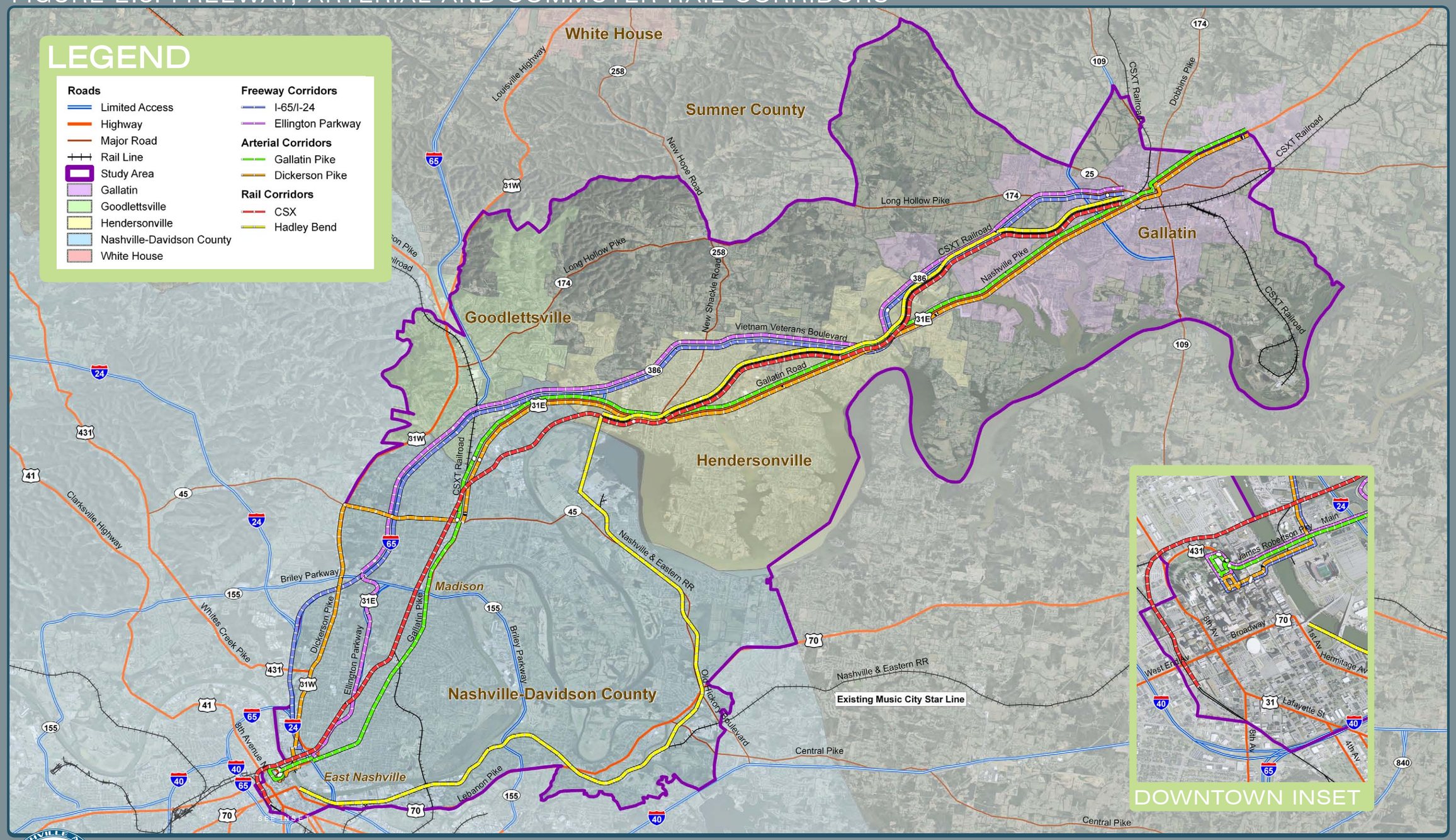
Figure E.7: *EMU - Metra, Chicago, an example of commuter rail*

Table E.1: 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

STUDY AREA CANDIDATE CORRIDORS

FIGURE E.8: FREEWAY, ARTERIAL AND COMMUTER RAIL CORRIDORS



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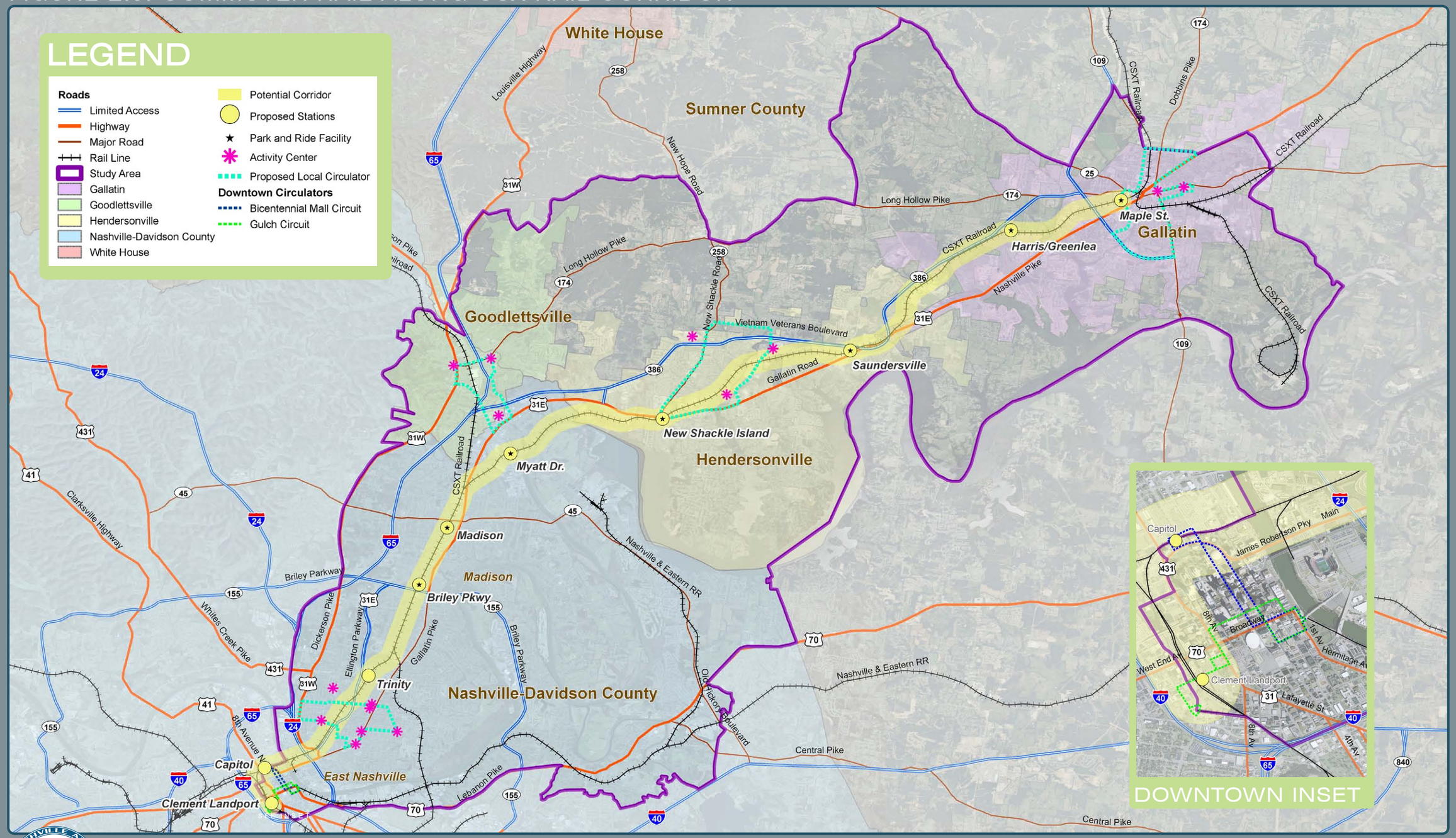
STUDY AREA COMMUTER RAILROAD CORRIDOR

FIGURE E.9: COMMUTER RAIL ALONG CSX RAIL CORRIDOR



STUDY AREA FREEWAY CORRIDOR

FIGURE E.10: LIGHT RAIL TRANSIT FREEEWAY: ELLINGTON PARKWAY/I-65/VIETNAM VETS

LEGEND

Roads
- Limited Access
- Highway
- Major Road
- Rail Line
- Study Area
- Gallatin
- Goodlettsville
- Hendersonville
- Nashville-Davidson County
- White House

- Proposed Alignment
- Potential Future Spur
- Proposed Station
- Park and Ride Facility
- Activity Center
- Proposed Local Circulato

Downtown Circulators
- Bicentennial Mall Circuit
- Gulch Circuit

White House
Sumner County
Goodlettsville
Hendersonville
Gallatin
Madison
Nashville-Davidson County
East Nashville
Cleveland
Trinity
Old Hickory
New Shackle Island
Saundersville
Harris/Greenlea
Maple St.
Conference Dr.
Music City Central
Louisville Highway
New Hope Road
Long Hollow Pike
Vietnam Veterans Boulevard
Gallatin Road
Nashville Pike
CSXT Railroad
Dobbins Pike
Briley Parkway
Ellington Parkway
Dickerson Pike
Gallatin Pike
Whites Creek Pike
Clarksville Highway
8th Avenue N
Old Hickory Boulevard
Nashville & Eastern RR
Central Pike
Lebanon Pike

DOWNTOWN INSET
James Robertson Pky
Main
Music City Central
Broadway
8th Av
1st Av
Hermitage Av
West End Av
Lafayette St
4th Av

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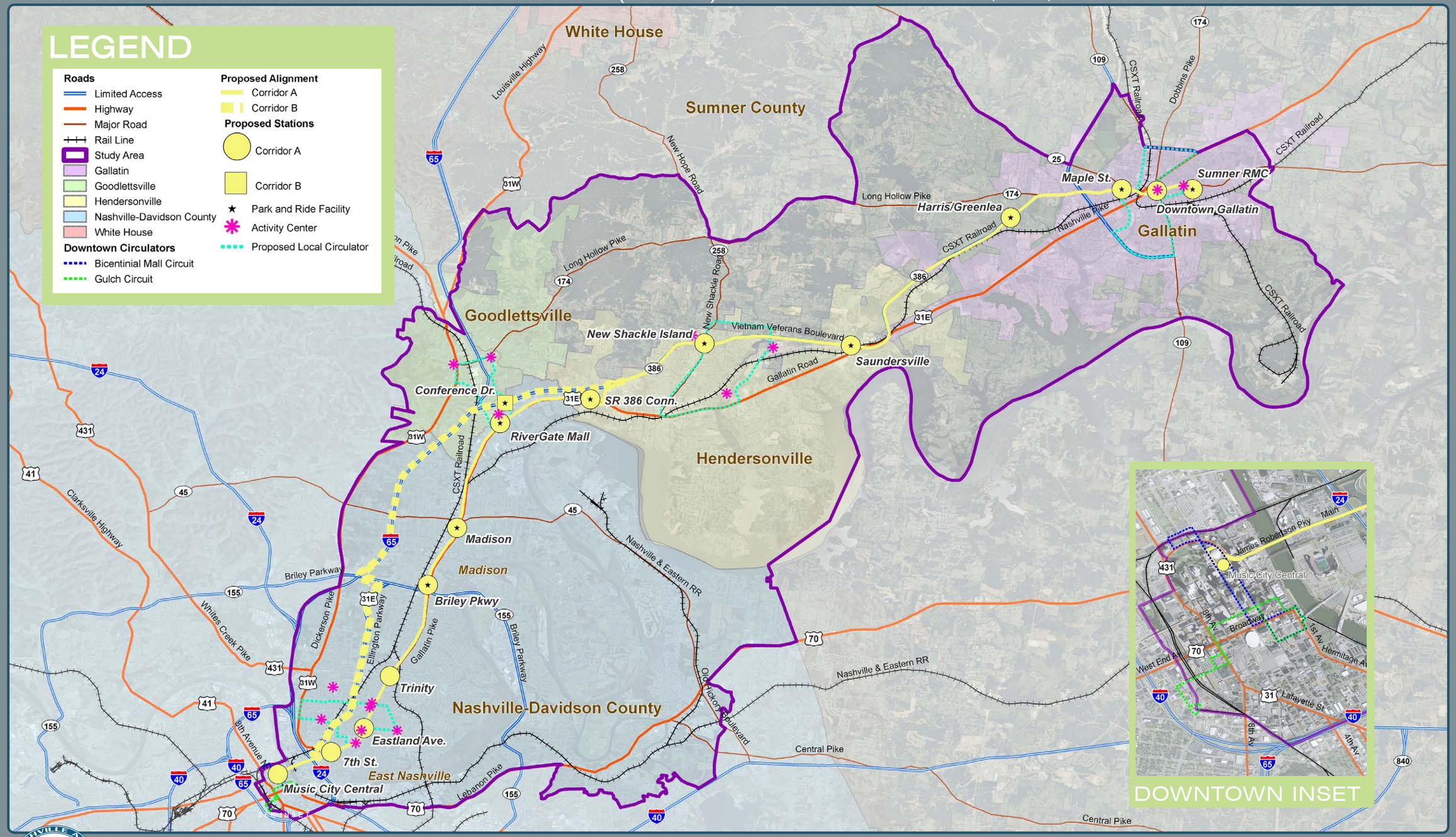
STUDY AREA ARTERIAL CORRIDOR

FIGURE E.11: BUS RAPID TRANSIT GALLATIN PIKE (US 31E) ELLINGTON PARKWAY/I-65/VIETNAM VETS



NORTHEAST CORRIDOR MOBILITY STUDY

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Summary of Alternatives Comparison

Table E.2, Estimates of Probable Cost, illustrates a summary of the modeling and cost estimating results for the No-Build, BRT, LRT, and commuter rail (CRT) alternatives. As indicated on the table, none of the alternatives is projected to achieve ridership or cost efficiency levels that would be competitive for federal funding. However, all three "Build" alternatives—BRT, LRT, and CRT would attract significantly greater ridership than the No-Build Alternative. Improved facilities, in the form of a new transit system in the corridor, would definitely attract many more people to use transit for work-related and other trips. The cost of building any of these proposed systems would be great ($373 million to $1.96 billion), and a source of funding would also need to be identified for operating costs.

Of the three build alternatives, the CRT would attract the lowest number of riders for a medium-level cost, so this alternative is not recommended for further analysis. The LRT has the highest cost, but also the highest ridership. BRT is projected to attract approximately 84 percent of the ridership of LRT, at approximately 19 percent of the cost. Operating costs of BRT are projected to be approximately 50 percent of operating costs of LRT.

Table E. 2: Estimates of Probable Cost

Route	No-Build	BRT Build	LRT Build	CRT Build
Average Weekday Projected Ridership (2035)	3,540	5,514	6,535	4,743
Annual Ridership (2035 with Annualization Factor of 311)	1,100,940	1,714,854	2,032,385	1,475,073
Total Order of Magnitude Capital Cost (2010 $)	$0	$373,000,000	$1,964,000,000	$630,000,000
Annualized* Capital Cost (2010 $) Assuming 7% Annualization Rate	$0	$26,110,000	$137,480,000	$44,100,000
Miles	-	29.4	30.7	27.1
Cost Per Mile	-	$12,687,075	$63,973,941	$23,247,232
Annual* Operating Cost (2010 $)	$0	$12,722,000	$25,371,600	$24,288,134
Total Annual Cost (2010 $; Capital + Operating)	$0	$38,832,000	$162,851,600	$68,388,134
Average Weekday User Benefits	0	3,584	4,171	3,277
Average Annual User Benefits (2035 with Annualization Factor of 311)	0	1,114,624	1,297,181	1,019,147
*Cost Efficiency (NOT FTA Cost Effectiveness)***	*NA*	*$34.84*	*$125.54*	*$67.10*
Average Annual Cost per Annual Boarding	*NA*	*$22.64*	*$80.13*	*$46.36*

**Annualized cost refers to a cost that has been adjusted to a yearly rate, though the cost may be incurred or quoted for a time frame other than a year (generally less than a year). Annual cost refers to a cost that is actually incurred on a yearly basis.*

***Cost Efficiency is a term used in this study to describe measures that combine cost and performance, and should not be confused with FTA Cost Effectiveness, which is used by FTA to help determine if a project is eligible to advance in the New Starts process.*

Short and Long-Term Strategies

The detailed alternatives analysis revealed that the BRT alternative has the lowest cost and transportation benefits that are less robust than LRT, but not significantly less. Input from the community as well as local elected officials have revealed that the strong local preference is for the LRT alternative, which has economic and regional identity benefits that they believe in the long term will justify the additional cost. Therefore, the recommendation of this report is to work toward the long-term vision of LRT from downtown Nashville to downtown Gallatin. Interim steps include changing land use regulations and providing incentives to encourage transit-supportive development, identifying a dedicated source of funding for transit in the corridor, and developing BRT (see

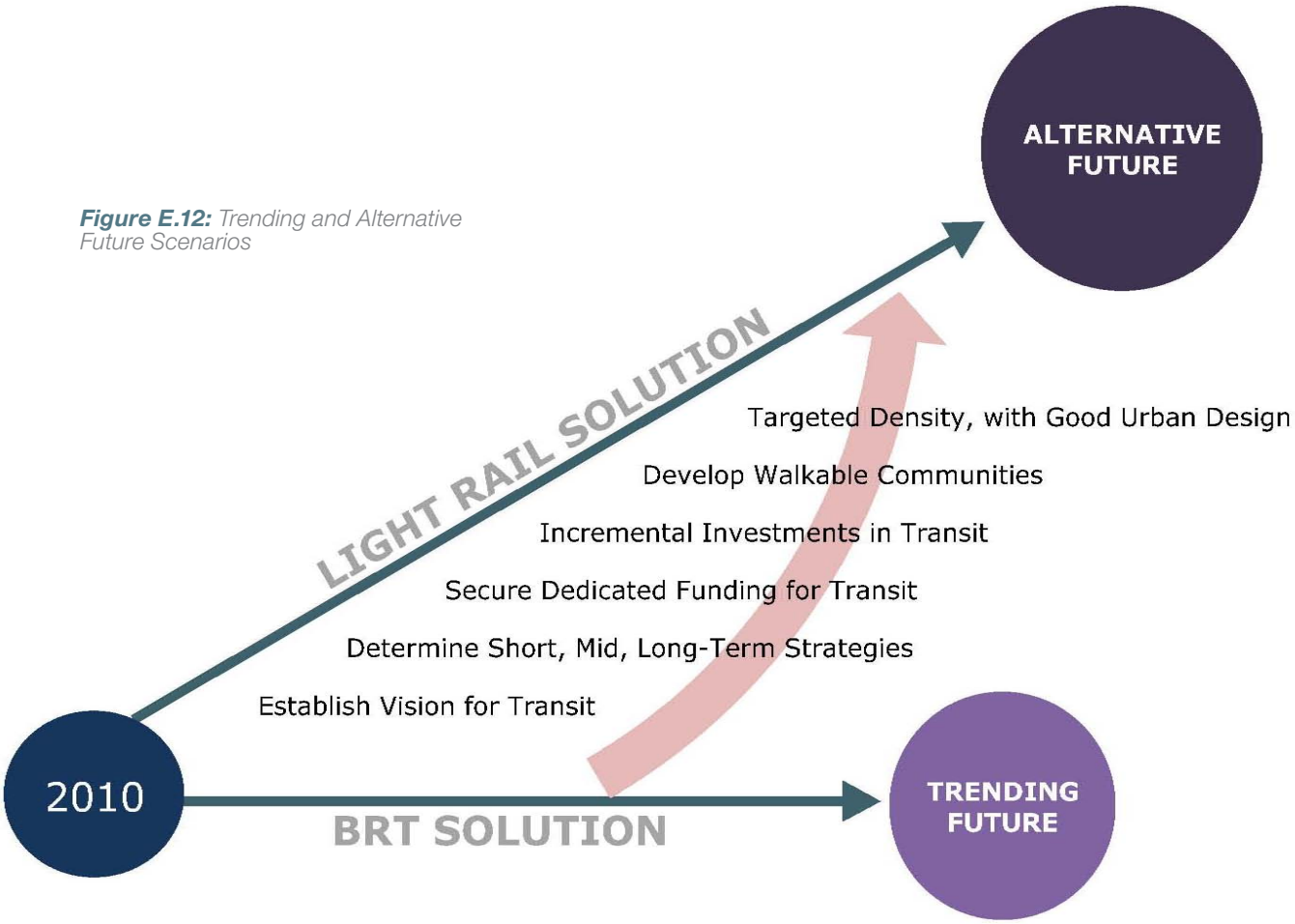
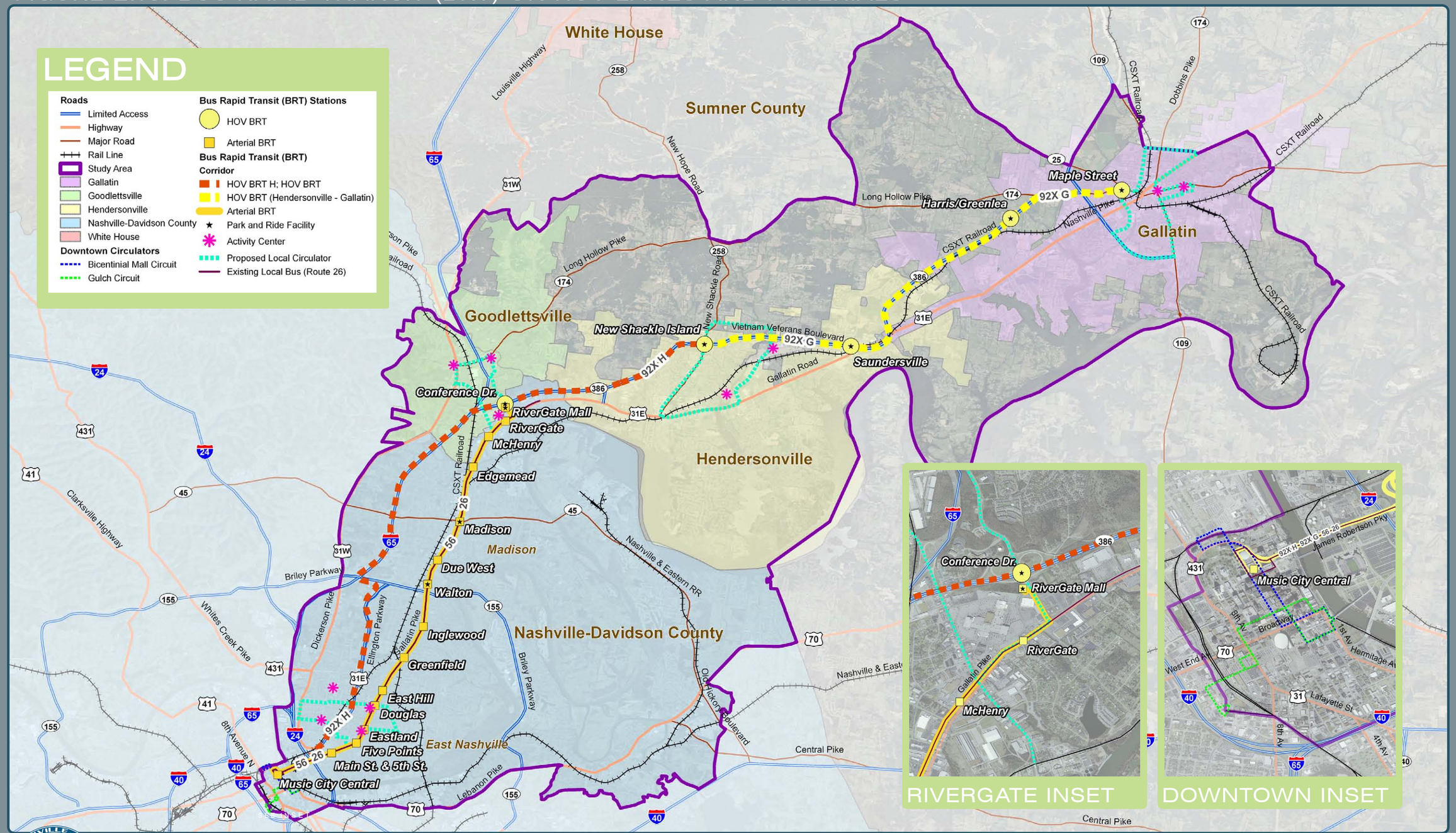


Figure E.12: *Trending and Alternative Future Scenarios*

STUDY AREA PREFERRED ALTERNATIVE

FIGURE E.13: BUS RAPID TRANSIT (BRT) ON HOV LANES AND ARTERIALS



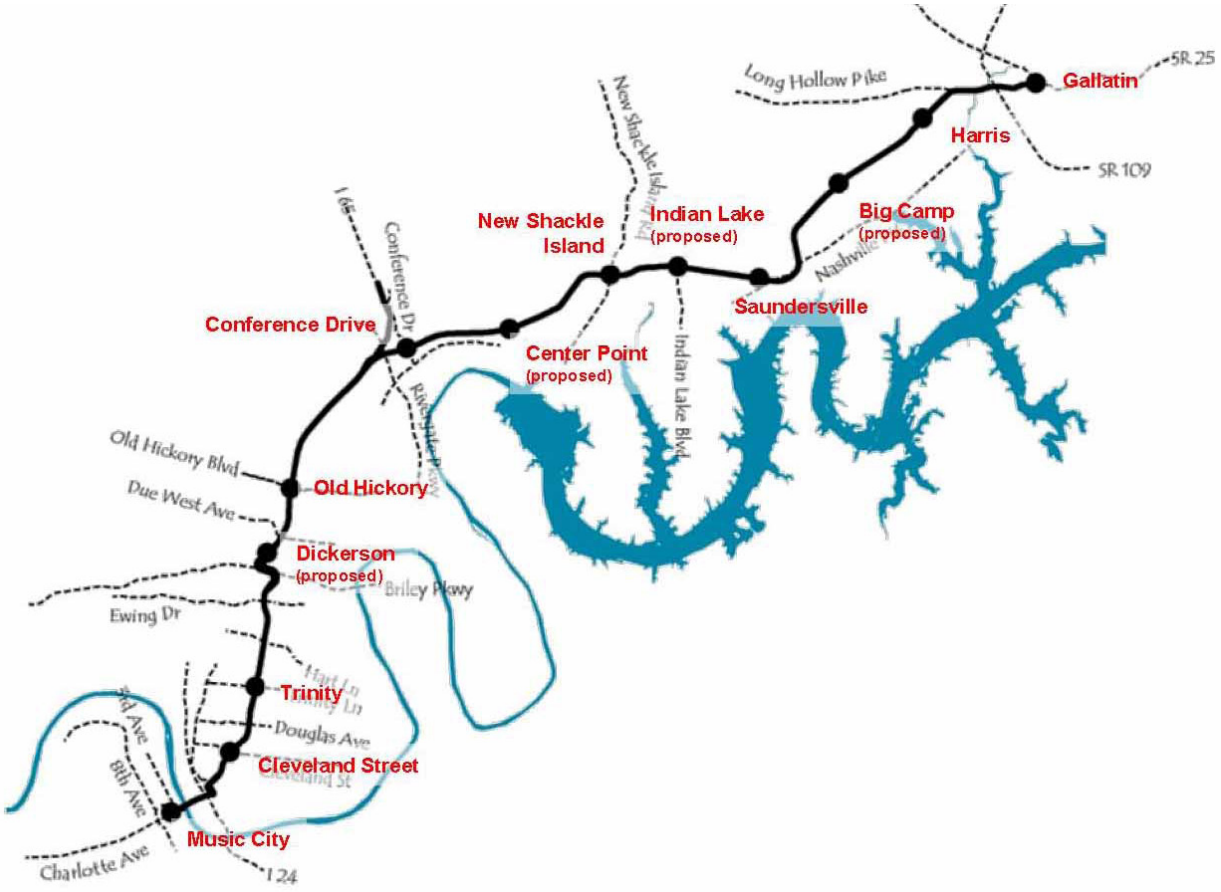


Figure E.14: *Light Rail Transit Proposed Station Areas*

Figure E.13) in the near-term (10 years) that can be phased into LRT once conditions are suitable.

Recommendations

The Northeast Nashville Corridor community envisions its future with more housing, shopping, and employment choices: urban, suburban and rural environments will offer a wide variety of options for residents and businesses, including options for reducing dependence on the single-occupant auto for trips related to work and leisure. There is strong support to implement Light Rail Transit (LRT) in the corridor should funding and travel demand make such an investment viable in the future. Implementing LRT in this corridor will both support and be supported by changes in land use patterns. The plan recommends and envisions development of walkable, transit-supportive communities near proposed LRT stops. Specific findings and recommendations include:

Land Use. Local governments in the corridor should adopt land use and other policies to encourage the type of transit-supportive development that will make LRT more feasible. For transit to be feasible in the corridor, more residents and businesses should be attracted to the corridor, with some of these in denser developments in station areas (see Figure E.15). If the region can concentrate most of the growth in the corridor within a ½-mile of proposed station locations, the forecasts for transit use will increase, making the corridor more competitive for funding for LRT.

Economic Development. Analysts concluded that transit-oriented development (TOD) can have significant positive short-term and long-term economic and fiscal impacts to the region. A prototype TOD development was estimated to account for approximately 3,000 employee-years over the duration of planning and construction. Total on-site permanent employment is estimated at approximately 1,100 full-time equivalent jobs for the associated office space and 450 jobs attributable to the retail component. Total wages for on-site

employment are estimated at approximately $64 million. Revenues to local governments and the state from sales, income and property taxes would also be expected to be significantly enhanced with these new developments.

Urban Design. Transit-oriented development can vary widely in its design and mix of uses. Downtown Nashville looks very different from Hendersonville or the many local neighborhoods that can be served by transit. In general, however, TOD has certain characteristics for a simple reason—so that more people can live, work, shop, or go to school within walking distance of the station. Generally, planning and design for station areas should include land-use intensities that are compact and dense relative to their surroundings; a rich mix of land uses, a great public realm, and shared parking that doesn't dominate the appearance of the development. Figure E.16 illustrates a potential TOD, with densities and design features appropriate for the Northeast Corridor.

Transportation. The plan recommends development of a new BRT in the corridor, including development of new BRT using HOV lanes on Ellington Parkway/SR386 that can eventually be phased into LRT when feasible. In addition, the plan recommends enhancements to the current MTA Routes 26 and 56, as well as local circulators.

Specific short-term actions to realize the vision include:

- Conduct a robust public education campaign to build support and make sure the entire community understands the benefits of transit
- Revise land use plans and policies to allow for greater density and transit-supportive mixed land uses
- Provide economic incentives for private developments that will support transit
- Leverage federal and local funds creatively to provide infrastructure that will support transit
- Build a Bus Rapid Transit System on SR 386/SR 6 that will provide congestion relief, attract transit-supportive development, and build ridership
- Monitor land uses and transportation patterns and revisit transportation modeling on a regular basis, for example every five years, to evaluate the feasibility and potential competitiveness of a Light Rail Transit System
- Make the following transportation investments:

1. Express BRT in HOV Lanes

Route 92XG and 92XH would provide express BRT service from Nashville to Hendersonville and Gallatin. The buses would operate in new HOV lanes with highway median stations and park-and-ride lots. This express type service is designed to accommodate longer commutes and would have infrequent stops.

2. Arterial BRT

Route 56 would be a modification of the existing Route 56 BRT. This service would continue to operate along Gallatin Pike from Nashville to RiverGate Mall and stop at the same moderately spaced stations as it does now. It would also provide a new transfer opportunity to the 92X routes at RiverGate Mall. Increased frequency of service, enhanced stations, queue jumps and some dedicated bus lanes are envisioned.

3. Local Bus

Route 26 would continue to provide local bus service from Nashville to Walmart primarily along Gallatin Pike in mixed traffic. This service would match the existing Route 26 and continue to make frequent stops at closely spaced bus stops. This service is aimed toward shorter trips and trips where convenient pedestrian access is important

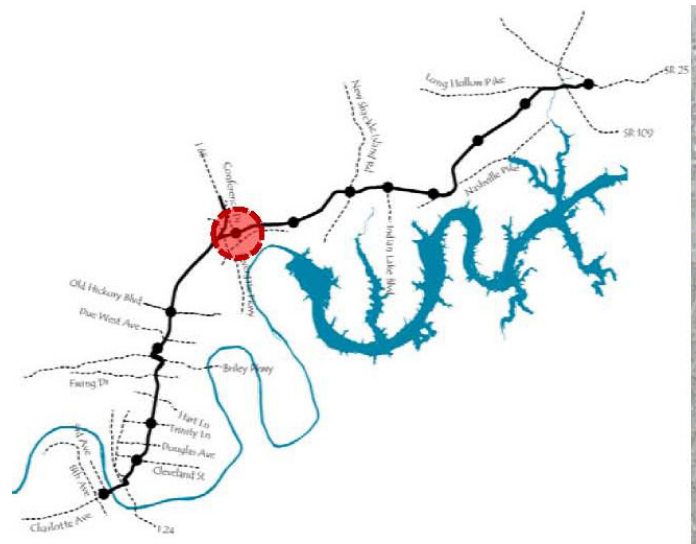
4. Circulator Bus

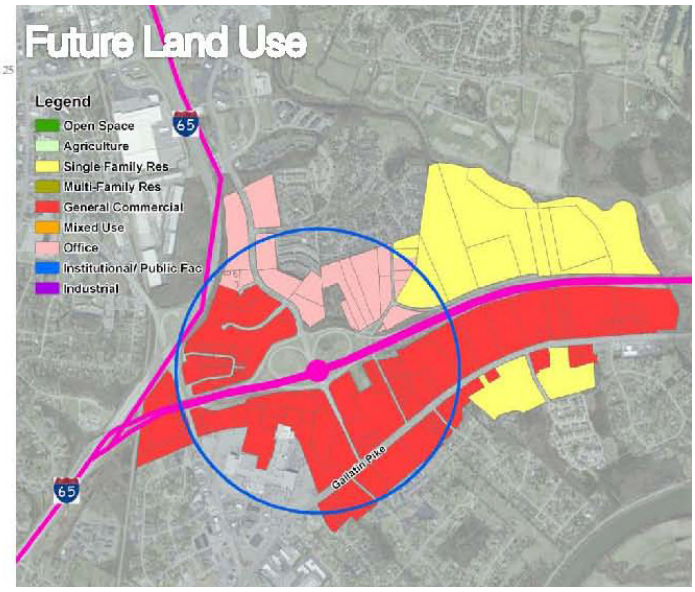
This type of service would be provided in Northeast Nashville, Goodlettsville, Hendersonville and Gallatin. Each circulator would provide transit connections to the major trip generators within each community and provide a direct connection to one or more of the services described above to accommodate longer trips by transit.

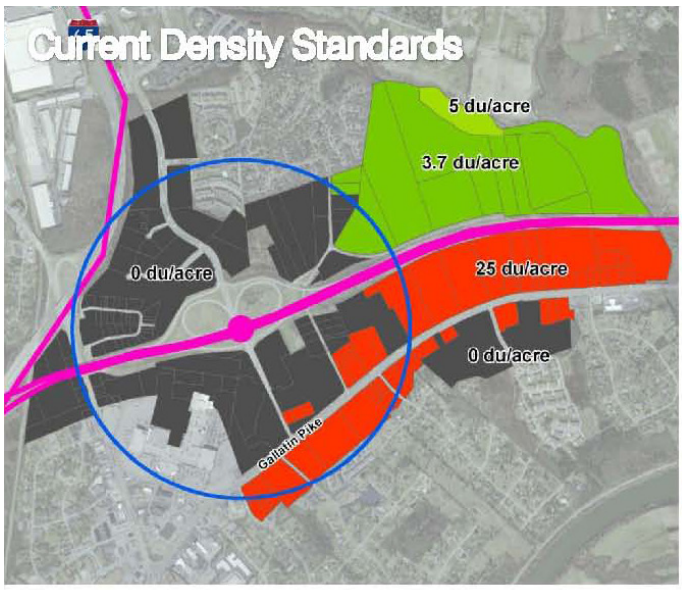
Conclusion

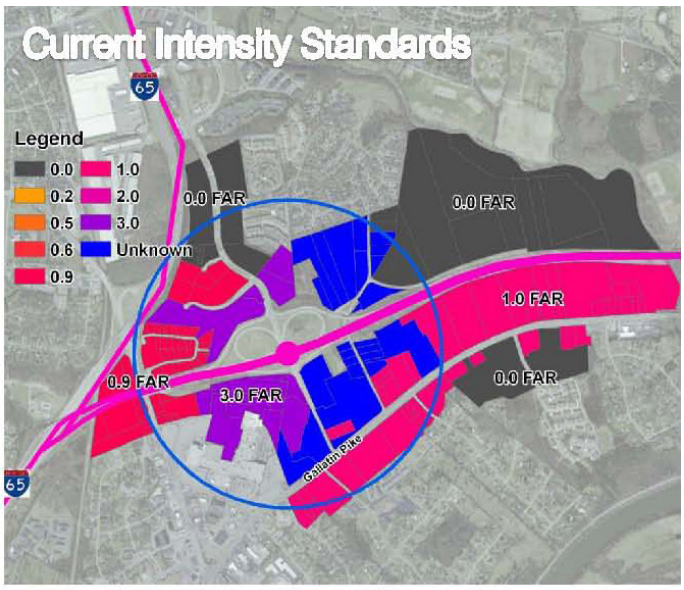
Regional public officials, stakeholders, and citizens have come together to form a vision for the Northeast Corridor that includes transit that supports and is supported by a variety of choices in housing, employment, shopping, and recreation.

Though much work remains to be done, this study provides a critical first step and a guiding framework to making transit a reality in the Northeast Corridor.









	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	**15-20** units/acre minimum (net)	**15-75** units/acre 26 units/acre (net) average	**25** units/acre maximum
Non-Residential Density (FAR)	**.50-.75** FAR minimum (net)	**.25-4.5** FAR .70 FAR (net) average	**3.0** FAR maximum

Figure E.15: *Conference Drive Station, one of the many proposed along the corridor*

Figure E.16: *Greenfield Transit Oriented Development Concept Model - Hendersonville*

1.0 Introduction

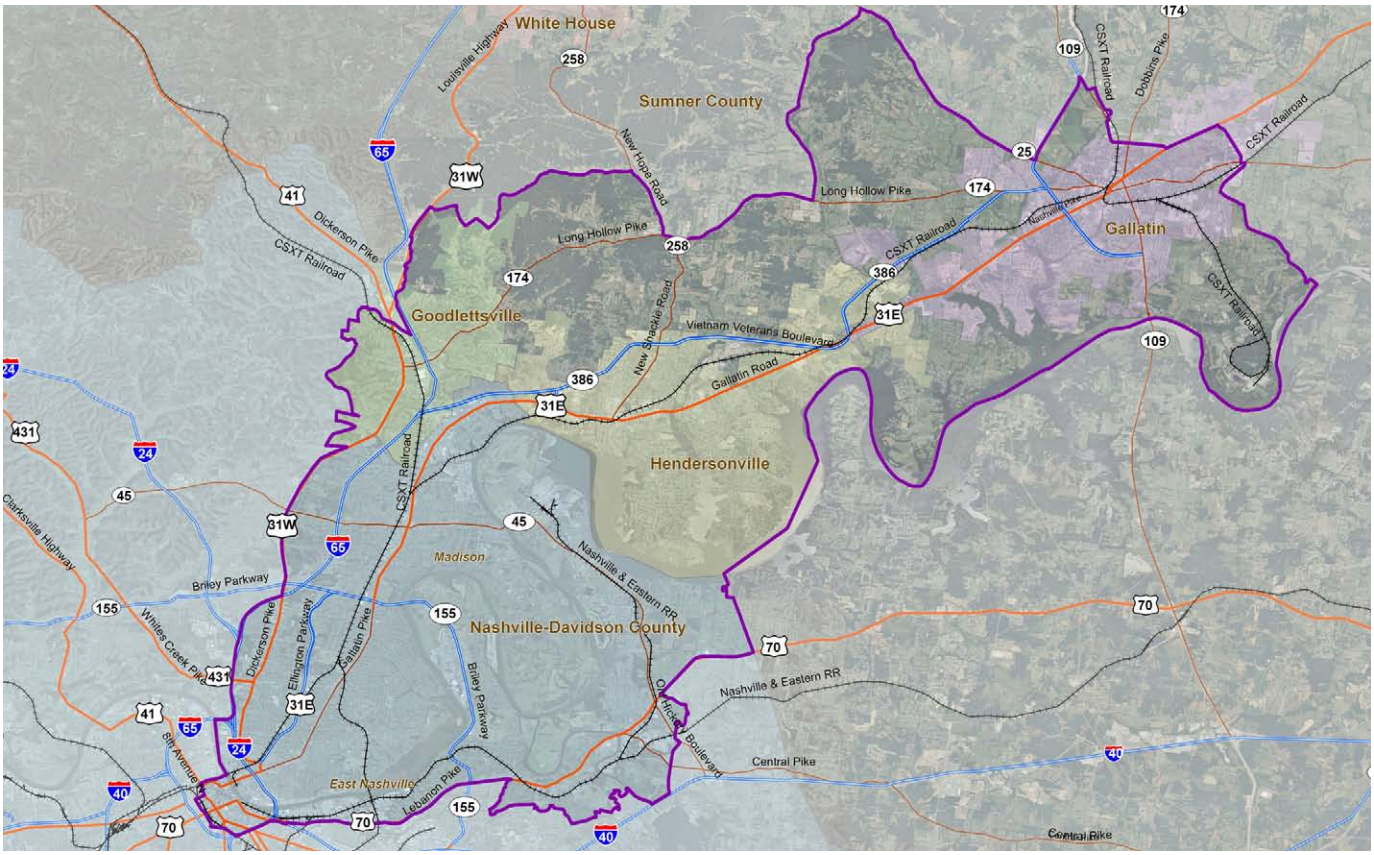


Figure 1.1: *Northeast Corridor Study Area*

In the fall of 2007 the Nashville Area Metropolitan Planning Organization initiated the Northeast Corridor Mobility Study to analyze and recommend appropriate transportation improvements within a 30 mile corridor. Recognizing the significance of the Northeast Corridor, the study recommendations provide options to serve existing and future transportation markets within the context of the greater Nashville area.

1.1. Study Area Context

Greater Nashville is "Music City USA," a thriving metropolitan area with approximately 1.8 million people in 2010 and projected population of 2.6 million in 2035. The Northeast Corridor stretches approximately 30 miles from downtown Nashville northeast to Gallatin, encompassing the cities of Hendersonville and Goodlettsville and surrounding areas. The area is characterized by thriving urban neighborhoods, 20th century and newer suburban neighborhoods, and open spaces. Major transportation corridors include US 31E (called Gallatin Pike in the south and Nashville Pike in the north) and State Road 386/Ellington Parkway.

1.2. Purpose and Need for Study

The Northeast Corridor Mobility Study was initiated by the Nashville Area Metropolitan Planning Organization (MPO). The intent of the study is to identify the current mobility challenges within the Corridor and to investigate multimodal solutions to

the increasing transportation demand created by the locally preferred future land use patterns.

This study is consistent with the MPO's 2035 Regional Transportation Plan, intended to help alleviate traffic congestion, provide more transportation choices, improve transportation system operations, and meet the region's air quality goals.

1.2.1. Project History

The heart of the Nashville region is a crossroads of three major interstate routes in the southeast: Interstate 65, Interstate 40, and Interstate 24. These interstates are used not only by travelers within the region, but also in large part by the nation's trucking industry. Historically, the five-county region that 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 region have produced travel demands that strain the existing highway system and pose environmental concerns such as reduced air quality.

Nashville's Regional Transportation Plan serves as a guide for both land use planning and the transportation system in the Nashville region. The plan ensures that land use planning supports 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 region has increased transit services, including shared ride systems, Metropolitan Transit Authority (MTA) and Regional Transit Authority (RTA) bus routes and services, 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 expanded services, increased travel demand has spurred the MPO to investigate alternative means of providing additional capacity.

The 1996 Regional Commuter Evaluation Report identified the Southeast and Northeast corridors as areas that might favorably support high-speed transit. As a result, a 2007 study evaluated potential high-performance transit systems along the Southeast Corridor, from Nashville to Murfreesboro. The Southeast Corridor Study[1] 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.

This study addresses similar issues in the Northeast Corridor, with increased emphasis on the relationships of land use and transportation alternatives.

1 Southeast Corridor High Performance Transit Alternatives Study. 2007. http://www.nashvillempo.org/southeast/

1.2.2. Need for Transportation Improvements

Population and Employment Growth

As will be further described in Sections 2.1 and 2.2, Davidson and Sumner Counties have grown substantially from 1990 to 2008 and are projected to continue strong growth through the year 2035, which is the horizon year for this study.

With the growth in the number of college educated persons and increase in population, employment centers are also emerging along the corridor. Sumner County, the City of Hendersonville, and the City of Gallatin are emerging as major employment centers, no longer considered simply bedroom suburbs of Nashville.

Growth in the Northeast Corridor will continue to have a noticeable impact on accessibility and mobility for those who live, work and shop in the corridor. Efficient and well-planned transportation improvements in the study area can provide the region with the ability to leverage its strengths to attract and sustain a strong employment base. Additionally, growth in the corridor will have a direct impact on land uses and quality of life, which warrants the establishment of a preferred land use scenario to coincide with appropriate transportation improvements.

Community and Environmental Sustainability

The growth experienced in the Nashville region over the last several decades has resulted in the conversion of large swaths of previously undeveloped land into low-density automobile-oriented development. There are many disadvantages to this pattern of development, including diminished agricultural lands and open space opportunities, encroachment upon critical ecologies and habitats, increased congestion and commuting time, and physically inactive populations. Furthermore, such low density development is costly to the public by increasing demand for the expansion and maintenance of inefficient infrastructure systems at a time when public sector budgets are already overextended.

By contrast, a regional growth pattern characterized by dense walkable town centers and urban nodes linked by transit could produce numerous sustainability benefits for the region. Supporting regional quality growth is a major objective of transit planning in the Nashville region. Expansion of transit, when coupled with smart land use strategies, can result in both increased transportation and housing options, allowing communities to support a mix of ages and incomes, increased access and mobility, and more physically active lifestyles while saving funds and preserving natural and cultural resources for future generations. Giving people more transportation choices means they can drive less and thus emit less carbon into the atmosphere. The benefits provided by a robust public transit system and the complimentary encouragement of transit-oriented development (TOD) form a significant impetus for the Northeast Corridor study.

Transit Dependent Population

mproving transit options can provide increased mobility for the transit dependent. A 2006 On-Board Survey for the Nashville Metropolitan Transit Authority (MTA) revealed that 54% of those using transit had zero working vehicles and the vast majority of riders (74%) had incomes less than $15,000 a year. This depicts a heavily transit dependent customer base for the MTA.

Improving transit options in the corridor can also attract transit users who have a choice as to which mode of transportation to use. Increasing ridership can have positive impacts for the entire system and all who use transit. Efforts such as MTA's Easy Ride program, which encourages employers and workers to increase transit commuting, can help improve the region's overall ridership profile, making transit a more viable area for public expenditure.

Table 1.1 shows the number of 0 and 1 Vehicle Households in Gallatin, Hendersonville and Goodlettsville. Gallatin appears to be the most transit dependent with some 8% of its households not owning a vehicle and another 30% having only one vehicle.

Table 1.1: Sumner County Households by Vehicles Available (2005)

	Total Households	0 Vehicle Households	1 Vehicle Households
Gallatin	14,497	1,130	4,401
Hendersonville	19,977	701	5,356
Goodlettsville	11,595	419	3,345

Source: Forward Sumner County Economic Coucil http://www.forwardsumner.org/demographics.aspx

Congestion and Mobility

Traffic volumes on Vietnam Veterans Parkway have increased substantially since 1996. Vietnam Veterans Parkway serves as a bypass to Hendersonville, pulling much of the traffic off of Gallatin Pike in this area. This is reflected in the 26% increase in traffic on Vietnam Veterans Parkway and 21% decrease in traffic on Gallatin Pike in Hendersonville. The completed extension of Vietnam Veterans Parkway to the City of Gallatin draws additional traffic from Gallatin Pike, as well as traffic currently using Dickerson Pike.

Through the implementation of the Existing and Committed (E+C) projects in the 2035 Regional Transportation Plan, virtually all of the congested areas within the Northeast Corridor are expected to be eliminated (with the exception of the I-65 segment in Davidson County). This does not imply that the overall travel time from Nashville to Gallatin will not increase, rather the severity of the congestion in the targeted areas is predicted to diminish.

Nashville's MTA provides several public transit services, including express and inner-city bus routes, paratransit, and shared ride van services. In total the bus ridership in the Northeast Corridor represents about a third of the total ridership in the entire greater Nashville network totaling some 2 million rides per year via the fixed route bus service. Such transit not only serves a needed public purpose, but also provides a relatively safe travel option for residents compared to other travel modes. Transit also has the potential to increase health benefits for residents as additional mobility options could encourage the use of non-motorized modes.

Air Quality

The Environmental Protection Agency (EPA) sets national standards for pollutants such as volatile organic compounds (VOCs) and nitrogen oxides (NOx), which are precursors of ozone formation. In the Middle Tennessee region, a large portion of ozone causing pollutants come from automobiles and trucks.

Pollution from cars and trucks has also been shown to increase health problems. Exposure to fine particulate matter, including tailpipe emissions, has been linked to increased incidences of asthma, lung cancer, and bronchial disorders. People who live near busy roads and road users (drivers and pedestrians) are at high risk of being adversely impacted by such pollution.

According to the Clean Air Act Amendments of 1977 and 1990, transportation plans must be coordinated with, and conform to, local air quality budgets in the local SIP in geographic areas designated by the EPA as non-attainment or maintenance for any of the criteria pollutants.

There are five counties in Middle Tennessee that form the boundaries of the Nashville Area MPO (Davidson, Rutherford, Sumner Williamson and Wilson). These counties were designated non-attainment in 1978 and declared maintenance areas in 1996 for the ozone precursor pollutants of NOx and VOC. In April, 2004, EPA developed new regulations for air quality conformity and established an 8-hour standard overwriting the existing 1-hour standard. This 8-hour standard established a longer period of sustained clean air than with the previous standard. Because of this, areas that once were designated attainment under the 1-hour standard could possibly fall into nonattainment status under the 8-hour standard.

In the Nashville Area, the 8-hour nonattainment area remained the same as the previous nonattainment area. However, on December 29, 2004, the region entered into an Early Action Compact (EAC) to be on a "fast-track" towards air quality attainment. As of April 15, 2009, the region was determined to be in attainment, indicating the success of the EAC.

A maintenance plan was submitted to EPA on October 13, 2010 by the State of Tennessee to ensure the region's continued attainment of the 1997 8-hour ozone air quality standards, through the year 2018. However, revised ozone air quality standards have been recently proposed. Acoording to EPA, requirements for the Nashville area under new 2011 air quality standards "will be addressed in the future." (See Federal Register: January 28, 2011 [Volume 76, Number 19], pages 5078-5080.) Under the new standards, it is likely that the Nashville region will again be in non-attainment. Reducing auto trips in the corridor will help reduce emissions and improve air quality in the region.

1.2.3 Summary

The Northeast Corridor Mobility Study is needed to address transportation issues in the corridor resulting from increasing population and employment, air quality challenges, and various additional mobility issues, including congestion and the number of transit-dependent citizens in the study area. In addition, the study provides the opportunity for the communities in the study area to assess land use, economic development, and quality-of-life goals for their communities, and provide a plan that cohesively addresses all of these elements. The following section describes the specific goals and objectives of the Northeast Corridor Mobility Study.

1.3. Project Goals/Principles

1.3.1 Guiding Principles

To ensure that the mobility needs of the community are addressed, the project team focused on the following issues:

- How do various growth scenarios inform demand for specific land uses such as residential, office, commercial and retail?
- What mix of transportation investments will most effectively meet the demand resulting from potential growth scenarios?
- What is the most appropriate mix of future land uses in the study area that encourage (and maximize the use of) specific transportation modes like bus rapid transit or commuter rail?
- What potential benefits and costs are there to local, state, and federal governmental entities including transit service providers?
- What are the fundamental economic connections among, and associated advantages of, land use planning, real estate development and various transportation-related initiatives such as joint development, transit-oriented development (TOD), transit-adjacent development (TAD), and other mechanisms?

Discussions surrounding these issues led to the development of the evaluation criteria and methodology aimed at analyzing the array of transportation options available to the study area. The criteria were based on current understanding of issues within the study area and throughout the region, and the transportation needs expressed by local decision-makers and representatives of local transit agencies. Additionally, a corridor vision was developed that consists of all ideas proposed by stakeholders, public participants, and planning agencies.

Reaching a broad consensus among key stakeholders is an essential element to ensuring a successful outcome. It was important that all stakeholders who live, work and have an interest in the corridor were kept informed during the project, given opportunities to provide input, and made aware that the project team is mindful of their issues. Providing continuous opportunities for meaningful dialogue with stakeholders, agencies, decision-makers and the public allowed for collaboration and interaction between all entities.

These discussions led to the formulation of the following guiding principles for the project:

Table 1.2: Guiding Principles
1 PROTECT VALUABLE RESOURCES
Historic Buildings and Landmarks; Natural Resources; Open Space; Agricultural Lands; Air & Water Quality; Community Character & Identity
2 IMPROVE ACCESS TO ECONOMIC OPPORTUNITIES
More Options to Commute to Jobs and Schools; Better Accessibility to Local Businesses
3 IMPROVE ACCESS TO GOODS & SERVICES
Protect Local Businesses; Encourage More Diversity in the Local Marketplace; Plan for Mixed-Use Developments
4 INCREASE HOUSING CHOICES
Preserve Low Density Options; Increase Higher Density Options
5 IMPROVE AESTHETICS THROUGHOUT THE CORRIDOR

These principles are expressed in the overarching project goal:

Expand and promote alternative transportation options to manage congestion, protect air quality, and facilitate desired walkable development patterns.

1.3.2 Goals and Objectives

Based on the needs established during the planning process, and informed by the guiding principles, the following goals and supporting objectives were developed for the Northeast Corridor Mobility Study. The goals and objectives were directly applied as part of the evaluation criteria used to develop the corridor alternatives.

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)

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

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 that are compatible with envisioned land use character districts (i.e., complete streets as appropriate)

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

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

1.4. Public Outreach

The Northeast Corridor Mobility Study was conducted in coordination with an extensive public outreach program that was intended to offer a wide range of venues for the Project team to obtain direct public input and for the public to have numerous opportunities to review, comment and help guide the development and evaluation of the identified mobility options. The Public Involvement Plan (included as Appendix A of this report) was designed to educate the public on the basis of the study and the planning process while creating the forum

to address the stated public involvement objectives. These objectives were:

1. Identify and implement the public participation mechanisms that are most suitable and effective for the various stakeholder groups and set meeting times and locations that will be most productive,
2. Increase the public awareness of the Northeast Corridor Mobility Study and identify and educate stakeholders on the study purpose,
3. Develop "character" districts that reflect the diversity of the study corridor and inform stakeholders on the issues of urban design and the choices they have for the "vision" of the districts, and
4. Work with the stakeholder groups create a long-term vision, identify issues and opportunities for the Northeast Corridor and to develop a sense of ownership and responsibility for that vision.

This process included a wide range of outreach tools to establish and maintain a healthy and interactive exchange of ideas and information between the Nashville Area MPO and the Project Team and the stakeholders and general public participants. Character Preference Surveys were conducted using images of transportation and development types, "before and after" renderings and 3-D simulation to reflect the relationships between buildings, open spaces, streets and the human scale. Multi-media video was incorporated to express the unique elements of the study area. News releases, fact sheets and project bulletins were developed and disseminated to offer information and project status. As a primary element of the community outreach, Corridor Workshops were organized and held in the major communities along the corridor. The agenda, input and outcomes from those workshops are described in the following sections of this report.

1.4.1. Committee Meetings

The MPO established a Steering Committee comprised of stakeholder representatives from throughout the corridor. The committee provided valuable insight and guidance throughout the process, reviewing drafts and previewing public presentations. Steering Committee members included representatives of:

- The planning departments of Nashville-Davidson County, Sumner County, Gallatin, Hendersonville, Goodlettsville, and White House
- Nashville-Davidson County, including members of the public works department
- The Nashville Metropolitan Transit Authority (MTA)
- The Regional Transportation Authority (RTA)
- Tennessee Department of Transportation (TDOT)
- Franklin Transit Authority (FTA)
- Clean Air Partnership of Middle Tennessee
- The TMA Group
- Cumberland Region Tomorrow

A full list of members is included in Appendix A, Public Involvement Plan.

1.4.2. Stakeholder Interviews

At the outset of the planning process planning team members met individually with approximately 25-30 stakeholders to gain a better understanding of corridor issues and goals for the planning process. Stakeholders interviewed included planning directors and other public officials, representatives from Chambers of Commerce, TDOT staffers, transit officials, citizens, and other stakeholders identified by the MPO and the Steering Committee.

Congestion was a frequent topic during the stakeholder meetings. Though it was recognized that "people like their cars," those interviewed were generally supportive of looking at mass transit options to help relieve traffic congestion. Several stakeholders commented that, often, adding extra traffic lanes does not solve the problem. The need to educate citizens on different transportation modes and alternatives was highlighted as a central issue.

Stakeholders said that transportation services are needed throughout the day - an issue that will become increasingly important to accommodate the area's aging population. Representatives from Volunteer State Community College also commented on the importance of increased modal choice for them, as they lose students who "lose their ride" (e.g. if a commuter friend on whom they rely drops out of school). Improved local transportation networks would also reportedly help them recruit out-of-state students.

Concerns about increasing transportation alternatives were raised in particular by stakeholders from areas that benefit from highway traffic. Goodlettsville representatives stated their reliance on I-65 and local roads for economic development, with people stopping for fuel, shopping, restaurants and more. Representatives from the Madison/Rivergate area, who are working to encourage a "destination" area for tourists around Neely's Bend, likewise voiced concern for losing traffic and therefore exposure. Whatever modes are ultimately recommended, representatives from multiple jurisdictions desire easy access for local residents.

It was recommended that multiple transportation alternatives be investigated (from roadway improvements to mass transit). Existing and future travel options between employment

centers (e.g. Hendersonville and Gallatin) were noted to be of particular import to study to enable a better understanding of the complexities of transportation choice and alternative proposals. Several stakeholders pointedly commented on their desire for light rail and/or commuter rail. One stakeholder remarked, however, that this is a long-term vision, "but we need something much sooner." In this regard, support was also noted for BRT (possibly through converting existing HOV lanes). Concerns about BRT were raised, though, as buses may have to conform to the existing traffic pattern, potentially impacting their timeliness and the accuracy of schedules. Ultimately, stakeholders felt that the ultimate solutions presented should be flexible and adaptable to situations over time.

1.4.3. Project Website

The project website, http://www.nashvillempo.org/northeast, was established at the outset of the process and provided information throughout the duration of the project on upcoming meetings, results of meetings, draft reports, and other project information.

1.4.4. Corridor Workshops 1

Four initial Corridor Workshops were conducted by the project team in March and April 2008. Each of the Workshops was open to the public and advertised as required. This first workshop series involved the Project Team working interactively with the Nashville Area MPO staff to introduce the public and stakeholders to the project and provide an overview of the planning process, the existing conditions as identified from the corridor data collection and literature reviews, and examination of historic growth trends and exercises to establish the guiding principles and goals for the corridor and the study.

Workshops were held in Madison on March 25, 2008, in Gallatin on March 27, 2008, in Goodlettsville on April 1, 2008 and in Hendersonville on April 3, 2008. Each Workshop was held over a 2 ½ hour period and followed essentially the same agenda. The agenda items were:

- Opening Remarks/Introduction
- Overview of Future Travel Demands and Goals (insert Workshop in Progress Photo)
- Presentation
  - » Corridor Characteristics
  - » Transportation Issues
  - » Land Use
  - » Urban Design
  - » Growth Trends
- Large and Small Group Discussions
  - » Corridor Likes/Dislikes
  - » Desired Changes
  - » Desired Preservation

The group discussions produced diverse responses based on the location of the workshop which is to be expected to some extent. The responses/input ranged from comments on physical elements such as parks and pedestrian features to related but not part of the study, such as property taxes. Each discussion lasted approximately 30 minutes after which the participants were brought back together to present key themes and responses that had emerged from the independent group sessions. These themes and responses were then used to assist the workshop participants in the development of guiding principles. The results of all four workshops produced the set of principles as shown in Table 1.2.

The workshops concluded with presentation of the next steps in the corridor study planning process, information on upcoming planning charrettes, examples of urban design and modeling tools and land use methodologies. Attendees were also provided information on remaining involved and active in the study progress and planning exercise, key study dates and project team contact information and the address for the project website.

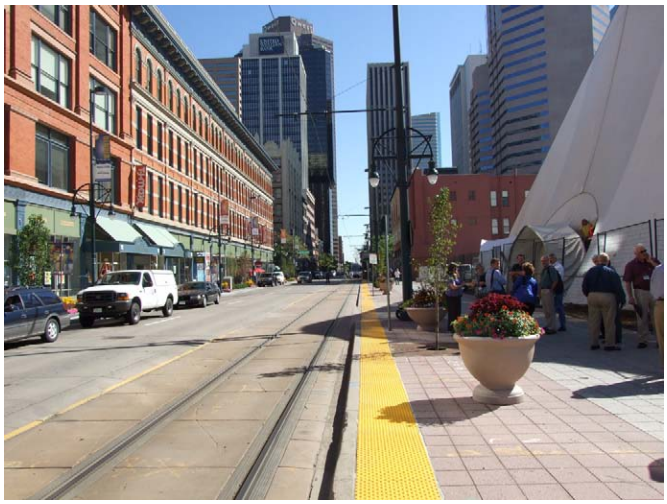


Figure 1.2: *Downtown Denver, CO*

1.4.5. Field Trips: Denver and Cleveland

Members of the Steering Committee and other stakeholders participated in fact-finding trips to Denver and Cleveland. These trips included discussions with local transit operators and tours of LRT, BRT and commuter rail facilities. Below is a brief summary of insights gained from the trips. For a full account, see Appendix H.

Denver: August 11-12, 2008

The Denver trip included discussions with local officials regarding the Denver Regional Transit District (RTD) system planning and financing; tours of local transit systems (LRT, BRT), and a tour of a transit-friendly development.

Important lessons from the Denver tour included:

- Importance of a long term plan: success can only come from persistence and consistency. People need a long-term vision to understand where the system is heading.
- Regional cooperation is essential.
- Importance of a dedicated funding source to implement the regional vision.
- Leadership from the business community is important
- Circulator systems are vital to the success of transit in post World War II lower-density environments.
- The plan can include provisions to link highway improvements to transit investments.
- A quality product creates demand: when citizens see a modern, convenient system they will use it.

Cleveland: November 6-7, 2008

The Cleveland trip included discussions with leaders of the Cleveland Regional Transit Authority (RTA) System, the Northeast Ohio Areawide Coordinating Agency (Cleveland area MPO), and the City of Shaker Heights. Transit options explored in Cleveland were a trolley system, BRT, and commuter rail. An early 20th century transit-oriented development was also visited.

Key points from the Cleveland tour included:

- The Cleveland transit system serves 200,000 customers per day; 15% rail/ 80% bus / 5% circulators; over 90+ bus routes
- The BRT was developed with economic and revitalization goals, linking downtown to the medical district and arts district
- The corridor is multimodal, with pedestrian-friendly amenities, bike lanes
- The system is called Rapid Transit Vehicle – the word "bus" is never used
- Ridership not limited to transit dependent population
- The naming rights were sold to hospitals on the route; it is now known as the "Health Line"
- Fits within existing transit network
- The Cleveland Plain Dealer estimates the line has stimulated $4.3 billion in private development

Figure 1.3: *Cleveland, OH*

1.4.6. Character District Workshops/ Charrettes

The MPO conducted five separate character workshops in Gallatin, Hendersonville, Goodlettsville, Madison, and East Nashville. The purpose of these workshops was to develop recommendations for land use and urban design in specific locations in the corridor. Participants were shown a series of photographs of residential, business, and industrial areas, as well as photos of various transportation facilities, and asked to rate each image as to how appropriate it was for their portion of the corridor.

The most preferred images for the corridor included images presented in Figure 1.4. These illustrate a desire to preserve the current character of the corridor: a small-town feel with plenty of open space and a variety of transportation choices. Detailed information regarding the input received concerning the specific Character Image Survey comments is contained in Appendix B.

Each workshop also included small-group exercises with maps, where participants were asked to indicate areas that were appropriate for transit stops, transit-oriented development, as well as areas for new residential and commercial development, and areas for employment. Participants also noted routes they thought would be appropriate for regional transit and local circulator facilities, as well as areas for open space and greenways. An overall graphic summary of all of the workshop maps was completed by the project team and is shown in Figure 1.5.

1.4.7. Corridor Workshops 2

The MPO conducted a series of five public meetings in the corridor to update citizens on the progress of the project and seek input on which three alternatives would move forward for more detailed analysis. Following introductions of speakers, staff and elected officials, MPO staff provided an overview of regional population growth trends, including a comparison to other metro areas such as Denver and Portland. Previous public workshops were summarized, including an overview of the least and most preferred images in the community preference survey, as well as the maps from the first series of public meetings expressing participants' preferences on future land use and development. The presentation ended with an overview of available transit modes, a description of the ten alternatives that the planning team evaluated, and the three alternatives that are recommended for more detailed evaluation.

Following the presentation, facilitators asked participants to share their experiences with various types of transit systems, positive and negative, in the Nashville region and elsewhere. This exercise sparked discussion of transit alternatives in the northeast corridor

Figure 1.4: *Preferred images*

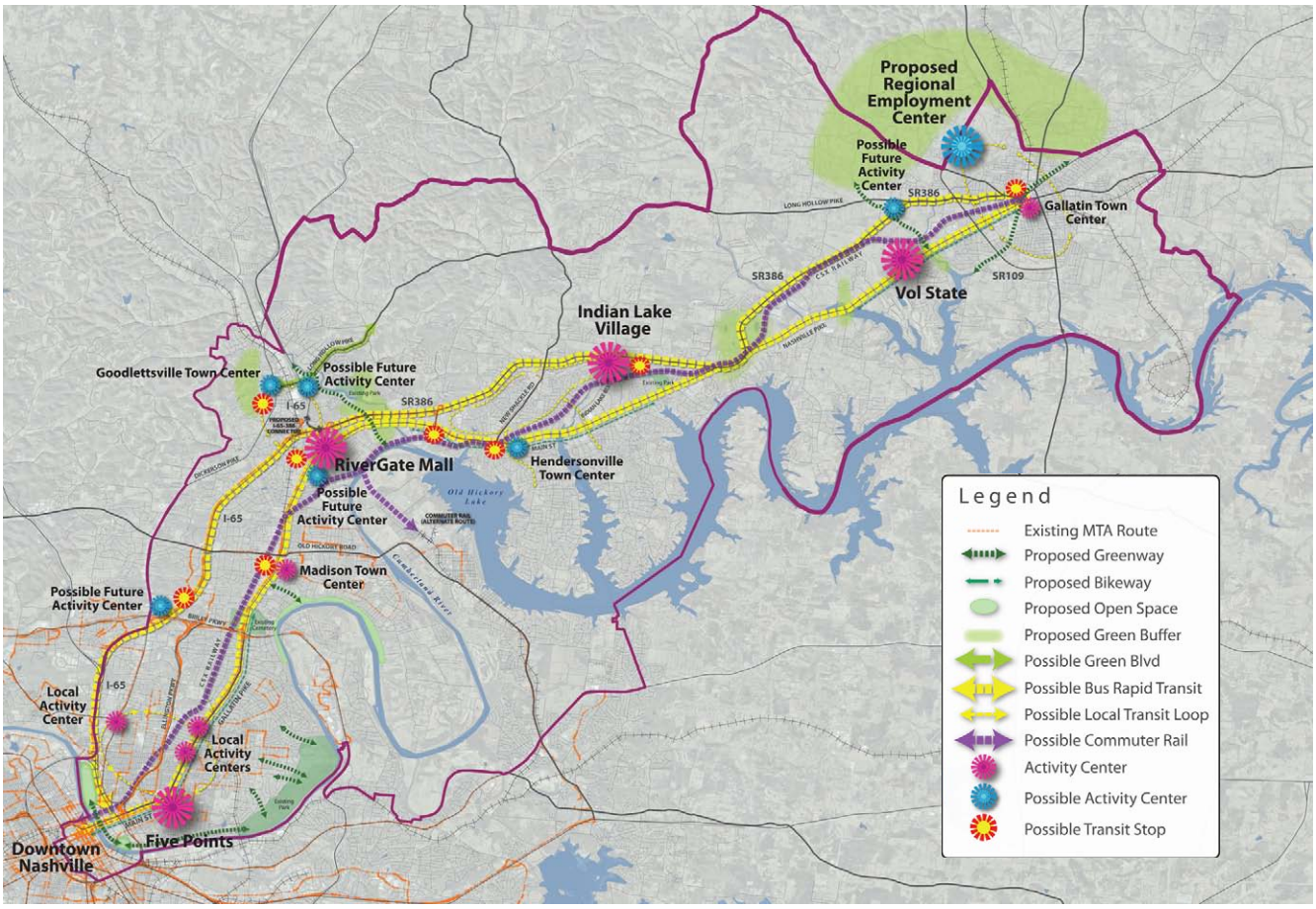


Figure 1.5: *Public Input Summary Map*

and led to a general question-and-answer and comment session. Participants at the five meetings voiced varied opinions and concerns, but several general themes emerged, including:

- Almost all attendees were enthusiastically supportive of transit in the northeast corridor.
- Participants believe that current and future land use densities need to be considered, but high density development doesn't necessarily need to be attracted to rural areas.
- Gallatin Pike alignment is generally preferred over interstate/Vietnam Veterans Parkway alignment for most effective transit investment.
- Many participants expressed strong reservations about the feasibility of using the current CSX tracks for transit.
- Light rail was generally the preferred mode for most of the length of the corridor. People believe that BRT is generally unattractive; too much like buses so people won't use the system. Others expressed doubts about the effectiveness of commuter rail in providing sufficient variety of stops and running times as well as desired effect on land use and economic development.
- The Goodlettsville community strongly requested a transit option that serves Goodlettsville.
- Many attendees stated that local circulators would be needed to provide an effective transit option for most people to access desired destinations.

Figure 1.6: *Public meetings and workshops*

2.0 Existing Conditions and Future Trends

Figure 2.1: *Revitalization in aging areas along the Northeast Corridor*

Figure 2.2: *Madison and other East Nashville communities depend on the Gallatin Pike corridor*

The Northeast Corridor is a thriving and growing segment of the Nashville metropolitan region, featuring urban neighborhoods, small towns, and quality suburban development. This section summarizes the characteristics of the study area, including demographics, urban design, transportation, and economic trends.

2.1 Regional Growth

Metropolitan Nashville is the economic center of a larger 10-County region known as the Middle Tennessee Region. The Middle Tennessee Region has experienced rapid and expansive growth over the last several decades. Today, over 1.7 million residents call the region home; and, within the next 25 years, the MPO anticipates the region adding nearly one million more people, making the area roughly comparable in terms of population to Denver, Colorado.

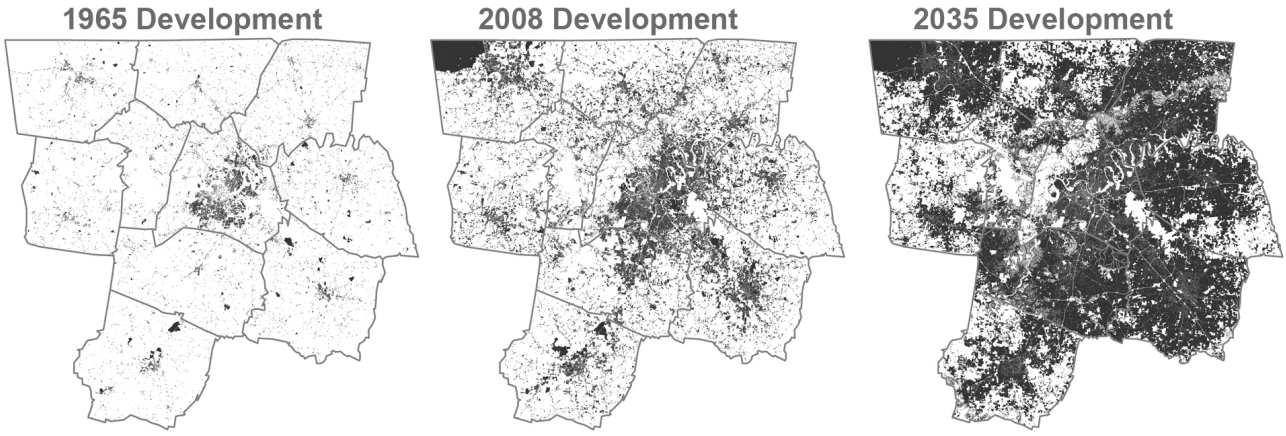


Figure 2.3: *Past, Present, and Forecasted Development Patterns across the 10-County Region*

Like many regions across the United States, Middle Tennessee has seen much of its rural countryside transformed into sprawling low-density development as result of its population boom. This land-extensive growth pattern has placed heavy pressure on roads, highways, and other public infrastructure. If growth over the next 25 years continues to follow a similar pattern to that of the last, substantially more undeveloped land will be consumed, roads will become increasingly congested, and demands on public infrastructure will become increasingly costly, eventually compromising both the long-term economic and environmental health of the region.

The MPO has developed a land use model which predicts future development patterns based on observed historical trends, current land use policies, and existing and proposed infrastructure. Figure 2.3 shows the anticipated development pattern across the Middle Tennessee Region if regional growth occurs as it has over the last several decades.

2.2. 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. The Nashville area's strong population growth between 2000 and 2007 can be attributed to a number of factors, including significant new job growth during that time, 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 rate of growth.

To understand the demographic profile of Davidson and Sumner Counties, general demographic trends and economic indices across four geographic areas were studied: Davidson County, Sumner County, the Nashville-Davidson-Murfreesboro Metropolitan Statistical Area (also known as the Nashville MSA), and the State of Tennessee. In addition, population, household, and employment forecasts prepared by the MPO for the period covering 2015-2035 for both Davidson and Sumner Counties were examined. Key findings from the study are provided in this section and a complete demographic analysis is presented in Appendix D, Tech Memo 4: Analysis of Conditions and Trends.

2.2.1. Population

The Metro Nashville and Sumner County have seen and will likely continue to see robust growth in population, households and incomes. Over the past 10 to 15 years, Sumner County has exhibited rapid population growth, at a rate of almost 16 percent. MPO forecasts for Sumner County suggest a population increase of 68,617 between 2008 and 2035, to 223,754 by 2035—a 44 percent increase.

Davidson County, on the other hand, is growing much more slowly than Sumner County and other outlying jurisdictions in the MSA. In fact, between 2000 and 2007, Davidson County's population increased by only 9,600 residents—an increase of less than two percent. MPO forecasts suggest an increase in Davidson's population from 600,931 in 2008 to 723,015 residents by 2035—a 20 percent increase. Figure 2.4 illustrates the projected population density for 2035, with a scale of zero (lightest areas) to ten (darkest areas) persons per acre, assuming no changes in current land use policies.

2.2.2. Housing

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

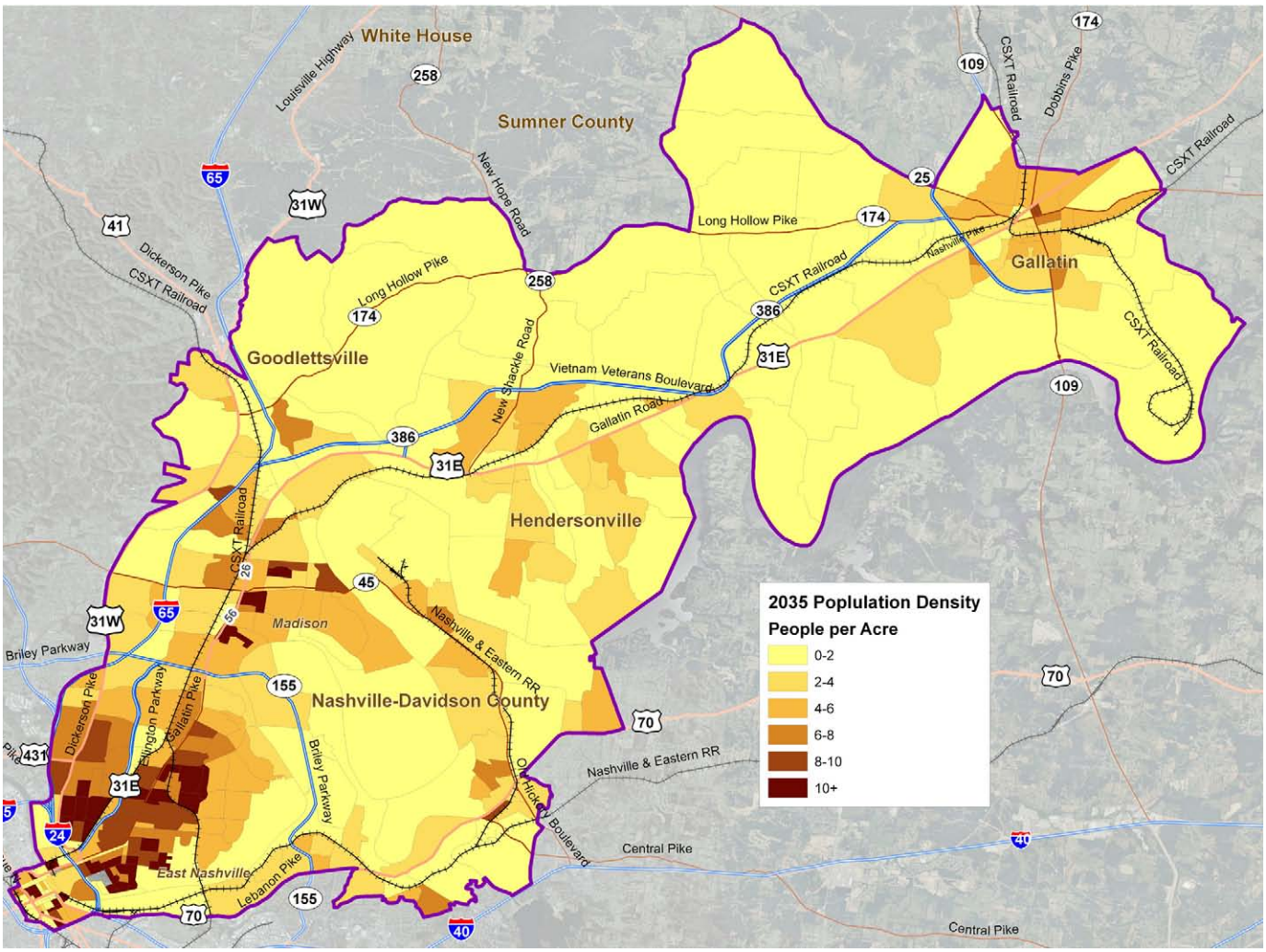


Figure 2.4: *Population Density in 2035*

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.

2.2.3. Race and Ethnicity

In addition to overall population growth, the Nashville area is also undergoing change in the presence of major ethnic groups such as Hispanics and Asians. As the populations of these ethnic groups increase, they will contribute to changing the characteristics of the study area. The Hispanic population is expected to have grown 29.1% and the Asian population is expected to grow 27.2% between 2007 and 2012. Growth among these groups is expected to bring in more economic investment and businesses in the communities where they reside.

2.2.4. Education Levels

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 region is projected to see a significant increase in the numbers of persons holding bachelors or advanced degrees: an increase in the number of people who are college educated has been forecast to increase over 35%.

2.2.5. Age

Apart from ethnic groups, another population group that is growing is the elderly: the population group representing

the highest rate of growth between 2000 and 2007 was that of persons ages 65 and above. This population group grew 30.4% between 2000 and 2007. However, the rate of growth among the 35 to 64-year old cohort is expected to slow in the coming years. This cohort typically spends the greatest amounts of discretionary household income that subsequently fuels economic expansion. Reduced growth in this cohort could therefore have economic implications, particularly in those sectors of the economy such as retail and real estate.

2.2.6. Household Income

Median household incomes reflect the changing geographic distribution of wealth that has occurred in metropolitan Nashville and other American metropolitan areas. Between Sumner and Davidson Counties, 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. Industry and Labor

Metropolitan Nashville is one of the primary job growth engines for the State of Tennessee's economy. Davidson County is the dominant county in the Nashville MSA's economy with 40 percent of its total employment. Davidson County and Sumner County have substantially different employment bases, with Davidson County's employment concentrated in education, health care, professional services, and tourism, while Sumner County's employment is concentrated in manufacturing and logistics. While Sumner County is seeing a stronger employment growth rate than Davidson County, the lion's share of future employment through 2035 is projected to locate in Davidson.

Nonetheless, recent employment trends do point to an increase in employment throughout metropolitan Nashville, especially outside of its traditional center in the Nashville central business district. Sumner County and the City of Gallatin offer examples of outlying communities emerging as major employment centers. Gallatin in particular is seeing an increase in the number of warehousing and manufacturing industries.

As part of this study, more detailed analysis examined trends in employment and wages for major state and regional industries. Data analyzed include employment trends and forecasts, unemployment, occupations and wages, and wage growth; these data came from sources such as the Bureau of Labor Statistics Quarterly Census of Employment and Wages reports, U.S. Census Bureau Local Employment Dynamics (LED) website, and the Tennessee Department of Labor. The analysis underscores the relative strength of the region's economy and is helpful to determine the expected economic drivers that will generate future job growth and its impacts on workplace-related real estate such as office and industrial development in the study area. Consistent with other elements of this trend analysis, four geographies were examined: the State of Tennessee, the Nashville-Davidson-Murfreesboro Metropolitan Statistical Area ("Nashville MSA"), Davidson County, and Sumner County. Key findings from the study are provided in this section and a complete demographic analysis is presented in Appendix D, Tech Memo 4: Analysis of Conditions and Trends.

2.3.1. Employment Trends and Conditions

The Nashville MSA is a major economic growth engine for the State of Tennessee, with nearly 25 percent of the state's job total located in the area. As the MSA's regional employment center, Davidson County contains nearly 40 percent (447,000) of the region's jobs. Davidson County, however, has lagged behind the metro area in job creation, with a compound growth rate in employment of just 0.6 percent annually, while Sumner County exceeded the region's growth rate—with compound annual growth of 2.5 percent per year. These data suggest that, while employment growth in the MSA has been quite strong, new jobs are gradually being generated in a decentralized manner away from the core areas clustered in Davidson County and toward outlying parts of the metropolitan area.

2.3.2. Major Industries

Various employment sectors are prominent within the Nashville MSA area, Davidson County, and Sumner County. The top industries in the Nashville MSA area are the food services industry and administrative and support services. Within Davidson County, the accommodations industry ranks high, with a strong supporting base concentrated in tourism, medicine, higher education, professional services, and business support services. In Sumner County, the employment base is employment is concentrated in the warehousing and manufacturing industries; this includes specific concentrations in fabricated metal, product manufacturing, and warehousing and storage industries dominate. With strong employment in these industries for Sumner County, as to be expected, the county consists of a higher concentration of commercial and industrial uses near smaller cities situated along the major roadways and highways.

2.3.3. Employment Growth

Metropolitan Nashville created 13,500 new jobs every year between 2001 and 2006. Although Davidson County added new jobs, its growth lagged behind the metropolitan area; however, Sumner County exceeded the region's rate

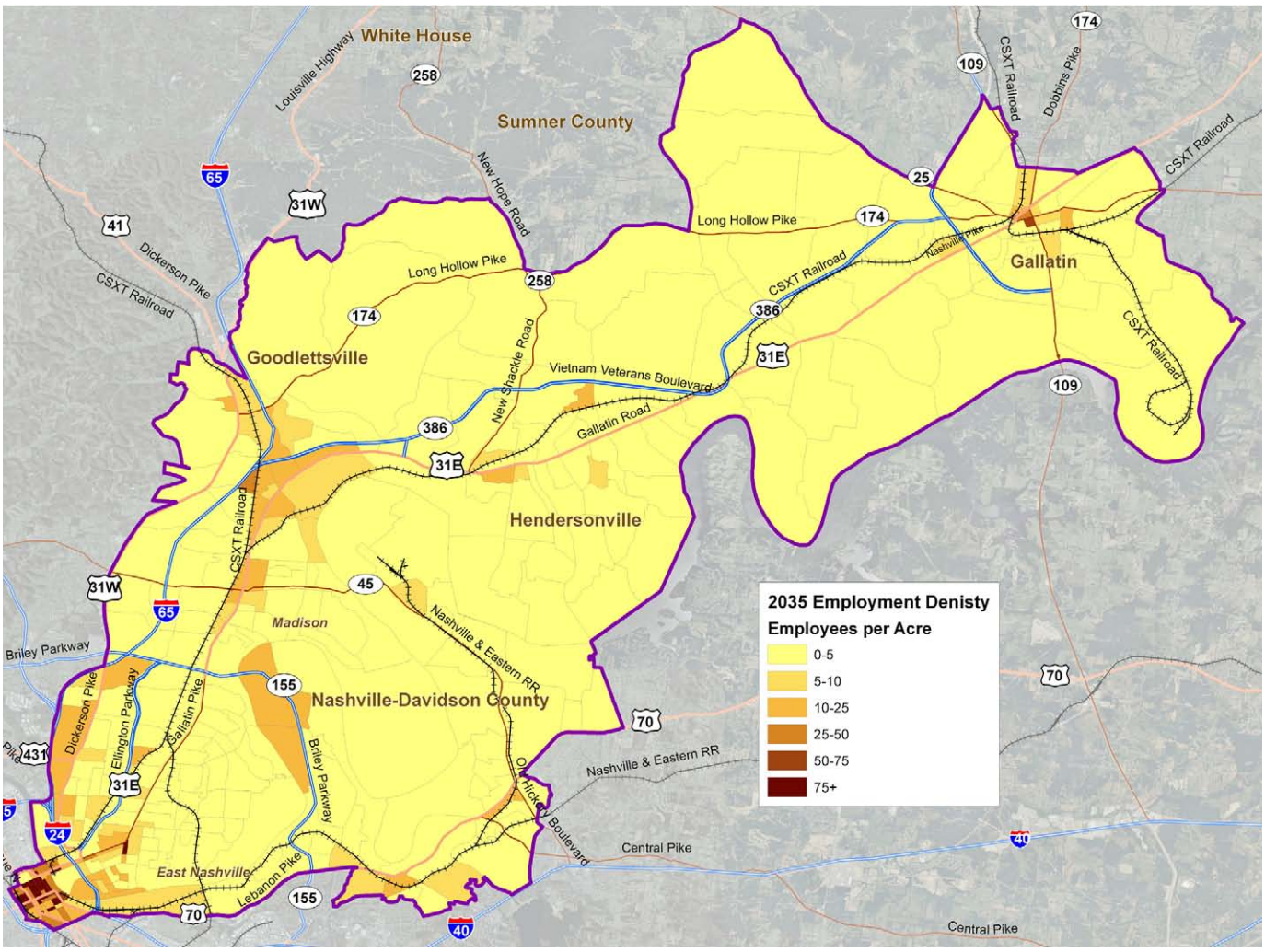


Figure 2.5: *Employment Density in 2035*

of employment growth over the same time period. These patterns further suggest that new jobs are being generated in a decentralized manner, moving away from the core and towards outlying parts of the metro area.

MPO forecasts that Davidson County will gain 183,332 new jobs between 2008 and 2035; by comparison, MPO forecasts that Sumner County will add 24,324 new jobs during the same period. For Davidson County, entertainment and health care industries are indicated as growth sectors, and in Sumner County, warehousing and population-related industries saw positive job growth. Other industries exhibiting high rates of new job growth in Sumner County include retail industries, education, social services, and construction.

The 2035 employment density map (Figure 2.5) shows that the highest densities (75 or more employees per acre) are projected to be in central Nashville, while most of the study area is comprised of lower densities (0 to 5 employees per acre).

2.4. Land Use

As is typical of US cities, the Nashville region consists of a city center with a radial development pattern following highway corridors. Existing land uses in the Northeast Corridor study area are dominated by residential (45.7 percent) and agricultural (28.9 percent) land uses, though there are frequent concentrations of commercial use along major corridors. In the portion of the corridor in Sumner County, commercial uses are not as dominant as residential or agricultural uses, but strip commercial development is prevalent along the corridor. Major destinations or employment centers along the Northeast Corridor are RiverGate Mall, the Nashville Auto Diesel College, Volunteer State Community College, Hendersonville Medical Center, and the Sumner Regional Medical Center. The smaller amount of vacant land adjacent to the Northeast Corridor, compared to Davidson and Sumner Counties as a whole, is a likely indicator of the relative maturity of development in the area.

The Northeast Corridor ranges from relatively mature but aging development in the southwest to new development in the northeast. Plans for development along the corridor vary substantially between the urban and suburban context. East Nashville is slowly undergoing revitalization of its commercial areas and residential neighborhoods while maintaining a traditional, compact urban development pattern. Gallatin Pike is an important transportation corridor in the East Nashville and Madison communities and land use plans call for concentrating development in nodal community centers with a pedestrian-oriented character. This denser development pattern has the potential to support a variety of transportation alternatives. Land use planning in Sumner County, Goodlettsville, Gallatin, and Hendersonville has in recent years addressed the goal of supporting more compact development as well, although continued decentralization and greenfield development is still likely to occur with current future land use policies and regulations.

The cities of Hendersonville and Gallatin are experiencing faster population growth and development with upscale residential and commercial development in less concentrated suburban development patterns. The City of Gallatin's land use plans call for commercial and mixed use development along the corridor, with medium density residential areas behind. Gallatin's plans also call for commercial development to be concentrated in nodes, discouraging strip commercial development patterns. Large scale, master planned developments are also occurring in the Sumner County portion of the study area.

To conduct the land use analysis, Geographic Information Systems (GIS) was used to gather existing land use information for the cities of Nashville, Goodlettsville, Hendersonville, Gallatin, as well as Davidson and Sumner Counties. Local land use and transportation plans were gathered from the jurisdictions in the study area in order to develop the Land Use Planning Inventory, including comprehensive plans, growth management plans, corridor studies, downtown master plans, and future land use maps. These plans were also consulted for information on future land use and potential impacts on

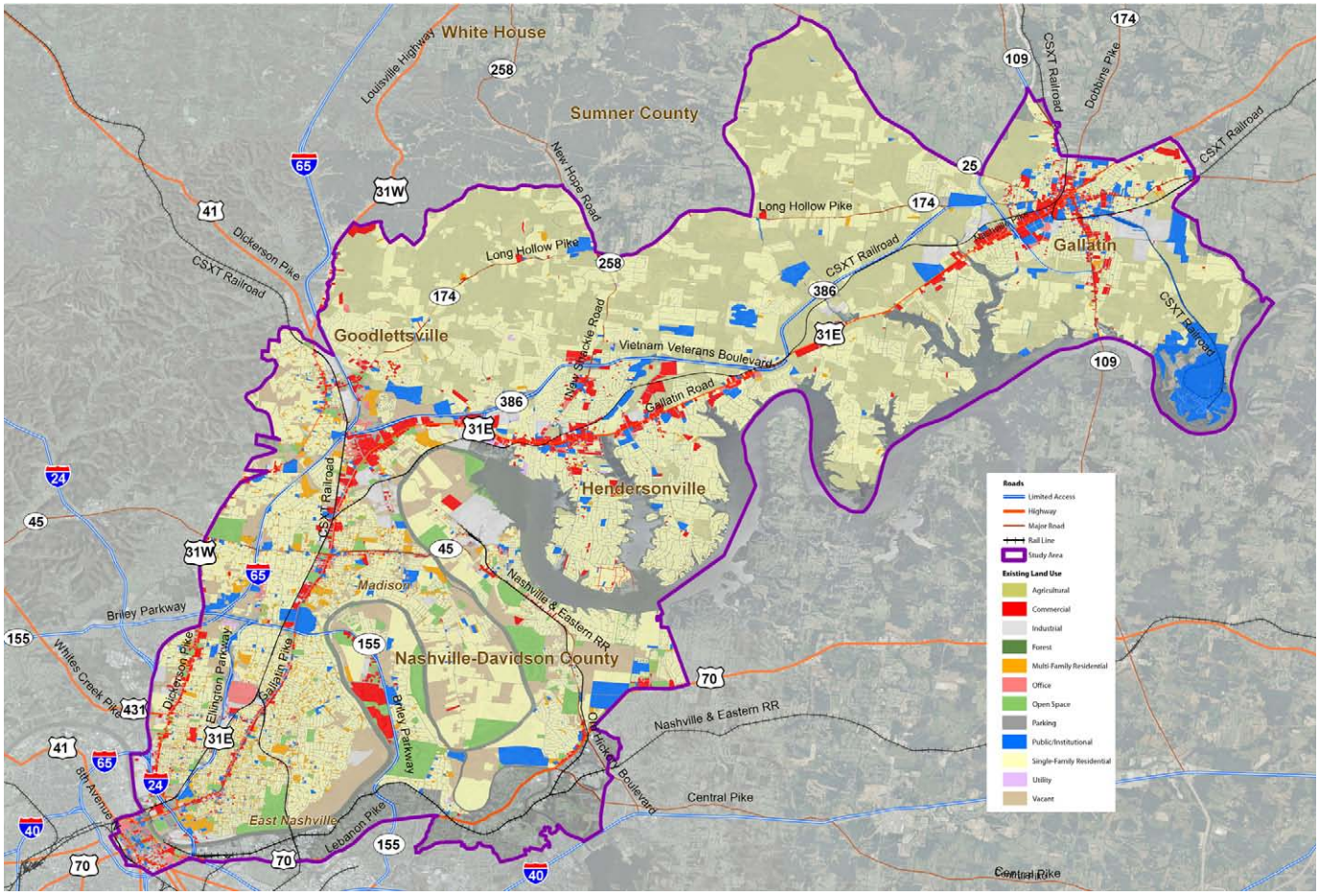


Figure 2.6: *Existing Land Use within Study Area*

transportation options in the Northeast Corridor Mobility Study. A summary of key findings are presented below (see Appendix D, Tech Memo 4: Analysis of Conditions and Trends for the complete initial land use analysis).

2.4.1. Existing Land Use

Residential and vacant land uses dominate Davidson County. Residential areas in the inner-ring suburbs are fairly compact although commercial and employment areas spread out along major transportation corridors. Although little vacant land exists directly adjacent to the Northeast Corridor, previously developed parcels, especially aging strip commercial centers, may provide redevelopment opportunities. Large amounts of existing undeveloped land could potentially support sparse development patterns in the study area. While the vacant land is not contiguous and has not been evaluated with regard to development suitability, the total vacant acreage, at 80,000 acres, is the size of the entire city of Atlanta, Georgia. Figure 2.6displays the specific land use and development patterns that exist within the study area.

Agricultural land uses dominate in Sumner County. The Northeast Corridor encompasses the county's southwest corner with the county's largest concentration of population in the cities of Gallatin, Goodlettsville, and Hendersonville.

The Cumberland River limits access to destinations south of the Northeast Corridor. The Cumberland River forms the southern boundary along most of the corridor. Few major roads such as State Highways 45 and 109 provide north-south access to destinations in Nashville-Davidson and Wilson Counties.

2.4.2. Land Use Planning Inventory

The following discussion reviews land use and transportation plans within Davidson and Sumner Counties to highlight existing land use trends and provide insight into planned future development patterns.

Metropolitan Government of Nashville-Davidson County

Overview

Within Nashville-Davidson County, the name of the Northeast Corridor is Gallatin Pike. There have been a number of studies conducted regarding land use along the Gallatin Pike and its associated neighborhoods and districts in recent years, as well as several planning efforts directed at the larger area around the Pike known as East Nashville, which is generally considered the part of the city east of I-24.

Development in East Nashville is currently somewhat haphazard with a surprisingly high amount of vacant land. Industrial land uses are prevalent but on the wane. Development pressures are generally considered to be modest in the area. The thrust of most of the future land use plans for the East Nashville area is to promote infill development, mixed use, and more consistent and higher urban design standards.

The Gallatin Pike corridor has been the subject of several plans, including a recent plan for the Gallatin Pike Improvement District. Future land use plans for the corridor generally call for medium density, mixed use, pedestrian oriented development patterns. Proposed densities along the Gallatin Pike corridor are typically under six stories. Land uses along the corridor are proposed as 'Main Street' type uses where residents from proximate neighborhoods gather for public and private services and social purposes. Also, the Gallatin Pike corridor is planned for a nodal development pattern, with high intensity development concentrated at major intersections.

Two major land uses under consideration in the Northeast Corridor are the RiverGate Mall area and the Nashville Auto Diesel College. The RiverGate Mall is planned to transition from its current pattern of industrial land uses towards more office land uses. The Nashville Auto Diesel College has recently completed a master plan, and it is seeking to create more uniform design standards for the campus and a more visible, urban, and pedestrian-oriented frontage along the Gallatin Pike Corridor.

Nashville/ Davidson County Mobility 2030

The Mobility 2030 study conducted analysis on the basis of two scenarios. The impact of continuing existing patterns (Base Case) versus a more compact approach to growth (Alternative Case) were modeled. It was the recommendation of the study that cities could conserve land and attract development by increasing densities. Furthermore, such an action would create opportunities for transit viability.

The Mobility 2030 plan has embraced the idea of the "Community Transect" and critiqued past transportation plans for leaning too heavily on a "one size fits all" approach. The document emphasizes the need for a variety of tailored approaches for transportation ranging from the urban core to rural areas.

To achieve such an end they utilize the Community Transect, which is divided as follows:

- Natural Areas. Publicly and privately owned land intended to be permanently maintained as open space due to environmental constraints.
- Rural Areas. Very low intensity development; farms and forests.
- Suburban Areas. Primarily low density, single-family

residential uses with some neighborhood commercial and civic uses.

- Neighborhood Areas. Low-to-medium density housing, with a variety of housing types, and compatibly-scaled commercial and civic uses located in neighborhood centers or commercial corridors along the neighborhood edge, within walking distance of homes.
- Centers. A more concentrated mix of land uses, with higher intensity residential and commercial areas that serve multiple surrounding neighborhoods.
- Core. A highly urbanized mixture of land uses that includes the Downtown.
- Districts. A range of generally single use areas including medical centers, universities, industrial parks, and airports that may vary in development form from suburban to neighborhood to center.

Community Character Manual

Recently, the Metropolitan Planning Commission of Nashville-Davidson County began using its Community Character Manual (CCM) as the primary land use policy document for the combined city-county. The CCM is a part of Metro's Concept 2010 comprehensive plan, replacing an earlier policy document that more closely resembles a future land use plan oriented to governing land use and density (the Land Use Policy Application, or LUPA). The primary difference between these two documents is that the Community Character Manual seeks to emphasize the character and form of development as part of a coherent district, where use and intensity are regulated, but not as the only criteria of a particular district. The LUPA did pay attention to the form of development, but it did not specify a range of intensities and community areas distinguishing between rural, suburban and urban development.

The CCM and its predecessor were both based on the concept of the built environment transect that has grown in use with the New Urbanism movement in town planning and urban design. This describes the various development patterns of a region from the most rural to the most urbanized areas and assigns general attributes of the massing and placement of buildings relative to streets and open space. In general, most of the area of Nashville-Davidson County within the Northeast Corridor is in more urbanized areas, suggesting that the CCM and Nashville's overall planning policy framework have identified this corridor as one area of the city where future development will be concentrated.

Gallatin Pike Improvement District, 2007

The Gallatin Pike Improvement District acts as a comprehensive design overlay ordinance for all parcels abutting Gallatin Pike from South 5th Street to Briley Parkway. This overlay includes regulations dictating standards and guidelines for development, signage, land use, and "systems," which are infrastructure needs such as transit, road medians, parking areas, and street buffers. These regulations only apply to the frontage of the parcels along the corridor. The plan provides for a number of specific exceptions along the road including the Nashville Auto Diesel College and "Planned Unit Developments."

The Gallatin Pike Improvement District divides the corridor into three different sub districts to allow for distinctive character areas. The sub districts are:

- Sub-District 1: South 5th Street to Douglas Avenue;
- Sub-District 2: Douglas Avenue to Inglewood railroad overpass;
- Sub-District 3: Inglewood railroad overpass to Briley Parkway

Much of the regulations for the each of the sub districts remain consistent; however, there are distinctive differences with regard to land use.

Within Sub-District 1 there are a number of different zoning classifications, but the first and largest portion of the corridor is designated Community Center (CC). The CC designation identifies "appropriate uses within CC areas include single-family and multifamily residential, offices, commercial retail and services, and public benefit uses," as explained by the Nashville Land Use Policy Document. Finally, "'Main Streets' are locations within CC areas that are intended to be the focal point of diverse pedestrian-oriented activity and the most important 'public' places in the community."

Sub-District 1 also includes several other zoning designations, including two similar Mixed Use designations. The Mixed Use (MxU) designation is geared toward commercial/residential development that is mixed both "vertically and horizontally," whereas the Mixed Housing (MH) designation allows for different housing types so long as they are of desired massing, scale, and setback. The MxU/ MH land uses comprise the northern half of Sub-District 1 with the CC designation filling the southern half. The Sub-District is split in half by a portion of land preserved for parks and open space planning, and also one parcel designated for Civic or Public Benefit.

Sub-District 2 is similar to the northern half of Sub-District 1, as it is comprised entirely of MxU and MH designations. It is important to note that this overlay only extends to the first row of parcels that directly abut the roadway. Sub-District 3 differs in that it has much greater diversity of uses than this middle district.

Sub-District 3 offers a new designation not seen in the previous sub districts, the Commercial Mixed Concentration. The designation provides a category that accommodates

mixed commercial development, including retail, services, and employment centers. In this way, it is unique from other Mixed Use districts as it provides more than strictly retail concentrations. The district also introduces the Office land use designation, which is designed specifically for low-rise office structures. Furthermore, this section differentiates itself from the other sub districts by providing a large percentage of Civic or Public Benefit land use, but no Park or Open space. Finally, about 40 percent of the parcels are designated Mixed Use and not CMC, Office, or Civic or Public Benefit.

Madison Community Plan: 2009 Update

The Madison Community Plan, which replaces the Subarea 4 Plan from 1998, was formulated to guide the community's development over the next seven to 10 years as part of the General Plan for Nashville/Davidson County (*Concept 2010*). The plan update brings attention to the commercial and residential growth that has occurred in surrounding counties in the past years, and focuses on community character and form rather than land use and density. The Nashville-Davidson Metro Planning Department solicited support from the public at various times in the course of the nine-month planning period to understand citizen and stakeholder concerns. In general, the Community Plan encourages the maintenance of stable neighborhoods, the enhancement of existing commercial centers into viable mixed use and walkable areas, and the preservation of environmentally sensitive and rural areas.

The Madison subarea is irregularly-shaped, with the border of the Cumberland River forming its eastern and southern border until the river intersects Briley Parkway. The Parkway finishes out the southern border until it is bound on the west by Interstate 65 and the City of Goodlettsville and the north by the Davidson County line.

The Madison community is primarily residential in character, with residential housing comprising 59 percent of the existing land use. Furthermore, vacant land represents 23 percent of the total use in the category, which is an unusually high percentage for a metropolitan area. Since 1998, the acreage of land in use as office, commercial and/or industrial increased by 271 acres and now represents 14 percent of the total land in the community. This equates to 18,470,000 square feet of office, commercial and industrial floor space, representing an increase of 59 percent over 10 years. It is believed that the growth of these land uses can be attributed to these areas being easily access either by interstate, or collector and arterial road networks. Mixed use developments, such as The Villages of Indian Lake in Hendersonville, are growing in popularity around the region and are creating retail and housing competition for the Madison community.

The plan utilizes the new urbanist principle of the "transect" to describe future development patterns, identifying character - from rural to urban - that should guide the type of development that takes place in Madison. Along Gallatin Pike, for example, the classification is largely "T3 CM: Suburban Mixed Use Corridor." Because these areas are meant to be serviced by a variety of transportation modes, higher densities of residential uses are called for here. Connectivity is also highlighted as an important feature, particularly for pedestrians to access future transportation options. Gallatin Pike also traverses areas planned to be regional centers and mixed use neighborhoods, indicating the shift away from traditional suburban development to more sustainable forms, and ultimately the type and intensity of development which might support transit.

The plan pointedly states that the redevelopment of the Gallatin Pike corridor with higher density and a greater mix of uses to support transit-oriented development "is critical to the health of the Madison Community in the future." Providing additional housing along the corridor would help supply consumers for area business and also support transit, the plan says. Such redevelopment "is key to ensuring that Madison remains an economic engine in Nashville and the region."

East Nashville Community Plan 2006 Update

The East Nashville Community Plan 2006 Update was conducted by the Nashville-Davidson Metro Planning Department as part of the city's comprehensive planning efforts. The study area "is bounded by I-24/I-40, the Cumberland River and I- 65 to the west, Briley Parkway to the north, and the Cumberland River to the east and south." Although huge growth pressure is not expected within the next decade, they expect a desire for "additional housing choices and revitalized commercial service areas."

The process included input from community stakeholders and consensus yielded a number of priorities for the area. The plan created several actions in an effort to accomplish the goals desired by stakeholders. For example, the document called for the creation of a committee specifically for Gallatin Road to develop strategies and priorities explicitly for the corridor.

With regard to land use, the document explained that "the concept of nodes" for both the Gallatin and Dickerson Pike corridors was a priority as it created an avenue for "concentrating development and increasing intensity within those areas." To do so, the plan argues for identifying Gallatin Road as a "Special Policy Area."

The decision to encourage centralized, nodal growth centers along the Gallatin Pike corridor was further bolstered by the sentiments voiced by stakeholders during the plan update process. The document explains participants were specifically upset about "the current uncoordinated pattern of building

types, setbacks, and building orientation," within the study area. Furthermore, citizens felt dissatisfaction in "the appearance of signs and their often disproportionate size." Finally, many felt there to be too many access points onto busy streets, which created dangerous situations for "pedestrian, cyclists, and autos."

Detailed Neighborhood Design Plan for Cleveland Park, McFerrin Park, and Greenwood Neighborhoods

The East Nashville Community Structure Plan is the official policy document that guides future land use decisions. Detailed Neighborhood Design Plans are supplements to and a part of the overall East Nashville Community Plan. These plans are commonly referred to as DNDPs and focus on an individual neighborhood more than does a community plan. These Detailed Neighborhood Design Plan processes build off the Structure Plan and are intended to provide detailed land use policy and design guidance for these sets of neighborhoods.

The stated goal of the DNDPs is to ensure that the Dickerson Road and Gallatin Pike corridors are both "safe and comfortable." To that end, the documents divide the corridors into "sub districts," which allow for certain areas to have the same land use but "call for different sizes or types of buildings."

The Cleveland Park DNDP handles the portion of Gallatin Pike from W Eastland Avenue to Douglas Avenue, but only the street's western frontage. Most of the parcels that do not have frontage on Gallatin Pike are defined as "Sub district 1" which is zoned for low-density, detached, single-family residential. Parcels with frontage on Gallatin Pike are either "Sub district 4" or "Sub district 5."

Both of these sub districts push for development no greater than 6 stories; however, they differ as to preferred use. Sub district 5, which composes most of the interior between West Eastland and Douglas, is limited to high intensity residential land use with properties reflecting "a mixture of housing types, including cottages, townhouses, and stacked flats." In contrast, Sub district 6 attempts to provide nodal centers of activity for parcels near both West Eastland and Douglas. This designation promotes high intensity mixed use development with the goal of accommodating commercial, residential, and office alike.

Detailed Neighborhood Design Plan for East Hill, Renraw, and South Inglewood (West) Neighborhoods

Much of the land use off of the main Gallatin Pike corridor between East Trinity Avenue and Douglas is delineated at R6 or RS5, appropriate for owner-occupied single family detached housing.

Immediately along Gallatin Pike, from Carolyn Avenue to Burchwood Avenue, the plan seeks to promote intense residential development. With properties reflecting "a mixture of housing types, including cottages, townhouses, and stacked flats."

This DNDP also establishes two nodal zoning districts along Gallatin at the intersections of Cahal Avenue and Burchwood Avenue. These nodal centers reflect the community's desire to, "establish neighborhood-scaled centers … to serve the daily needs of residents." Furthermore, these areas are geared toward mixed-use development with commercial and office on first floor with residential on the upper floors.

At the northern end of the DNDP, at Gallatin's intersection with East Trinity Lane, the community hopes to encourage an "intense" mixed-use district with large anchor grocery stores, restaurants, and office buildings. The DNDP has set maximum height for development at five stories in this area.

Finally, the DNDP hopes to support the Nashville Auto Diesel College as it works toward implementing its master plan. This master plan seeks to redevelop the college's image along Gallatin Pike, and encourage open space within the campus through an overlay ordinance. The DNDP has outlined a number of alternative scenarios concerning NADC since the college's master plan includes several parcels east of Gallatin in the overlay but has yet to acquire them. The alternative identified for these parcels is for them to be zoned with an intense residential designation until they can be acquired by the college.

Other aims of the DNDP include adding bus stop locations along Gallatin Pike at Douglas Avenue and Trinity Lane as properties redevelop into mixed-use destinations. The community also hopes that any parking structures serving buildings along Gallatin Pike will incorporate uses for the ground floor to minimize visual impact and add vitality to the street environment. Finally, the community hopes to alter the several access points to major thoroughfares to promote a more pedestrian and bicycle friendly environment.

Nashville Auto Diesel College

The Nashville Automotive and Diesel College (NADC) has been a part of the East Nashville community for over 80 years. The College has crafted a vision for a new campus and hopes to aid in the re-vitalization of the East Nashville neighborhood through completion of this plan. The campus is situated on Gallatin Pike at its intersection with Douglas Avenue and currently consists of 19 acres.

However, since the campus is separated from Gallatin by several commercial parcels not owned by the college, much of the Master Development Plan focuses on the acquisition of

these parcels to help raise the college's visibility. Furthermore, the Master Plan document argues that focusing expansion toward the Gallatin Pike corridor benefits the community by "promoting higher land values through stability."

For an initial step, the Master Development Plan seeks to revamp current zoning. Currently, the college and the surrounding area are comprised of five different land use classifications, and the school hopes to propose a single Overlay Zone with unified design criteria. At present, NADC owns approximately 56 percent of the parcels in the proposed overlay area and hopes to have ownership of parcels fronting both the east and west borders of Gallatin Pike in the near future.

The overlay specifies several parameters for parcels with immediate frontage to Gallatin Pike. These parameters were guided by stipulations placed on the college by the Metro Planning Commission. These requirements can be found in the Appendix and read as follows:

"The intent of this plan is for the NADC to be an urban campus with a strong street wall along Gallatin Pike, including the phasing out of parking in front of buildings. The buildings need to be close to the street with visual and direct pedestrian access, and an adequate sidewalk width provided (greater than 5 foot standard)."

These demands are reflected in the proposed changes for the existing and new structures along Gallatin. The overlay specifies that the buildings are to be four stories in height and with setbacks ranging from 12 to 16 feet to provide adequate spacing for sidewalks but still keeping a defined urban frontage.

City of Goodlettsville

Overview

Goodlettsville is a small city adjacent to a rail line and I-65 north of Nashville with a small downtown area. Their 2004 streetscape plan suggests that the City is seeking to improve its downtown area and may be seeking redevelopment for the area. Transportation plans forecast employment growth in the area of Goodlettsville near RiverGate Mall between I-65 and the Gallatin Pike.

Goodlettsville Major Thoroughfare Plan Study

This 2003 plan was focused on developing a major thoroughfare plan for the Goodlettsville area. The study includes a review and analysis of all transportation facilities in the area as well as land use projections for employment and population growth by Transportation Analysis Zone (TAZ). Community input is integrated into the plan.

Two TAZs in the study are immediately adjacent to Gallatin Pike, wedged between the Pike and I-65. One of these TAZs is a predominantly retail area dominated by RiverGate Mall, while the other TAZ is predominantly residential. The land use forecasts for these TAZs projects significant growth in employment in both TAZs and marginal growth in population for the residential TAZ. Otherwise, this plan does not address current or future land use.

Goodlettsville Streetscape Plan

The Goodlettsville Streetscape Plan was developed to provide transportation and streetscape design recommendations for a network of streets in the heart of 'downtown' Goodlettsville. The study area for the plan is west of I-65 and does not adjoin the Gallatin Pike. Land use and urban design standards for buildings are not primary subjects of the study, however, the study does designate Rivergate Parkway as a primary gateway into the City of Goodlettsville and suggests design features that would highlight Rivergate Parkway as a gateway.

Rivergate Area Land Use Study

Completed in April 2008, the Rivergate Area Land Use Study was commissioned by the City of Goodlettsville in an effort to identify opportunities and challenges facing the RiverGate Mall and surrounding properties and to recommend strategies for improving the presence of the area in the community. For the purposes of hte study, the Rivergate area is composed of the 1.1 million square foot RiverGate Mall, the Wade Circle neighborhood, the properties that front the east side of Gallatin Pike and Conference Drive, the area known as "Birdland" west of RiverGate Mall, and the L & N Railroad Line. The Rivergate area is divided between the jurisdictional boundaries of the City of Goodlettsville and Metropolitan Nashville/Davidson County, which, as the study notes, poses particular challenges for regulatory management.

Using a combination of field reviews, data analysis, and stakeholder input, the planning team studied and established the existing conditions of the Rivergate area. The study found that, while RiverGate Mall remains a high-performing regional shopping center, the nearly 30-year old complex and surrounding area is increasingly characterized by aging buildings, access management problems, a severely lacking pedestrian environment, and growing competition from newly-developed shopping centers in Hendersonville. The area is also largely built-out, offering few vacant parcels of sufficient size for new development that might catalyze revitalization.

Though the study found that, while current zoning and land use policies do not prohibit redevelopment, both Goodlettsville and Metro Nashville policies (at the time of the study) largely supported the large-scale, single-use development that currently exists. It should be noted that Nashville Metro has

since adopted relatively aggressive mixed use future land use policies for the Rivergate area via the 2009 Madison Community Plan Update and the Community Character Manual.

In order to ensure the long term viability of the Rivergate area, the study recommends the establishment of a defined "Rivergate District" accompanied by a strategy to develop a strong and cohesive visual identity through signage, critical entry ways, and clear boundaries. Key gateways would be developed and visually treated at the following intersections: Rivergate Parkway and I-65; Rivergate Parkway and Gallatin Road; Conference Drive and Vietnam Veterans Parkway; and Conference Drive and Gallatin Road. Addressing one of the primary challenges of the Rivergate area, the study includes strong recommendations for improving the pedestrian realm, including streetscapes, crosswalks, and human-scaled building design. The study also makes several recommendations for improving circulation and expanded access options for automobiles, including a rear access road behind Rivergate Parkway, allowing U-turns at signalized intersections, and managing access points.

From a land use perspective, the study calls for a redevelopment-based strategy and identifies key parcels for development, with programs including higher density residential, an international market, and a restaurant destination. To implement improvements to the physical realm, an Urban Design Overlay is envisioned, although the study stops short of prescribing what might be included in the actual ordinance. Finally, the study recommends the creation of a business improvement district (BID) or redevelopment district in order to provide capacity for the management of a coordinated strategy and the leveraging of legal and financial mechanisms available to such entities under state law.

The Rivergate Area Land Use Study provides a first step in addressing the challenges and opportunities of one of the Northeast corridor's most significant activity centers. While the study certainly touches on concepts that are important to the implementation of transit-oriented development along the corridor, particularly an improved pedestrian realm and cohesive sense of place, the study falls short of recommending the level of density and intensity and mix of uses that will be critical to supporting premium transit in the longer term.

City of Hendersonville

Overview

The City of Hendersonville is located in Sumner County and straddles the Northeast Corridor. In Hendersonville, parts of the corridor are known as Highway 31E, while other parts are known as Main Street. Land uses along Highway 31E are predominantly commercial with some industrial. In the vicinity of Hendersonville City Hall there is a planned unit development district.

The City of Hendersonville recently engaged in a master plan for its Town Center. The plan calls for locating the town center off of the Highway 31E/Main Street corridor because the high volumes of traffic and wide street widths planned for the corridor were considered an uninviting environment for the desired walkable, pedestrian friendly town center that is planned. However the planned Town Center, while not concentrated along Highway 31E, will be located immediately adjacent to the corridor.

Town Center Master Plan, November 2005

The Town Center Master Plan was commissioned by the City of Hendersonville. The city's historic town center is located directly along the Northeast Corridor, giving this effort relevance to the project at large. The City is located northeast of Nashville and the study area consists of approximately 200 acres along the southern portion of Highway 31E, between Walton Ferry Road and Sanders Ferry Road.

The report identified the current land uses and zoning districts within the study area. The land proximate to Highway 31E was mostly utilized for Commercial Uses, as well as having underlying zoning of General Commercial Zoning District (GCD). However, a large portion of the corridor's northern edge is primarily Mixed Use Commercial, which is for manufacturing and distribution or other uses with heavy shipping traffic. The area closest to the City Hall is under a Planned Unit Development Zoning District and finally the eastern most portion of the study area shows residential land use along Highway 31E.

The study showed the current zoning along the Northeast Corridor was "not supportive" of a mix of uses or densities within the desired study area, prohibiting distinctive urban development. Furthermore, the required setbacks on most of the zoning districts were not "conducive" to pedestrian oriented development. Finally, the study notes a number of smaller parcels dotting the area, which pose a challenge to assembling large parcels for development.

A transportation study pointed out that the area's Long Range Transportation Plan (LRTP) has planned on increasing the Highway 31E to seven lanes plus a bike lane, which would greatly detract from pedestrians' desire to utilize the area due to noise and dangerous conditions. In light of the above land use and transportation factors, it was decided the future town center would be best suited pulled away from Highway 31E.

To support the Town Center Master Plan and other city planning efforts, Hendersonville's city government created the

Hendersonville Tomorrow Committee. The Committee was charged with identifying appropriate growth strategies and priorities. Thus, the Hendersonville Tomorrow's March 29, 2007 report has a fifteen year time horizon to cover the scope of long-range planning and short-term work planning.

The document itself is broken down into three different components: Goals, Vision, and Objectives. Creating a Land Use/Growth Management Plan is the first major Goal for the community. The plan explicitly calls for promoting an environment that is walkable, convenient, pedestrian friendly, and provides commercial and employment choices for those wishing to work closer to home.

First, the Committee recommended a new Zoning Ordinance and Zoning Map to foster consistency with the Town Center Master Plan. Moreover, this plan places priority on incorporating the various neighborhood plans into a cohesive land use plan. Furthermore, the community desires a stronger presence of parks and schools in neighborhoods, and hopes to promote their presence through the land use plan.

The Hendersonville Tomorrow Plan has several other objectives regarding land use outlined. For example, the community would like to investigate the possibility of adopting residential design and landscape standards. The frequent review of the County Growth Plan also provides the opportunity for Hendersonville to seek an expansion for the Urban Growth Boundary. Finally, the Plan presents the objective of coordinating the LUP with the extension of various utilities.

City of Hendersonville Land Use & Transportation Plan, 2009

Hendersonville's Land Use and Transportation Plan sets out the framework for growth for the entire city. In total, the land area covered by the study is more than 50 square miles in size, encompassing the Hendersonville city limits, the Hendersonville Planning region, and the Hendersonville urban growth boundary. Zoning and subdivision are controlled by the City of Hendersonville in both the city limits and the planning region, while the urban growth boundary is regulated by Sumner County. The plan is the result of an extensive community and stakeholder engagement process.

A primary guiding principle of the land use element of the plan is to "Transform Hendersonville from a bedroom community to a self-sustaining city..." To help accomplish this and other land use goals, the City uses a system of character areas comprised of different uses, meant to guide future development by forming recognizable districts of the city. The Hendersonville Plan's Land Use element describes the character areas, and its Implementation element specifies the relationship between these character area definitions and the City's zoning ordinance.

In general, character areas recognize traditional neighborhood development and the need to coordinate density with urban design, but these concerns are not supported by strong policy that clearly defines the City's vision for land use and development. In particular, the potential for development of a premium transit corridor is not mentioned in the land use policies.

The desire to understand the best transit options for the area is noted, however, and reference is made to the Northeast Corridor Mobility Study. The plan notes that land use, density, and infrastructure networks all play roles in accommodating transit services, and that these need to be evaluated before decisions can be made. As part of the evaluation effort, an area around the proposed Rockland Road extension was studied as a possibility for supporting a commuter rail station. According to the plan, the land use mix and density proposed for this area exhibits the characteristics of a successful commuter rail transit station, as well as an employment center.

City of Gallatin

Overview

Land use patterns for the City of Gallatin are concentrated in its historic center with radial development patterns emanating out along major corridors, namely Nashville Pike, Long Hollow Pike, Water Street, Main Street and Broadway. Denser residential neighborhoods are found near the historic town center and radiate outward into lower densities. Commercial developments are primarily found in strip patterns along major arterials such as Nashville Pike, Water Street, Main Street, and Broadway. Institutional and public land uses are scattered in and around the historic center. Industrial developments tend to be on a larger scale and are concentrated on the eastern edge and the southeastern corner of the City limits. There is a planned business park development on the east side of town called the Village Green Business Park.

Development is particularly concentrated near the Northeast Corridor. Visual estimates indicate that perhaps as much as half the city's development is within ½ mile of the corridor.

The City of Gallatin Urban Growth Study Plan included a land use summary of all existing land use within the City of Gallatin's limits. Land use was primarily in the open space/agricultural and residential categories. Specifically, open space comprised 36 percent, residential 37 percent, public/semi-public 12 percent, commercial 7 percent, and industrial 7 percent.

The City's Future Land Use map shows that the southern portion of the Northeast Corridor is planned for primarily commercial development with some clusters of mixed use development, along the corridor. Beyond the corridor there are a variety of land uses, but primarily low and medium density

residential. A major commercial development is planned for the area near Big Station Camp and SR 386, and a business park is planned adjacent to Harris Lane adjoining the rail corridor. The Northeast Corridor passes through the City's downtown redevelopment area. The northern portion of the Northeast Corridor is planned primarily for low density residential development.

The SR 386 Access Management Plan assumed that a high performance transit corridor would be developed with a transit stop in the vicinity of SR 386 and the Harris Lane Extension. A variety of circulator transit services and a pedestrian and bicycle lane network are proposed to enhance access to and from this proposed multimodal transit facility. This study also included a discussion of transit oriented development features.

Urban Growth Boundary Plan, 1999

The Urban Growth Boundary Plan is intended to assist Sumner County is identifying an urban growth boundary surrounding the Gallatin area. The plan closely follows the state mandate for an Urban Growth Boundary Plan. This includes an inventory of existing land use, population projections, an inventory of urban services, and current and projected costs for urban services. Also, the plan provides a proposed Urban Growth Boundary.

The Urban Growth Boundary proposed is significantly larger than the entire City of Gallatin and should propose no restriction on growth along the Nashville Pike corridor.

The discussion of existing land use in the Urban Growth Boundary Plan is very broad and primarily at the level of the entire City. A table of current land uses is provided and a discussion of the adequacy of vacant land for additional development is included. The existing land use maps in this study only distinguish between three land use types, commercial, publicly owned or non-profit, and other.

Gallatin Major Thoroughfare Plan, 2000

The Gallatin Major Thoroughfare Plan is a detailed transportation study that recommends a series of transportation improvements in order to meet future projected transportation demand. The study includes a review of existing conditions including land use and current roadway capacity and volume. Projections are developed for future traffic volumes based on the existing (plus approved improvements) roadway network and deficiencies are determined. New projects, including roadway expansions and extensions, are recommended to address these deficiencies. Projects are prioritized and cost estimates are developed. Other related issues such as pedestrian improvements and air quality impacts are also evaluated.

The Gallatin Major Thoroughfare Plan discussed existing land use patterns in a fair amount of detail and identified major corridors with concentrations of development in the City. Population and employment forecasts are developed by Transportation Analysis Zone through 2020 to support the transportation model.

SR-386 Access Management Plan, 2005

This study considers the impact of the proposed extension of SR-386 to Long Hollow Pike in terms of the overall transportation network. The study area is defined, existing conditions are reviewed, and current transportation plans are evaluated, including the Gallatin Major Thoroughfare Plan. Access management issues for each of the major corridors are addressed in detail. A travel demand model is developed and run twice, once on the existing system (plus approved improvements) and once on the proposed transportation system with recommended improvements. Recommendations are developed, primarily concerning road widenings, but also additional linkages in the roadway system are proposed. Priorities for projects are established and future problem areas are identified. There is also a discussion of multimodal area planning and transit oriented development land use patterns. A recommended bicycle access plan is also developed.

A future land use plan is compiled in the study in order to facilitate running the future transportation demand model. This future land use includes proposed densities and land use intensities. Otherwise land use is little discussed other than generic recommendations in the section on Transit Oriented Development. There is also discussion of a major retail development planned in the vicinity of Big Station Camp Boulevard.

Gallatin Transit Feasibility Study, 2005

This Transit Feasibility Study reviews the need for transit in the City of Gallatin and recommends a preferred alternative for a Gallatin transit system. The need for transit is analyzed by examining demographics, transportation patterns, household densities, and concentrations of employment. The current demand response transit system is also reviewed. Key stakeholders were also interviewed to understand the context for the transit planning.

Three transit alternatives are summarized, analyzed, and compared. A two route Flexible Bus Service system is selected as the preferred alternative, and implementation issues are explored. Implementation issues explored in the study include estimated ridership, cost, funding, alternative levels of service, and management and operations considerations. Connections to regional service are also considered.

Land use patterns are briefly explored in determining the need for transit. A map of household densities is used to determine where the greatest transit demand is likely located in the City. Major transit destinations are identified, including Wal-Mart, Volunteer State Community College, the downtown square, and the Sumner County Regional Medical Center.

City of Gallatin, Greenway Master Plan, 2006

The City of Gallatin Greenway Master Plan proposed a network of connected greenways centered on the historic town center. Four planning principles are articulated to guide the Master Plan, including Transportation, Recreation, Conservation, and Education. Design standards for different segments of the proposed Greenway Master Plan are developed, with consideration taken into account for multiple user groups. Implementation priorities are identified, and recommendations for action are suggested. The Greenway Master Plan includes a map of proposed greenways in a trunk and branch system. All the proposed greenways are connected through a common trunk that increases connectivity between the greenways. The propose greenway system trunk closely parallels the Nashville Pike.

Land use patterns are little discussed in the document. However the greenway system is intended to provide access to key community features such as schools and parks.

The current Hendersonville Town Center Master Plan calls for locating its proposed town center off of the Northeast Corridor because of its high volumes of traffic. While downtown Hendersonville is directly adjacent to the Northeast Corridor, this master plan does not focus on redevelopment of parcels adjacent to the corridor that may be missing opportunities for connections to the regional transportation network.

Future land use planning and development in East Nashville (east of I-24) and Madison are focused on redevelopment and infill, while future land use planning in Sumner County supports continued decentralization and greenfield development, though efforts have been made to incorporate compact design into land use plans. Plans for development along the corridor vary substantially between the urban and suburban context. Suburban areas are forecast for more development overall, but current plans do not focus on redevelopment and infill. Because land is in abundant supply in the suburban and rural segments of the corridor, without a comprehensive and robust growth management strategy, future concentrations of development in these areas are likely to be somewhat scattered.

Forecast 2035 population and employment densities are low relative to a downtown urban context (See Figures 2.3 and 2.4). Within the Northeast Corridor, population and employment centers are clustered along the corridor; however, the current and forecast densities are not very supportive of transportation alternatives.

Gallatin on the Move 2020 (City of Gallatin General Development and Transportation Plan 2008-2020)

The City of Gallatin's primary land use plan is its General Development and Transportation Plan, adopted in 2009. This plan has a time horizon of 2020. Five primary land use goals are outlined in the General Development Plan:

- Balanced, consistent growth and redevelopment that is addressed by the City in a proactive, cooperative manner
- Strong, healthy, walkable neighborhoods located near commercial, service and employment centers that provide a mix of uses, and a variety of housing choices
- Ensure availability of land for development to support employment growth
- Preserve rural character, open space and farmland
- Preserve green space, tree canopies and environmentally sensitive areas

Like Hendersonville, Gallatin aims to accompish its future land development goals through defining a series of thematic Character Areas. Future land use patterns are provided ample guidance in the plan. Different types of residential, non-residential, and mixed use development are outlined, and policy guidance and implementation measures is developed for each. Notably, linear, strip commercial development is discouraged (with retrofitting of existing strip development into pedestrian-scale interconnected nodes recommended), and mixed use development is encouraged. A multi-modal transportation plan is meant to accompany the next draft of the General Plan.

Sumner County

Overview

Sumner County is located just east of Nashville-Davidson and comprises approximately half of the Northeast Corridor study area. Most of Sumner County remains relatively rural, particularly in the northern portions of the county, though southern portions of the county have developed over time due to the area's proximity to Nashville's employment base. The cities of Gallatin, Hendersonville, and parts of Goodlettsville are located in Sumner County. The County government exercises land use regulations in unincorporated parts of the county.

At the time of the writing of this report, Sumner County is in the process of finalizing its 20.35 Comprehensive Plan. Though virtually all of the Northeast Corridor itself is located within incorporated communities, most of the study area's supply of undeveloped land is located in unincorporated Sumner County. The degree to which land use policies encourage or discourage

the development of this land has particular implications for transit viability in the study area, as this will likely impact the success of other jurisdictions' efforts to encourage growth clustered around transit stations.

Sumner County 2035 Comprehensive Plan

The Sumner County 2035 Comprehensive Plan is on-going as of the writing of this report. However, draft portions of the plan were reviewed by the Northeast Corridor planning team.

The plan identifies the consumption of previously undeveloped land by more urbanized land development patterns over the last several decades as an important area of concern, as pressures continue to mount on the county's natural and environmental resources, including rural viewsheds, water quality, and forested lands. Public meetings conducted during the comprehensive planning process revealed that the preservation of rural identity and character is important to the residents of Sumner County.

Making use of the "Centers & Corridors" concept proposed in the Nashville MPO's Tri-County Transportation and Land Use Study (2010) as a starting point, the Sumner County Comprehensive Plan proposes a future development framework that emphasizes growth in existing communities and along key corridors, while generally preserving rural and undeveloped areas. The Land Use Element of the comprehensive plan organizes the county into community character areas based on existing development patterns and visual qualities. Context maps depicting each character area have been developed during the planning process and meld together to form a 2035 General Framework Map, which identifies the desired growth scenario for the county.

The vast majority of unincorporated land falling within the Northeast Corridor study area is defined in the draft 2035 General Framework Map as "suburban," characterized by low densities and automobile-oriented land use. Much of the land falling within this category is currently undeveloped rural land. While the overall spirit guiding the Sumner County Comprehensive Plan is one of thoughtful planning and growth management, regional leaders should consider whether continued transformation of undeveloped land within the study area to low density suburban development serves to advance or encumber the transit vision for the corridor.

2.5. Transportation

A variety of transportation infrastructure and services currently serve the Northeast Corridor. A series of roadways parallel the corridor and offer varying levels of mobility and access. Traffic volumes are increasing along these alternate roadways and may produce higher levels of congestion. A variety of transit services is also available on the corridor, including fixed route bus service, express service, and park and ride lots. Several roadway and transit improvements are being considered to address the growing demands on the corridor's transportation network.

Key findings from the baseline transportation analysis, intended to describe the existing transportation infrastructure and services within the corridor, are presented below; however, a more complete analysis can be found in Appendix D.

2.5.1. Existing Major Roadways

Four north-south corridors run in parallel in the northeast Nashville area: Interstate 65/ Vietnam Veteran's Boulevard (SR 386), Gallatin/Nashville Pike (US 31E), Dickerson Pike (SR 11), and Ellington Parkway. From 2000 to 2006, average traffic volumes increased on some roadways and decreased on others, as follows:

- I-65 = 4 percent increase
- Vietnam Veteran's Boulevard = 14 percent increase
- Ellington Parkway = 16 percent increase
- Gallatin Pike = 4 percent decrease
- Dickerson Pike = 3 percent decrease

It appears that some traffic was diverted from Gallatin Pike to the Vietnam Veteran's Boulevard. However, in total there was an average increase in traffic volumes of six percent. Traffic volumes are expected to continue to increase into the future based on the population and employment growth projections.

Although some congested areas currently exist within the study area (such as areas of the Gallatin Pike in Hendersonville and areas of I-65 in Davidson County), through the implementation of the Existing and Committed (E+C) projects in the 2035 Regional Transportation Plan, most of the congested areas within the study area are forecast to be eliminated (with the exception of the I-65 segment in Davidson County). This does not imply that the overall travel time from Nashville to Gallatin will decrease; rather, the severity of the congestion in the targeted areas is predicted to diminish.

2.5.2. Existing Railroad Facilities

CSX owns and operates a mainline railroad that travels through Downtown Nashville (a hub), Madison, Hendersonville, and Gallatin. Within this project's corridor, three CSX mainline segments have been previously considered for commuter rail service extending some 30 route miles along the corridor. The first segment begins at the Clement Landport intermodal

transportation facility (at the CSX Kayne Yard) on the southwest side of downtown Nashville and runs parallel to the James Robertson Parkway as it turns northeast to the 8th Avenue split. 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. The second segment runs from 8th Avenue, across the Cumberland River, and extends to Amqui (near the Gallatin Road crossing). This segment is the most heavily traveled in the project area with some 96 trains per day, with 45 of those traveling in the daytime hours. The third segment extends from Amqui to Gallatin and primarily has one mainline track (two tracks exist from Gallatin Pike to a point just north of Myatt Drive). This segment carried 32 trains per day in 2005 with about half (15) running during the day. This indicates a heavily used freight corridor. The CSX railroad corridor (together with the Clement Landport in addition to the four roadways discussed above) will be considered for transportation improvements within the study area.

2.5.3. Existing Transit Services

Nashville's MTA and RTA provide several public transit services, including express and inner-city bus routes, paratransit, and shared ride van services. According to a 2006 survey, 54 percent of the MTA transit riders had no working vehicle and 74 percent had incomes less than $15,000 per year, indicating a heavily transit dependent customer base.

MTA currently provides Route 26 bus service between downtown Nashville and RiverGate Mall. In 2003, the route carried 10 percent of all fixed route customers in the MTA's network and was the route with the overall highest ridership. Data from 2007 indicated substantially increased ridership. Bus Rapid Transit (BRT) service is provided on Route 56, which mirrors Route 26 on Gallatin Road. Unlike local Route 26 service, these buses stop only at dedicated BRT stops (Music City Central, Five Points, Greenfield, Madison, RiverGate, and Walmart). Bus service is also provided via Route 35x which extends from downtown Nashville to Goodlettsville with service provided in the morning and evening rush hours. Currently, no fixed route bus service extends from Davidson County to the City of Gallatin. Five park and ride lots are provided in the study area for bus transfers and car and van pools. In total, over 250 parking spaces are available. In addition, the RTA offers coach bus service for commuters ("Relax and Ride") via Route 92X between Nashville, Hendersonville, and Gallatin.

2.6. Urban Design

As the Northeast Corridor radiates from Nashville to Gallatin connecting each community along its path, the urban design characteristics represent a continuum of regional development patterns over the last 50 years. Each community has small commercial nodes that formed as their original town centers. Connecting these nodes are various scales of strip commercial development. The scale of these strip commercial areas is smaller within the segment between Nashville's Central Business District (CBD) and Madison. With the exception of large grocery store schemes, the size of these developments is typically under an acre with less than 100 feet of street frontage. Larger strip commercial developments are more characteristic of the segments around the RiverGate Mall. These developments commonly include three or more acres with street frontage exceeding 150 feet. Indian Lake Village in Hendersonville, a large office, residential, and retail center currently under construction, has begun to introduce a large-scale multi-use development pattern to the north Hendersonville portion of the corridor.

Figure 2.7: *Low-density Strip Development in Hendersonville*

Figure 2.8: *Pre-1950s Commercial Buildings in Madison*

The majority of the corridor's urban form and scale is almost exclusively oriented toward the automobile. Development is characterized by one-story, low-rise buildings. With the exception of the few commercial nodes, most structures are not built to the street. Parking is predominantly located in the front of the property between the sidewalk and the entry to

the building. Within older areas, vehicular access to individual properties is typically uncontrolled, while access to newer developments is characterized by individual curb cuts to each parcel. Each community has a small core of pre-1950 buildings that is distinctly different from the rest of the corridor.

The images in Figure 2.9 show that, in some areas, the pedestrian environment is not welcoming, and facilities oriented toward pedestrians (e.g., sidewalks, crosswalks) are limited within the corridor. Many of the communities (Nashville, Goodlettsville, Hendersonville, and Gallatin), however, have adopted new zoning and design guidelines that are more form-based for some portions of the corridor within their jurisdiction. These efforts encourage more urban, multi-modal friendly development patterns.

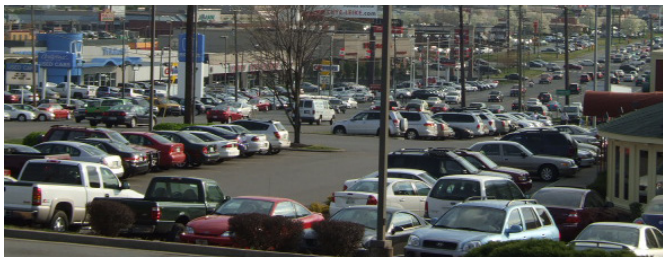


Figure 2.9: *Examples of auto-oriented urban design within study area*

2.7. Real Estate

Housing and commercial real estate characteristics in greater Nashville were examined in order to understand patterns of development—particularly in Sumner and Davidson Counties—as they may affect transportation and infrastructure alternatives in the Mobility Study. Inventory and building permit activity; historical development trends; and, depending of the availability of data, market activity such as absorption among specific uses, including commercial office, industrial, and retail as well as residential uses, were analyzed. 2007 market data from CB Richard Ellis was used in the analysis, coupled with information gathered from interviews with local brokers.

The Northeast Corridor has historically been a strong growth market for real estate in the office, industrial, retail, and residential sectors, and a large portion of the metro area's stock is located here, reflecting strong local submarkets. In recent years, the office submarkets near the corridor have seen weak absorption and high vacancies, indicating a short term market weakness. The industrial and retail submarkets were found to be strong with large amounts of new development planned or under construction. While the industrial submarkets surrounding the Northeast Corridor are historically very competitive, some stakeholders are concerned that freight access issues may pose an impediment to future growth in this sector.

Prior to the current recession, the residential market in Davidson and Sumner counties was strong, boasting some of the highest median prices in the region. While both counties are dominated by single family residential product, Davidson County in particular has seen a large amount of condominium development targeted at the young professional market. Key findings from the analysis are summarized below and presented in full in Appendix D.

2.7.1. Commercial Office

The Northeast Corridor study area falls in a number of commercial real estate "submarkets" as defined by professionals in the real estate industry. These vary based on use, locational characteristics such as highways, physical barriers such as Old Hickory Lake, and concentrations of specific types of development, among other variables. The study area straddles three office submarkets—Downtown Nashville, Airport North, and North Nashville, which collectively contain 10.8 million sq. ft. of office space—35 percent of the region's office inventory. Leasing activity was limited to 107,000 sq. ft. in 2007.

2.7.2. Industrial

The industrial submarkets surrounding the study area (Elm Hill Pike/I-40 East, I-65 North) contain 57.6 million sq. ft. of industrial space—38 percent of the region's inventory. Industrial space requires transportation infrastructure, including ready access to air freight, rail, and highways to ensure its overall viability. Net absorption totaled 383,600 sq. ft. in 2007, with

Figure 2.10: *RiverGate Mall*

Elm Hill Pike accounting for half of the entire metropolitan area's leasing activity (with an additional 2.7 million sq. ft. of industrial space under construction). Brokers report that limited truck and freight access (particularly in the area surrounding RiverGate Mall) are impediments to further industrial development in this submarket.

Sumner County's industrial uses are concentrated in warehousing and manufacturing, which are "horizontal" and land consumptive in nature. Tenants typically seek locations with lower land and real estate costs in outlying (or emerging) locations of a metropolitan area such as Sumner.

2.7.3. Retail

Madison and Goodlettsville, including RiverGate Mall, provide some of the region's most significant retail opportunities, with 3.6 million sq. ft. of retail space. Others include Hendersonville and Gallatin, with 2.7 million sq. ft. of retail inventory. More than 941,500 sq. ft. of new retail space is under construction in the Hendersonville/ Gallatin market, such as The Streets at Indian Lake. Indian Lake Village and RiverGate Mall are two important existing retail anchor destinations within the study area.

2.7.4. Residential

Between 1996 and 2006, Davidson County issued 45,700 permits for new housing development, reflecting a pace of 4,200 permits per year, primarily for single-family detached units. Sumner County issued 15,700 permits, reflecting a pace of 1,600 permits per year; fully 89 percent of new housing activity in Sumner is single-family detached, with multi-family apartments comprising only 150 permits per year.

2.8. Land Use Demand Analysis

A land use demand forecast was prepared to understand the amount of new acreage that will likely be developed in the study area from 2008 until 2035. Growth forecasts (2008-2035) prepared by the MPO were analyzed, and a preliminary land use demand analysis was prepared to translate future population, household, and employment growth into real estate requirements – both residential and commercial. The analysis focused on translating this expected growth into demand for housing and particular types of employment-related real estate in the study area, including office space, industrial parks, and shopping centers, in order to evaluate the provision of appropriate modes of transportation in the Northeast Corridor. A variety of assumptions were made to develop this forecast, generally guided by the principle that future new development will occur in patterns similar to existing development in the area.

The study area is forecast for substantial growth in both residential and commercial land uses. In general, the study area is forecast to experience a growth rate comparable to the two-county area, with approximately a 1 percent annual growth rate for both population and employment. Hundreds of acres of new commercial development and thousands of acres of new residential development are forecast for the corridor. Also, this forecast suggests that the study area will have a balanced mix of users – residents, employers, and shoppers - in relatively closer proximity.

The amount of land consumed by development can vary greatly depending upon future land use development patterns. If land use densities increase, or if there is a shift towards focusing on redevelopment, the amount of land consumed by new development could decrease significantly. A more detailed explanation of the methodology and results of the analysis can be found in Appendix D; however, a summary of key findings is presented below.

2.8.1. Population and Households

By 2035, the MPO forecasts that the study area will add 49,193 new residents in almost 28,581 new households. As part of the character districts task, locations for these new housing units—and likely types and densities—have been identified and are described in Section 6. Currently, average densities (or floor area ratios, FAR) are lower-density, characteristic of suburban patterns of development.

2.8.2. Employment and "Workplace" Land Uses

The study area contains more than 64.7 million sq. ft. of "workplace" uses—including speculative/multi-tenant and medical office buildings, industrial parks, public/institutional uses, and shopping centers (such as RiverGate Mall). According to the MPO, the study area is forecast to gain approximately 77,027 new jobs by 2035 which is expected to translate into increased demand for new "workplace" uses. With the exception of Downtown Nashville, the overall average FAR of workplace buildings in the study area is 0.24 (i.e. workplace buildings occupy an average of 24 percent of their lots).

2.7.3. Retail

Using MPO assumptions that approximately 333 sq. ft. are needed to support one retail emplyee, the analysis suggests that an estimated 2.8 million sq. ft. of additional retail space would be demanded from future growth. If similar patterns of development continue in the study area, this will require another 250 acres of land for new shopping centers in various formats (strip centers, Big Box/power centers, regional malls, etc.).

2.7.4. Industrial and Office

Similarly, using MPO assumptions of 250 sq. ft. per office employee and 350 sq. ft per industrial employee, the analysis suggests that more than 16 million sq. ft. of additional office space and approximately 4.4 million sq. ft. of industrial space will be demanded from future employment growth. If current development patterns in the study area continue, this may require around 600 acres of land for new office (assuming an average FAR 0.62) and other non-retail commercial buildings and roughly 135 acres for new industrial parks (at average FAR of 0.22).

3.0 Initial Transportation Alternatives

Figure 3.1: *Music City Star, Nashville*

The planning process began in earnest with the development of ten preliminary alternatives. These alternatives were a combination of modes and corridors; an application of the planning principles and criteria narrowed the ten to three alternatives. This section describes the alternatives and the narrowing process.

3.1 Description of Modes

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

Figure 3.2: *Articulated bus, Minneapolis, Minnesota*

Figure 3.3: *Standard 40-foot bus, Nashville*

To define a narrowed set of technology options, each of these modes of transportation was evaluated qualitatively. Criteria such as system characteristics (e.g., station spacing and speed), infrastructure compatibility, study purpose and goals, as well as costs were examined. Appendix D, Tech Memo 4: Universe of Alternatives Definition and Evaluation Report 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.

Table 3.1: Bus Characteristics

Characteristic	Description
Person/Vehicle Capacity	40 to 60 seats; 50 to 80 passengers per vehicle
Vehicles per Set	1
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 (compressed natural gas, 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

3.1.1. 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.

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 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.

Figure 3.4: *Las Vegas MAX*

Figure 3.5: *Euclid Avenue HealthLine - Cleveland, Ohio*

- 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.

Table 3.2: BRT Characteristics

Characteristic	Description
Person/Vehicle Capacity	40 to 60 seats; 50 to 80 passengers per vehicle
Vehicles per Set	1
Guideway	Mixed traffc but separate right-of-way recommended
Speed (Maximum)	70 mph
Speed (Average)	15-45 mph (depends on application)
Power Supply	Diesel, compressed natural gas (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

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.

Figure 3.6: *Dallas, Texas*

Figure 3.7: *Denver, Colorado*

Table 3.3: LRT Characteristics

Characteristic	Description
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 1 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 smaller 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.

Table 3.4: Heavy Rail Characteristics

Characteristic	Description
Person/Vehicle Capacity	64 seats; 120-300 passengers
Vehicles per Set	2 to 10
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

Figure 3.8: *MARTA - Atlanta, Georgia*

Figure 3.9: *Metrorail - Washington, DC*

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 central business district 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.

Figure 3.10: *Music City Star, Nashville*

Table 3.5: Commuter Rail Characteristics

Characteristic	Description
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

Locomotive-Hauled Commuter Rail

Locomotive-hauled trains can be diesel or electricpowered. 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.

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 selfpropelled 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.

Figure 3.11: *DMU Demonstration Project - Tri-Rail, South Florida*

Figure 3.12: *EMU - Metra, Chicago*

Table 3.6: Monorail Characteristics

Characteristic	Description
Person/Vehicle Capacity	Varies
Vehicles per Set	Varies
Guideway	Exclusive fixed guideway
Speed (Maximum)	55 mph
Speed (Average)	20-30 mph average including 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 Revenue 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.

Figure 3.13: *Las Vegas Monorail*

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.

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.

Table 3.7: AGT Characteristics

Characteristic	Description
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

Figure 3.14: *Miami MetroMover*

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.

Table 3.8: PRT Characteristics

Characteristic	Description
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

Figure 3.15: *PRT on test track*

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 fi xed 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 (0.2 to 0.6 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 fi rst 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 fi nal 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.

Figure 3.16: *Linimo, Japan*

Table 3.9: Maglev Characteristics

Characteristic	Description
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	NA
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.

Table 3.10: High Speed Rail Characteristics

Characteristic	Description
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

3.1.10 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 identifi ed 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.

Figure 3.17: *Acela Express*

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 0.5 to 1 mile apart.

Water taxis typically provide service on demand; whereas water buses operate on a fi xed 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)

Table 3.11: Ferry/Water Taxi Characteristics

Characteristic	Description
Person/Vehicle Capacity	Varies by vessel: 25-150 passengers
Vehicles per Set	One
Guideway	Exclusive right-of-way on navigable waters
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	0.5-1 mile apart
Capital Cost	Varies by type of vessel, $160,000 to $2.8 million
Current Revenue Operations	Yes. Public and private operations in the 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

Figure 3.18: *Fort Lauderdale Water Taxi*

3.2 Developing and Evaluating the Ten Alternatives

The methodology used to evaluate the various modes of transit presented above, as well as potential travel routes ("alignments") within the study area, included a detailed screening and narrowing process. The overarching intent was to achieve a balance between the economic, land use and transportation benefits along with maximized project budgeting.

Comprehensive criteria and measures of effectiveness were used to analyze each option. Each step in the process was designed to yield progressively decreasing alternative options that were thereafter evaluated with increasing scrutiny. This evaluation process weighed the benefits and impacts of each alternative in comparison with the established need for the project. The result is the identification of the "most suitable" alternative option. The alternatives were weighed by the stakeholders and decision-makers in terms of ultimate feasibility in order to determine the appropriate mode and alignment for the Northeast Corridor.

For this corridor study, each alternative was measured quantitatively as well as by an ordinal scale, rating the impact of each option from favorable to unfavorable. This approach introduced some subjectivity into the evaluation process, but generally recognized positive and negative impacts and key weaknesses. Such shortcomings ultimately justified the elimination of some alternatives and the continued review of others. As a general rule, however, an alternative advanced in the screening process unless there were compelling reasons for its elimination.

While the Northeast Corridor Mobility Study was not designed to produce a Locally Preferred Alternative as part of a New Starts application for project funding, the process to evaluate the potential multimodal options did closely follow the Federal Transit Administration (FTA) guidelines. The work product could therefore potentially be applied toward a New Starts Project when feasible.

The summary of the process utilized is provided in the following sections of this report. A detailed presentation of the technology screening, preliminary alternatives development and review, and the recommendations for final comparative evaluation of the alternatives that "survived" the screening process can be found in Technical Memorandum #5: Universe of Alternatives Definition and Evaluation Report, Northeast Corridor Mobility Study, January 2010.

3.2.1. Goals and Objectives

The development of alternatives was from the onset a function of the guiding principles established for the study. The MPO and the project planning team drafted the guiding principles based on input received from a series of public meetings, where participants shared their ideas on mobility and future development. These guiding principles are: Protect Valuable Resources, Improve Access to Economic Opportunities, Improve Access to Goods & Services, Increase Housing Choices, and Improve Aesthetics throughout the Corridor. Table 1.2 in Section 1 of this report provides a more detailed discussion of the project principles. These principles were used throughout the comparative alternative development and evaluation process.

An additional set of goals and objectives was devised to specifically help analyze the impact of transit options and routes through out the screening process. These goals respond directly to issues considered important to the Nashville area, as gleaned from interviews and meetings with stakeholders, the public, and the MPO:

- **Issue 1:** Population and employment growth and resulting highway congestion

  Goal: Improved access and mobility within the study area

  Objectives: Reduce highway congestion; provide alternative travel modes; and reduce travel time

- **Issue 2:** Zero-car households

  Goal: Ensure adequate service to transit dependant populations

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

- **Issue 3:** Increased automobile and truck traffic and the related air quality impacts

  Goal: Promote sustainability through appropriate land use, development patterns, and transportation options

  Objectives: Improve/minimize adverse air quality impacts; reduce/minimize impacts on environmental and cultural resources; provide compatible land use and transportation options; and provide compatible transportation amenities and solutions

- **Issue 4:** New industries and businesses are generating increasing automobile traffic

  Goal: Steward transportation investments to support and incentivize realistic development plans

  Objectives: Invest in financially feasible transportation solutions; stimulate/enhance economic development; and target markets and communities with needs

- **Issue 5:** Increased traffic and inappropriate street design contribute to unsafe environments

  Goal: Improve safety and security in the corridor with focus on the transit/pedestrian/auto interface

  Objectives: Implement projects that reduce traffic accidents; incorporate streetscapes and amenities that support safe environments and add character

Figure 3.19: *Alternatives Analysis Process*


ISSUE #1
Population & Employment Growth & Resulting Highway Congestion
GOAL
Improved Access & Mobility within the Study Area
OBJECTIVES
Reduce Highway Congestion
Provide Alternative Travel Modes
Reduce Travel Times
ISSUE #2
Zero-Car Households
GOAL
Ensure Adequate Service to Transit Dependent Populations
OBJECTIVES
Provide Transportation Options to the Transit-dependent, Low Income & Minority Populations
ISSUE #3
Increased Automobile & Truck Traffic & the Related Air Quality Impacts
GOAL
Promote Sustainability through Appropriate Land Use, Development Patterns & Transportation Options
OBJECTIVES
Improve/minimize Adverse Air Quality Impacts
Reduce/minimize Impacts on Environmental & Cultural Resources
Provide Compatible Land Use & Transportation Options
Provide Compatible Transportation Amenities & Solutions
ISSUE #4
New Industries & Businesses are Generating Increasing Automobile Traffic
GOAL
Steward Transportation Investments to Support & Incentivize Realistic Development Plans
OBJECTIVES
Invest in Financially Feasible Transportation Solutions
Stimulate/enhance Economic Development
Target Markets and Communities with Needs
ISSUE #5
Increased Traffic & Inappropriate Street Design Contribute to Unsafe Environments
GOAL
Improve Safety & Security in the Corridor with Focus on the Transit/Pedestrian/Auto Interface
OBJECTIVES
Implement Projects that Reduce Traffic Accidents
Incorporate Streetscapes & Amenities that Support Safe Environments and Add Character

3.2.2. Evaluation Process

The alternatives developed for the Northeast Corridor were identified using the principles, goals and objectives described above. In addition to the mobility alternatives, a No-Build alternative was developed for comparison purposes. This alternative reflected the maximum expected improvement that can be achieved without major capital investments in infrastructure. The No-Build alternative, and its comparison with a baseline alternative and the build alternatives that were advanced through the screening process, is described in further detail Sections 4 and 5 of this report.

The preliminary analysis for the alternatives consisted of three elements:

- Identification of the appropriate transit technologies for the corridor (i.e. screening of modes or technology screening);
- Identification of the universe of alternatives that would support the goals and objectives for the corridor (i.e. the evaluation of alignments); and
- Screening the universe of alternatives to eliminate those that do not support the goals and objectives.

The evaluation process resulted in the narrowing of 10 initial alternatives to three alternatives that meet the established criteria. These three alternatives were advance to a more detailed stage of evaluation, explored in Section 4. The results of the preliminary screening analysis are shown in Table 3.14, Technical Screening Evaluation Scores. The following sections describe the process which led to the selection of the three alternatives for advancement to the next stage of evaluation.

Screening of Modes

The screening process which focused on narrowing down suitable mode options for the corridor examined a total of 11 technologies, which are described earlier in this section. At this stage, transit modes were eliminated based on an analysis of several factors, including lack of demonstrated success in the U.S., high capital cost per mile, or that it clearly does not meet the project purpose and need. The analysis resulted in the elimination of all but conventional bus, BRT, LRT, and commuter rail, as summarized in Table 3.12, Screening of Modes.

Table 3.12: Screening of Modes

Criteria	Measure	Alternatives										
		Conventional Bus	Bus Rapid Transit	Light Rail Transit	Heavy Rail Transit	Commuter rail	Monorail	Automated Guideway Transit	Personal Rapid Transit	Maglev	High Speed Rail	Water Taxi/ Bus
SUITABILITY												
Average Operating Speed	+ / o / -	o	o	o	o	+	o	o	-	+	+	-
Average Station Spacing	+ / o / -	o	+	+	o	o	+	+	-	-	-	o
Compatibility with Transportation System	+ / o / -	+	o	o	-	+	-	-	-	-	-	o
Satisfies Study Purpose & Need	+ / o / -	+	+	+	-	o	-	-	-	-	-	-
Order of Magnitude Capital Costs	+ / o / -	+	+	o	-	+	-	-	-	-	-	+
APPLICABILITY												
Proven Revenue Service in US	+ / o / -	+	+	+	+	+	-	-	-	-	-	+
RESULT	Advance / Do Not Advance	Advance	Advance	Advance	**Do Not Advance**	Advance	**Do Not Advance**	**Do Not Advance**	**Do Not Advance**	**Do Not Advance**	**Do Not Advance**	**Do Not Advance**

Qualitative Ratings by Comparison

\+ Favorable o Neutral - Unfavorable

Indicates a Cause for Elimination

Evaluation of Alignments

The initial range of alternatives focused on three primary alignments. These were the Freeway Corridor (SR 386/I-65, I-24, Ellington Parkway), the Arterial Corridor (US 31E/SR 6, Gallatin Pike, Broadmoor/Dickerson Pike/1st Street) and the Railroad Corridor (CSX, Hadley Bend Connector/N&E). Alighnments were evaluated for their potential proximity to population bases and activity centers as well possible impacts as related to the Goals and Objectives identified for the study. The candidate corridor alignments are shown on Figure 3.20 on the following page.

Candidate corridors were paired with potential transit modes for further evaluation. The actual screening of alignments was carried out in tandem with the modes that advanced through the transit technology screening. The screening process is described in the following section and summarized in Table 3.13. Additional detail on the evaluation and screening process is also available in Appendix E, Technical Memorandum #5: Universe of Alternative Definition and Evaluation.

Technical Screening of Mode & Alignment Alternatives

Once identified, the potential corridor alignments were evaluated in concert with the modes that advanced from the first transit technology screening - those which best aligned with study goals and objectives: BRT, LRT and commuter rail. In total, 10 options combining the modes appropriate for the Nashville area and the potential alignments were analyzed.

Detailed criteria was developed to quantify and measure the performance of each alternative against the Goals and Objectives. Appropriate data was collected in order to evaluate each alternatives' performance and the criteria were applied to determine the benefits and impacts of each distinct option and to further narrow the range of alternatives for more detailed evaluation. The goals, evaluation criteria, and measures used to advance or discard alternatives are shown on Table 3.14, Technical Screening Evaluation Scores.

Six alternatives were eliminated from consideration: #1, #2, #3, #4, #9 and #10. Alternative #10, the Hadley Bend Commuter Rail Corridor alternative, was the worst overall performer due to its limited access to major activity centers, population centers and employment opportunities. Alternatives #1-#4 and #9 each performed poorly in relation to the key criteria on zero-car households served, number of low-income households served, and number of minority households served. These alternatives also provided access to a low forecast year 2035 population and have a low amount of properly zoned land adjacent to the alignments.

Four final candidates remained: #5 -#7 and #8. From these, BRT was found to have a clear advantage over LRT in terms relative cost. That suggested that Alternative #5 – Gallatin Pike (US-31E) Arterial Corridor BRT and Alternative #7 – Dickerson Pike Arterial Corridor BRT should advance. Between Alternatives #6 and #8, Alternative #6 – Gallatin Pike Arterial Corridor LRT - performed best on end-to-end travel time, number of zero-car households served, acres on potential impacts to parks and wetlands, and estimated capital cost. For these reasons, Alternative #6 was determined to be the superior of these two alternatives and considered for advancement.

Table 3.13: 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

STUDY AREA CANDIDATE CORRIDORS

FIGURE 3.20: FREEWAY, ARTERIAL AND COMMUTER RAIL CORRIDORS

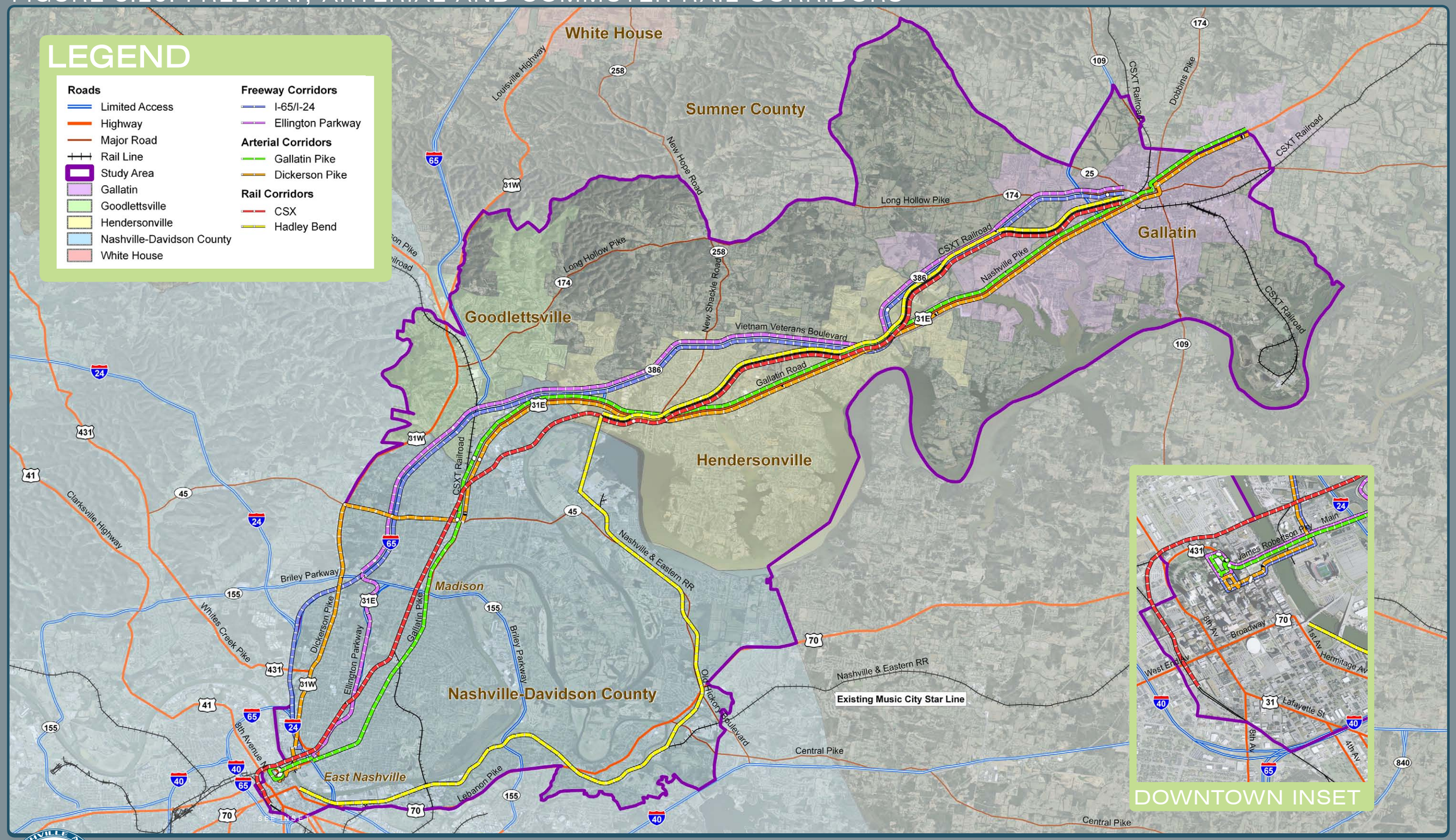


Table 3.14: Technical Screening Evaluation Scores

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	Do Not Advance	Do Not Advance	Do Not Advance	Do Not Advance	Advance	Advance	Advance	Do Not Advance	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.

Local Officials' Input and Public Input

Nashville Area MPO staff met with the mayors from the jurisdictions along the study area as well as with their planning staff to discuss the initial analysis results from Technical Memo #5 – Evaluation of Alternatives. An outline summarizing the previous documents leading to Technical Memo #5 was presented to help explain the background information and to establish how the three alternatives recommended for detailed analysis emerged. MPO staff emphasized key areas of the Technical Memo and sought local input from the mayors and planning staff in order to have a better understanding of how the technical analysis results met the local government expectations. The results from those discussions are summarized below:

Sumner County – September 22, 2009

- Meeting with Sumner County Executive and County Planner.
- It was stressed the importance of having a strong link between land-use and transportation.
- County staff expressed a general desire to have a rail alternative included moving forward.
- Concerns about the community's perception and the appeal of BRT were discussed.

City of Gallatin – September 22, 2009

- Meeting with City Mayor and Community Development Coordinator.
- The value of having a commuter rail alternative along the CSX corridor was questioned since it has been widely discussed that they operate very heavy freight traffic in that corridor.
- The frequency of CSX trains in the corridor was a point of discussion.
- Utilization of the CSX corridor does not mean sharing the tracks. New tracks could be built along the corridor.
- Implementation of bus service may not be necessarily what the community would like to see in that part of the corridor.
- There was a feeling that this part of the corridor may not be suitable for BRT.
- Concerns were expressed about regional mass transit being a one-time investment for Sumner County and some type of rail investment could be the way to go.
- There was discussion about looking at a freeway light rail alternative similar to what was seen in Denver during one of the site visits as part of the study and that has proven successful there.

City of Hendersonville – September 23, 2009

- Meeting with City Planning Director
- Hendersonville is interested in seeing some type of rail alternative.
- It was discussed mentioned that the CSX corridor should remain an alternative. One particular possibility in looking at the CSX corridor going through Hendersonville could be building a bypass for CSX freeing access to the existing line that goes through the middle of Hendersonville.

City of Goodlettsville – October 7, 2009

- Meeting with City Mayor and the City's Planning Director.
- Concerns were expressed that none of the three alternatives proposed goes directly into Goodlettsville's city center.
- City's staff concerns focused more on alignments rather than modes proposed.
- The need to reinvest and redevelop in Goodlettsville was emphasized.
- City leaders see mass transit service at a strategic location within City limits as an essential element that can become a catalyst for future economic development.
- Possible areas in Goodlettsville for this included areas around Long Hollow Pike, Conference Drive, I-65, Dickerson Pike and Rivergate Parkway
- Metro Nashville/Davidson County – October 19, 2009
- Met with Metropolitan Government Mayor, Mayor's Senior Advisor and the City's Bicycle/Pedestrian Coordinator.
- There were questions about the need or value of moving forward two BRT alternatives. One of them could be LRT.

Top Transit Alternatives

The technical evaluation, while including both qualitative and quantitative measures based on the purpose, needs and goals of the project, tended to favor the alternatives that are the most economical to construct and located nearest the high population and employment centers that exist today. The local government officials' input, and much of that received from the public, was based on their vision for the future of the corridor and thus had to be taken under serious consideration, as the implementation of any proposed system must be evaluated for its benefits to the community over a long period of time. This vision emphasized the future corridor opportunities that could be "created" by the introduction of appropriate public transportation, including development and redevelopment of property in a form conducive to the use of transit and other alternative travel modes.

Public input echoed that of the elected and appointed officials. Almost all of the public that participated in community workshops concurred with the suggestions from the local officials that the final evaluation must be conducted based on an analysis of three alignments within the study corridor, each using a different transit technology. These recommendations lead to the final selection of three "build" alternatives. For purposes of the detailed evaluation, they have been renumbered 1, 2, and 3 for ease of comparison and discussion.

The results of the final analyses are described in the next section of this report.

Alternatives Moving Forward:

#1 - Commuter Rail along the CSX Corridor

#2 - LRT along Ellington Parkway/SR-386 Corridor

#3 - BRT along the Gallatin Pike (US – 31E) Corridor

4.0 Top Transit Alternatives Evaluated

Figure 4.1: *Identifying alternatives to auto-dependency could help create a more sustainable future for the Nashville area*

As described in the previous Section, the preliminary analysis narrowed a broad universe of alternatives to 10 feasible combinations of modes and routes. A more detailed analysis further narrowed the alternatives and community leaders and planners selected three for very detailed analysis: commuter rail in the CSX corridor, LRT on SR 386/SR 6, and BRT on US 31E. This section details the in-depth analysis of the three transportation alternatives, a baseline alternative, and a no-build alternative. This analysis included further development and application of the regional travel demand model, development of planning-level siting and design recommendations, and estimates of costs and travel benefits.

4.1. Baseline and No Build Evaluations

4.1.1. Baseline Evaluation

This section describes the Baseline Alternative, which provides the baseline against which the cost-effectiveness of the major capital investments in the build alternatives can be evaluated. A requirement of the FTA project development process, the Baseline Alternative includes a set of relatively low cost transit improvements designed to improve measures of transit mobility in the corridor. It is intended to reflect the "best that can be done" to meet the travel needs of the project corridor without major capital investments in new infrastructure.

Major features of the Baseline Alternative service plan are as follows:

- Maintain and improve bus service on Gallatin Pike from Music City Central to RiverGate Mall area. This has been accomplished by improving Route 56 frequencies and maintaining Route 26 frequencies.
- Improve service in the freeway corridor to Gallatin. This has been accomplished by improving Route 92X

frequencies and adding new stops mirroring the freeway service in the build alternatives and allowing for the elimination of Route 35X. Route 35X circulation between RiverGate Mall and Goodlettsville would be maintained by the addition of the Goodlettsville circulator routes, as described below.

- Provide strong bus connections to the corridor stations/stops by including new circulator routes in the East Nashville, Goodlettsville, Hendersonville, and Gallatin areas to complement the corridor service. These circulators are designed to provide connecting service to the major activity centers surrounding key stations/stops.

Bus Services

Corridor Bus Service

The corridor service in the Baseline Evaluation is similar to that of the No-Build Evaluation, with some minor changes. Route 26 would experience improved bus frequencies, with weekend and holiday service would be more frequent. Route 56 will experience more frequent bus service on all days at all time periods. Route 35x would be eliminated in conjunction with service changes to Route 92x (also called "Relax and Ride," a commuter service) . This route would be modified to provide service out to the Sumner Regional Medical Center, with additional stops at the park-and-ride lots near Harris/Greenlea Road, Saundersville Road, New Shackle Island Road, and RiverGate Mall, therefore eliminating the need for Route 35x. The service on Route 92x would change from a peak-hour operation to an all-day operation with bus frequencies as close as 20 minutes.

Connecting Local & Express Bus Service

Changes to the corridor bus service in the Baseline scenario do not affect the available transfers to Routes 20, 30, or 34x or the Madison Connector (Route 76). The connecting local and express bus service is identical to the no-build scenario.

Circulator Bus Service

The Baseline scenario includes the current Music City Circuit routes in Downtown Nashville, with additional circulator routes in the East Nashville, Goodlettsville, Hendersonville, and Gallatin areas. The East Nashville circulator would connect to existing stops on Route 56, while the Goodlettsville, Hendersonville, and Gallatin routes would connect to the 92x express route.

Bus Network Operating Requirements

The Baseline scenario bus network would require 52 buses in service during the peak hour with a total fleet of 63 buses. This represents a 110 percent increase over the requirements in the no-build scenario. Annual revenue hours, with respect to the revised bus service operations, would increase by almost 129 percent, and revenue miles would increase by 153 percent. Full statistics on operating characteristics and requirements can be found in Appendix F, Operating Plan and O&M Costs Report.

4.1.2. No Build Evaluation

Generally, a No-Build Alternative encompasses the existing plus committed transportation network, where "committed" projects are considered to be those that are likely to be built given fiscal constraints. For this analysis, this network includes the existing MTA transit services and facilities that existed in November 2009 as well as the downtown Music City Circuit Routes implemented in March of 2010.

Bus Services

Corridor Bus Service

Under the no-build conditions, the corridor is served by Route 26 (Gallatin Road), Route 35x (Rivergate Express), Route 56 (Gallatin Road Bus Rapid Transit), and Route 92x (Gallatin/Hendersonville Express, also known as "Relax and Ride," a commuter service). Route 56 utilizes the same routing plan as 26, but provides an express option with fewer stops and more frequent buses. The 35x and 92x express routes offer service from park-and-ride lots within the study area to downtown and the Vanderbilt University area.

Connecting Local & Express Bus Service

Routes 26 and 56 along the corridor provide connections to four additional transit services. Route 20 (Scott) provides service to neighborhoods paralleling Gallatin Pike from Music City Central to Inglewood Library. Areas to the west of Gallatin Pike from Music City Central through the Douglas Park Neighborhood are serviced by Route 30 (McFerrin). Route 34 services Opry Mills, the park-and-ride lot at Kmart in Madison, and downtown. Finally, the Madison Connector (Route 76) offers bus service in the Madison area, with a scheduled stop once every hour at the Madison Station BRT.

Circulator Bus Service

Circulator service was implemented by MTA in March 2010, offering two routes in Downtown Nashville that link to the Gallatin Pike Corridor bus services described above. The Blue Circuit, or Bicentennial Mall Route, operates between the Schermerhorn Symphony Center and Bicentennial Mall. The Green Circuit, or Gulch Route, provides service between the Gulch and the Riverfront Commuter Rail Station.

Bus Network Operating Requirements

The no-build alternative, which includes the corridor bus

service, connecting routes, and downtown circulators, requires 25 bus vehicles during the peak operating hour, which translates to a fleet total of 30 buses (accounting for repairs and back-up buses). On an annual basis, these routes will conduct 85,900 revenue hours and almost one million revenue miles. Full statistics on operating characteristics and requirements can be found in Appendix F.

4.2. Alternative 1 (Commuter Rail on CSX Corridor)

This alternative represents the deployment of a commuter rail technology along the existing CSX rail corridor between downtown Nashville and the City of Gallatin. This alternative would provide AM and PM service to commuters with similar characteristics to those associated with the Music City Star.

4.2.1. Operating and Service Characteristics

The Commuter Rail Alternative is a 10 station, 27.0 mile line from downtown Nashville to Gallatin. In downtown Nashville, the alignment would begin at the Clement Landport, follow the CSX line around the Capitol, cross the Cumberland River, and parallel the CSX tracks to Gallatin, terminating at a station near the intersection of Long Hollow Pike and the proposed Maple Street Extension. Characteristics for the Commuter Rail Alternative are summarized in Table 4.1.

The Commuter Rail Alternative is defined by operating plans that include modifications to the underlying bus network in addition to the introduction of new service along the existing rail corridor. These feeder bus plan modifications include eliminating existing MTA routes that duplicate the proposed commuter rail service, modifying alignments of existing MTA routes to ensure connectivity with the proposed commuter rail service, and adding local circulators to provide strong bus connections to the stations and extend the service coverage of the alternative. These modifications, operating plans, and travel time statistics are detailed in Appendix F: Operating Plan and O&M Costs Report. Figure 4.2 illustrates the alignment, proposed station locations, and proposed circulator routes.

Capital costs are estimated to be approximately $630 million (in 2010 dollars), which is approximately $23 million per mile. New parallel tracks are assumed to the east/south of the existing freight tracks. Crossings would mirror the existing freight tracks. Therefore, some crossings would be at-grade, while others are grade separated. Table 4.2 contains a detailed breakdown of probable costs associated with the Commuter Rail Alternative.

Table 4.1: Operating and Service Characteristics - Alternative 1 (Commuter Rail)

Characteristic	Description
Frequency	20 minute headways
Station Locations	• Clement Landport • Capital • Trinity • Briley Parkway • Madison • Myatt Drive • New Shackle Island • Saundersville • Harris/Greenlea • Maple
Ridership & User Benefits	4,743 daily (1,475,000 annually)/3,277 weekday benefit hours
Financial Impacts	• Capital Costs: $630 million (2010 dollars); $950 million (inflated costs to 2020 opening year) • See Table 4.2 for the detailed Opinion of Probable Cost. • Operating Costs: $30,716,000 (change from no-build) • Cost Effectiveness: $67.10

Alignment travel time estimates were developed for the full commuter rail alignment. The total travel time from Clement Landport to Maple is estimated to be 54.73 minutes, while station-to-station travel times range between around 4 and 7 minutes. The Commuter Rail Alternative has the lowest ridership estimates of the three build alternatives, at 4,743 daily boardings.

STUDY AREA COMMUTER RAILROAD CORRIDOR

FIGURE 4.2: COMMUTER RAIL ALONG CSX RAIL CORRIDOR

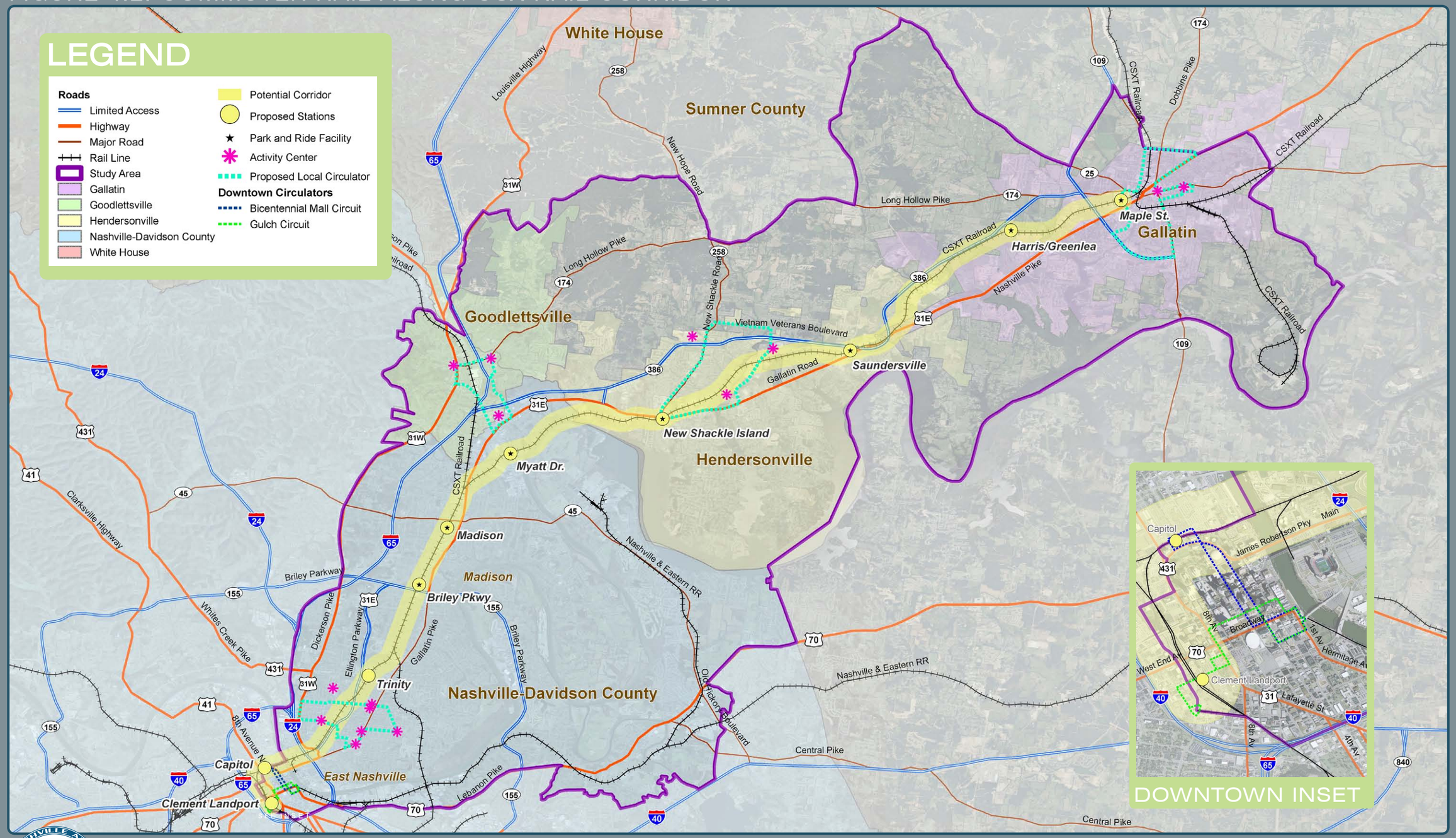


Table 4.2: Opinion of Probable Capital Costs, Commuter Rail Alternative					
Capital Cost Component	**Units**	**2010 Unit Cost**	**Quantitiy**	**2010 Component Cost**	
Basic Station	each	$ 4,300,000	9	$ 38,700,000	Includes waiting area, partial platform canopy, lighting, security camera, fare vending, train schedule display (visual), communications (including audible announcements), etc.
Platform	each	$ 310,000	0	$ -	Platforms included in Station Costs
Downtown Station	each	$ 6,450,000	1	$ 6,450,000	Estimate only - Assumes need for larger waiting area downtown (for the outbound commute) plus need for more extensive pedestrian facilities and facilities for connecting buses
Park-and-Ride Lot	space	$ 7,000	2,400	$ 16,800,000	Surface Lots (including drainage, entrance, exit, landscaping, pedestrian walkways - does not include signalization at exit if required)
Park-and-Ride Structure		N/A	0		Parking Structure
Track	mile	$ 1,650,000	27.13	$ 44,756,000	Track and subballast (single track)
Earth cut/fill	mile	$ 3,600,000	26.62	$ 95,835,000	
Right of Way and Relocation	LS	$ 5,000,000	1	$ 5,000,000	Estimate only, not including Yard ROW (which is in the Yard line item)
Locomotive	each	$ 4,230,000	8	$ 33,840,000	
Passenger Car	each	$ 2,210,000	16	$ 35,360,000	
Passenger Car - Cab End	each	$ 2,500,000	8	$ 20,000,000	
Retaining Wall	linear foot	$ 1,410	3,400	$ 4,794,000	Assumes sheet pile wall, maximum 15’ in height
Signals	mile	$ 500,000	27.13	$ 13,563,000	
Special Track Work	mile	$ 830,000	27.13	$ 22,514,000	
At-grade Crossings	each	$ 675,000	9	$ 6,075,000	
Bridges and Viaducts	linear foot	$ 6,200	902	$ 5,592,000	Single track, non-complex
Bridges and Viaducts	linear foot	$ 11,200	1,760	$ 19,712,000	Single track, complex or river/ stream crossing
Central control facility	LS	$ 3,500,000	1	$ 3,500,000	
Yard and Shop	LS	$ 22,000,000	1	$ 22,000,000	Storage for 8 train sets with light maintenance facility
Engineering, Construction,		30%		$ 90,090,000	30% of non-vehicle, non-ROW costs
Testing, Start-up Contingency		30%		$ 145,419,000	Includes utility relocation, traffic control, flagging, sales tax on materials, etc.
Total				**$630,000,000**	
			Route Miles:	27.1	
			Cost per Mile:	$23,200,000	

4.3. Alternative 2 (Light Rail Transit on Ellington Parkway/ SR 386 Corridor)

This alternative considers the deployment of Light Rail Transit (LRT) service extending along Ellington Parkway (SR 6), Vietnam Veteran's Parkway (SR 386), and I-65 for the provision of direct access into downtown Nashville, Tennessee.

4.2.1. Operating and Service Characteristics

The LRT Alternative is a nine station, 28.3 mile line from Downtown Nashville to Gallatin. Characteristics for the LRT Alternative, including station locations, are summarized in Table 4.3.

Within the downtown Nashville area, the proposed alignment would operate at-grade in mixed traffic from an LRT station adjacent to Music City Central on 5th Avenue. Outbound from Music City Central, the alignment would be along 5th Avenue, Gay Street, and James Robertson Parkway to Ellington Parkway North. Inbound from Ellington Parkway South, the alignment would be James Robertson Parkway, 4th Avenue, Charlotte Avenue, and 5th Avenue to the LRT station at Music City Central.

East of downtown Nashville, the alignment would operate in dedicated right-of-way parallel to Ellington Parkway, I-65, and SR 386/Vietnam Veterans Parkway until reaching the Harris Lane interchange in Gallatin. In this portion of the alignment, LRT operations would also be grade separated from ramps, cross streets, and other roadways going over or under the freeway.

East of Harris Lane, the alignment would be at-grade in mixed traffic along Long Hollow Pike to a proposed station near the intersection of Long Hollow Pike and the proposed Maple Street Extension. Figure 4.3 illustrates the alignment, proposed station locations, and proposed circulator routes.

Infrastructure investments associated with the LRT Alternative carry a capital cost estimate of approximately $1.9 billion (in 2010 dollars), roughly $64 million per mile, the highest cost of the three build alternatives. Table 4.4 contains a detailed breakdown of probable costs associated with the LRT Alternative.

The LRT Alternative is defined in terms of operating plans, including specific modifications to the underlying bus network. These feeder bus plan modifications include eliminating existing MTA routes that duplicate the proposed LRT service, modifying alignments of existing MTA routes to ensure connectivity with the proposed LRT service, and adding local circulators to provide strong bus connections to the stations and extend the service coverage of the alternative. These modifications, as well as operating plans, and travel time statistics are detailed in Appendix F: Operating Plan and O&M Costs Report.

Table 4.3: Operating and Service Characteristics - Alternative 2 (LRT)

Characteristic	Description
Frequency	10 minute headways
Station Locations	• Music City Central • Cleveland • Trinity • Old Hickory • Conference Drive • New Shackle Island • Saundersville • Harris/Greenlea • Maple
Ridership & User Benefits	6,535 daily (2,032,000 annually)/4,171 weekday benefit hours
Financial Impacts	• Capital Costs: $1.9 billion (2010 dollars); $2.8 billion (inflated costs to 2020 opening year) • See Table 4.4 for the detailed Opinion of Probable Cost. • Operating Costs: $32,125,000 (change from no-build) • Cost Effectiveness: $125.54

Travel time estimates were developed for the portion of the route that operates in dedicated rights-of-way. Where the line is proposed to operate in mixed-traffic, travel times were determined from the travel demand model based on congested speeds. For LRT, the total travel time from Music City Central to RiverGate Mall is estimated to be 41.82 minutes, with station to station travel times ranging between just over two to just under seven minutes. The LRT Alternative attracts the highest ridership estimates of the three build alternatives, at 6,535 daily boardings.

STUDY AREA FREEWAY CORRIDOR

FIGURE 4.3: LIGHT RAIL TRANSIT FREEEWAY: ELLINGTON PARKWAY/I-65/VIETNAM VETS

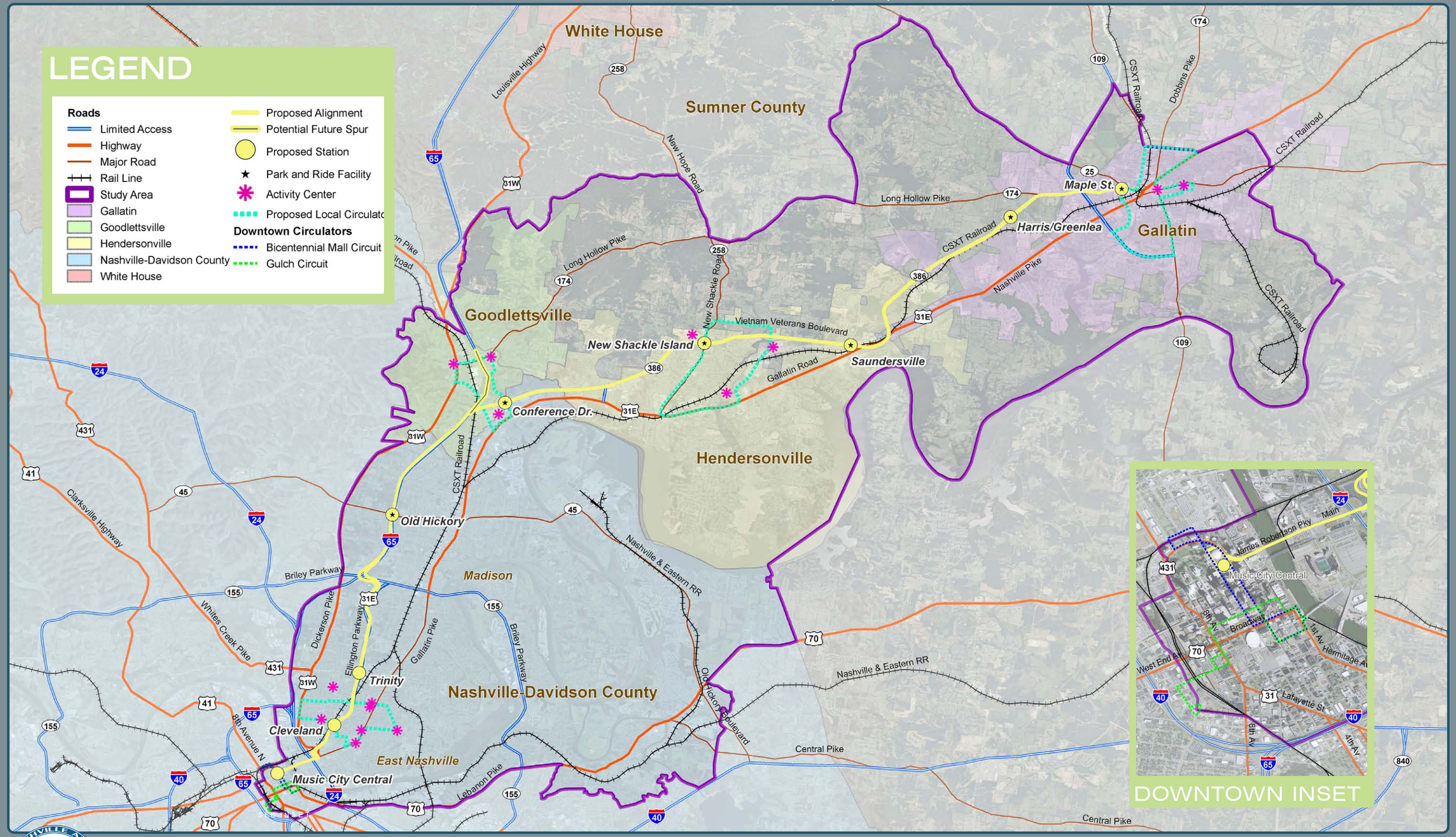


Table 4.4: Opinion of Probable Capital Costs, LRT Alternative					
Capital Cost Component	**Units**	**2010 Unit Cost**	**Quantitiy**	**2010 Component Cost**	
Embedded track	mile	$13,700,000	2.06	$ 28,211,000	Includes platform, tactile strip, more enclosed shelter, lighting, security camera, fare vending, next bus display, communications, landscaping, and higher grade surfaces/ fixtures
Center platform station	pair	$ 4,390,000	14	$ 61,460,000	Same features as more substantial station stop except with bus bays for transfers
Ballasted track	mile	$ 7,360,000	23.85	$ 175,511,000	
Elevated track on structure	mile	$132,600,000	4.76	$ 631,734,000	
Park-and-Ride lot (surface lot)	space	$ 7,000	2,400	$ 16,800,000	
LRV	each	$ 3,500,000	22	$ 77,000,000	
Signal reconstruction	intersection	$ 250,000	14	$ 3,500,000	
At-grade crossing	crossing	$ 675,000	14	$ 9,450,000	
Maintenance facility and yard	LS	$ 22,000,000	1	$ 22,000,000	
Embankment	mile	$ 3,090,000	20.3	$ 62,633,000	
Retaining Walls	linear foot	$ 1,080	21,750	$ 23,490,000	
Utility Relocation	LS	$ 13,702,000	1	$ 13,702,000	5% of costs except ROW, vehicles, ballasted track in freeway ROW, and flyovers
Right of Way and Relocation	LS	$ 10,300,000	1	$ 10,300,000	at stations and park-and-ride lots
Sound Walls	linear foot	$ 370	8,100	$ 2,997,000	
Roadway Widening	mile	$ 4,618,000	0.93	$ 4,291,000	Coming into Gallatin, 24' widening (use cost for 6-lane section with closed drainage, widening to the outside)
Roadway Bridges	square feet	$ 200	196,000	$ 39,200,000	New roadway/ramp bridges over the LRT
Engineering, Construction, Testing, Start-up		28%		$ 328,493,000	
Contingency		30%		$ 453,228,000	
Total				**$1,964,000,000**	
			Route Miles:	30.7	
			Cost per Mile:	$64,000,000	

4.4. Alternative 3 (Bus Rapid Transit on US 31E Corridor)

The Bus Rapid Transit (BRT) Alternative was considered for the heavily travelled transportation corridor between Nashville and Gallatin. The alternative includes two corridors with three different operating patterns. Corridor A includes two operating patterns and would run along Gallatin Pike from downtown Nashville (via James Robertson Parkway) to the SR 386 Connector just beyond the RiverGate Mall area, transitioning to SR 386/Vietnams Veteran Parkway and then local streets into Gallatin. Corridor B would enter Ellington Parkway (via James Robertson Parkway), continuing in the freeway corridor along I-65 and SR 386/Vietnam Veterans Parkway and then local streets into Gallatin.

4.4.1. Operating and Service Characteristics

As noted above, three operating patterns in two alignments are proposed for the BRT Alternative. Characteristics for the BRT Alternative, including station locations, are summarized in Table 4.5.

BRT A-1 is proposed to be operated along a seven station, 11.3 mile line from downtown Nashville to RiverGate Mall. Within the downtown Nashville area, BRT A-1 would operate at-grade in mixed traffic from Music City Central on 5th Avenue. Outbound from Music City Central, the alignment would be along 5th Avenue, Gay Street, and James Robertson Parkway to Interstate Drive. Inbound from Interstate Drive, the alignment would be James Robertson Parkway, 4th Avenue, Charlotte Avenue, and 5th Avenue to Music City Central. From Interstate Drive, BRT A-1 would operate at-grade but in dedicated right-of-way along Gallatin Pike, terminating at the RiverGate Mall station.

BRT A-2 is proposed to be operated along a 14 station, 29.4 mile line from downtown Nashville to Gallatin. From downtown Nashville to RiverGate Mall, its alignment would be the same as BRT A-1. After reaching the RiverGate Mall station, BRT A-2 would continue at-grade but in dedicated right-of-way along Gallatin Pike and then via the SR 386 Connector to transition to SR 384/Vietnam Veterans Parkway.

Along SR 386/Vietnams Veteran Parkway, BRT A-2 vehicles would operate in center High Occupancy Vehicle (HOV) lanes. Stations in the HOV portion of the alignment would be at freeway level in center lanes with structures providing for vertical pedestrian circulation to/from roadways crossing over or under the freeway, thus eliminating the need for BRT vehicles to exit the freeway to reach the stations.

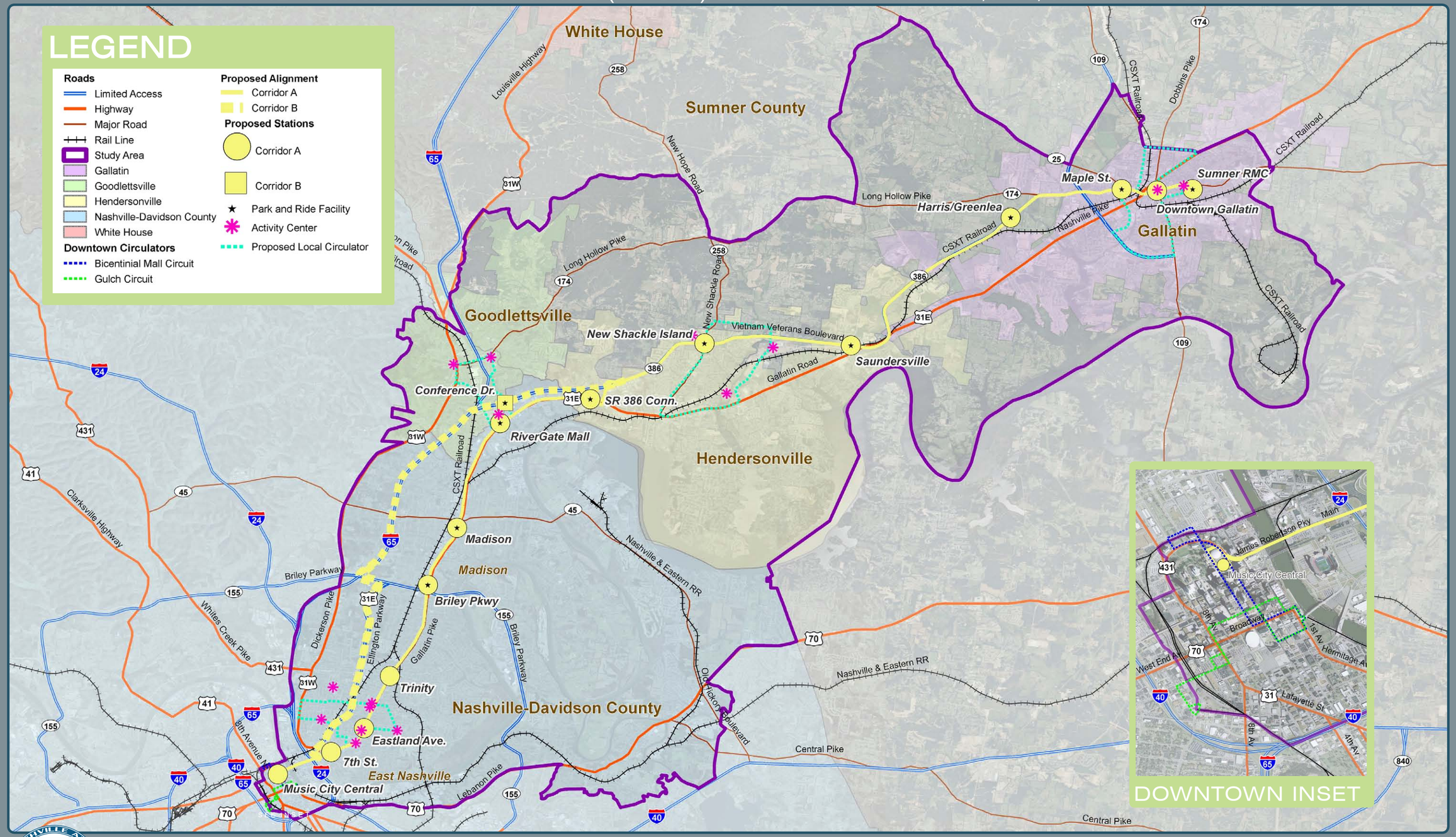
Table 4.5: Operating and Service Characteristics - Alternative 3 (BRT)

Characteristic	Description
Frequency	10 to 20 minute headways
Station Locations Corridor A	• Music City Central • 7th Street • Eastland Avenue • Trinity • Briley Parkway • Madison • Conference Drive • SR 386 Connector • New Shackle Island • Saundersville • Harris/Greenlea • Maple • Downtown Gallatin • Sumner Regional Medical Center (RMC)
Station Locations Corridor B	• Music City Central • Conference Drive • New Shackle Island • Saundersville • Harris/Greenlea • Maple • Downtown Gallatin • Sumner Regional Medical Center (RMC)
Ridership & User Benefits	5,514 average daily (1,715,000 annually)/3,584 weekday benefit hours
Financial Impacts	• Capital Costs: $373 million (2010 dollars); $550 million (inflated costs to 2020 opening year) • See Table 4.6 for the detailed Opinion of Probable Cost. • Operating Costs: $15,534,000 (change from no-build) • Cost Effectiveness: $34.84

East of the Harris Lane/Greenlea Station, the alignment would be at-grade in mixed traffic through downtown Gallatin to the Sumner Regional Medical Center. The proposed alignment is along Long Hollow Pike, Red River Road, Main Street, Hartsville Pike, Steam Plant Road, and Bledsoe Street to the rear entrance of the hospital.

STUDY AREA ARTERIAL CORRIDOR

FIGURE 4.4: BUS RAPID TRANSIT GALLATIN PIKE (US 31E) ELLINGTON PARKWAY/I-65/VIETNAM VETS



NORTHEAST CORRIDOR MOBILITY STUDY

JULY 2011

SCALE IN FEET
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Table 4.6: Opinion of Probable Capital Costs, BRT Alternative					
Capital Cost Component	Units	2010 Unit Cost	Quantitiy	2010 Component Cost	
Typical 6-lane section with center HOV lanes in both direction (widen outside)	mile	$5,491,000	2.36	$12,959,000	
Typical 6-lane section with center HOV lanes in both direction (widen outside)	mile	$6,146,000	9.13	$56,113,000	
Typical two lane ramp with HOV/exclusive lane (widen outside)	mile	$2,457,000	1.84	$4,521,000	
Typical 8-lane section with exclusive lanes, open drainage (widen outside)	mile	$2,969,000	0.55	$1,633,000	
Typical 7-lane section with exclusive lanes, open drainage (widen outside)	mile	$4,867,000	0.28	$1,363,000	
Typical 6-lane section with exclusive lanes, open drainage (widen outside)(existing 4 lane)	mile	$4,903,000	0.4	$1,961,000	
Typical 6-lane section with exclusive lanes, open drainage (widen outside)(existing 5 lane)	mile	$3,943,000	3.83	$15,102,000	
Typical 6-lane section with exclusive lanes, closed drainage (widen outside)(existing 4 lane)	mile	$6,114,000	0.28	$1,712,000	
Typical 6-lane section with exclusive lanes, closed drainage (widen outside)(existing 5 lane)	mile	$5,367,000	4.97	$26,674,000	
Typical 7-lane section with exclusive lanes, closed drainage (widen outside)	mile	$5,715,000	1.03	$5,886,000	
Typical 6-lane section with exclusive lanes, closed drainage & on-street parking (widen outside)	mile	$6,287,000	0.85	$5,344,000	
Resurfacing of BRT Lanes (for portions in mixed traffic)	mile	$195,000	3.92	$764,000	
Major Utility Relocation	lump sum	$200,000	1	$200,000	For major utility work - in addition to the per mile utility cost
Highway bridge widening/lengthening	s.f	$200	126,900	$25,380,000	
Railroad bridge widening/lengthening	s.f.	$260	10,000	$2,600,000	
Railroad track adjustment	s.f.	$500,000	2	$1,000,000	
Highway Bridge Replacement	each	$200	157,250	$31,450,000	
Freeway widening for BRT Center Station	each	$6,215,000	4	$24,860,000	cost for widening and tapers at stations
Park-n-ride lot construction	site	$4,613,000	4	$18,452,000	
Freeway Center Station	each	$5,220,000	4	$20,880,000	
Reconstruction/ Restriping of Ramps	each	$70,000	17	$1,190,000	
Center Platform Station on Arterial	each	$1,270,000	10	$12,700,000	pair of platforms on far side of intersection

Table 4.6: Opinion of Probable Capital Costs, BRT Alternative (Continued)					
Capital Cost Component	**Units**	**2010 Unit Cost**	**Quantitiy**	**2010 Component Cost**	
Pedestrian and bike access	station	$65,000	14	$910,000	
40-ft hybrid bus	each	$694,000	0	$0	specialized BRT hybrid including smart card fare collection equipment with percentage for spare parts
60-ft articulated hybrid bus	each	$950,000	22	$20,900,000	
Maintenance Facility	bus	$460,000	22	$10,120,000	
Signalized Intersection Modification	each	$50,000	46	$2,300,000	
Subtotal				**$306,974,000**	
Engineering for transit items				$17,000,000	
Unallocated Contingency	15%			$66,026,000	
Total				**$373,000,000**	
			Route Miles:	29.4	
			Cost per Mile:	$12,700,000	

BRT B is proposed to be operated along an eight station, 30.1 mile line from downtown Nashville to Gallatin. From downtown Nashville to Ellington Parkway, its alignment would be the same as BRT A-1 and BRT A-2.

BRT B would then transition to center HOV lanes along Ellington Parkway, I-65, and SR 386/Vietnam Veterans Parkway to Gallatin. As in BRT A-2, stations in the HOV portion of the alignment would be "on-line" at freeway level in center lanes with structures providing for vertical pedestrian circulation to/from roadways crossing over or under the freeway. East of the SR 386 Connector, its alignment would be the same as BRT A-2 to Sumner RMC.

Infrastructure investments associated with the BRT Alternative carry a capital cost estimate of approximately $373 million (in 2010 dollars), roughly $12.7 million per mile, the lowest cost of the three build alternatives. Table 4.6 contains a detailed breakdown of probable costs associated with the BRT Alternative.

The BRT Alternative has been defined in terms of operating plans, including specific modifications to the underlying bus network. These feeder bus plan modifications include eliminating existing MTA routes that duplicate the proposed BRT service, modifying alignments of existing MTA routes to ensure connectivity with the proposed BRT service, and adding local circulators to provide strong bus connections to the stations and extend the service coverage of the alternative. These modifications, operating plans, and travel time statistics are detailed in Appendix F: Operating Plan and O&M Costs Report. Figure 4.3 illustrates the alignment, proposed station locations, and proposed circulator routes.

For each route pattern, travel time estimates were developed for the portion of the route that operates in dedicated rights-of-way. Where the route is proposed to operate in mixed-traffic, travel times were determined from the travel demand model based on congested speeds. As the BRT along arterials would operate at-grade (even where it operates in dedicated lanes), delays are assumed at signalized intersections and stop signs. An average of 15 seconds per delay point has been assumed. For the dedicated right-of-way portions of the BRT service (i.e., along Gallatin Pike) and the freeway portions in HOV lanes, maximum speeds are assumed to mirror the speed limits. For BRT A-1, the total travel time from Music City Central to RiverGate Mall is estimated to be 34.12 minutes, with station-to-station travel time between roughly three and seven minutes; For BRT A-2, the total travel time from Music City Central to Sumner Regional Medical Center is estimated to be 64.53 minutes, with station-to-station travel times between roughly two and seven minutes; and, For BRT B, the total travel time from Music City Central to Sumner Regional Medical is estimated to be 64.53 minutes, with station-to-station travel times ranging between around two and six minutes (not including the fifteen minute outlier between Music City Central and RiverGate Mall.)

4.5. Travel Demand Model Analysis

The travel demand estimates are an extremely important factor in the decision making process, not only for the selection of a preferred technology and corridor alternative, but for the ultimate decision on the feasibility of the implementation of any alternative public transportation mode. Appendix F describes in detail the methodology, tools, analysis and results of the extensive effort conducted to provide detailed ridership forecast for the no-build and the three (3) primary corridor alternatives. Included in the Appendix is a description of on-board surveys (conducted 2006 and 2008) of the Nashville Metropolitan Transit Authority's bus system, how speeds, paths, and mode choices were calibrated for the transit modeling, model validation processes and future year scenarios. The results of the modeling exercise are summarized below.

4.6. Summary of Alternatives Comparison

Table 4.7, Comparison of Estimates of Probable Cost, illustrates a summary of the modeling and cost estimating results for the No Build, commuter rail, BRT, and CRT alternatives. As indicated on the table, none of the alternatives is projected to achieve ridership or cost efficiency levels that would make it competitive for federal funding.

All three "build" alternatives—BRT, LRT, and CRT - would attract significantly greater ridership than the No-Build Alternative. Improved facilities, in the form of a new transit system in the corridor, would definitely attract many more people to use transit for work-related and other trips. The cost of building any of these proposed systems, however, would be great ($373 million to $1.96 billion), and a source of funding would also need to be identified for operating costs.

Table 4.7: Comparison of Estimates of Probable Cost

Route	No-Build	BRT Build	LRT Build	CRT Build
Average Weekday Projected Ridership (2035)	3,540	5,514	6,535	4,743
Annual Ridership (2035 with Annualization Factor of 311)	1,100,940	1,714,854	2,032,385	1,475,073
Total Order of Magnitude Capital Cost (2010 $)	$0	$373,000,000	$1,964,000,000	$630,000,000
Annualized* Capital Cost (2010 $) Assuming 7% Annualization Rate	$0	$26,110,000	$137,480,000	$44,100,000
Miles	-	29.4	30.7	27.1
Cost Per Mile	-	$12,687,075	$63,973,941	$23,247,232
Annual* Operating Cost (2010 $)	$0	$12,722,000	$25,371,600	$24,288,134
Total Annual Cost (2010 $; Capital + Operating)	$0	$38,832,000	$162,851,600	$68,388,134
Average Weekday User Benefits	0	3,584	4,171	3,277
Average Annual User Benefits (2035 with Annualization Factor of 311)	0	1,114,624	1,297,181	1,019,147
*Cost Efficiency (NOT FTA Cost Effectiveness)***	*NA*	*$34.84*	*$125.54*	*$67.10*
Average Annual Cost per Annual Boarding	*NA*	*$22.64*	*$80.13*	*$46.36*

**Annualized cost refers to a cost that has been adjusted to a yearly rate, though the cost may be incurred or quoted for a time frame other than a year (generally less than a year). Annual cost refers to a cost that is actually incurred on a yearly basis.*

***Cost Efficiency is a term used in this study to describe measures that combine cost and performance, and should not be confused with FTA Cost Effectiveness, which is used by FTA to help determine if a project is eligible to advance in the New Starts process.*

Of the three build alternatives, the CRT would attract the lowest number of riders for a medium-level cost, so this alternative is not recommended for further analysis. The LRT has the highest cost, but also the highest ridership. BRT is projected to attract approximately 84 percent of the ridership of LRT, at approximately 19 percent of the cost. Operating costs of BRT are projected to be approximately 50 percent of operating costs of LRT.

4.7. Selected Alternatives: Short and Long-Term Strategy

As described in the previous sections, the detailed alternatives analysis revealed that the BRT alternative has the lowest cost and transportation benefits that are less robust than LRT, but not significantly less. Input from the community as well as local elected officials have revealed, however, that the strong local preference is for the LRT alternative, which has economic and regional identity benefits that they believe in the long term will justify the additional cost. Therefore, the recommendation of this report is to develop BRT in the corridor in the near-term (10 years) while continuing to work toward the long-term vision of LRT from downtown Nashville to downtown Gallatin. The remaining Sections of this report describe the steps necessary to implement the short-term plan and achieve the long-term vision of a robust LRT system with accompanying transit-supportive development.

Recommended Plan:

- **Short Term (5-10 years):**
  - **Develop BRT on SR 386 by 2020**
  - **Incremental investments in multi-modal solutions, such as enhanced bus services and complete streets**
- **Long Term (10+ years):**
  - **Work toward vision of LRT on SR 386**

5.0 Recommended Projects

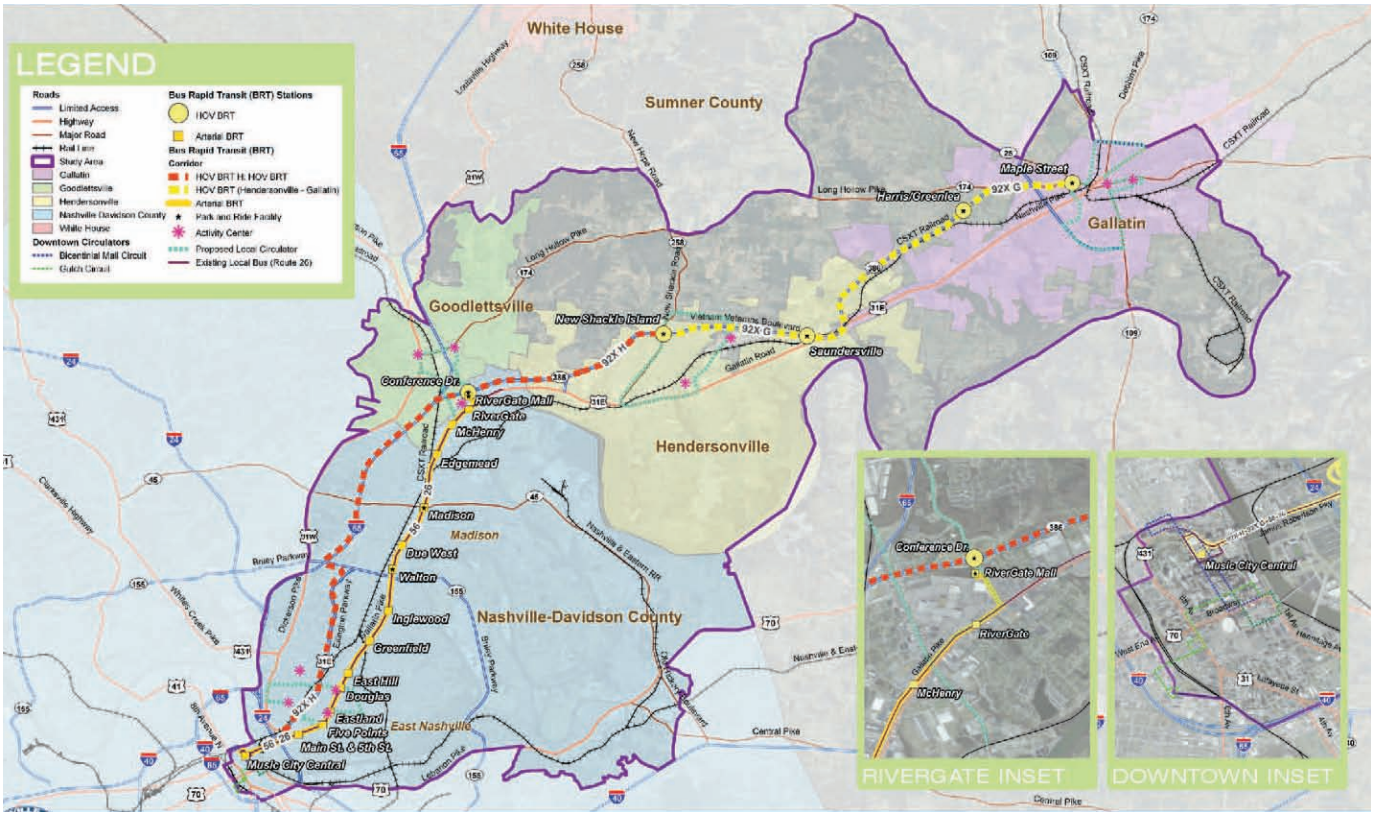


Figure 5.1: *BRT Preferred Alternative*

As described in Section 4, under current conditions, Bus Rapid Transit (BRT) is the most cost-effective method of providing transit service in the Northeast Corridor. Nonetheless, after review and consideration of the benefits and costs of the three build alternatives and the baseline and no-build alternatives, elected officials and other corridor stakeholders expressed a strong long-term preference for Light Rail Transit (LRT). Therefore, with LRT as a long-term goal, the planning team (MPO and consultants) developed a plan to implement a BRT solution in the near term, while taking actions to build transit-friendly communities in the Northeast Corridor, leading to eventual funding and implementation of the community's ultimate vision for LRT in the corridor. The BRT will also be developed in such a way that some or all of the facilities may be adapted to support LRT in the future.

5.1. Description of the Proposed BRT

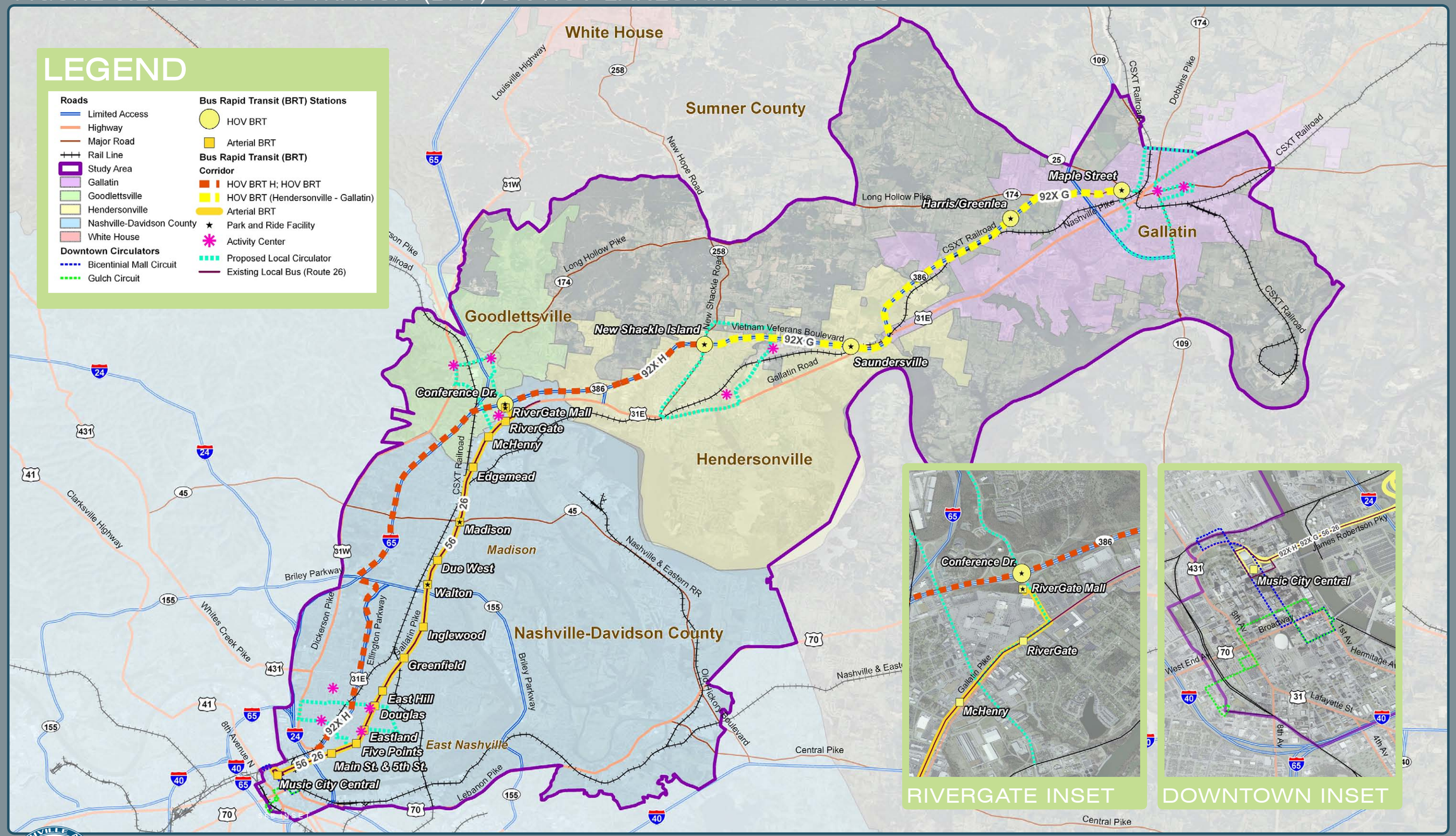
5.1.1 BRT Concept

The recommended BRT concept will provide express transit service between Gallatin and downtown Nashville, with one line operating on Ellington Parkway and Vietnam Veterans Parkway, with additional service on Gallatin Pike in Davidson County.

On Ellington Parkway and Vietnam Veterans Parkway, the concept includes a system of left-exiting HOV slip ramps that will allow BRT and carpool access to BRT stations and park and ride lots, as well as residences, jobs, and shopping. The concept is designed to take advantage of proposed widening of the HOV lanes. In addition, the system could be designed for eventual transition to LRT when land use and other conditions indicate a projected level of ridership that would justify the larger investment required for LRT.

STUDY AREA PREFERRED ALTERNATIVE

FIGURE 5.2: BUS RAPID TRANSIT (BRT) ON HOV LANES AND ARTERIALS



The proposed BRT system also features a series of local bus circulators that will provide convenient access to BRT for residents, workers, and shoppers in Hendersonville, northeast Nashville, Goodlettsville, and Gallatin.

The bus rapid transit alternative is designed to accommodate two different travel markets. One market is the shorter trips between downtown Nashville and RiverGate Mall and points in between. This existing market is well established and currently served by Route 56 (BRT) and Route 26 (local bus). BRT enhancements are to provide a better transit experience and better reliability for the transit customers.

Another target market is the longer distance commuter with a traditionally daily commute from home in the far suburbs to downtown Nashville. Transit investments for this market includes the construction of HOV lanes (which the buses could use), and convenient station locations with park-and-ride lots. Service would be focused on peak period with infrequent stops at the population centers.

To serve these two separate markets, the proposed BRT system (presented in a larger format on the next page) essentially consists of four types of bus services and associated capital improvements as follows:

1. Express BRT in HOV Lanes

Route 92XG and 92XH will provide express BRT service from Nashville to Hendersonville and Gallatin. The buses will operate in new HOV lanes with highway median stations and park-and-ride lots. This express type service is designed to accommodate longer commutes and will have infrequent stops.

2. Arterial BRT

Route 56 is a modification of the existing Route 56 BRT. This service will continue to operate along Gallatin Pike from Nashville to RiverGate Mall and stop at the same moderately spaced stations as it does now. It will also provide a new transfer opportunity to the 92X routes at RiverGate Mall. Increased frequency of service, enhanced stations, queue jumps and some dedicated bus lanes are included.

3. Local Bus

Route 26 will continue to provide local bus service from Nashville to Walmart primarily along Gallatin Pike in mixed traffic. This service will match the existing Route 26 and continue to make frequent stops at closely spaced bus stops. This service is aimed toward shorter trips and trips where convenient pedestrian access is important.

4. Circulator Bus

This type of service will be provided in Northeast Nashville, Goodlettsville, Hendersonville and Gallatin. Each circulator will provide transit connections to the major trip generators within each community and provide a direct connection to one or more of the services described above to accommodate longer trips by transit.

A more detailed description of the operating plans and capital improvements is provided later in this Section. The capital costs and operating costs associated with these concepts are provided in Sections 5.1.4 and 5.1.5 respectively.

Figure 5.2: *Circulators like the existing downtown Music City Circuit can feed the primary transit system with riders from surrounding areas*

5.1.2. Operating Plans and Capital Improvements

Express BRT in HOV Lanes

As noted above, the express BRT service would be provided via two routes (i.e., 92XG and 92XH) and are described in this section.

92XG Express

This route provides express service between downtown Nashville and Gallatin and generally follows the existing 92x route. Within the downtown Nashville area, 92XG will operate in mixed traffic from Music City Central on 5th Street, Gay Street, James Robertson Parkway to Interstate Drive. The bus will then utilize new HOV lanes on Ellington Parkway, I-65 and SR 386. Operating in the HOV lanes will provide the buses with travel time savings and improved reliability compared to using shared travel lanes.

If the future travel markets warrant the construction of additional HOV lanes in this corridor, there are three basic ways for buses to access the HOV lanes and stations as outlined below. For

purposes of discussion, the HOV lanes are assumed to be added in the median or center of the right-of-way as provided elsewhere in the region.

1. The buses can utilize general purpose entrance and exit ramps to access stations in close proximity to the highway. This approach is the least costly, but the buses would be subjected to the potential congestion on the ramps and arterials. The buses would also need to merge and weave through traffic from center HOV lanes to right hand exit and entrance ramps.
2. Buses can use stations located in the highway median. This type of station would be at the same elevation as the highway, with simple bus only acceleration and deceleration lanes provided to transition the buses to and from the HOV lanes. Pedestrian ramps, walkways and elevators will provide access to and from the park-and-ride facilities at each station. This concept was incorporated into the definition of the preferred alternative because it provided the shortest station-to-station travel time and will be less costly than construction of fly-over or fly-under slip ramps as discussed below.
3. Another option would be to construct bus only slip ramps to and from the HOV lanes and BRT stations. This would provide the buses with congestion relief and provide perhaps the most convenience to the customers, but it would be the most costly. This type of configuration would require extensive new bus only infrastructure. Typically, each station would require four new slip ramps with bridges (one off ramp and one on ramp in each direction).

If HOV lanes are advanced to the next steps in the project development process, a more robust Phase I study will be required.

Assuming the use of median BRT stations, the 92XG has a one way operating distance of about 28 miles and is estimated to travel end-to-end in 43 minutes with an average overall speed of 39 miles per hour. The BRT in HOV lane service will stop at the following locations. All but the existing Music City Central hub will require newly constructed BRT stations and park-and-ride facilities.

- Music City Central
- RiverGate Mall
- New Shackle Island
- Saundersville
- Harris/Greenlea
- Maple Street

92XH Express

This route provides supplemental express service from downtown Nashville to Hendersonville during the peak morning and evening periods. 92XG follows the same route as the previously described 92XG from Music City Central to New Shackle Island. This supplemental service is provided to accommodate the higher demand within this section of the corridor. This service will also utilize the HOV lanes on Ellington Parkway, I-65 and SR 386 and median BRT stations. Because this service is planned to turn back at New Shackle Island, a convenient turn around will need to be integrated into that particular station.

92XH has a one way operating distance of about 17 miles and is estimated to travel end-to-end in 27 minutes with an average overall speed of 38 miles per hour. The BRT in HOV lane service would stop at the following locations. All but the existing Music City Central hub would require newly constructed BRT stations and park-and-ride facilities.

- Music City Central
- RiverGate Mall
- New Shackle Island

Although a stop is not currently proposed for Indian Lake, which is planned to be serviced by the Hendersonville Circulator, a future Indian Lake Village stop should be considered at a later stage if the area develops as anticipated with transit-supportive land use densities.

Arterial BRT

The arterial BRT service in the corridor will be an enhanced version of the current Route 35 BRT. Like the existing service, this route will begin at Music City Central but would terminate at the RiverGate Mall park-and-ride rather than at Walmart. The outbound route will follow 5th Street, to Gay Street, to James Robertson Parkway, which turns into Gallatin Pike. At the RiverGate Mall, the route turns left on Conference Drive (to access the RiverGate Mall park-and-ride lot). This terminal station will provide a transfer opportunity to and from the 92XG and 92XH Express service.

Between Music City Central and Briley Parkway, Route 56 will operate in mixed traffic, but five congested intersections will need to be studied for potential queue jumps and Transit Signal Priority (TSP), or other improvements to provide the bus with some congestion relief and travel time savings.

- Main Street and 5th Street
- Gallatin Pike and Eastland Ave
- Gallatin Pike and Douglas Ave
- Gallatin Pike and Trinity Lane
- Gallatin Pike and Hart Lane

Transit signal priority (TSP) is a system where the traffic signals detect the presence of a bus in the proximity of the intersection and can trigger an early green signal or an extended green signal to allow the bus to pass through the intersection without waiting through the traffic signal cycle. Queue jumps are typically located at congested intersections and provide a lane for the bus to board and alight passengers and allow for the bus to travel through the intersection ahead of the general public via an advanced special traffic signal.

For purposes of travel demand modeling, queue jumps were assumed at the five locations noted above. However, full traffic analysis would be required to determine the actual feasibility of implementing queue jumps at any location in the corridor.

Dedicated bus lanes will be constructed between Briley Parkway and Conference Drive. One new bus lane in each direction will be added to the outside. TSP will also be integrated into this section of the corridor. The alignment would avoid the historically significant cemetery north of Briley Parkway. The BRT stations will be located on the sidewalks adjacent to the bus lane and configured as far side stops, meaning they will be located on the far side of the intersection in the direction of travel. The existing stations are to be complemented with additional amenities such as off-board fare collection, real time information systems and pedestrian amenities, including cross walks, pedestrian signals and ADA ramps. Stations are assumed to remain at the following locations.

- Music City Central
- Main Street
- Five Points
- Eastland
- Douglas
- East Hill
- Greenfield
- Inglewood
- Walton
- Due West
- Madison
- Edgemead
- McHenry
- RiverGate
- RiverGate Mall (new stop with park-and-ride and 92X transfer)

Local Bus - Route 26 Gallatin Road

The BRT plan includes the continuation of the Route 26 local bus service. This route operates between Music City Central and the Walmart/Sam's Club shopping center consistent with existing operations. No changes are proposed to the alignment or station locations. This bus stops frequently (virtually any corner where a customer is waiting) and is designed specifically for convenient trips with short walks to and from the bus stop(s). The frequency of service is proposed to be reduced as shown in Table 5.1 due to the increase of the other BRT services proposed in the corridor.

Circulators

All four of the circulators are intended to provide transit service in communities where there is currently little or no service. This will accommodate trips within the communities to the various activity centers and will provide direct, seamless connections to the longer-haul BRT services proposed in the corridor. In addition to providing convenient access to the BRT, the circulator service has the added benefit of greatly reducing the dependency on automobile trips in these communities.

All four of the circulators will provide bi-directional circumferential service. Ideally, each schedule would be synchronized to provide convenient transfers to and from the BRT services with minimal wait time. The frequency of the circulator services is shown in Table 5.2 and is intended to correspond with the frequency of the BRT services. A map of each circulator route is provided in Figures 5.3 through 5.6.

The only capital cost associated with this service is the purchase of the fleet of buses. We recommend 30-foot diesel buses. The buses will stop at virtually any corner where a customer is waiting. No shelters or special pedestrian amenities are included in the costs, but they certainly could be added should the communities desire and identify funds for such amenities.

East Nashville Circulator

A new circulator route is proposed in the East Nashville area to provide for local circulation to/from the Route 56 stops at Douglas, Five Points and Eastland. This route will operate in a loop serving the retail areas along Gallatin Pike and Dickerson Pike and the residential neighborhoods in the area, primarily to the west of Gallatin Pike. Bidirectional loops are proposed, as this is a large six-mile loop to minimize out-of-direction travel and maximize ridership.

Beginning at the Route 56 Eastland stop, the clockwise route will operate south on Gallatin Pike, north on McFerrin Avenue, west on Marina Street, north on 9th Street, west on Cleveland

Street, north on Dickerson Pike, east on Douglas Avenue, southeast on Chapel Avenue, and west on Eastland Avenue to complete the loop. The routing will be reversed for the counter-clockwise service.

Goodlettsville Circulator

A new circulator route is proposed in the RiverGate Mall/ Goodlettsville area to provide for local circulation to/from the proposed Route 92XG and 92XH stop at the RiverGate Mall park-and-ride, as well as the Route 56 RiverGate stop on Gallatin Pike. This route will operate in a loop serving RiverGate Mall and surrounding shopping centers, downtown Goodlettsville, the Goodlettsville Kmart, and retail, hotel, and multi-family housing in Goodlettsville. Bidirectional loops are proposed, as this is a large five-mile loop to minimize out-of-direction travel and maximize ridership.

Beginning at the Route 92X park-and-ride at RiverGate Mall, the clockwise loop will operate south on Conference Drive, west on Gallatin Pike, north on Rivergate Parkway, north on South Main Street, east on Long Hollow Pike, and south on North Creek Boulevard and Conference Drive to complete the loop. The routing will be reversed for the counter-clockwise service.

Hendersonville Circulator

A new circulator route is proposed in Hendersonville to provide for local circulation and to provide a connection to the proposed 92XG and 92XH New Shackle Island park-and-ride. This route would operate in a loop serving the Glenbrook Shopping Center, Indian Lake Village, downtown Hendersonville, and Hendersonville Medical Center. Bidirectional loops are proposed, as this is a large eight-mile loop to minimize out-of-direction travel and maximize ridership.

Beginning at the Route 92X park-and-ride in Hendersonville, the clockwise loop would operate east on Glenbrook Way, north on New Shackle Island Road, east on Stop 30 Road, south on Indian Lake Boulevard, west on Gallatin Pike/Main Street, north on New Shackle Island Road, and west on Glenbrook Way to complete the loop. The routing would be reversed for the counter-clockwise service.

Gallatin Circulator

The Gallatin Circulator is proposed to serve greater downtown Gallatin and provide a connection to the Maple Street park-and-ride for connections with the 92XG BRT service. In the clock wise direction; starting at the Maple BRT station the bus will follow Long Hollow Pike east, and then follow this route: Turn right on Red River Road. Turn left on Blythe Avenue. Turn right on Old State Highway 109 and continue onto Albert Gallatin Avenue. Turn right on US 31E. Turn left on North Water Avenue. Turn left on East Main Street and continue onto Hartsville Pike. Turn right on Steam Plant Road. Turn right on East Bledsoe Street. Turn left at South Westland Avenue. Turn right on East Winchester Street. Turn left on South Water Avenue. Turn left on TN 109. Turn right on Hancock Street and continue on Maple Avenue and proposed Maple Street Extension back to the Maple BRT Station. A counter clockwise service will also be provided to minimize out of direction travel.

Frequency of Service

Table 5.1 shows the proposed frequency of service for the peak and off-peak periods for all four of the types of services in the corridor as described above.

Table 5.1: Frequency of Service by Route

Route	Peak/Off Peak
Route 92XH: BRT Express in HOV Lanes	20/-
Route 92 XG : HRT Express in HOV Lanes	20/60
Route #56: Arterial BRT	10/15
Route #26: Local Bus	40/60

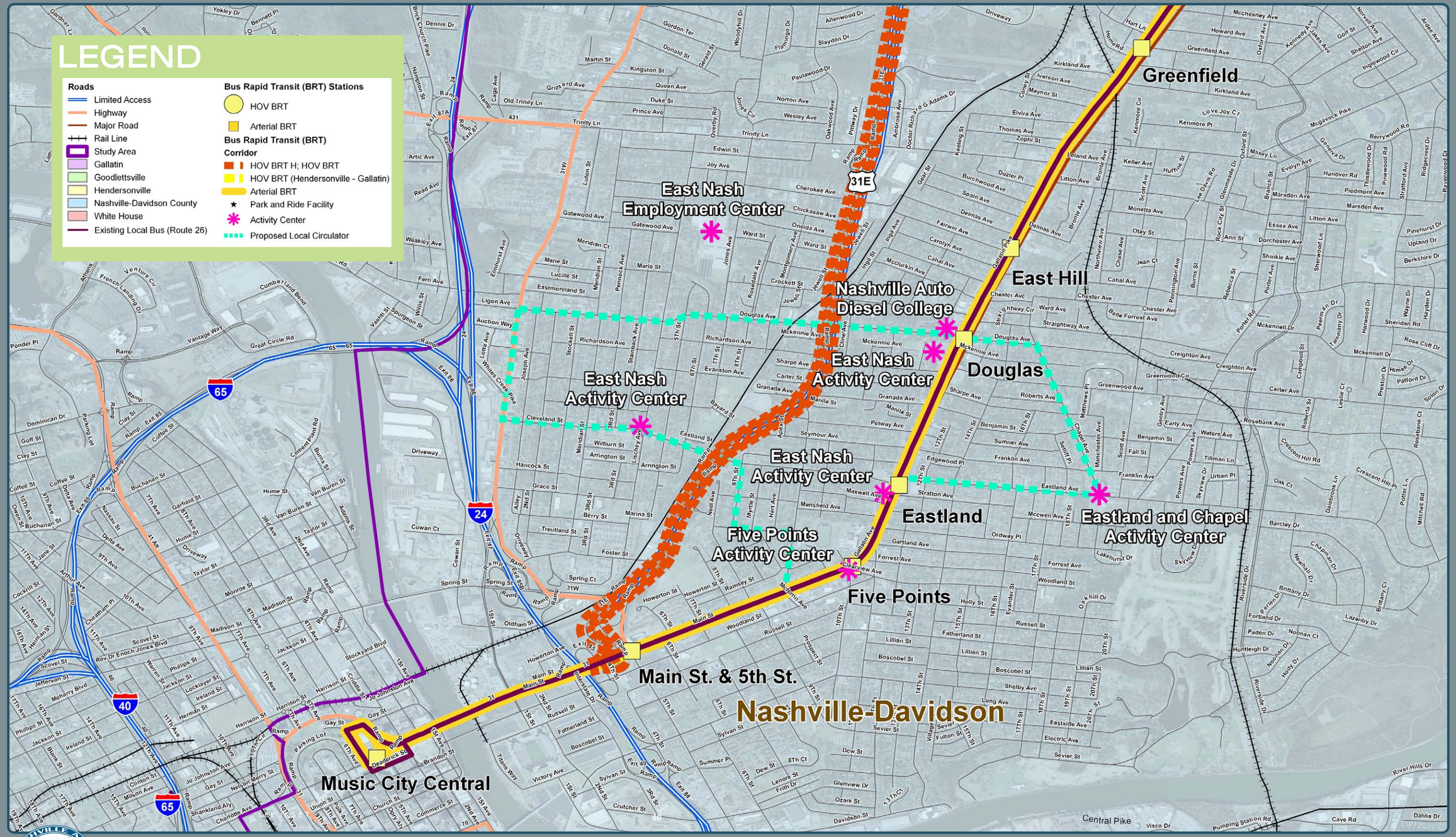
5.1.3. Ridership

A comparison of the No-Build Alternative and the proposed BRT ridership is shown below. Ridership is expressed as the average number of boardings per day. (Another way of phrasing it would be to say the total number of trips taken on all of the vehicles combined in one day.) Since most people probably take a round trip on the transit, constituting at least two daily boardings or trips per person, the total number of people using the system is likely half of the total number of boardings or less, depending on the number of transfers used. In total it is roughly estimated that 5,500 people or less will use the system as currently defined and under the status quo land use assumptions as currently mandated by the FTA evaluation criteria. It is important to note that alternate land use scenarios based on smart growth principles and an associated increase in the percentage of people who would use transit could increase the projected ridership numbers dramatically.

For comparison purposes, the table includes the No-Build Alternative, which includes the continuation of current services in the project horizon year of 2035. The model estimates that the No-Build would attract close to 4,000 boardings, which is similar to current ridership estimates in the corridor. With the new services and amenities, the proposed BRT is estimated to attract nearly three times that of the No-Build boardings or about 11,000 total. Virtually all of the increase in ridership over the No-Build is attributed to the express service and the circulators. The circulators alone account for about half of the total ridership in the Preferred Alternative.

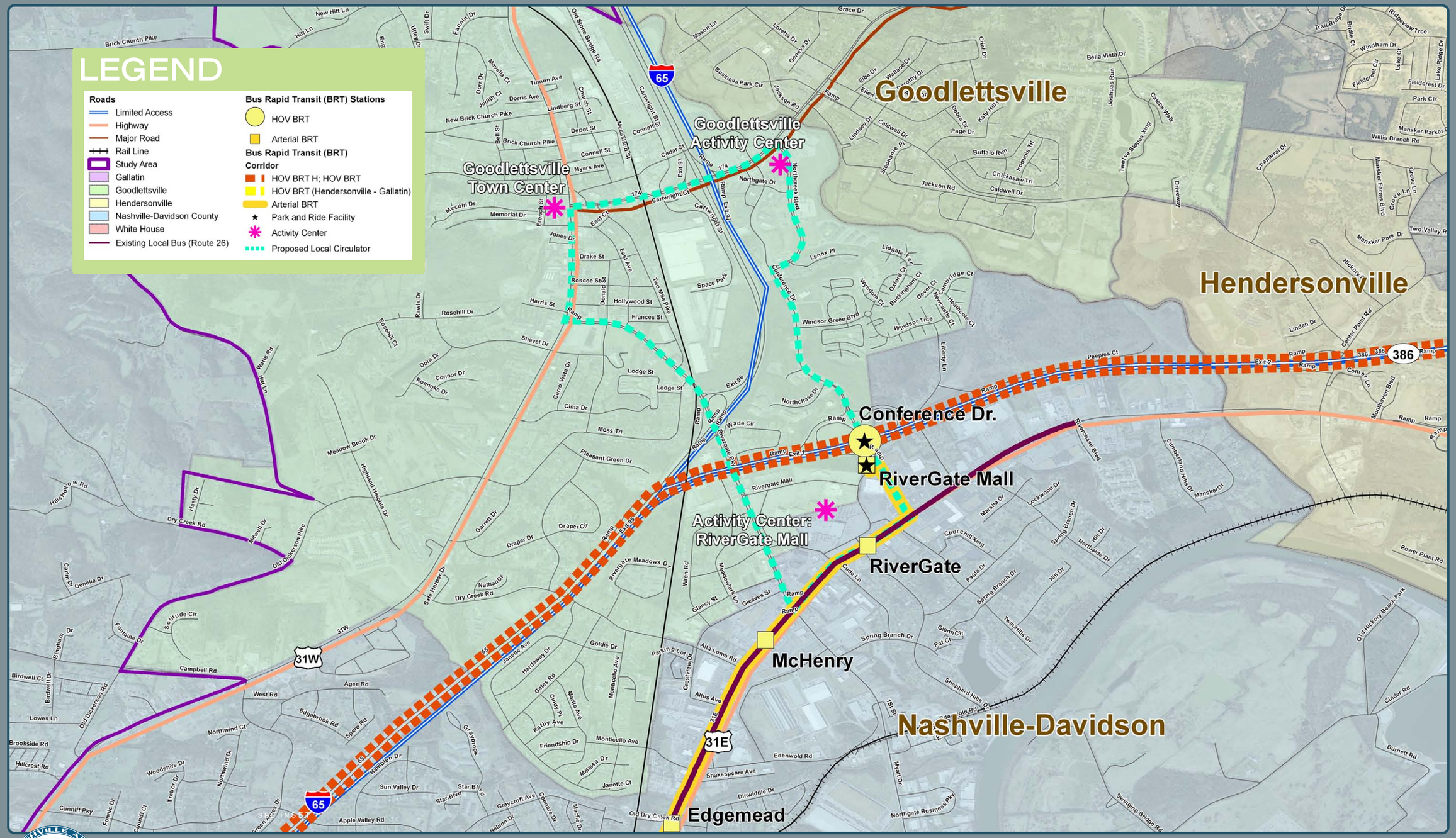
STUDY AREA PREFERRED ALTERNATIVE

FIGURE 5.3: PROPOSED EAST NASHVILLE CIRCULATOR



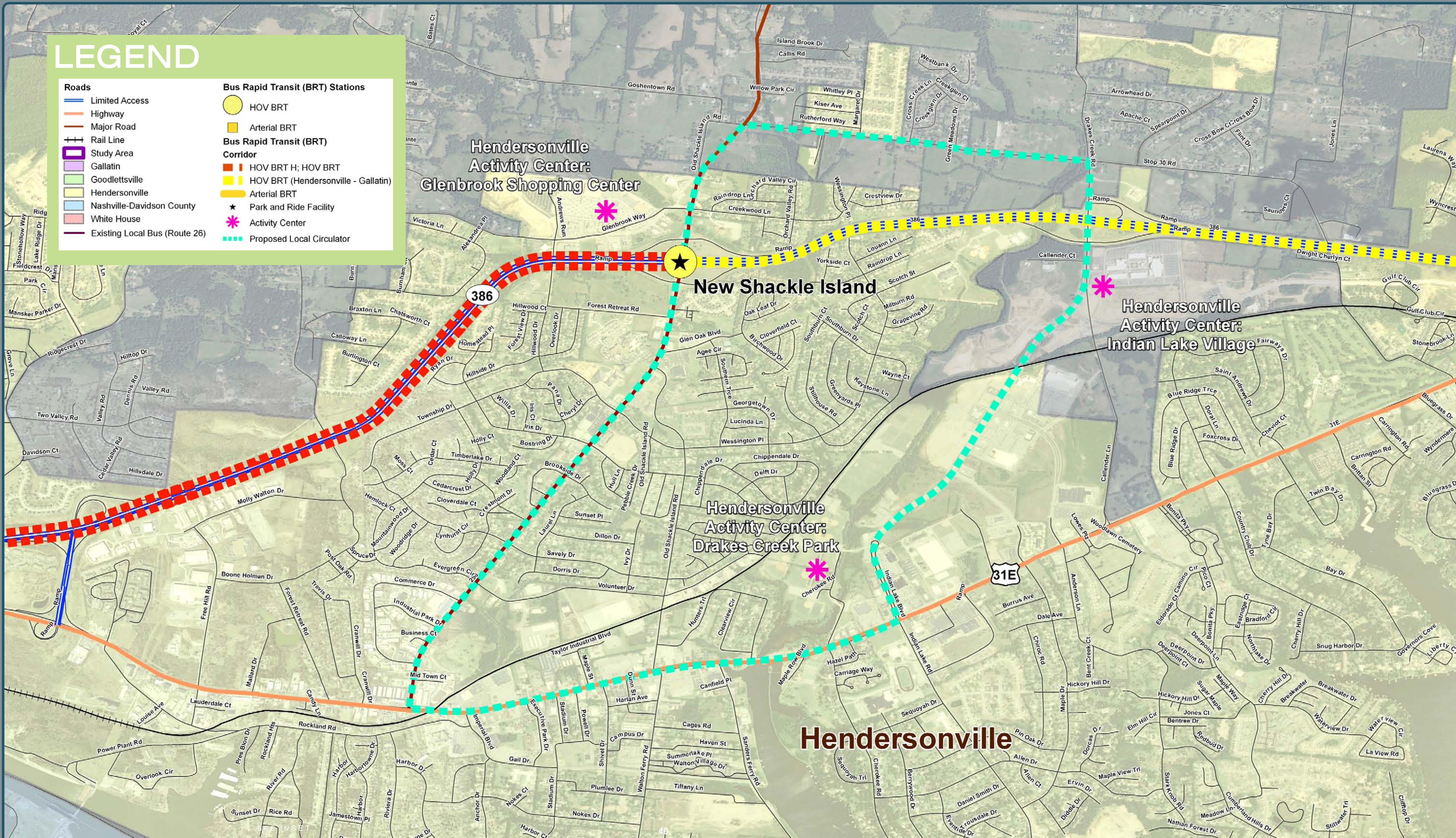
STUDY AREA PREFERRED ALTERNATIVE

FIGURE 5.4: PROPOSED GOODLETTSVILLE CIRCULATOR



STUDY AREA PREFERRED ALTERNATIVE

FIGURE 5.5: PROPOSED HENDERSONVILLE CIRCULATOR

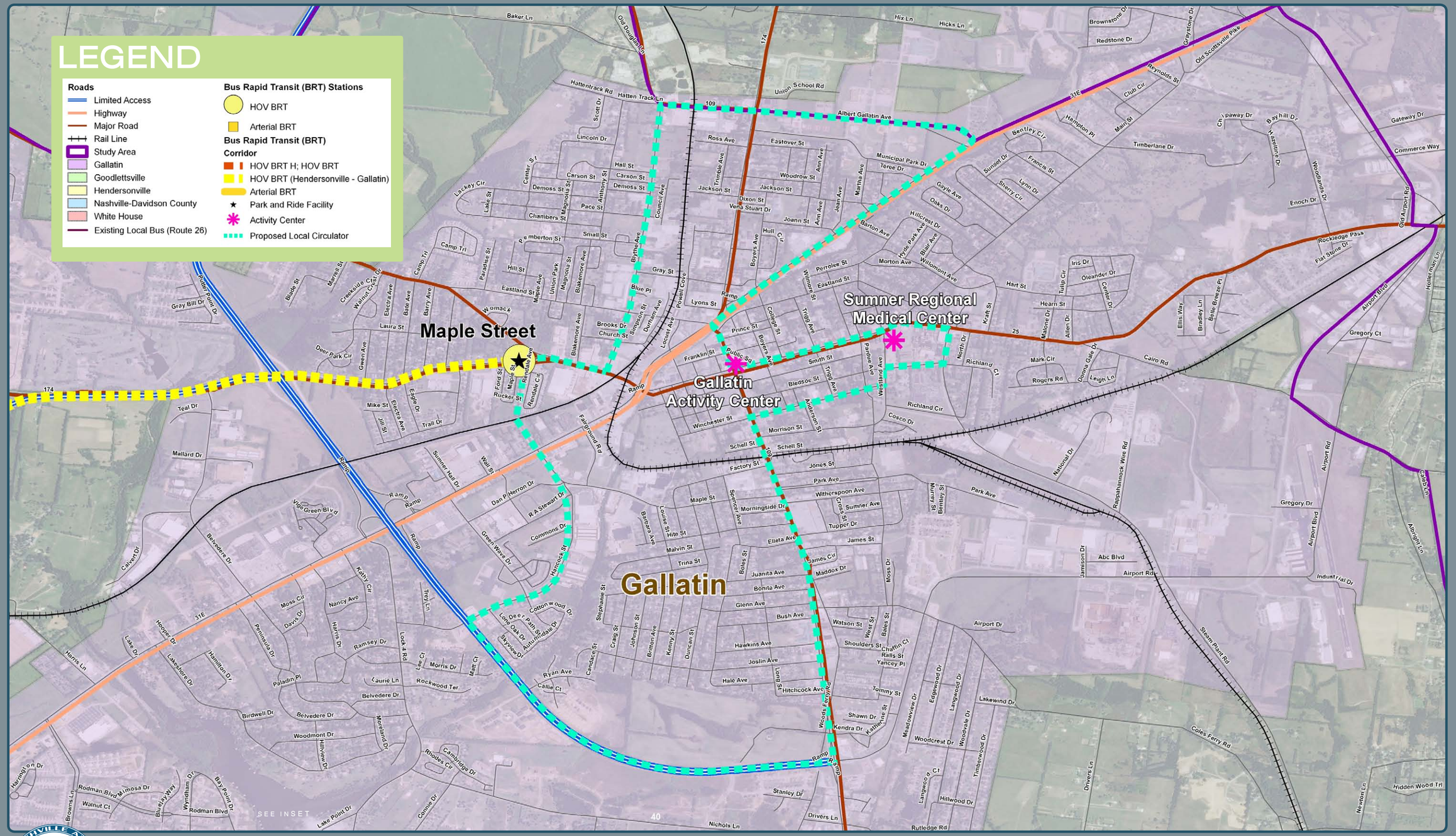


SCALE IN FEET
0 7500 15000

N

STUDY AREA PREFERRED ALTERNATIVE

FIGURE 5.6: PROPOSED GALLATIN CIRCULATOR



NORTHEAST CORRIDOR MOBILITY STUDY

JULY 2011

N

SCALE IN FEET
0 7500 15000

Table 5.2: Frequency of Service by Route		
Route	**2035 No-Build**	**2035 Preferred Alternative (BRT)**
Existing Route #35X: Rivergate Express	167	-
Existing Route #92X: Gallatin Express	272	-
Route #92 XH: Hendersonville Express BRT in HOV Lanes	-	498
Route #92 XG: Gallatin Express BRT in HOV Lanes	-	1,352
Express Route Subtotal	*439*	*1,850*
Existing Route #26: Local Bus	1,706	620
Existing Route #56: BRT	1,834	-
Route #56: Arterial BRT	-	2,913
Arterial Service Subtotal	*3,540*	*3,533*
East Nashville Circulator	-	2,284
Goodlettsville Circulator	-	847
Hendersonville Circulator	-	967
Gallatin Circulator	-	1,515
Circulators Subtotal	*0*	*5,613*
Corridor Total	*3,979*	*10,996*

Table 5.3: Route 92XG Estimated Average Daily Boardings by Station					
BRT 92 XG (20/60)					
Station Name	**Is PnR?**	**Total Activity**	**Peak Period Activity**	**Off-peak Period Activity**	**Peak Period Peak Direction Activity**
Music City Central	No	510	410	100	400
RiverGate Mall	Yes	272	181	90	169
New Shackle Island Rd	Yes	195	151	44	145
Saundersville	Yes	23	8	16	6
Harris/Greenlea	Yes	92	62	31	60
Maple Ave	Yes	259	186	73	184
Total		*1,352*	*998*	*354*	*964*

Table 5.4: Route 92XH Estimated Average Daily Boardings by Station					
BRT 92 XH (20/60)					
Station Name	**Is PnR?**	**Total Activity**	**Peak Period Activity**	**Off-peak Period Activity**	**Peak Period Peak Direction Activity**
Music City Central	No	232	232	-	222
RiverGate Mall	Yes	133	133	-	122
New Shackle Island Rd	Yes	133	133	-	128
Total		*499*	*499*	*-*	*472*

Table 5.5: Route 56 Estimated Average Daily Boardings by Station					
BRT 56 (10/15)					
Station Name	**Is PnR?**	**Total Activity**	**Peak Period Activity**	**Off-peak Period Activity**	**Peak Period Peak Direction Activity**
Music City Central	No	969	350	619	324
7th St	No	79	15	64	11
Five Points	No	178	42	136	31
Eastland	No	111	31	80	26
Douglas	No	246	68	178	60
East Hills (Trinity)	No	98	27	71	22
Greenfield	No	158	42	116	35
Inglewood	No	94	22	72	18
Walton (Briley Pkwy)	Yes	486	164	323	150
Due West	No	63	15	48	11
Madison	Yes	127	34	93	24
Edgemead	No	56	15	41	8
McHenry	No	30	13	17	8
RiverGate (Gallatin Pike)	No	40	11	29	3
RiverGate Mall	Yes	178	46	132	31
Total		*2,913*	*895*	*2,019*	*763*

The ridership for the express BRT services in the HOV lanes is shown by station below. Music City Central generates the most boardings due to its successful function as a regional transit hub. RiverGate Mall, New Shackle Island and Maple Avenue all generate fairly robust ridership. Saundersville and Harris/ Greenlea produce considerably less by comparison.

Although 92XH is only offered in the peak periods, 80% of the total combined 92XG and 92XH ridership occurs during the peak hours. Nearly 78% of the combined trips are during peak hours and are in the peak direction. These observations indicate a very strong traditional commute pattern from the suburbs to work in downtown Nashville.

Route 56 ridership by station is provided in Table 5.5. Again, Music City Central performs well as a transit hub and generates 33% of the total boardings on Route 56. The second highest ridership is at Walton, in part due to the park-and-ride facility. The end-of-line RiverGate Mall station with a park-and-ride facility generates about 180 boardings, including some transfers from the 92XG and 92XH routes.

In contrast to the express routes, Route 56 is dominated by about 70% off-peak ridership and about 30% peak ridership. About one quarter of the total ridership occurs during peak period in the peak direction. These observations indicate Route 56 is filling the gaps of the express service by primarily serving trips other than the traditional suburb-to-city morning work commute.

Route 26 ridership by station is provided in Table 5.6 on the previous page. Similar to Route 56 ridership, Music City Central has the highest boardings on the route and represents about 26% of the total on this route. The Madison and Walton (Briley Pkwy) stations show the second and third highest boardings respectively, partially due to the attractiveness of the park-and-ride facilities provided at those locations.

This route serves primarily a traditional commute market where 77% of its trips occur during the peak travel periods and about 46% of all trips occur during peak periods and in the peak direction. Peak direction is toward downtown Nashville (inbound) in the morning and away from downtown Nashville (outbound) in the evening.

Table 5.6: Route 26 Estimated Average Daily Boardings by Station					
Route 26 (40/60)					
Stop Name*	**Is PnR?**	**Total Activity****	**Peak Period Activity**	**Off-peak Period Activity**	**Peak Period Peak Direction Activity**
Music City Central	No	161	141	19	100
7th St	No	22	15	6	5
Five Points	No	34	29	5	17
Eastland	No	22	19	3	16
Douglas	No	30	25	6	15
East Hills (Trinity)	No	18	14	4	8
Greenfield	No	21	16	5	11
Inglewood	No	35	23	12	13
Walton (Briley Pkwy)	Yes	59	45	13	37
Due West	No	52	36	16	22
Madison	Yes	97	60	38	27
Edgemead	No	26	17	9	7
McHenry	No	20	17	3	2
RiverGate (Gallatin Pike)	No	24	19	6	8
Walmart	Yes	0	0	0	0
Total		*620*	*476*	*144*	*286*
*Shown in this table are only the stops at which BRT #56 stops (this route has multiple stops between these timepoints)					
**The activity numbers in this table are the sum of activities at all stops between the timepoints mentioned in this table.					

5.1.4. Travel Time Savings

The User Benefits shown in Table 5.7 represent the average daily number of hours of travel time savings in the region as a result of the project. In this case, the user benefits are based on a comparison of the No-build Alternative. The FTA uses user benefits to help determine the cost-effectiveness of projects that compete for New Start (5309) funding. For planning purposes, projects which demonstrate higher travel time savings generally attract more riders because of the more competitive travel times. It should be noted that user benefits include total travel time, including drive access, walk access, wait time and in vehicle time. All of these factors undergo increased scrutiny as a project advances in the project development process and a fully calibrated and FTA approved travel demand model is required to produce results suitable for FTA funding decisions. Additionally, the FTA currently requires a Baseline alternative to be developed and used as the basis for calculating user benefits. User benefits compared to a Baseline are generally lower than user benefits compared to a No-build as shown in Table 5.7.

Table 5.7: Travel Time Savings	
Purpose	**Average Daily User Benefits**
Home-Based-Work Trips	1,546
Home-Based-Other Trips	1,229
Non-Home-Based Trips	709
Total	*3,484*

Table 5.8: Order-of-Magnitude Capital Cost Estimates

Capital Cost Component	Units	2010 Unit Cost	Quantity	2010 Component Cost
Typical 6-lane section with center HOV lanes in both direction (widen outside)	mile	$5,491,000	2.36	**$12,959,000**
Typical 6-lanesection with center HOV lanes in both direction (widen to center)	mile	$6,146,000	9.13	**$56,113,000**
Typical 8-lane section with exclusive lanes, open drainage (widen outside)	mile	$2,864,000	0.2	**$573,000**
Typical 6-lane section with exclusive lanes, open drainage (widen outside)(existing 4 lane)	mile	$4,903,000	0.4	**$1,961,000**
Typical 6-lane section with exclusive lanes, open drainage (widen outside)(existing 5 lane)	mile	$3,397,000	2.01	**$6,828,000**
Typical 6-lane section with exclusive lanes, closed drainage (widen outside)(existing 5 lane)	mile	$4,356,000	1.6	**$6,970,000**
Typical 7-lane section with exclusive lanes, closed drainage (widen outside)	mile	$5,574,000	0.56	**$3,121,000**
Resurfacing of BRT Lanes (for portions in mixed traffic)	mile	$195,000	13.18	**$2,570,000**
Major Utility Relocation	lump sum	$200,000	1	**$200,000**
Highway bridge widening/lengthening	s.f.	$200	108,900	**$21,780,000**
Highway Bridge Replacement	s.f.	$200	157,250	**$31,450,000**
Freeway widening for BRT Center Station	each	$6,215,000	4	**$24,860,000**
Park-n-ride lot construction	site	$4,613,000	4	**$18,452,000**
Freeway Center Station	each	$5,220,000	4	**$20,880,000**
Reconstruction/ Restriping of Ramps	each	$70,000	17	**$1,190,000**
Outside Platform Station on Arterial	each	$1,270,000	7	**$8,890,000**
Pedestrian and bike access	station	$65,000	11	**$715,000**
Queue Jump Ramp	each	$341,000	10	**$3,410,000**
Sound Wall Relocation	s.f.	$67	447,400	**$29,976,000**
40-ft hybrid bus	each	$694,000	24	**$16,656,000**
60-ft articulated hybrid bus	each	$950,000	5	**$4,750,000**
Maintenance Facility	bus	$460,000	22	**$10,120,000**
Signalized Intersection Modification	each	$50,000	46	**$2,300,000**
Subtotal				***$286,724,000***
Engineering for transit items				$17,000,000
Unallocated Contingency	30%			$108,276,000
Total				***$395,000,000***

5.1.5. Capital Cost

The total order-of-magnitude cost of capital improvements required for the Preferred Alternative is $400 million. The improvements are spread over about 30 miles, resulting in some $13 million per mile. The average cost for BRT in dedicated lanes is between $10 million and $17 million per mile. This project has a wider variety of improvements, and the cost per mile falls about in the middle of the national averages.

As shown in Table 5.8, the capital costs include per mile costs for the varying typical sections along the corridor. Approximately 13.2 route miles will be used for BRT services in mixed traffic. Per mile costs associated with these miles assume milling and resurfacing of two 12 foot lanes to maintain ride quality. Widening will be required on the remaining 16.2 route miles to accommodate exclusive BRT lanes or HOV lanes. Each per mile widening cost includes clearing and grubbing, road and drainage excavation, earthwork, pavement materials, drainage, traffic control, engineering, testing, mobilization, construction management, right-of-way acquisition, utility relocation and a contingency factor. Costs for all per-mile items are based on TDOT unit prices.

Table 5.9: Operating Statistics and Cost

Mode	Characteristic	No-Build Alternative	Preferred BRT Alternative	Change from No-Build
Bus	Peak Buses	21	31	**10**
	Fleet Buses	26	38	**12**
	Ann. Rev. Bus - Hr's.	58,300	103,900	**45,600**
	Ann. Rev. Bus - Mi's.	698,600	1,035,000	**336,400**
	O&M Costs	**$5,572,500**	**$9,181,800**	**$3,609,300**
BRT	Peak Buses	6	20	**14**
	Fleet Buses	8	24	**17**
	Ann. Rev. Bus - Hr's.	27,600	62,500	**34,900**
	Ann. Rev. Bus - Mi's.	292,200	1,097,800	**805,600**
	O&M Costs	**$2,390,600**	**$7,328,500**	**$4,937,900**
Alternative Totals	**Peak Buses**	**27**	**51**	**24**
	Fleet Buses	**34**	**50**	**29**
	Ann. Rev. Bus - Hr's.	**85,900**	**166,400**	**80,500**
	Ann. Rev. Bus - Mi's.	**990,800**	**2,132,800**	**1,142,000**
	O&M Costs	**$7,963,100**	**$16,510,300**	**$8,547,200**

Notes:
1. Costs in 2010 dollars.
2. No-Build Route 92X statistics included under Bus category
3. Bus costs based on an MTA cost model developed for the study, using 2009 NTD expenditures.
4. BRT ops/maint. costs determined with MTA bus cost model, but with additional costs added for vehicle, station and busway maintenance, as appropriate.

Construction of the BRT will require widening or lengthening 13 highway bridges – two on Gallatin Pike between Briley Parkway and RiverGate Mall, and 11 on SR 386. In addition, nine bridges on SR 386 will be replaced. The estimated cost reflects modification or replacement of approximately 266,150 square feet of bridge deck.

Construction of HOV lanes on SR 386 will require relocation of approximately 4.2 miles of sound wall. While it is may be possible to re-use some of the panels, this cost estimate assumes the installation of new walls. Assuming an average height of 20 feet, the estimated cost of relocating the sound walls is just under $30 million.

Widening on SR 386 will also impact approximately 17 on- and off-ramps. Assuming impact to 500 feet of ramp at each exit, the cost of reconstructing and/or restriping is estimated to be $1.2 million.

The proposed BRT includes four freeway center stations on SR 386. The cost estimate reflects construction of the station itself, widening the roadway to accommodate tapers, and pedestrian and bicycle access to the station. Seven outside platform stations are proposed on Gallatin Pike, each including a pair of platforms on the far side of the intersection. Pedestrian and bicycle access to these stations is also included in the cost estimate.

Five queue jump locations are included in the estimate where one lane is assumed to be added in each direction near the BRT station so the bus can board and alight passengers and advance through an intersection before other traffic waiting in queue.

The fleet quantities shown represent the estimated net fleet required to satisfy the BRT operating plan compared to the No-build. 60-foot articulated hybrid buses are proposed for the Route 56 BRT. 40-foot hybrid busses are assumed for all other services due to the economies associated with more flexible fleet rotation and maintenance. If or when the project moves closer to implementation, other bus specifications should be considered well in advance of procurement.

The costs shown are intended to be order-of-magnitude costs for high level planning purposes only and commensurate with this mobility study. Preliminary engineering and identification of specific environmental impacts will be required to refine the cost of the project. The cost of the project will evolve together with the scope of the project(s).

5.1.5 Operating Statistics and Cost

As shown in Table 5.9, the incremental cost to operate and maintain the proposed BRT services (compared to No-Build) would be between $8 and $9 million per year. This is based on MTA's operating and maintenance cost and includes all of the services described above.

5.2. Potential Project Funding and Phasing

The traditional approach to advancing a mass transit major investment in fixed guideway, where federal funding is needed, is through the New Starts process. The New Starts project cycle would include the following steps:

- Alternatives Analysis
- Environmental Evaluation (NEPA), and Preliminary Engineering (PE)
- Final Design
- Construction

With this process, Federal Transit Administration (FTA) approval is required to advance the project from one step to the next based on established evaluation criteria. The current program is primarily based on transportation costs and benefits, where a project must compete for funding based on how much it costs compared to the travel time savings achieved for its customers. There are other criteria that must be met, but the most formidable obstacle is often the cost-effectiveness measure. In this case, the cost of the BRT's infrastructure and operations would not compare favorably with the potential travel time savings. New Starts projects are also required by the FTA to advance through a prescribed Alternatives Analysis (AA) process prior to being authorized to advance into preliminary engineering.

The future of the New Starts AA itself is in question as this step in the process may no longer be required in the coming years because some argue that the New Starts AA is redundant to and/or confused with the alternatives analysis required under the National Environmental Policy Act (NEPA). In either case, the criteria to fund New Starts projects will likely change as it has been the topic of intense scrutiny by stakeholders and public officials for some time now. In the future, it is likely to include some elements of livability and economic development measures, but the specifics have not been determined at this time.

Although the specific rules for federal funding of transit projects will most likely change in the near future, it is highly likely that federal funding programs for new services will likely include some form of transportation-based cost effectiveness criteria so the costs and travel time savings associated with projects in the planning stages should not be ignored. It is also highly likely that federal funding programs will continue to require a local match.

The BRT alternative as proposed will operate in existing managed lanes (HOV or transit) on I-65 between Ellington Parkway and Vietnam Veterans Parkway. New HOV lanes are proposed on Ellington Parkway and SR 386. Only a fraction of the HOV lane capacity will be used by the buses so only a fraction of the funding (if any) would likely come from New Start or other transit type funding programs. The large majority of funding for the HOV lanes would likely come from typical highway funding sources and given the ridership estimates and the frequency of service, the HOV lanes would likely need to be justified independent of the BRT service. However, the median stations and park and ride lots may be eligible for transit funding.

The 2035 Regional Transportation Plan includes three projects that could provide potential opportunities to access funds for improvements needed to implement the Northeast Corridor Study recommendations. Project RTP# 1052-179 proposes the widening of SR-386 in Sumner County from four lanes to five lanes from I-65 to Saundersville Road. This project could potentially provide an opportunity to access Federal Highway Administration funds for HOV lanes. Project RTP# 1053-264 requests funds for construction on completed plans for a new interchange on SR-386 at Forest Retreat Road in Hendersonville. The funding request for this project specifically references the Northeast Corridor Study and the need for the interchange to be designed to support transit. Finally, Project RTP#1012-218 calls for the widening of SR-6 Ellington Parkway from North 1st Street to Broadmoor Drive to accommodate additional vehicular and transit capacity, as per the Northeast Corridor Study. This project will support the Arterial BRT alignment.

Although the BRT proposal outlined in this section represents the Preferred Alternative of the MPO, the long-range vision for the corridor is to implement light rail transit along the I-65/ Vietnam Veterans Parkway. The dual visions of BRT in the near term and LRT in the long-term are not exclusive to one another. If LRT is the ultimate mass transit solution along the highway alignment, investment in temporary, but significant BRT stations, ramps and park-and-ride lots may not be desired. It may be possible to design some of the infrastructure to serve BRT in the near term and LRT in the long term, while minimizing temporary infrastructure, but this requires careful planning, engineering and due consideration to the environmental impacts.

As funding for the entire corridor may not become available at one time, decision-makers should also consider phasing corridor construction by segment. For example, an initial phase could be constructed between Downtown Nashville and Hendersonville where the majority of ridership will be captured, with later phases completing the alignment between Hendersonville and Gallatin.

The proposed BRT system includes a number of different types of service and each entails various capital improvements, all of which do not need to be built and implemented simultaneously. One proven approach to developing transit corridors is to build upon your existing customer base and services. Here, it may be appropriate to capitalize on the Route 56 service and explore the possibilities of installing queue jumps to aid the busses through traffic. The station areas can continue to be improved with enhanced pedestrian and handicapped-accessible environments and service levels can be increased commensurate with the market. Likewise the 92X park-and-rides can be improved and/or added and service can be adjusted to match the market. These lower cost improvements (if justified with independent utility) should be studied for potential near term implementation, while the longer term solutions are further developed and refined.

General Project Time Line

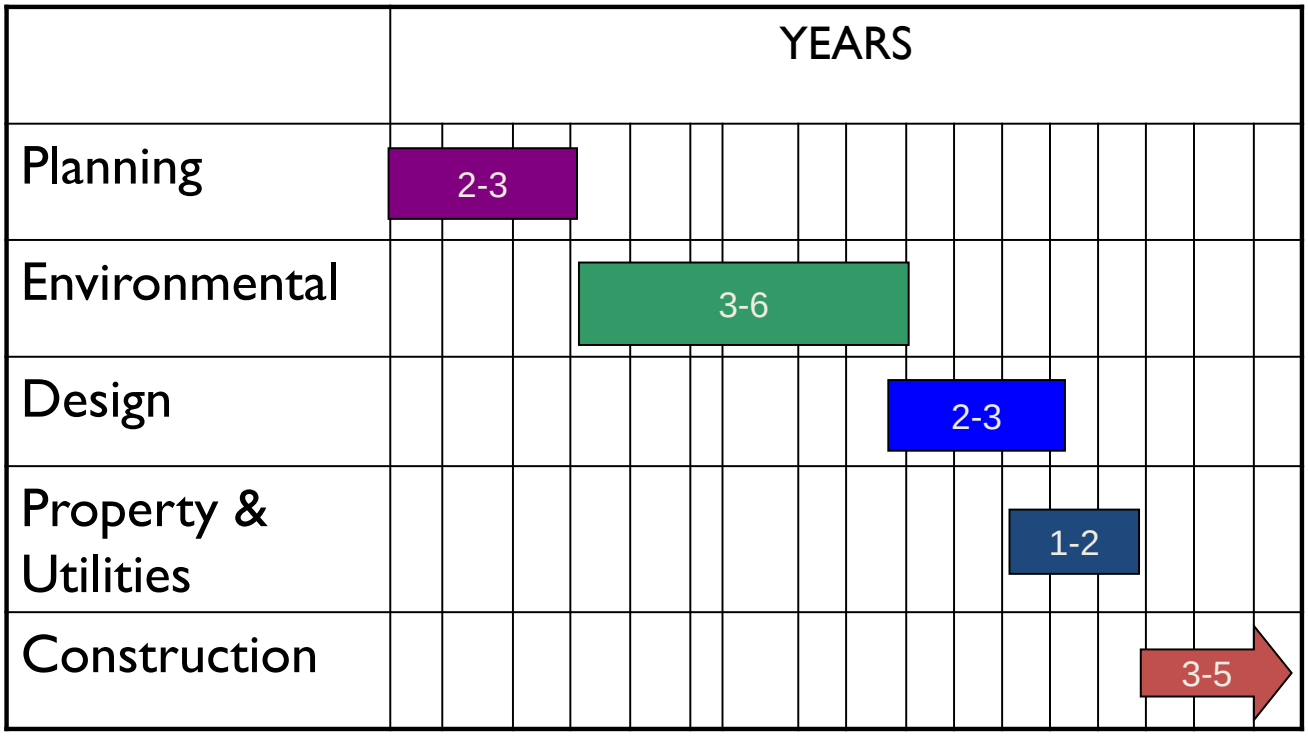


Figure 5.7: General Project Timeline

6.0 Long-Range Vision

Figure 6.1: *Light Rail Transit remains the vision for the region*

Figure 6.2: *Existing Low Density Conditions are Insufficient to Support Light Rail Transit Today*

Engagement with the public and elected officials throughout this planning process revealed that the strong local preference for the Northeast Corridor is to develop a light rail system connecting downtown Nashville with Gallatin, including Goodlettsville, Hendersonville and other points between. While analysis of current development and transit ridership patterns indicates that such a light rail system is not financially feasible in the near future, the goal of the region remains to link Gallatin and Nashville with light rail. This Section describes changes in policy that could lead to conditions favorable for development of this light rail link.

6.1. Long-range Vision

While it is recommended that Bus Rapid Transit (BRT) be implemented in the near-term (within 10 years), the long-range vision is to work toward the implementation of Light Rail Transit (LRT) from downtown Nashville to downtown Gallatin. The service would extend along Vietnam Veteran's Parkway (SR 386), I-65, Ellington Parkway (SR 6) for the provision of direct access into downtown Nashville.

The inspiration for the long-range vision can be traced to a visit by part of the project team and local leaders to the Denver, Colorado region in 2007. The purpose of the visit, discussed in Section 2 of this report, was to allow the team to learn from the successful transit developments the region has implemented. The group was particularly impressed with Denver's T-Rex corridor, which features LRT in a highway setting, utilizing dedicated slip ramps that lead to limited access stations and transit-oriented developments. Like the Northeast Corridor, the T-Rex corridor operates in both urban and suburban settings, with transit-oriented development supporting ridership in both high and low density land use contexts. The popularity and success of the T-Rex system serves as a model for the recommendation of a similar system for the Nashville Northeast Corridor.

Figure 6.3: *Denver's T-Rex operates in both urban and suburban contexts*

6.1.1. Light Rail Concept

The proposed long-term light rail concept for the Northeast Corridor is based upon the LRT Alternative described and evaluated in Section 4. Figure 4.4 illustrates the concept, which is the same as the LRT Alternative, with the addition of four proposed station locations at Dickerson/I-65, Center Point, Indian Lake, and Big Camp. The addition of these stations would most likely increase ridership as more destinations would be accessible by transit. In addition, these locations also present opportunities for development or redevelopment that would support and be reinforced by proximity to transit.

6.1.2. Success Factors for Light Rail

To be competitive for federal funding under current U.S. Federal Transit Administration policy, new transit systems generally should have much more favorable ridership and cost efficiency numbers than the alternatives described in Section 4. Two major variables can affect ridership projections: mode split and land use patterns.

Mode Split

Federal funding evaluators rely upon current ridership patterns when projecting likely future mode split. Currently a very small percentage of regional commuters and other travelers use the regional bus system or the Music City Star. Therefore, using FTA rules, a similarly low percentage of travelers are projected to use a proposed transit system. However, the development of the Bus Rapid Transit route described in Section 5 is very likely to attract more transit users in the corridor. This will improve the region's transit use rate and lead to higher ridership projections for a proposed light rail facility.

Land Use Patterns

The current low ridership figures are also based on current land use patterns and plans in the various jurisdictions in the Northeast Corridor. Existing land use patterns are, for the most part, not transit-supportive as they generally reflect a low-density, suburban pattern, with relatively few residents and businesses within walking distance of proposed transit stations. The key to improving ridership is to develop these transit areas in a more transit-supportive way, attracting residents and businesses who desire to be transit customers. Transit supportive development tends to be characterized by a mix of land uses, organized in a pedestrian-friendly manner, developed at moderate to high densities.

Section 6.3 on the following pages explores an alternative land use scenario in which the distribution of residents and employment achieves a density sufficient to provide enough daily transit riders to support the LRT vision. Sections 6.4 and

6.5 take a closer look at specifically how the proposed light rail stations in the Northeast Corridor could be developed to generate more riders for the desired light rail facility. Section 6.3 includes general land use concepts for each station location, and Section 6.4 provides more detailed case studies of how a few prototypical stations could develop. First, in section 6.2, case studies of "success stories" - where similar suburban areas have successfully developed transit systems - is presented.

6.2. Success Stories

Several American cities, including Charlotte and Denver, have successfully developed light rail facilities in the past decade. The experience of these cities can inform the planning process for light rail in the Northeast Corridor, as they are both cities developed mostly after World War II with typical suburban densities outside the inner core. As described in the brief summaries below, ridership has exceeded initial projections in both cases, and light rail has been a stimulus for economic development.

To further inform potential transit options, a review of two cities with innovative TOD solutions was performed: Charlotte, North Carolina and Denver, Colorado.

6.2.1. Charlotte, North Carolina

Charlotte maintains a rich history of rail activity that originated in the 1890s, when the Southern, Seaboard Air Line, and Norfolk Southern Railways brought their first trains to the city. The rail industry in Charlotte declined, however, in response to growth in the use of private automobiles as a primary form of transportation and to the city's diversifying economy. During the 1990s, a group of rail enthusiasts restored an antique trolley car and created the Charlotte Trolley line that connected Uptown to South End. This endeavor helped set the stage for future Light Rail Transit by providing the opportunity to demonstrate pioneering mixed-use development and to get community members used to the presence of rail transit in Charlotte.

By the 1990s, Charlotte had experienced tremendous growth as it became a national center for the banking and finance industries. The City proactively sought to create a strategy that would ensure growth occurred in a way that enhanced livability in the metropolitan region and sought to optimize new investments in public infrastructure. This strategy was developed primarily as a collection five primary growth corridors, where capital improvements for high-capacity infrastructure would be focused; activity centers that would provide higher-intensity development within these five corridors; and wedges that are reserved for low to medium intensities, typically existing single-family neighborhoods. The 2025

The LYNX Blue Line - Charlotte, NC

The Lynx Blue line (South Corridor) was the first of the five transit corridors advanced to the Major Investment Study/ Alternatives Analysis phase in 1998 and Preliminary Engineering/ Draft Environmental Impact Statement (PE/ DEIS) in August of 2000. The project received its Federal Record of Decision in May of 2003 and a Full Funding Grant Agreement (FFGA) in May 2005. The Corridor opened for revenue service on November 24, 2007. Land use and transit supportive development considerations were integrated throughout the planning of the Blue line from early regional visioning and feasibility assessments to detailed corridor planning, design, and construction, even prior to receiving the FFGA from FTA. Although there was a risk that the City would not receive funding, City leaders knew that their investment in conducting early coordination of land use and transit decisions would yield more optimum results for the community as a whole. Because of the City's proactive planning and their commitment to follow through with infrastructure investment and regulatory changes, the private sector was given a sense of confidence that the City was committed to creating better places in the entire South Corridor, and this in turn generated an enthusiastic private development response.

Ridership for the corridor was projected to open with approximately 9,000 riders per day and grow to 18,000 by 2025. In actuality, the system opened with 13,000 passengers per day and is currently carrying 15,000 per day, after only three years of operation. Between 2005 and 2009, the South Corridor had over 1,900 new residential units, 100,000 square feet of retail, and 80,000 square feet of office constructed. Furthermore, South Corridor's land values increased 52% from 2000-2007 while the land prices for the rest of city increased by 40%. The City estimates that more than $400 million in private sector development was realized prior to the line's groundbreaking and a projected $1.8 billion of new tax revenue is expected between 2005 and 2011.

Integrated Land Use and Transit Plan was created to support this regional land use vision, while increasing mode choices, developing a regional transit system, and supporting economic growth.

The community demonstrated its support in this integrated land use and transportation effort by passing a half-cent sakes tax to implement the 2025 plan. This became a large milestone for the Charlotte region because it expressed local commitment for transit and allowed the City to collect the matching funds for its FTA New Starts grant application. The success of these efforts has been realized through ridership that far exceeds projections and property values in transit station areas that are increasing at a rate greater than the rest of the city.

6.2.2. Denver, Colorado

Denver has enjoyed a long and successful relationship with rail transit. The city was established in 1858 by a band of prospectors as a supply center for westward-bound settlers seeking gold. The population quickly grew to 4,549 by 1860 and there were great expectations for continued rapid growth. The city's efforts to consolidate railroads allowed its growth to continue as its economy diversified, and the city in turn began investing in local rail transit as early as the 1870s.

Although the city's rail transit system went into decline and was eventually closed in the mid-20th century, as was the case in many other American cities, Denver began to plan for modern light rail transit as a means of offering mode choice and helping to manage traffic congestion so that the city could continue to grow and prosper. Denver's light rail transit service began operations in 1994 and since then, nearly 35 miles of light rail routes and over 30 stations have been added.

Denver has recognized the positive impact that transit service can have on land use around transit stations. In 2006, the Transit Oriented Development (TOD) Strategic Plan was adopted as a guide for setting priorities for the investment of City resources and to provide development standards and identify tools for the implementation of TOD around existing and future LRT stations. Further planning efforts are underway to provide additional momentum for TOD growth. The Denver Department of Community Planning and Development has partnered with Public Works, the Office of Economic Development, RTD and others to "identify a vision and strategies to direct appropriate change at the station areas and utilize the transit investment as a catalyst to enrich and enhance Denver's neighborhoods."

Bus and LRT - Denver, CO

Denver's passenger transit system today, which is operated by the Regional Transportation District (RTD), consists of bus service and Light Rail Transit (LRT) lines. Denver opened its first LRT line in 1994, with a 5.3 mile, 15 station section that is now the D Line. Today, in 2010, the LRT system has grown to 5 lines with 36 stations and nearly 40 miles of track. Twenty of the LRT stations have park and ride lots. The LRT system is fully integrated with and supported by over 150 bus routes plus special bus services such as "call-n-Ride" which provides curb-to-curb service in certain areas and "access-a-Ride" for disabled riders. As of the first quarter of 2010, LRT ridership was averaging 63,100 weekday rider-trips.

The future of LRT in Denver is bright. Construction is underway on the 6th LRT line (West Corridor Line) that is scheduled to open in 2013, connecting Denver to Golden. The new line is the first part of the multi-billion dollar RTD FasTracks comprehensive transit expansion that was approved by voters in 2004 and calls for the construction of a total of 119 miles of new commuter and light rail lines and 70 new stations along with new bus service.

6.3. Making the Northeast Corridor Transit-supportive

If light rail transit is the ultimate vision for the Northeast Corridor, proactive steps will need to be taken to encourage a future land use pattern in the study area that is dense and intense enough to support transit. Transit and development are integral to one another as transit attracts development, and development likewise increases transit ridership. Generally, mixed use patterns of moderate to high density have proven to be the most transit supportive, with residential densities averaging 20-25 units per acre. This figure should be seen as an average of the area within approximately ½-mile of a station; generally parcels directly adjacent to the station would be higher, with densities gradually decreasing to surrounding neighborhoods.

As has been described, current land use patterns along the corridor are not transit-supportive. Figure 6.5 shows the existing land use in the study area and Figures 6.6 and 6.7 show 2008 household and employment density, respectively. In order to support transit ridership, a substantial increase in the number of residents and jobs must occur within close proximity of the corridor. Although most of the jurisdictions within the study area have adopted land use policies that encourage some form of growth management, if the study area develops under a business-as-usual approach - meaning population and jobs are distributed based on existing infrastructure, available land, and current future land use policies - land use densities sufficient to produce transit ridership will not be reached in the foreseeable future.

6.3.1. Ridership and Peer Systems

While there is no sure method for estimating how many residents and jobs are needed to produce transit ridership, successful transit systems in peer cities and regions may offer some clues. Daily boardings per track mile of LRT range widely - between 300 and 8,000 boardings per mile. Table 6.1 shows daily boardings per mile for LRT systems in four peer cities: Cleveland, St. Louis, Charlotte, and Boston. According to the MPO's travel demand model, the proposed Northeast Corridor LRT would attract a total of 217 daily boardings per mile in 2035 under business-as-usual conditions, which would not be adequate to be competitive for federal funding.

Table 6.1: Peer Systems Daily Boardings per Mile *(refers to selected lines, not entire systems)*

Transit System	Daily Riders/mile
Cleveland	550
St. Louis	1,050
Charlotte	2,000
Boston	8,250

Source: Nashville MPO

6.3.2. Alternative Ridership Scenario

Using the peer city examples as rough benchmarks, the MPO modified its travel demand model in order to assess the scale of increase in residents and jobs that may be needed to produce comparable daily boardings per mile on the proposed Northeast corridor LRT. The following assumptions were used to modify the MPO's model:

- Modest increase in cost to operate vehicles;
- Modest increase in travel time savings for LRT;
- Maintain county-wide auto ownership rates through 2035;
- Reduced corridor auto ownership by 1/3;
- New growth to occur closer to existing development;
- Triple households and jobs forecast within 1/2 mile of LRT corridor.

Making these adjustments, the MPO model created an alternative scenario that produced 734 daily boardings per mile, a total of 22,000 daily boardings. When ridership is only considered from Nashville to Hendersonville, where urban development densities already exist in many cases, the alternative scenario would produce 1,334 daily boardings per mile along the roughly 15-mile stretch.

6.3.3. Alternative Future Land Use and Development Patterns

The alternative ridership scenario assumes a regional land use pattern that is considerably more dense and intense - at strategic locations - than what is currently existing or planned for. Similarly, as has been noted, the scenario assumes triple households and jobs within proximity to the corridor; thus, the scenario is not constrained by market realities or current MPO projections for future population and employment. To illustrate, the modified transportation demand model assumes that approximately 108,000 new households and 200,000 new jobs will be placed within the corridor. By comparison, under business-as-usual conditions, the MPO forecasts approximately 10,000 new households and 37,000 new jobs to be placed within the same area by 2035. While growth at this scale may arguably be within the ranges projected for some of the region's fastest growing counties, these assumptions are certainly more aggressive than current projections. Therefore, the alternative scenario should be seen not as a recommendation of the Northeast Corridor Study, but rather as a hypothetical scenario intended to demonstrate a potential land use and ridership outcome that would support the long-range vision.

As has been described elsewhere in this report, the land use plans adopted by the various jurisdictions within the study area have often emphasized nodal and corridor-based

development as opposed to the continued sprawl that has often characterized development in the past. For example, Nashville Metro has adopted community plans that identify US 31E as an urban mixed used corridor and the RiverGate Mall area as a major mixed use center, Hendersonville has identified goals related to building up its town center, and Gallatin has adopted policies intended to preserve the viability and vibrancy of its downtown. *The Plan of Nashville: Avenues to a Great City*, completed by the Nasvhille Civic Design Center, imagines major transformation for Nashville and it surroundings, calling for the transition of part of Ellington Parkway into an urban boulevard (see Figure 6.4). In general, however, the majority of adopted policies, while sometimes complementary to transit-supportive land use planning, are unlikely to produce the level of density and intensity needed to generate transit ridership. Figure 6.7 shows a generalized composite of the existing business-as-usual future land use plans for the study area. Figures 6.8 and 6.10 show forecasted household and employment densities expected at 2035 based on the business-as-usual scenario.

Figure 6.4: *This image from the Plan of Nashville proposes what a potential alignment of Ellington Parkway could look like as an urban boulevard.*

In order to produce density capable of absorbing the ridership numbers identified in the MPO's alternative scenario, changes will need to be made to future land use policies across jurisdictions within the Northeast Corridor. Specifically, a mix of relatively high density residential, commercial, and office uses must be encouraged within close proximity to proposed stations, as well as a moderately dense mix of uses at activity centers, along key corridors, and along circulator routes. Residential densities within station areas could range from 15 - 75 dwelling units per acre, with high density office buildings and ground floor retail providing employment densities. Section 6.4 provides specific details regarding station area development, including visual examples of a range of densities.

Figure 6.12 illustrates a possible future land use pattern for the study area that reflects densities needed to support the alternative scenario. This illustrative map builds on the strengths of the business-as-usual scenario with adjustments made at strategic locations, particularly at proposed transit stops along key corridors, to support transit-supportive density. Key highlights of the illustrative alternative land use scenario are as follows:

A new Transit-oriented Development (TOD) future land use category with suggested density up to 75 dwelling units per acre is added and applied to potential redevelopment areas around proposed stations;

- The majority of new residential development is concentrated around stations
- US-31E redevelops as a mixed use urban corridor with employment densities of up to 35 employees per acre;
- Employment density is concentrated in TOD areas and mixed use areas along the corridor and circulator routes;
- Undeveloped land classified as future single-family use in Sumner County is preserved as rural or agricultural land.
- Existing single-family neighborhoods are preserved

Figures 6.9 and 6.11 illustrate possible density patterns under the alternative scenario for households and employment, respectively. The density patterns shown reflect the placement of all households and jobs identified in the MPO's alternative ridership scenario with their distribution based upon a transit-supportive land use pattern. As the alternative scenario does not rely on projected population or employment estimates, no specific time horizon is assumed.

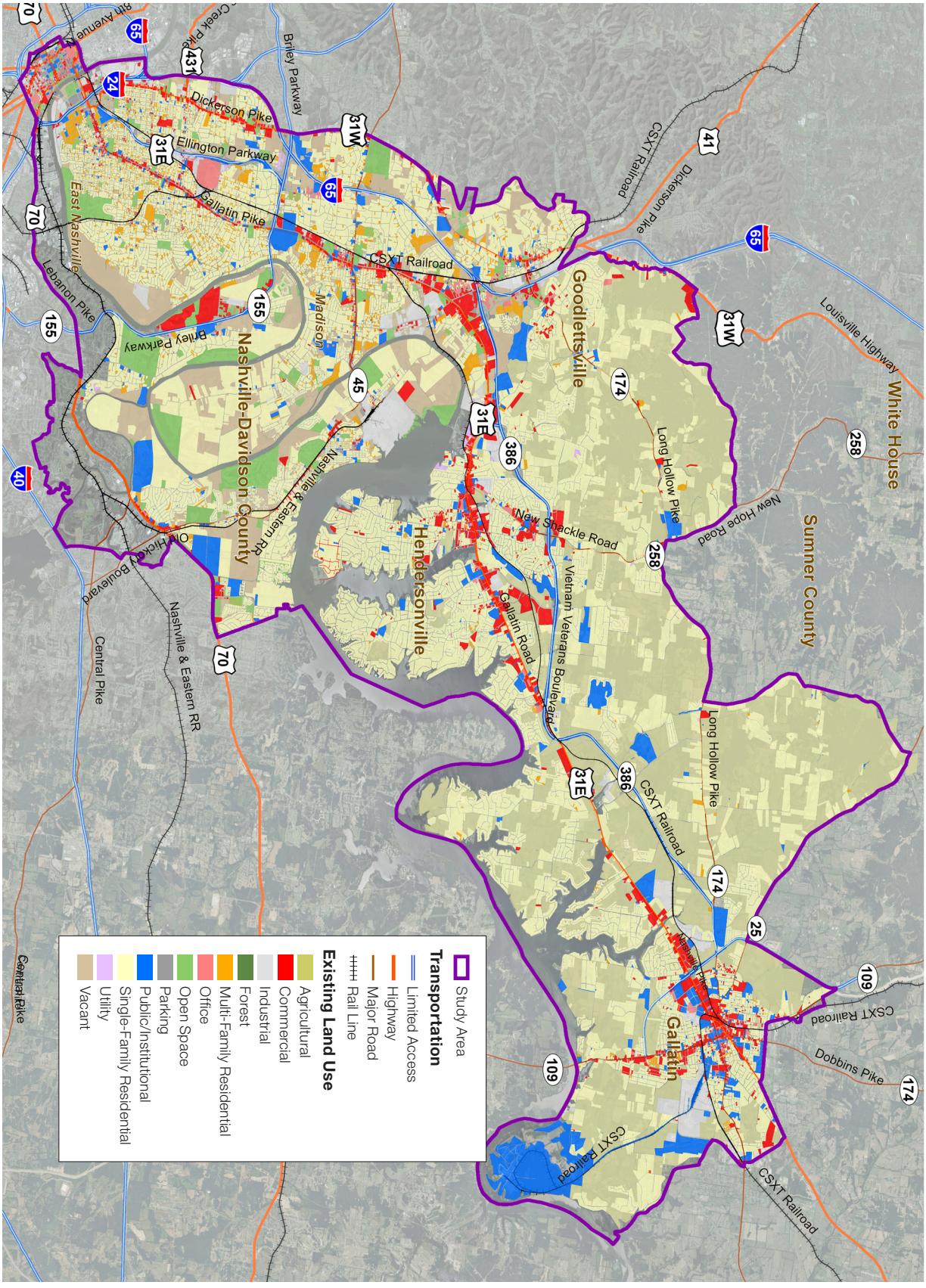


Figure 6.5: Existing Land Use

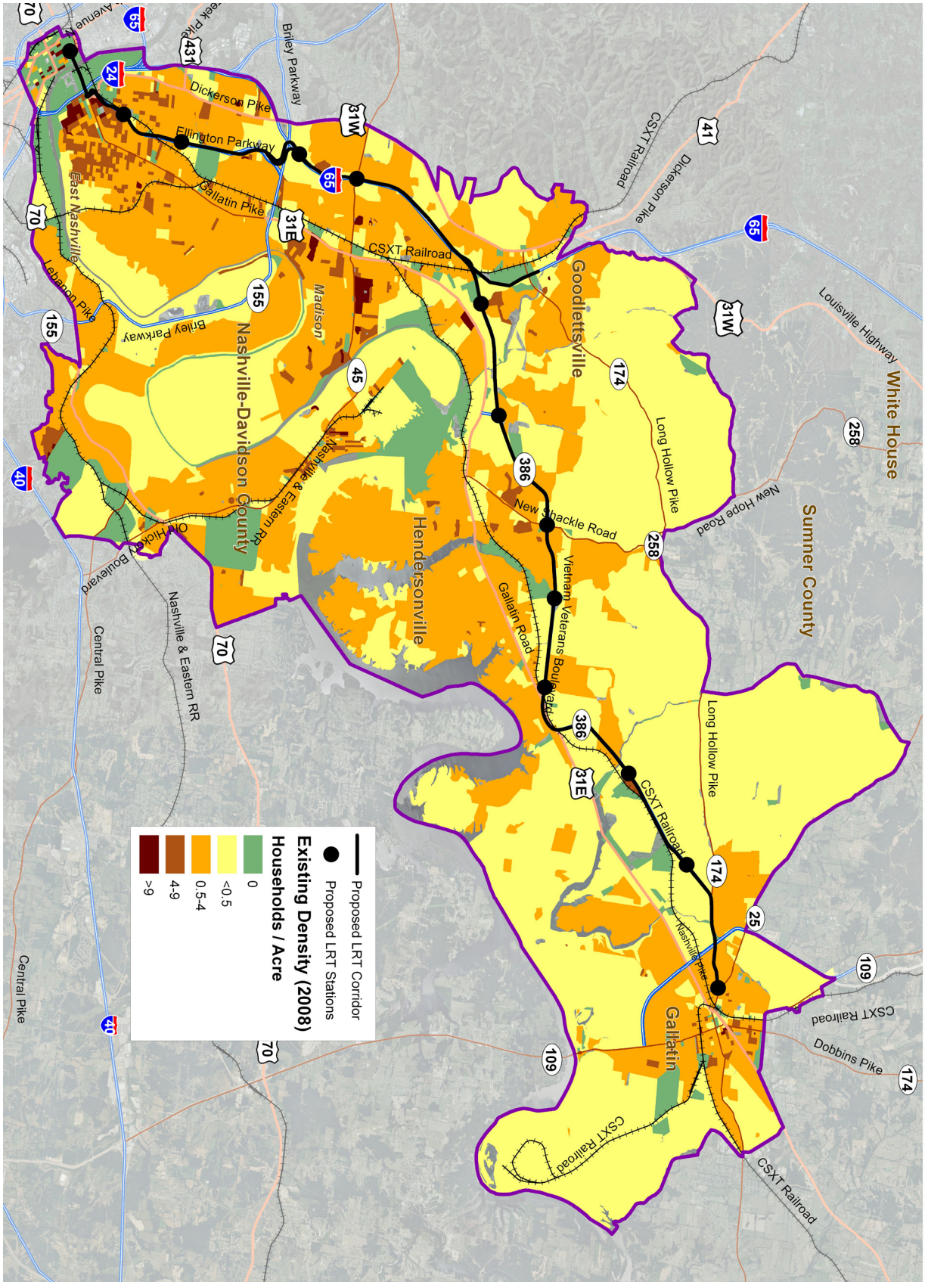


Figure 6.6: *Existing Household Density (2008)*

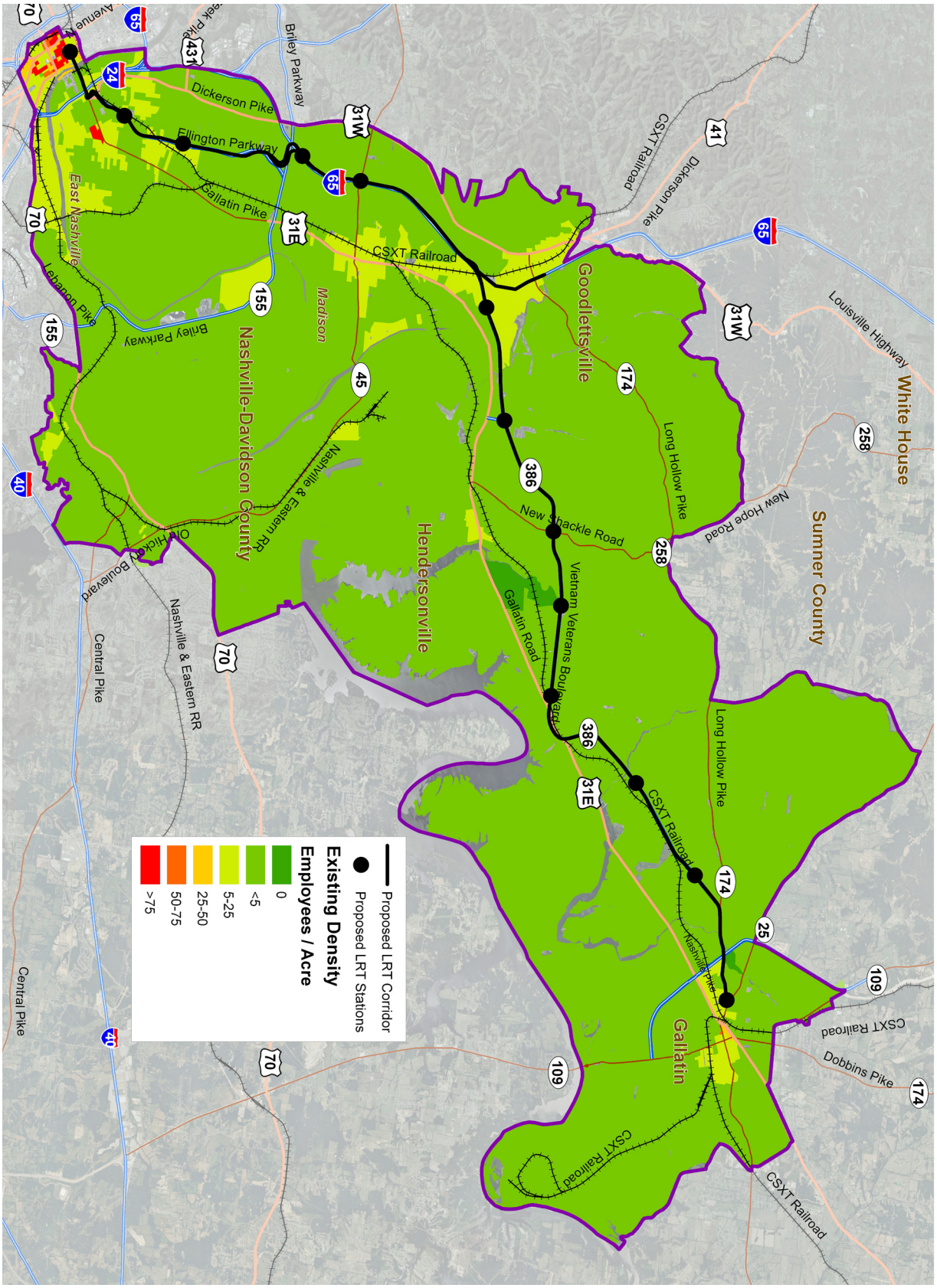


Figure 6.7: *Existing Employment Density (2008)*

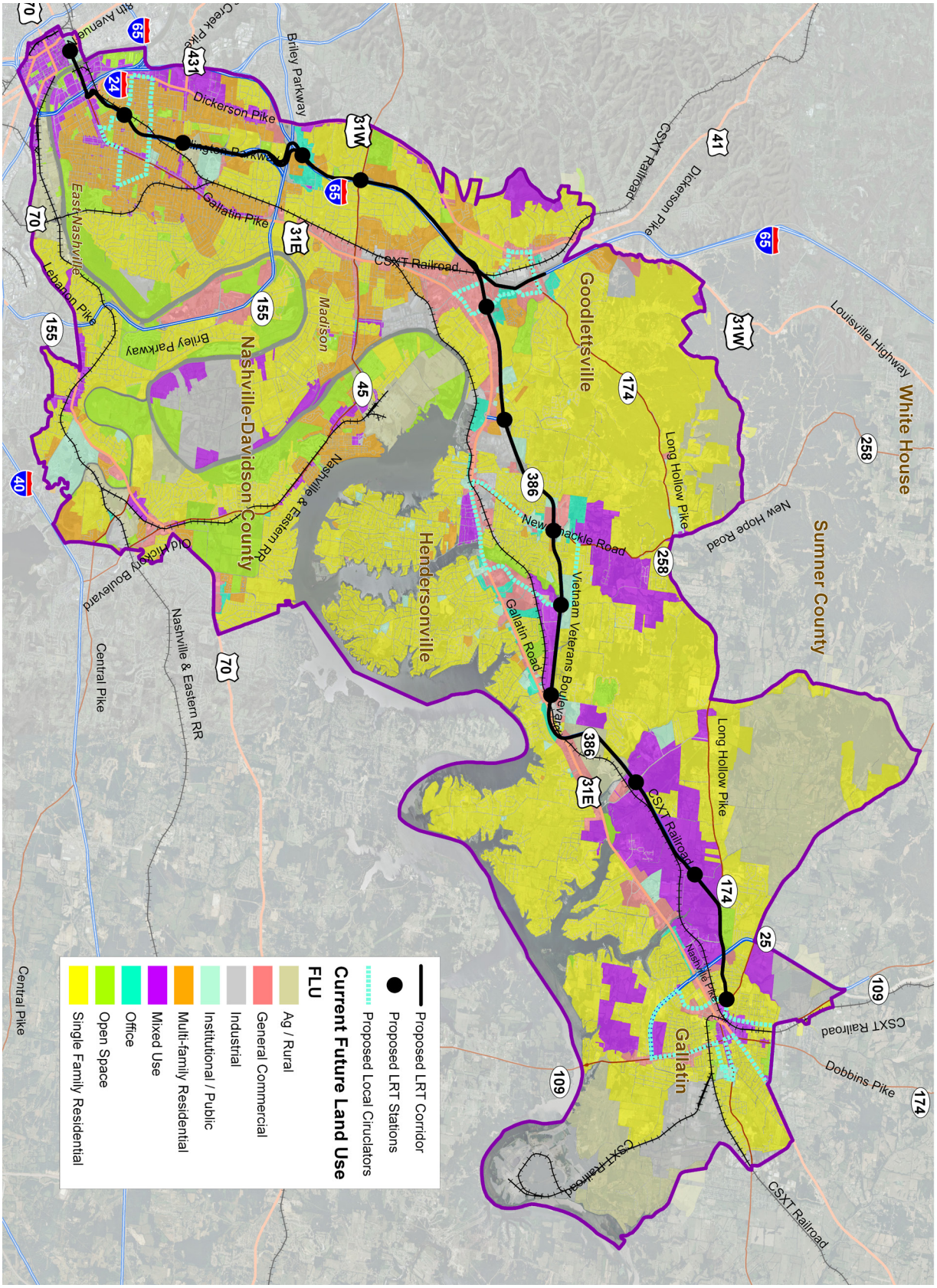


Figure 6.8: Business-as-Usual Future Land Use

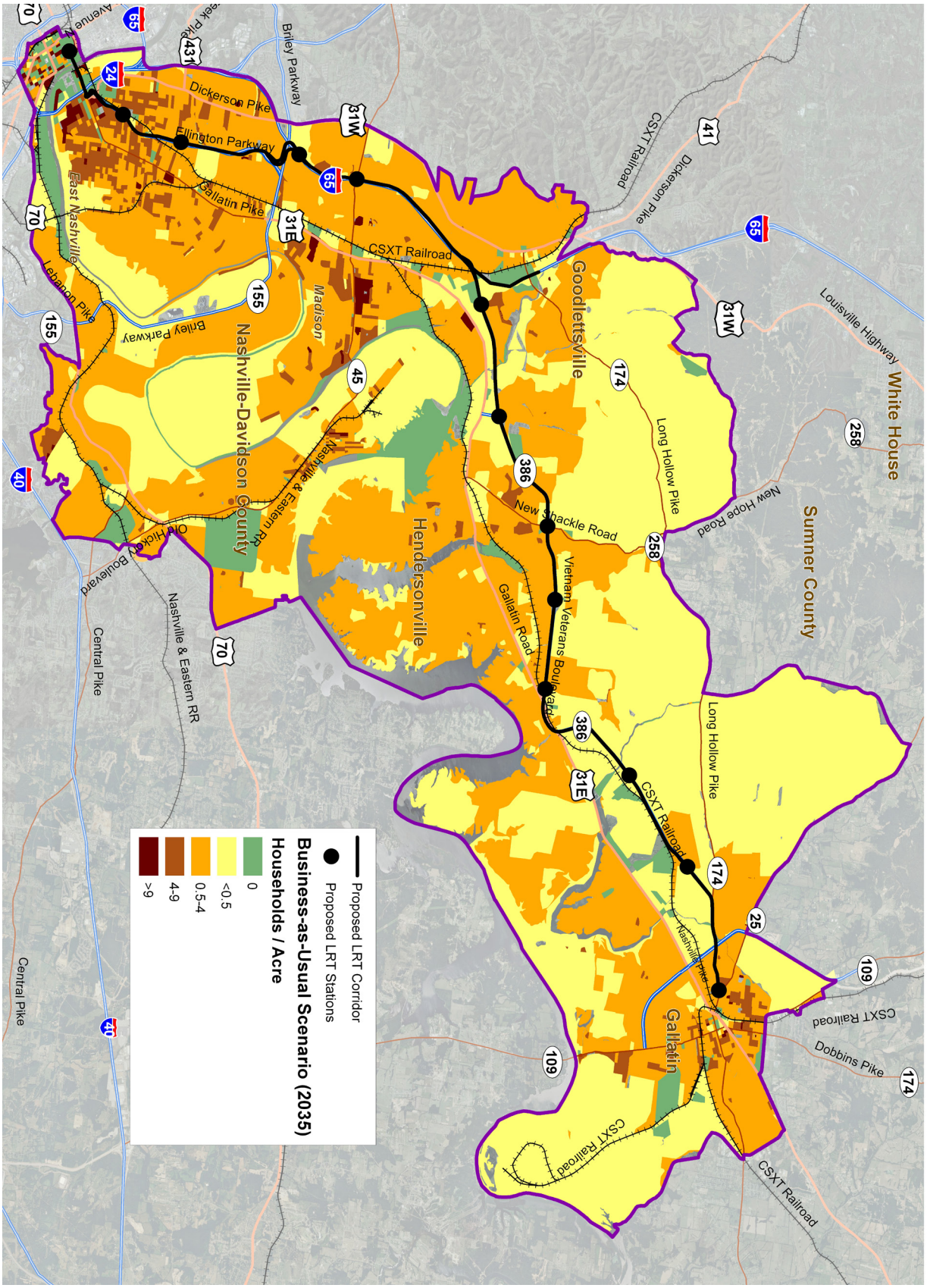


Figure 6.9: *Business-as-Usual 2035 Household Density*

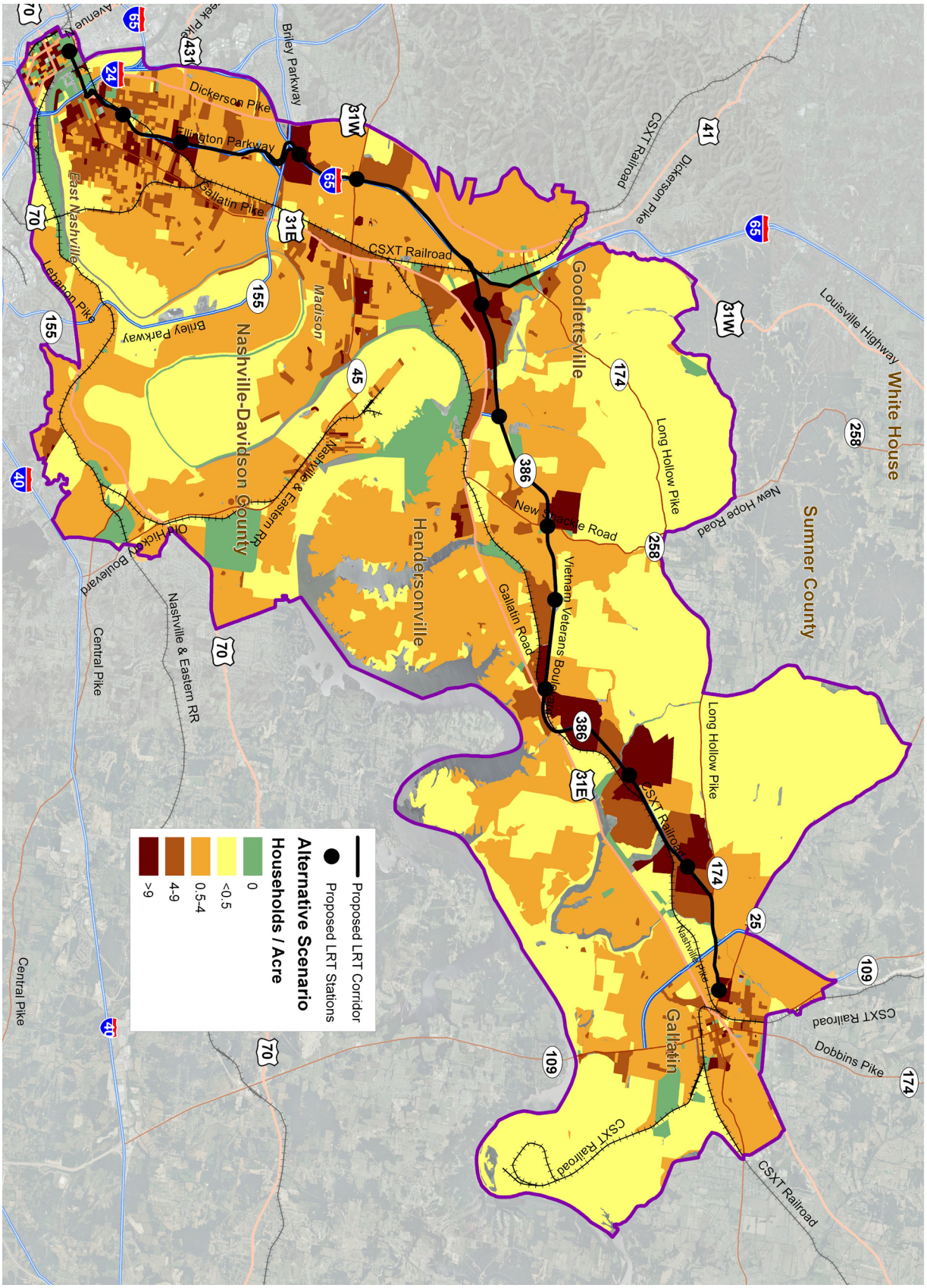


Figure 6.10: *Alternative Scenario Household Density*

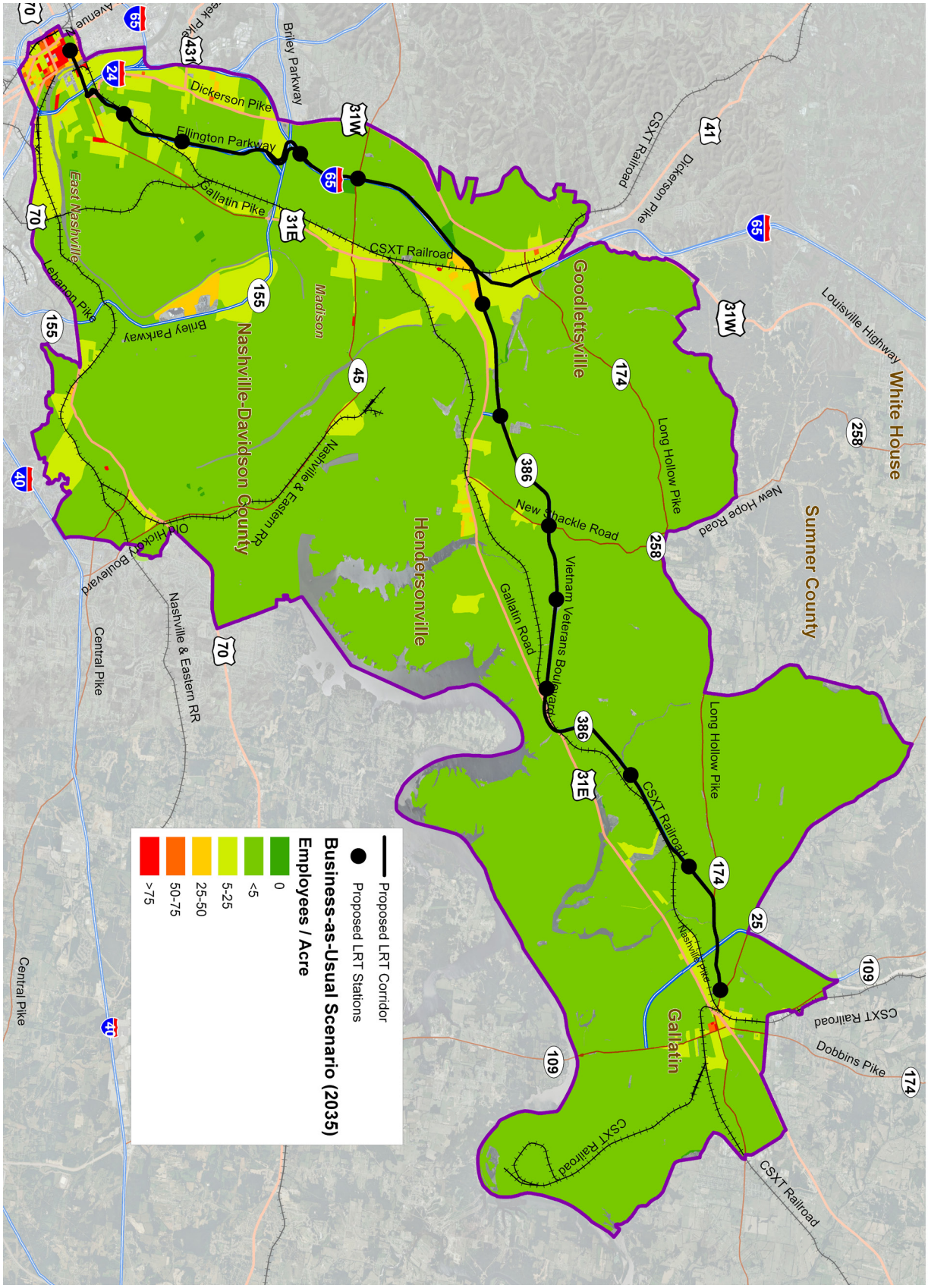


Figure 6.11: Business-as-Usual 2035 Employment Density

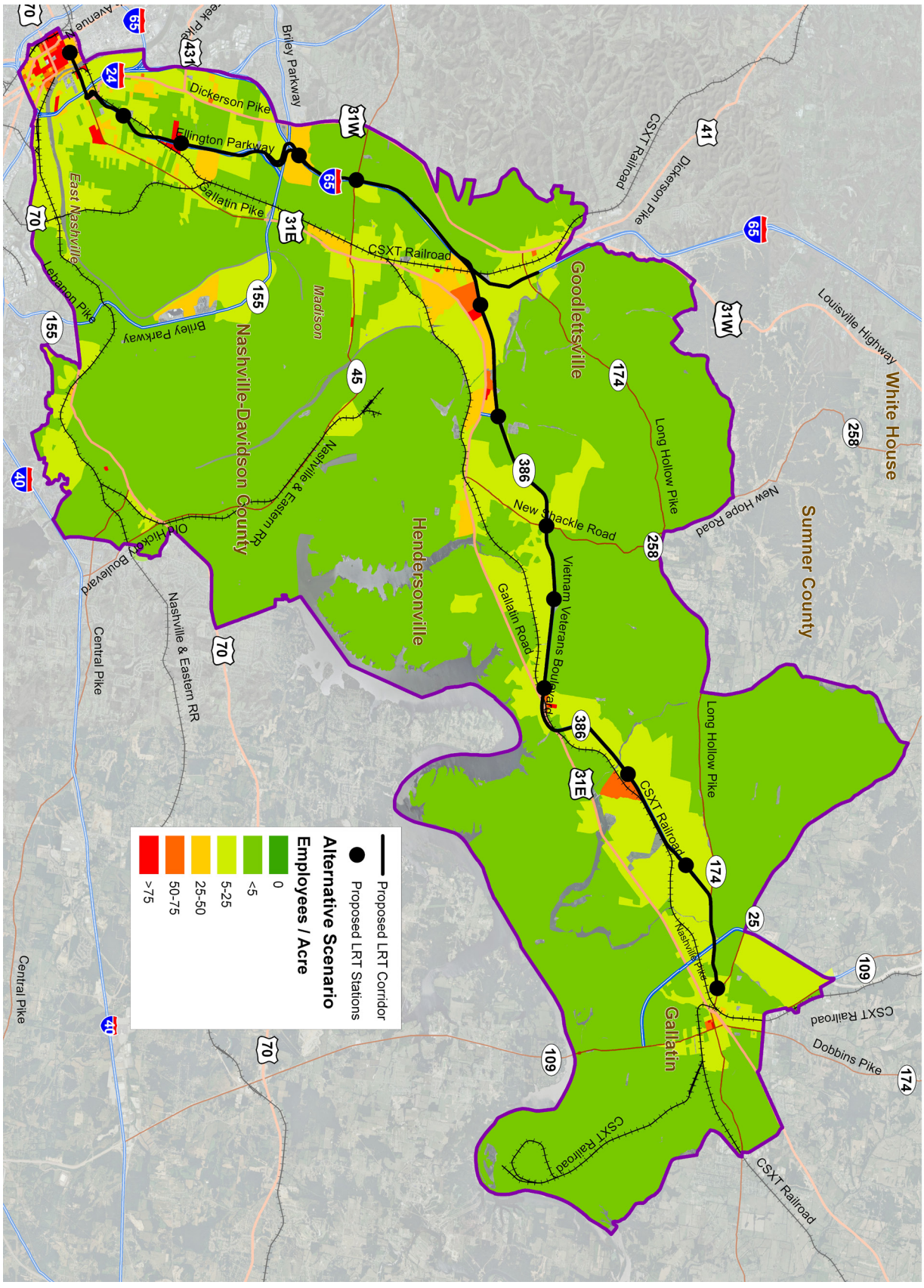


Figure 6.12: *Alternative Scenario Employment Density*

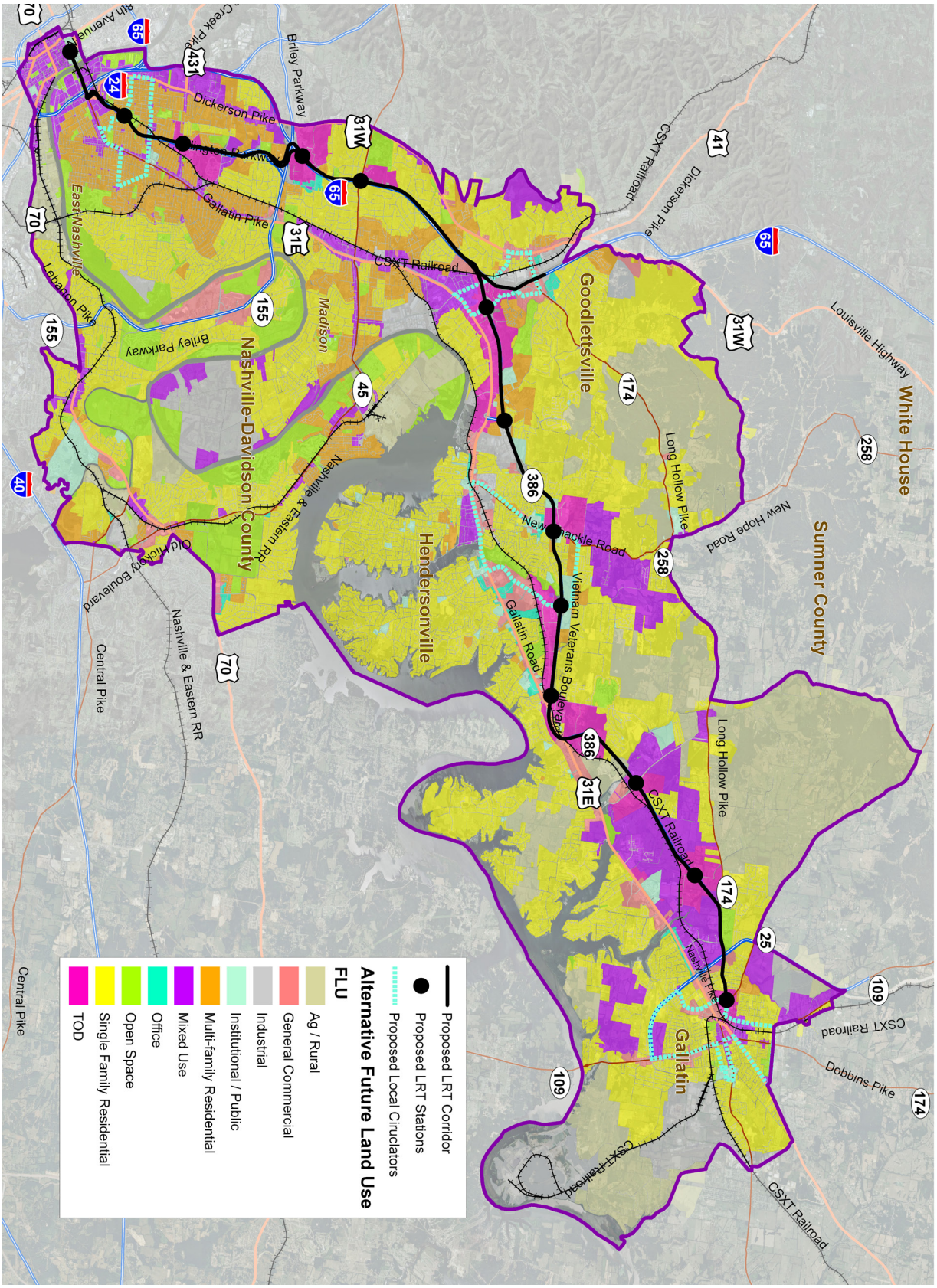


Figure 6.13: *Alternative Scenario Future Land Use*

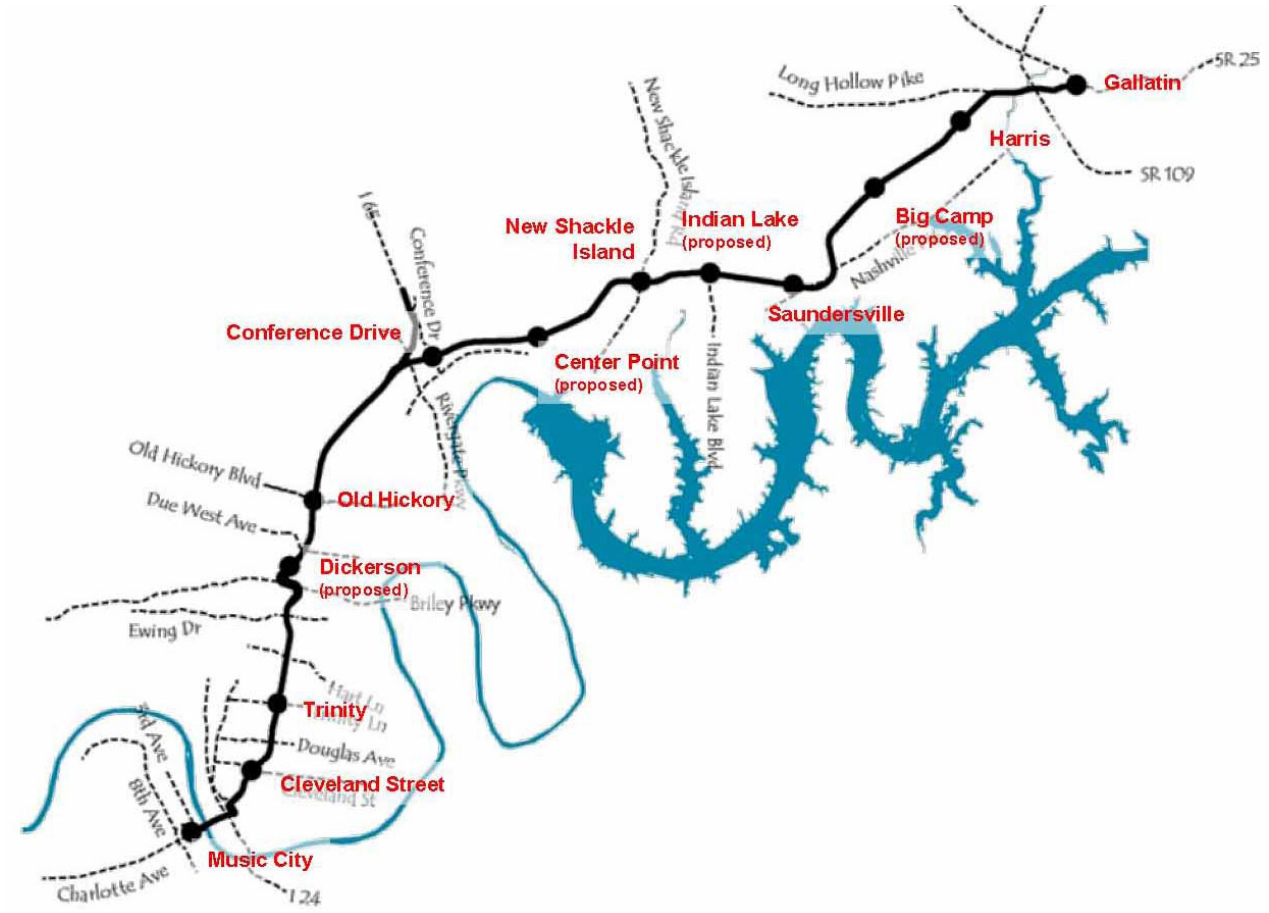


Figure 6.14: *Light Rail Transit Proposed Station Areas*

6.4. Recommended Station Area Redevelopment

6.4.1. Introduction

In order to assess the potential for adding density and intensity to the corridor, the planning team conducted a parcel-level analysis of redevelopment opportunities around a total of 13 proposed station areas along the proposed LRT corridor (see Figure 6.14).

The assessment outcome is a hypothetical sum of redevelopment opportunity as a whole, by acreage, density, and intensity. The outcome reflects the total of potential redevelopment based on available sites and their physical characteristics. As such, the outcome is not based on a market analysis and should not be seen as the total of market-driven development opportunity. As described in Sections 2.7 and 2.8, current and projected market conditions in the study area are many years away from achieving the level of demand needed to produce the land uses and intensities identified in this analysis. The outcome of this station area redevelopment analysis should therefore be considered aggressive.

Eight of the station areas assessed are stations that were included as part of the LRT alternative explored in Section 4.0 of this study, including Cleveland Street, Trinity, Old Hickory, Conference Drive, New Shackle Island, Saundersville, Harris, and Gallatin.

Music City Station is located in downtown Nashville, where density/intensity increases will occur almost exclusively from redevelopment of existing properties. Land use entitlements in the proposed Music City Station area are currently not road blocks to attaining densities and intensities that support transit. Therefore, no additional density or intensity was assessed at Music City in the hypothetical exercise. Goals for future intensification must be accomplished through specific policy actions that encourage properties to redevelop at higher densities/intensities. The Nashville-Davidson community has already identified increases in density/intensity as goals for the Downtown area.

Four of the station areas assessed are proposed as additional station sites to those initially identified in the LRT scenario studied in this report. These additional stations are proposed to provide increased opportunity for land use densification and intensification within the corridor, and include Dickerson, Center Point, Indian Lake, and Big Camp.

Achievable densities were determined for each specific station area by identifying and quantifying available redevelopment sites and assessing the character of the area to determine what density would be appropriate in the given context. Additional residential density was assumed to be achievable through policy action in downtown Nashville at Music City Station, downtown Goodlettsville, downtown Hendersonville, and downtown Gallatin.

The aggregated potential densification and intensification identified in the corridor as a result of this exercise for each land use type follows:

- Residential: 53,150 units
- Office: 14,508,899 square feet
- Retail: 6,590,791 square feet
- Industrial: 7,547,646 square feet

The MPO's alternative ridership scenario described in Section 6.3 calls for roughly 108,000 additional households and 200,000 additional jobs to be located within the corridor after the 2008 base year. Applying MPO assumptions regarding the number of square feet of non-residential land use needed to support a single employee, the potential square footage capacity of non-residential land uses identified within station areas as part of this analysis could support a total of just under around 100,000 jobs[1]. Therefore, redevelopment of parcels within the station areas have the physical capacity to absorb approximately 50% of the residential units and jobs identified in the alternative ridership scenario. As was described in Section 6.3, the remainder of households and jobs could be allocated outside of station areas to mixed use districts and corridors throughout the study area, many of which would have access to transit via one of the four proposed circulator routes.

The station area analysis confirms that capacity exists within the proposed station areas to support substantial increases in density and intensity under appropriate policy conditions. Equally important, most stations have the potential to support redevelopment at levels that meet or exceed minimum density goals for Transit Oriented Development (TOD), as described in the following section.

1 The Nashville MPO assumes the following: Industrial (350 sq. ft / 1 employee); Retail (333 sq. ft. / 1 employee); Office (250 sq. ft. / 1 employee).

Table 6.2: Station Area Identified Redevelopment Potential

			Residential			Office			Retail			Industrial	
Station Area	Gross Acres	Net Acreage*	Acres	Avg. Units/ Acre	Housing Units	Acres	Avg. FAR	Sq.Ft.	Acres	Avg. FAR	Sq. Ft.	Acres	Sq. Ft.
Music City Central	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Trinity	316	158	34	34	2,400	79	0.4	1,307,671	8	0.3	86,031	0	0
Dickerson/I-65	470	235	49	49	5,727	94	0.7	2,824,656	23	0.7	716,398	0	0
Old Hickory	133	67	27	27	1,796	0		0	0		0	0	0
Conference Drive	616	308	26	26	4,848	77	0.7	2,379,879	46	0.7	1,307,257	0	0
Center Point	245	123	23	23	827	61	0.7	1,840,955	25	0.6	640,332	0	0
New Shackle Island	334	167	32	32	2,630	50	0.5	1,167,560	33	0.5	745,638	0	0
Indian Lake	225	113	32	32	1,773	34	0.7	1,015,305	23	0.6	588,583	0	0
Saundersville	697	349	26	26	7,111	35	0.5	812,398	35	0.3	512,494	0	0
Big Camp	1,120	560	24	24	10,752	56	0.5	1,305,058	56	0.3	823,284	0	0
Harris	1,327	663	24	24	12,735	66	0.5	1,545,794	66	0.3	975,150	0	0
Gallatin - Mixed Use	266	133	24	24	2,551	13	0.5	309,623	13.3	0.3	195,323	0	0
Gallatin - Industrial	619	433	0	0	0	0	0	0	0	0	0	433	7,547,636
Total	*6,367*	*3,307*	*1,980*		*53,150*	*566*		*14,508,899*	*328*		*6,590,491*	*433*	*7,547,636*

* Takes into account likely open space requirements and other site development constraints

6.4.2. Station Area Planning

A review of planned Future Land Use as of 2009, current density, and current intensity around the 13 proposed station areas was undertaken to identify factors that should guide policy and planning direction in the interest of future LRT viability.

Minimum density goals were established for the station areas to lay the groundwork for viable Transit Oriented Development (TOD) planning. No station specific plans were made; this would be a next step should the corridor plan move forward. However, Section 6.4 provides guidance on site-specific TOD planning and presents four conceptual TOD prototypes designed to illustrate how sites within the corridor might be transformed to support transit and other quality of life objectives.

Station Area Design Principles

The following principles were defined for station areas:

- Station areas should focus on roughly a half-mile radius around each station to promote walkability.
- Densities and Intensities should be highest adjacent to the stations to take advantage of the greater transportation opportunities.
- Each station should have a mix of uses and intensities that effectively support the transit and are appropriate to its land use context.
- Densities and Intensities should step down and transition into the surrounding existing uses.
- Vertical mixing of uses is a necessity to the success of transit stations.
- Plans should capitalize on the development of vacant lands and the redevelopment of marginal and transitional lands.
- Existing neighborhoods should be protected and strengthened.

Transit Oriented Development (TOD) *Minimum* Density Goals

In order to create a viable TOD, minimum density goals were assumed for areas within 1/2 mile of the proposed station):

- Residential: 15-20 units/acre minimum
- Mixed Use, Office, Commercial: .50 -.75 FAR

Visualizing Density and Intensity

The station area analysis is quantitative and applies industry-standard metrics: dwelling units per acre (units/acre) and floor-area ratio (FAR). Dwelling units per acre is a commonly applied measure of residential density, and is calculated simply by summing the total number of housing units and the total number of acres in a given area and dividing the total units by the total acreage. FAR, rather than being concerned with the number of units, relates the total square footage of floor space to a defined land area. This number is calculated by summing the square footage of all floors in a building and dividing that number by the total land area (in most cases a given lot or a site composed of a collection of lots). For the purposes of this study, we apply FAR to measure commercial, office, and industrial intensity, and use units/acre to measure residential density.

These measures, though useful, are often difficult to visualize. For this reason, a collection of images illustrating a range of density and intensity across land use types is presented on the following pages.

Visualizing Residential Density

Precedent imagery was compiled to provide a visual reference for reidential density assumptions. Figures 6.15 - 18 depict examples of the following residential densities:

- Residential, 10-20 units per acre (2-3 stories, surface parking)
- Residential/Mixed Use, 15-30 units per acre (2-4 stories, surface and structured parking)
- Residential/Mixed Use, 30-40 units per acre (4-6 stories, structured parking)
- Residential, 75+ units per acre (10+ stories, structured parking)

Figure 6.15: *Residential; 10-20 units per acre (2-3 stories, surface parking)*

Figure 6.16: *Residential; 15-30 units per acre (2-4 stories, surface and structured parking)*

Figure 6.17: *Residential/Mixed Use; 30-40 units per acre (4-6 stories, structured parking)*

Figure 6.18: *Residential; 75+ units per acre (10+ stories, structured parking)*

Visualizing Office Intensity

Precedent imagery was compiled to provide a visual reference for office intensity assumptions. Figures 6.19 - 20 depict examples of the following intensities:

- Office, 0.4 FAR (4-6 stories, surface parking)
- Office, 1.0 FAR (5-15 stories, partial structured parking)
- Office, 4.0+ FAR (20-30 stories, structured parking)

Figure 6.19: *Office; 0.4 FAR (4-6 stories, surface parking)*

Figure 6.20: *Office; 1.0 FAR (5-15 stories, partial structured parking)*

Figure 6.21: *Office; 4.0 FAR (20-30 stories, structured parking)*

Visualizing Retail Intensity

Precedent imagery was compiled to provide a visual reference for retail intensity assumptions. Figures 6.21 - 6.22 depict examples of the following intensities:

- Retail, 0.25 FAR (1 story, retail, big box, surface parking)
- Retail, 0.6-0.8 FAR (2-3 story, retail, big box, office, structured parking)

Figure 6.22: *Retail; 0.25 FAR (1 story, big box, surface parking)*

Figure 6.23: *Retail; 0.6-0.8 FAR (2-3 story,retail, office, structured parking)*

Station Specific TOD Land Use Evaluation

Each station area was defined and studied, and the following actions were applied to each:

- Potential development and redevelopment parcels within each station area were identified.
- Land use and density assumptions were applied.
- "TOD Scenarios" were compared to current land use policy to identify potential land use obstacles to TOD.

6.4.3. Station Specific Analysis

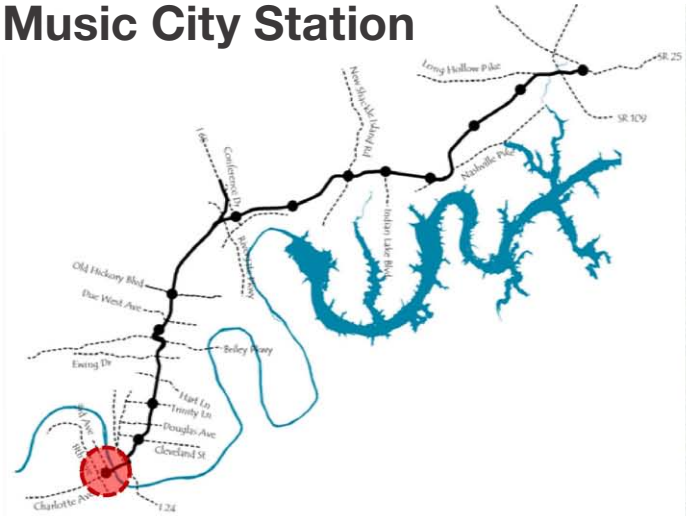
In addition to establishing overall principles and goals, observations were made about the specific context and issues of each proposed station with regard to redevelopment potential and densification.

Music City Station

The station area context is downtown Nashville, a regional employment destination. The site is already built out and presents no immediate land use driven redevelopment opportunities. Rather, needed density/intensity increases must come from allowing high density office and residential redevelopment to happen incrementally over time in the downtown core.

Transformation of the Music City Station Area will be driven by focusing high density regional employment and residential opportunities.

Music City Station



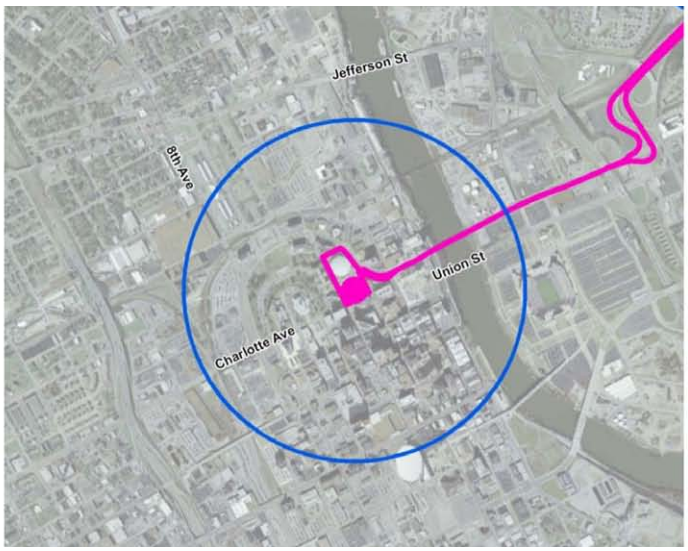


Figure 6.24: *Music City Station.*

Cleveland Street Station

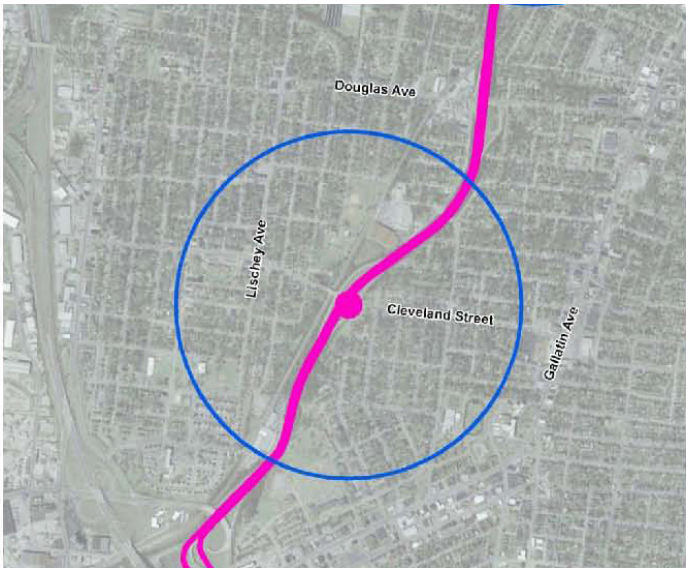


Figure 6.25: *Cleveland Street Station.*

Cleveland Street Station

Because the station area context is an established urban neighborhood (currently housing density within a half mile radius of the station location is about 6.3 dwelling units per acre), new density increases would likely come from small-scale residential infill in the future. However, the East Nashville Community Plan: 2006 Update calls for the addition of some higher density housing than is currently present in the area, achievable through infill and redevelopment. Increased density is proposed over the next 20 years primarily along Cleveland Street, Meridian Street, and McFerrin Avenue. The "Paradise" neighborhood, located north of the station, is also proposed for increased density over this timeframe (however it is currenlty inaccessible to the station location by foot). According to policies in the community plan, therefore, the pedestrian shed should intensify over the next 20 years, and the range of 10-20 residential units per acre could be achievable.

Trinity Station

The Trinity Station Area lies within an urban neighborhood with larger potential development opportunities.

As depicted in Figure 6.26, current Future Land Use, density, and intensity in the station area present several hurdles to achieving TOD that must be addressed, including:

- Rather than the current single-use categories, a mix of uses must be permitted adjacent to the station.
- Adjacent industrial uses could be changed to more suitable uses to support TOD (office/residential).
- Allowable residential density should be increased adjacent to the station. In the overall corridor assessment, it was estimated that Trinity Station could accommodate residential densities of 15 to 75 units per acre, with an average of 35 units per acre. However, the current allowable residential maximum density is 15 units per acre.
- Vertical mixed-use should be, but currently is not, permitted.

Dickerson Station

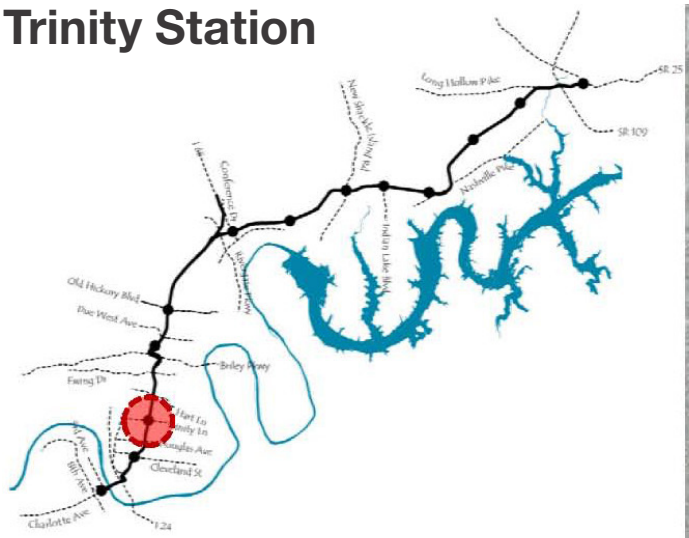
The Dickerson Station Area is located at a suburban interchange. The site has significant office, residential, and commercial opportunity adjacent to I-65, Route 41, and the future LRT. Primarily undeveloped and large parcels in the area provide a unique opportunity for a coordinated, mixed use master plan.

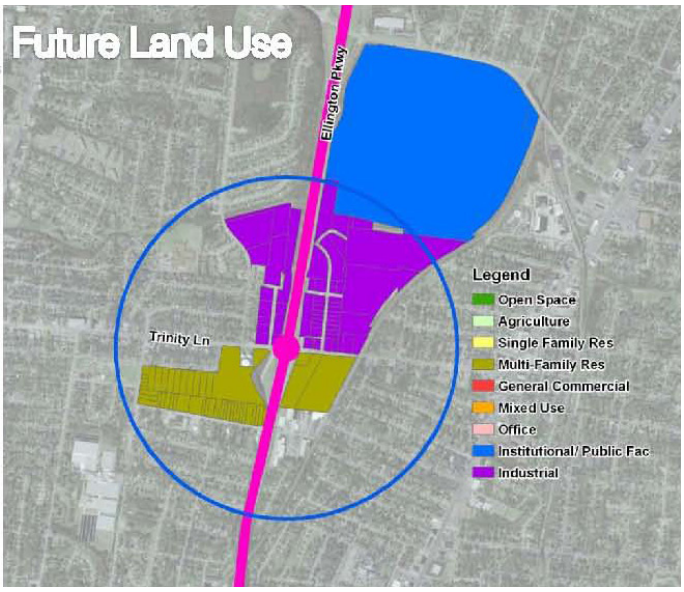
The Madison Community Plan: 2009 Update addresses the area east of I-65 and identifies the area just west of Briarville Road on both sides Cheron Road as the future site of Nossi College of Art. The plan anticipates that this area could be an important opportunity for a significant public/institutional and office development. The plan encourages a higher density redevelopment than is currently allowed. The plan recommends that proposals for residential parcels of up to 40 units/acre should be considered. However, due to topographic constraints and the barrier provided by I-65, ensuring access to the proposed Dickerson Station from the properties east of I-65 will prove problematic.

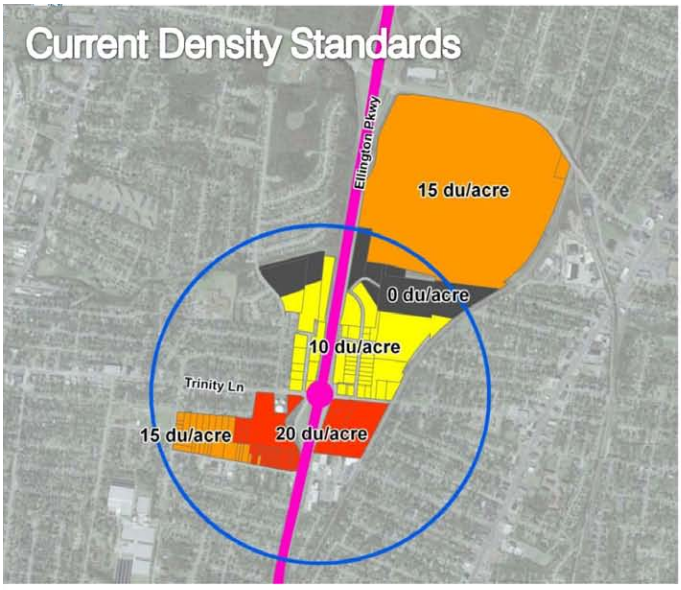
As depicted in Figure 6.27, current Future Land Use, density, and intensity in the station area must address some challenges, including:

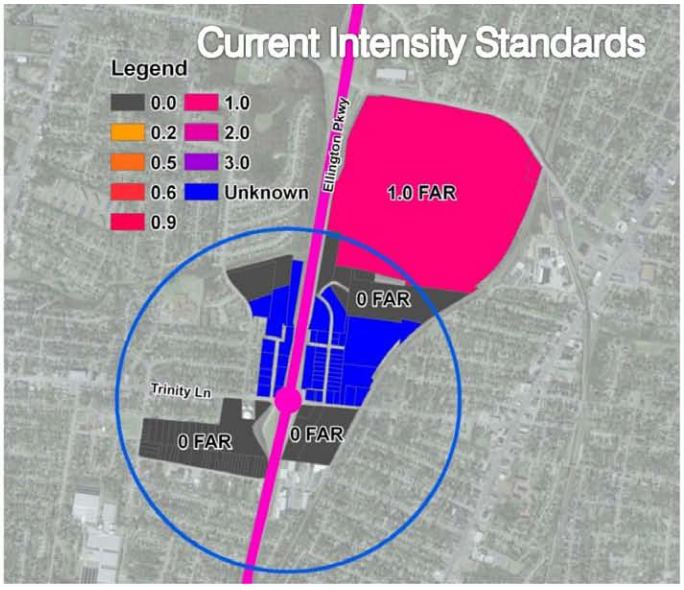
- Rather than the current single-use categories, a mix of uses must be permitted adjacent to the station.
- Vertical mixed-use should be, but currently is not, permitted.
- Allowable residential density and office/commercial FAR adjacent to the station should be increased. In the overall corridor assessment, it was estimated that Dickerson Station could accommodate residential densities of 15 to 75 units per acre, with an average of 50 units per acre. However, the current allowable residential maximum density is 6 units per acre. Non-residential density was estimated at 0.4 to 0.6 FAR, but allowable density is currently 0.6 FAR.
- New street connectivity will be needed to maximize access to the station area.

Trinity Station





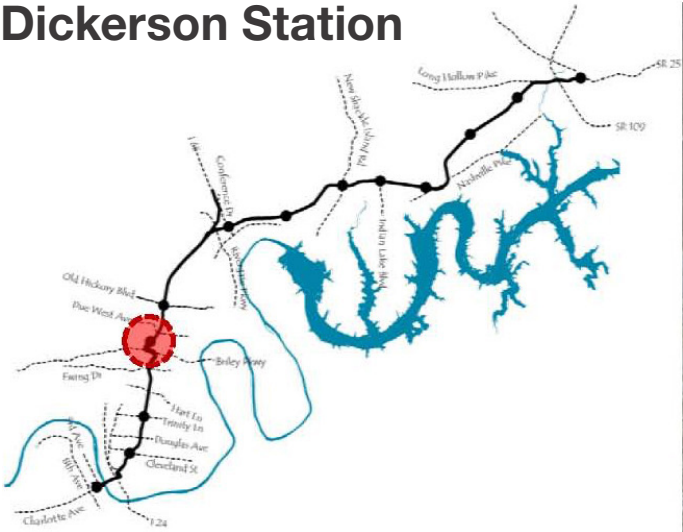


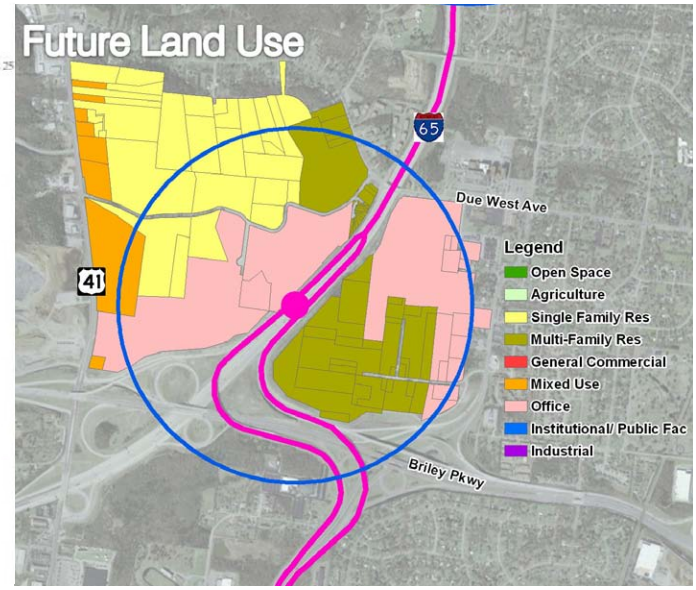


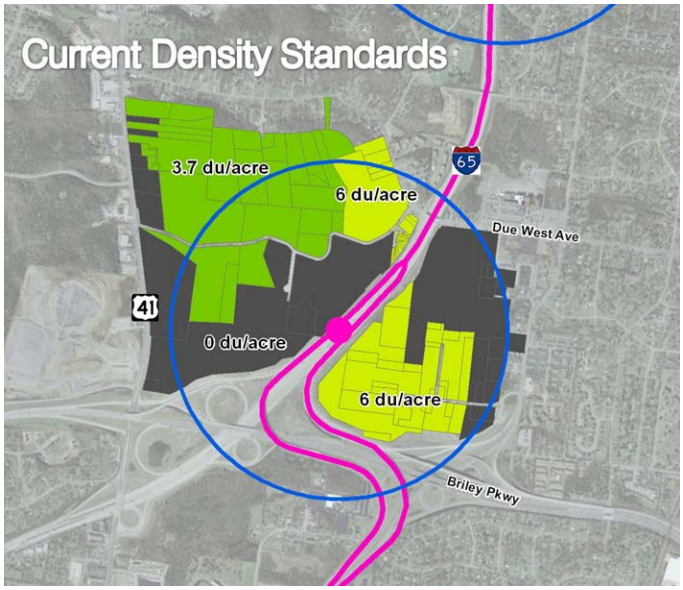
	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	15-20 units/acre minimum (net)	15-75 units/acre 35 units/acre (net) average	15 units/acre maximum
Non-Residential Density (FAR)	.50-.75 FAR minimum (net)	.25-.40 FAR .30 FAR (net) average	1.0 FAR maximum

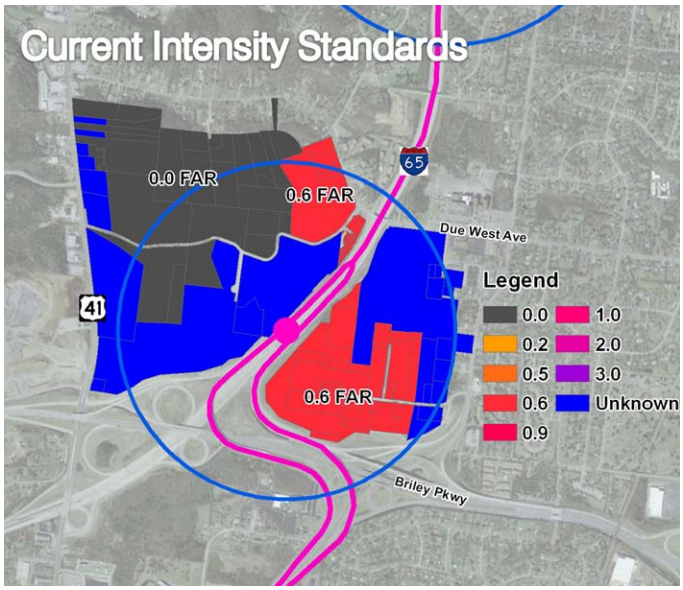
Figure 6.26: *Trinity Station.*

Dickerson Station









	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	15-20 units/acre minimum (net)	15-75 units/acre 50 units/acre (net) average	6 units/acre maximum
Non-Residential Density (FAR)	.50-.75 FAR minimum (net)	.40-.80 FAR .70 FAR (net) average	.60 FAR maximum

Figure 6.27: *Dickerson Station.*

Old Hickory Station

The Old Hickory Station Area lies within a single-family neighborhood, which may present challenges with regard to density and compatible uses. However, there are large undeveloped multi-family opportunities adjacent to the proposed station and I-65. The area provides limited office/commercial opportunity.

As demonstrated in Figure 6.28, allowable residential density should be increased adjacent to the station. In the overall corridor assessment, it was estimated that Trinity Station could accommodate residential densities of 15 to 75 units per acre, with an average of 27 units per acre. However, the current allowable residential maximum density is 20 units per acre.

Conference Drive Station

The Conference Drive Station Area is an established regional commercial and office activity center. The area is composed of a primarily single-use, suburban development pattern. Needed TOD density/intensity increases in this area will come from redevelopment.

Though future land use policies used in this analysis were current at the time, the adoption of *The Madison Community Plan: 2009 Update* established a new, and more transit-supportive vision for the RiverGate Mall Area. The plan identifies mixed use neighborhoods of moderate density and intensity surrounding a more intense mixed use environment in the immediate RiverGate Mall Area. The plan recommends more detailed study of the area to identify implementation policies to help guide future redevelopment. A large portion of the area, specifically RiverGate Mall proper and most of the properties north of I-65 are within the jurisdiction of the City of Goodlettsville. The Madison Community Plan notes the need for jurisdictional cooperation between Metro Planning and the City of Goodlettsville in future planning and implementation actions.

As depicted in Figure 6.29, and similar to other station areas, the 2009 Future Land Use, density, and intensity in the Conference Drive Station Area must address the following challenges:

- A mix of high density/intensity uses must be permitted adjacent to the station (*The Madison Community Plan: 2009 Update* is a good start on this).
- Maximum FAR standards governing the area are sufficient, but there may be a need for minimum standards to ensure intensity is achieved adjacent to the station.
- The suburban parking standards currently enforced should be reduced in order to allow increased intensity (via shared/transit access standards).

Center Point Station

The Center Point Station Area offers the opportunity of developing a suburban activity center with a mix of multifamily, commercial and office development.

As depicted in Figure 6.30, the current Future Land Use, density, and intensity in the Center Point Station Area must address the following challenges:

- Rather than the current single-use categories, a mix of uses must be permitted adjacent to the station.
- Maximum FAR standards governing the area are sufficient, but there may be a need for minimum standards to ensure intensity is achieved adjacent to the station.
- New street connectivity will be needed to maximize access to station area.

New Shackle Island Station

The New Shackle Island Station Area is an undeveloped suburban interchange adjacent to single-family neighborhoods. It is the site of a partially developed suburban retail center.

As depicted in Figure 6.31, the area would have to address the following issues in order to move toward adopting a TOD standard for development:

- Rather than the current single-use categories, a mix of uses must be permitted adjacent to the station.
- Allowable residential density adjacent to the station must be increased. In the overall corridor assessment, it was estimated that the area could accommodate residential densities of 15 to 75 units per acre, with an average of 32 units per acre. However, the current allowable residential maximum density is 17 units per acre.
- Maximum FAR standards governing the area are sufficient, but there may be a need for minimum standards to ensure intensity is achieved adjacent to the station.
- New street connectivity will be needed to maximize access to station area.

Indian Lake Station

The Indian Lake Station Area is another undeveloped suburban interchange adjacent to a recently-developed 'lifestyle' retail center. The station area presents significant mixed use development opportunity.

As depicted in Figure 6.32, the area would have to address the following issues in order to move toward adopting a TOD standard for development:

- Allowable residential density adjacent to the station must be increased. In the overall corridor assessment, it was estimated that the area could accommodate residential densities of 15 to 75 units per acre, with an average of 32 units per acre. However, the current allowable residential maximum density ranges from 5 to 12 units per acre.
- Vertical mixed-use development is currently not permitted under existing land use regulations.
- Maximum FAR standards governing the area are sufficient, but there may be a need for minimum standards to ensure intensity is achieved adjacent to the station.

Saundersville Station

The Saundersville Station Area is located at a suburban interchange with significant industrial and institutional land uses.

As depicted in Figure 6.33, the area would have to address the following issues in order to move toward adopting a TOD standard for development:

- Current land use regulations permit single uses only. A mix of uses would need to be permitted adjacent to the station to support TOD.
- The presence of significant industrial land uses and public facilities limits TOD opportunities in the station area.
- Vertical mixed-use development is currently not permitted under existing land use regulations.
- New street connectivity will be needed to maximize access to the station area.

Big Station Camp Station

The Big Station Camp Station Area is located at an undeveloped suburban interchange composed primarily of large and undeveloped parcels. This provides a unique opportunity along the corridor for a coordinated, mixed-use master plan.

As depicted in Figure 6.34, the area would have to address the following issues in order to move toward adopting a TOD standard for development:

- Allowable residential density adjacent to the station must be increased. In the overall corridor assessment, it was estimated that the area could accommodate residential densities of 15 to 75 units per acre, with an average of 24 units per acre. However, the current allowable residential maximum density ranges from 5 to 17 units per acre.
- Minimum FAR standards would need to be established to ensure appropriate intensities adjacent to the station.
- Vertical mixed-use development is currently not permitted under existing land use regulations.
- New street connectivity will be needed to maximize access to the station area.

Harris-Greenlea Station

The Harris-Greenlea Station Area is located at an undeveloped suburban interchange composed primarily of large and undeveloped parcels. This provides a unique opportunity along the corridor for a coordinated, mixed-use master plan.

As depicted in Figure 6.35, the area would have to address the following issues in order to move toward adopting a TOD standard for development:

- Allowable residential density adjacent to the station likely needs to be increased. In the overall corridor assessment, it was estimated that the area could accommodate residential densities of 15 to 75 units per acre, with an average of 24 units per acre. However, the current allowable residential density allows a maximum of 25 units per acre. Permitted densities beyond this level would help to ensure TOD-compatible development.
- Although current maximum FAR standards are sufficient, minimum FAR standards would need to be established to ensure appropriate intensities adjacent to the station.
- Vertical mixed-use development is currently not permitted under existing land use regulations.
- New street connectivity will be needed to maximize access to the station area.

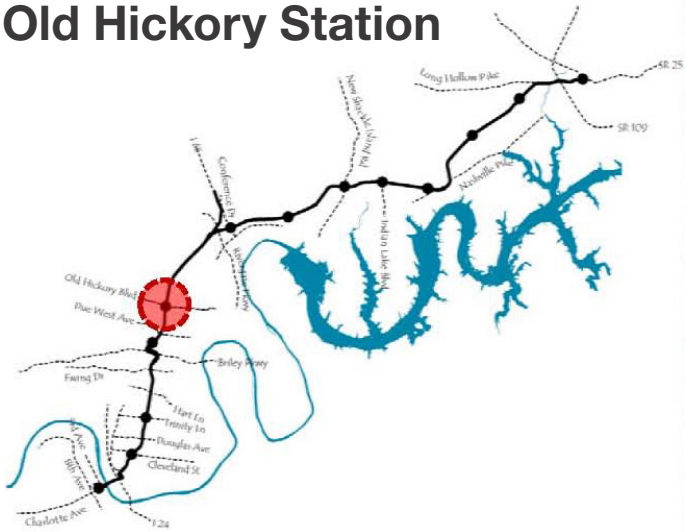
Gallatin Station

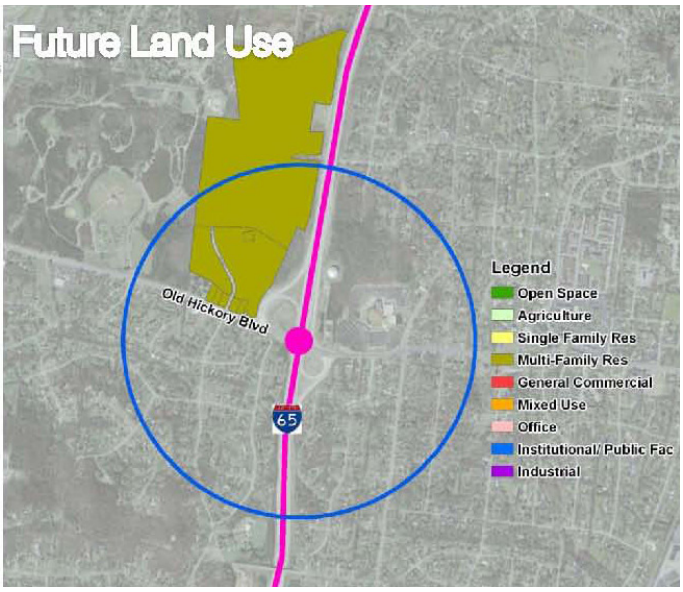
The Gallatin Station is located adjacent to a traditional town center. Its primary development opportunities are for mixed-use and industrial development and are outside of the immediate station area.

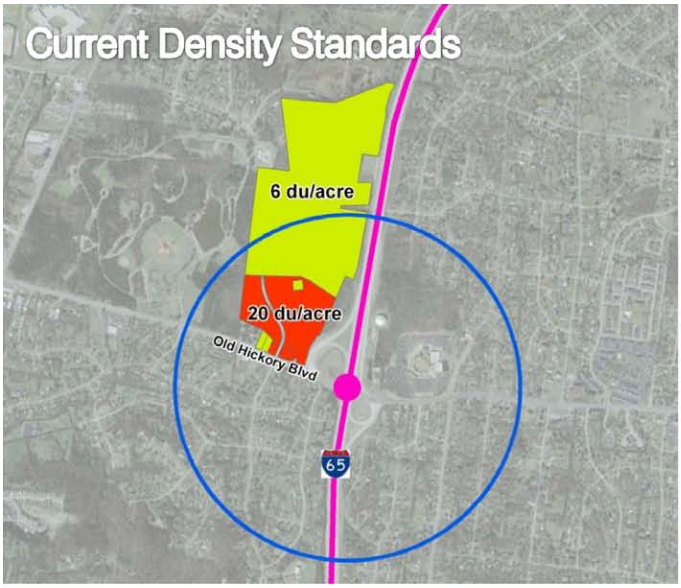
As depicted in Figure 6.36, the area would have to address the following issues in order to move toward adopting a TOD standard for development:

- Allowable residential density adjacent to the station must be increased. In the overall corridor assessment, it was estimated that the area could accommodate residential densities of 15 to 75 units per acre, with an average of 24 units per acre. However, the current allowable residential maximum density is 5 units per acre.
- Industrial FAR could be increased to support more employment.
- Vertical mixed-use development is currently not permitted under existing land use regulations.
- New street connectivity will be needed to maximize access to the station area.

Old Hickory Station

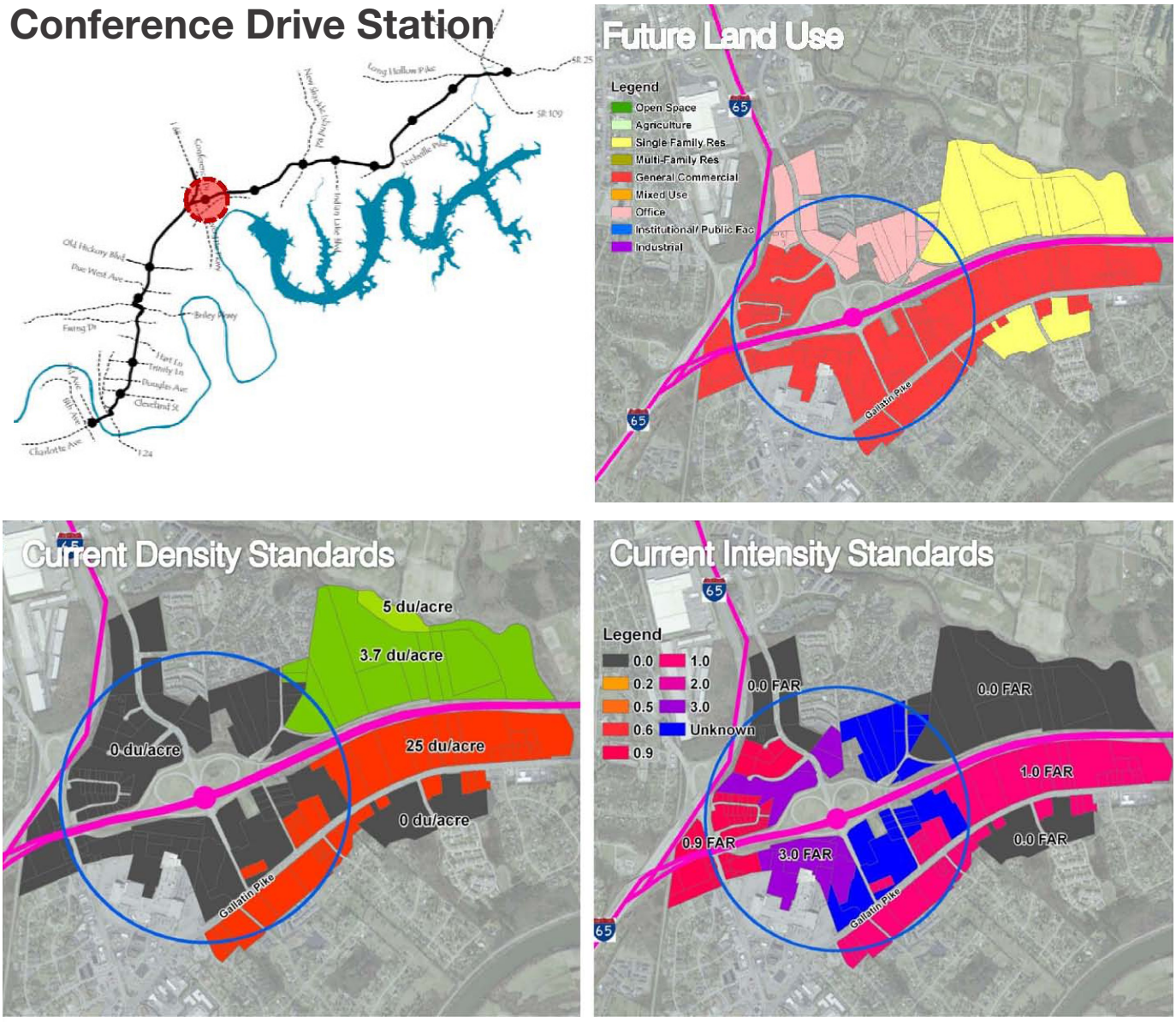






	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	15-20 units/acre minimum (net)	15-75 units/acre 27 units/acre (net) average	6-20 units/acre maximum
Non-Residential Density (FAR)	.50-.75 FAR minimum (net)	None	.60 FAR maximum

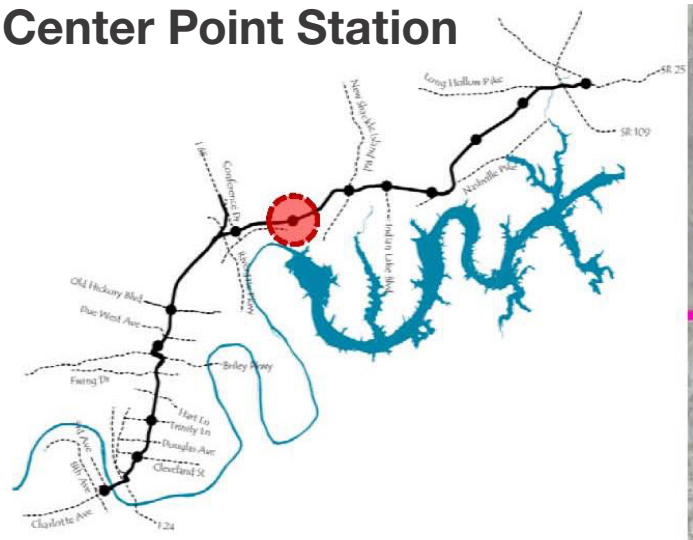
Figure 6.28: *Old Hickory Station.*

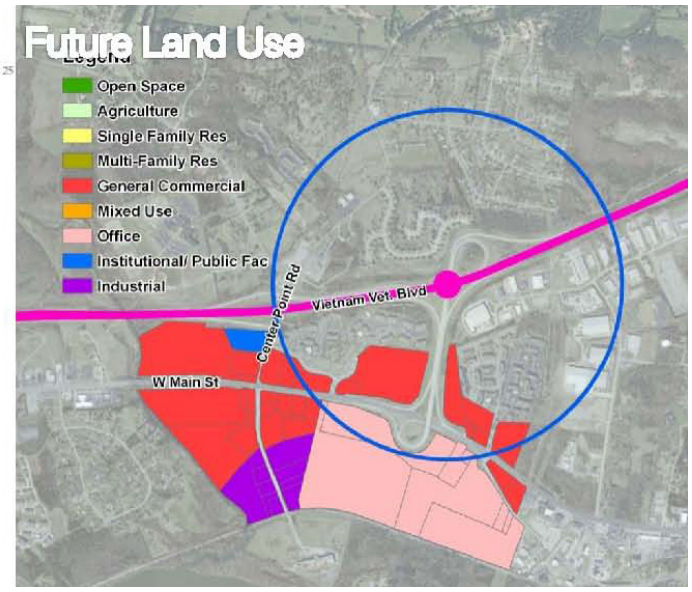


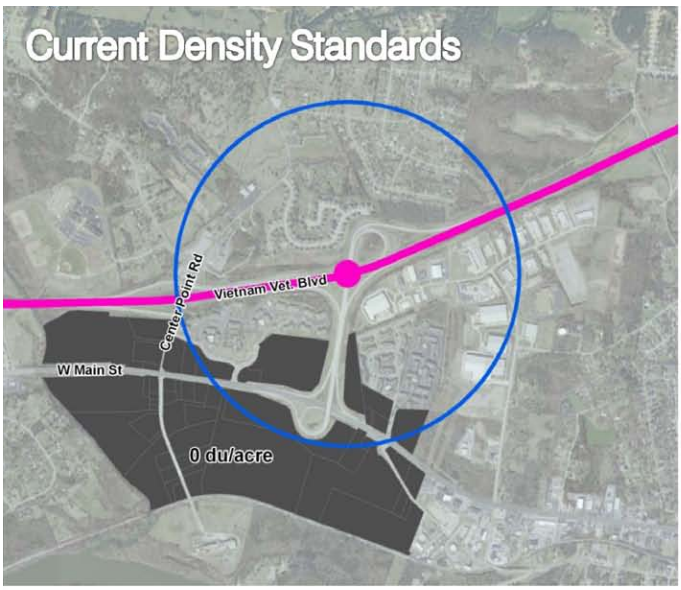
	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	15-20 units/acre minimum (net)	15-75 units/acre 26 units/acre (net) average	25 units/acre maximum
Non-Residential Density (FAR)	.50-.75 FAR minimum (net)	.25-4.5 FAR .70 FAR (net) average	3.0 FAR maximum

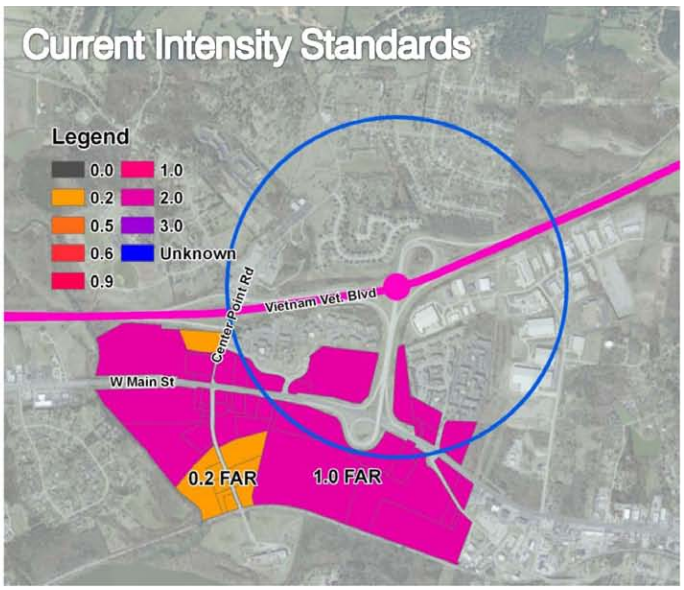
Figure 6.29: *Conference Drive Station.*

Center Point Station





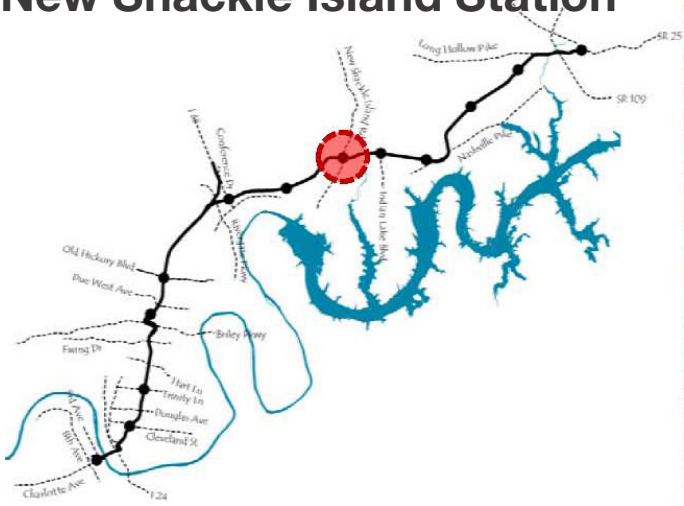


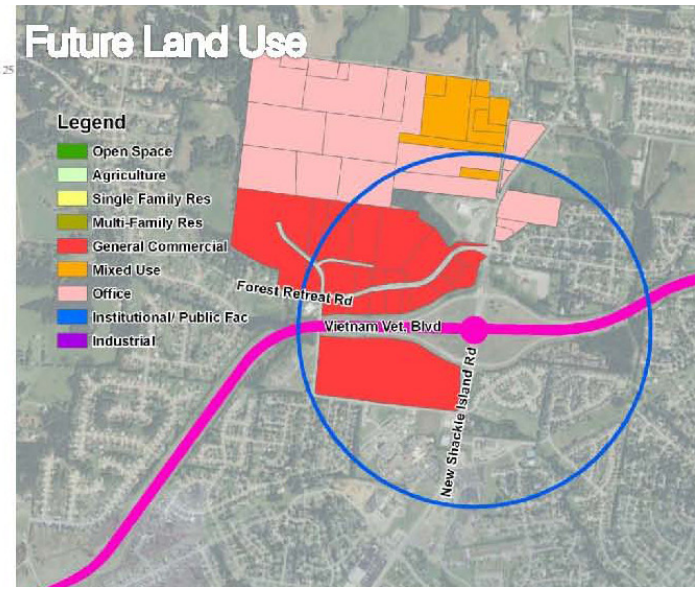


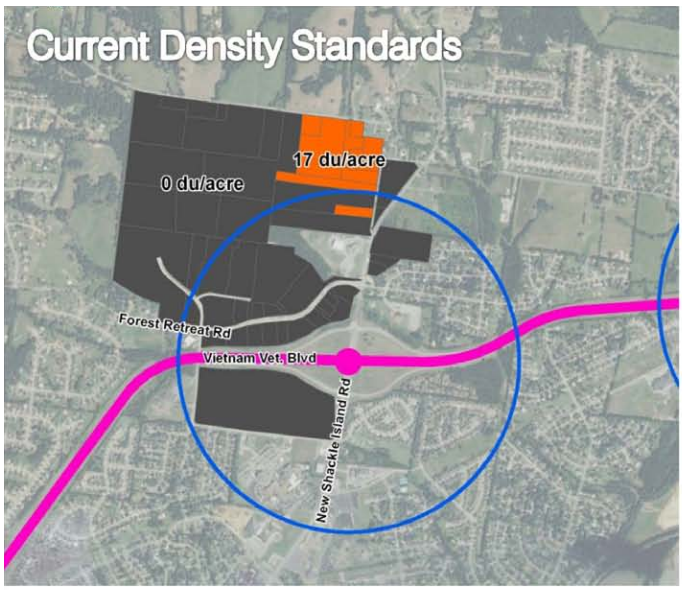
	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	15-20 units/acre minimum (net)	15-30 units/acre 23 units/acre (net) average	None
Non-Residential Density (FAR)	.50-.75 FAR minimum (net)	.25-1.0 FAR .60 FAR (net) average	.20-1.0 FAR maximum

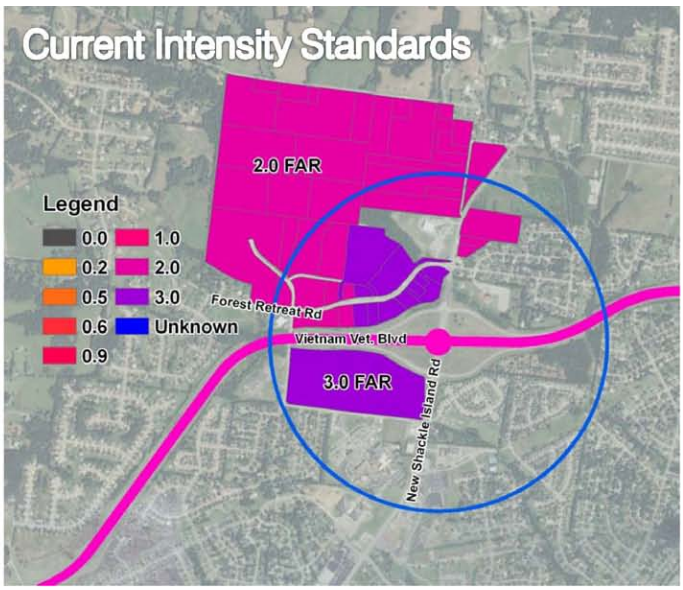
Figure 6.30: *Center Point Station.*

New Shackle Island Station





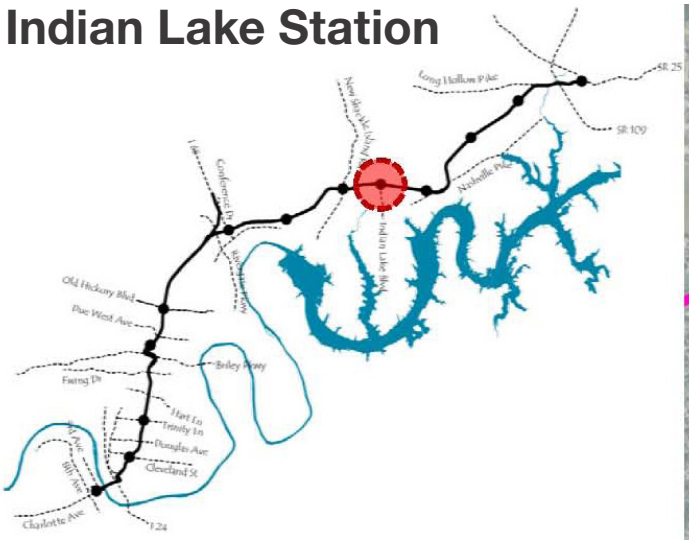


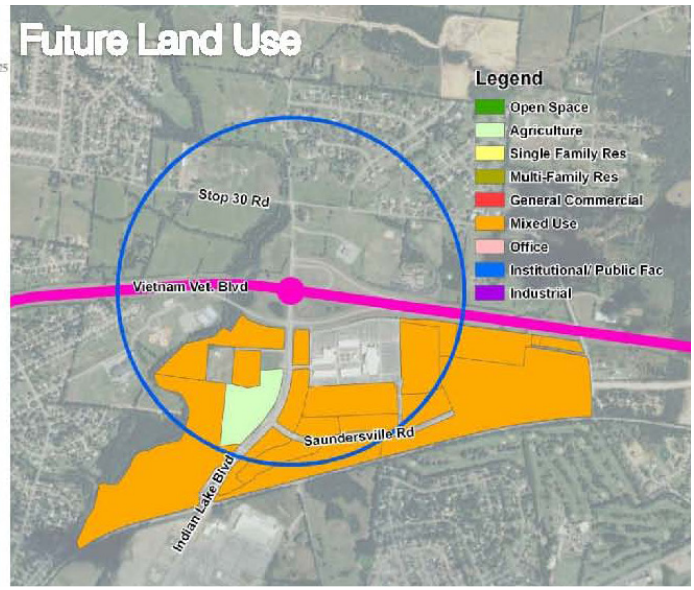


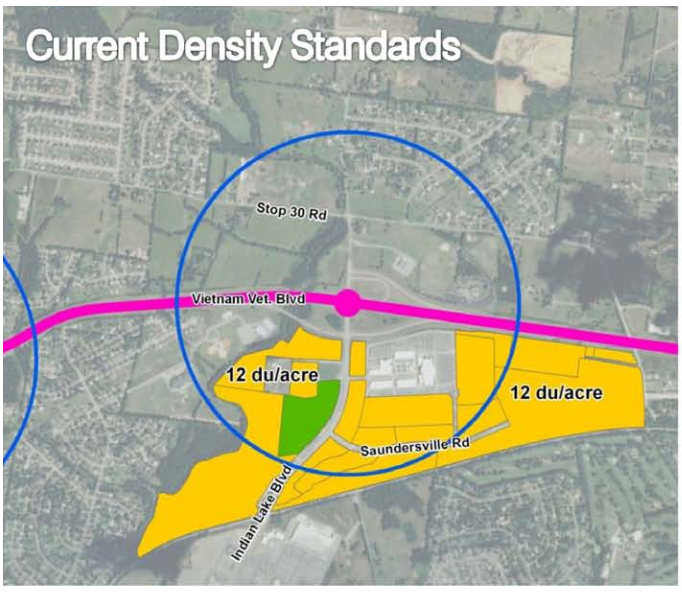
	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	15-20 units/acre minimum (net)	15-75 units/acre 32 units/acre (net) average	17 units/acre maximum
Non-Residential Density (FAR)	.50-.75 FAR minimum (net)	.25-1.0 FAR .50 FAR (net) average	2.0-3.0 FAR maximum

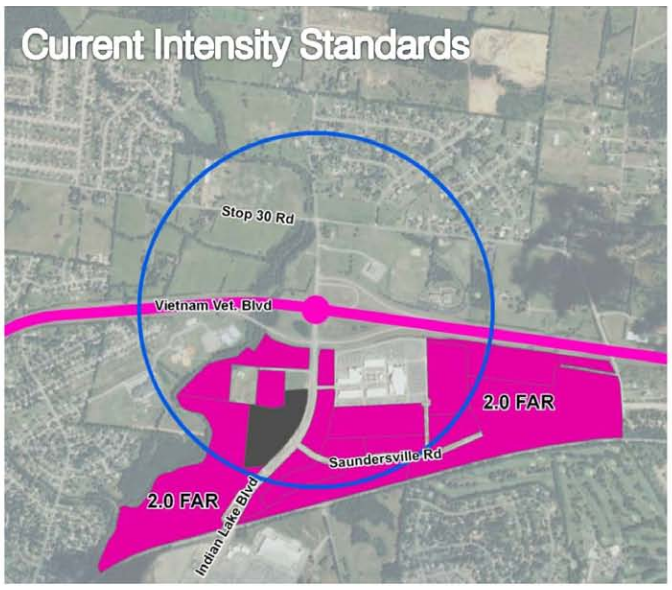
Figure 6.31: *New Shackle Island Station.*

Indian Lake Station



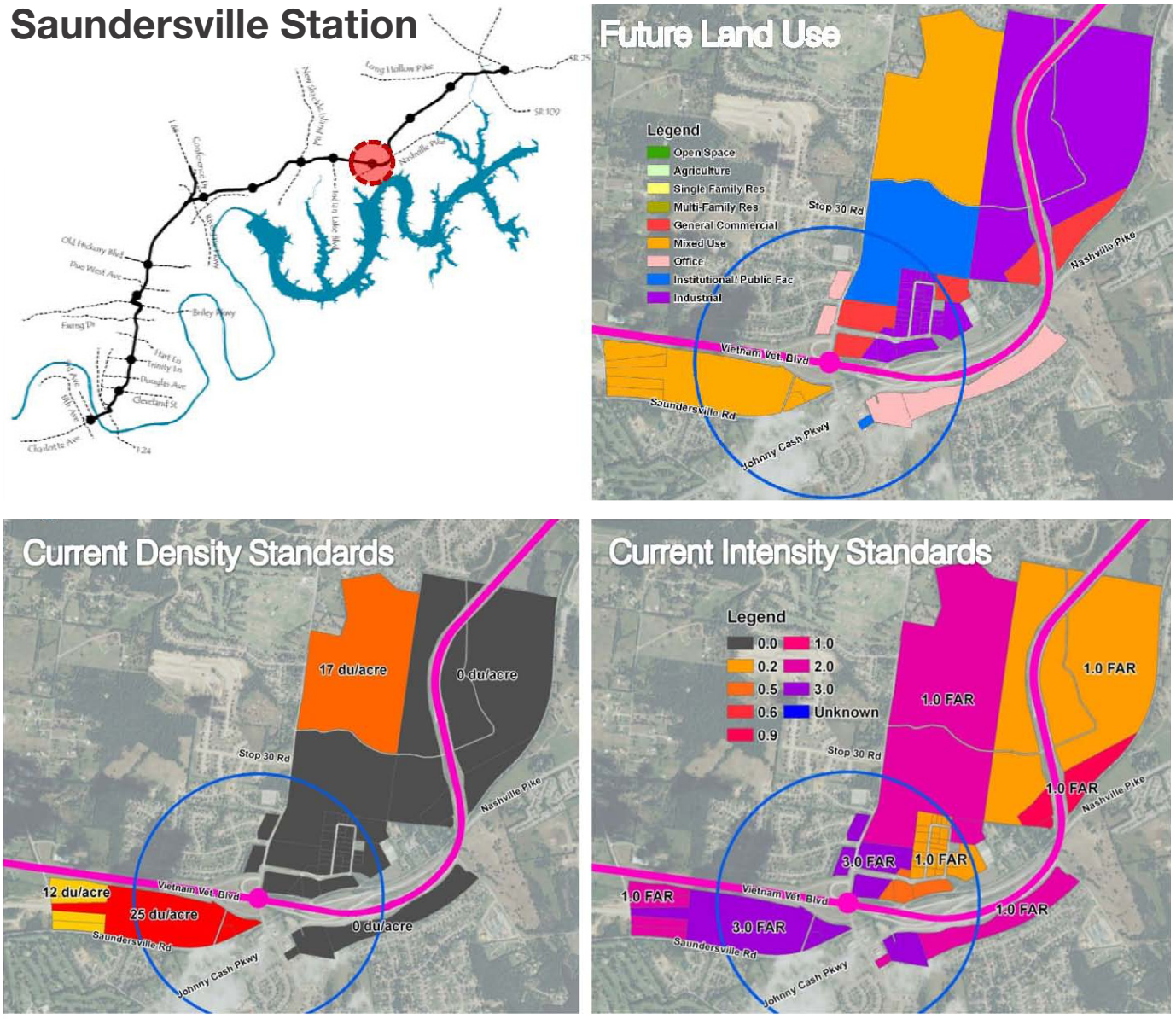






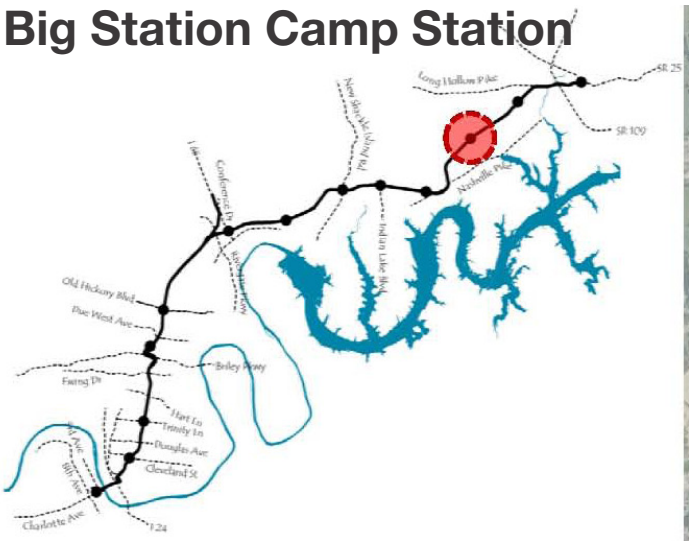
	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	15-20 units/acre minimum (net)	15-75 units/acre 32 units/acre (net) average	5-12 units/acre maximum
Non-Residential Density (FAR)	.50-.75 FAR minimum (net)	.25-1.0 FAR .60 FAR (net) average	2.0 FAR maximum

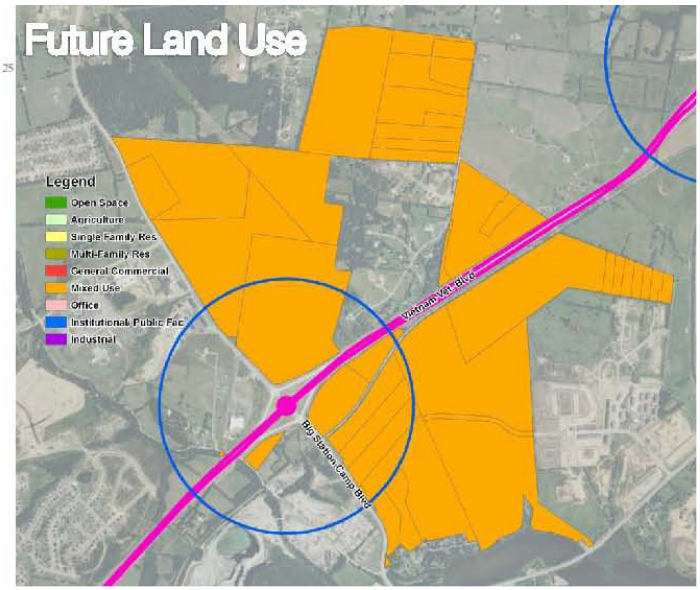
Figure 6.32: *Indian Lake Station.*

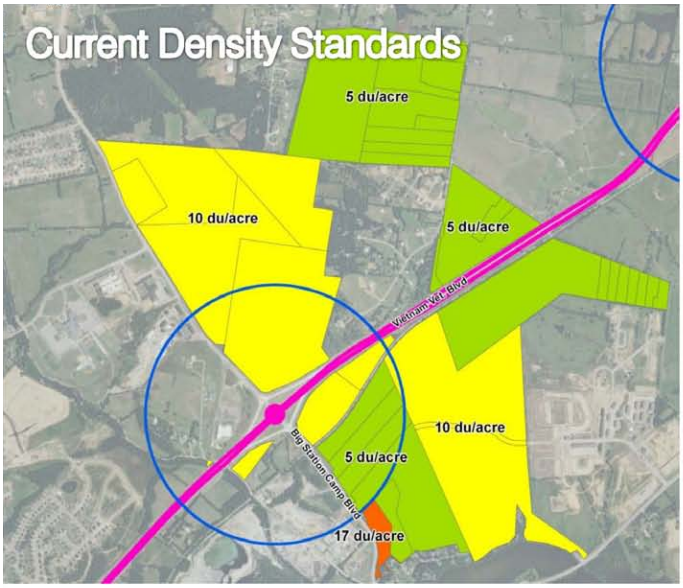


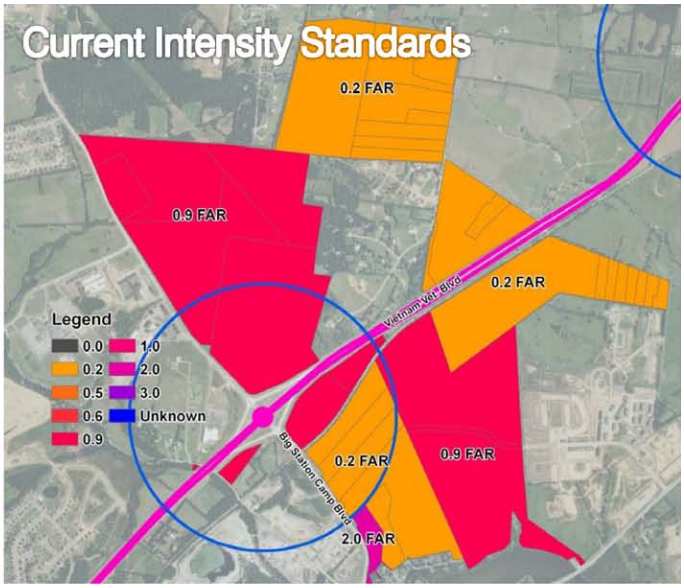
	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	15-20 units/acre minimum (net)	15-75 units/acre 26 units/acre (net) average	25 units/acre maximum
Non-Residential Density (FAR)	.50-.75 FAR minimum (net)	.25-1.0 FAR .40 FAR (net) average	3.0 FAR Maximum
Industrial Density (FAR)			**.20** FAR

Figure 6.33: *Saundersville Station.*



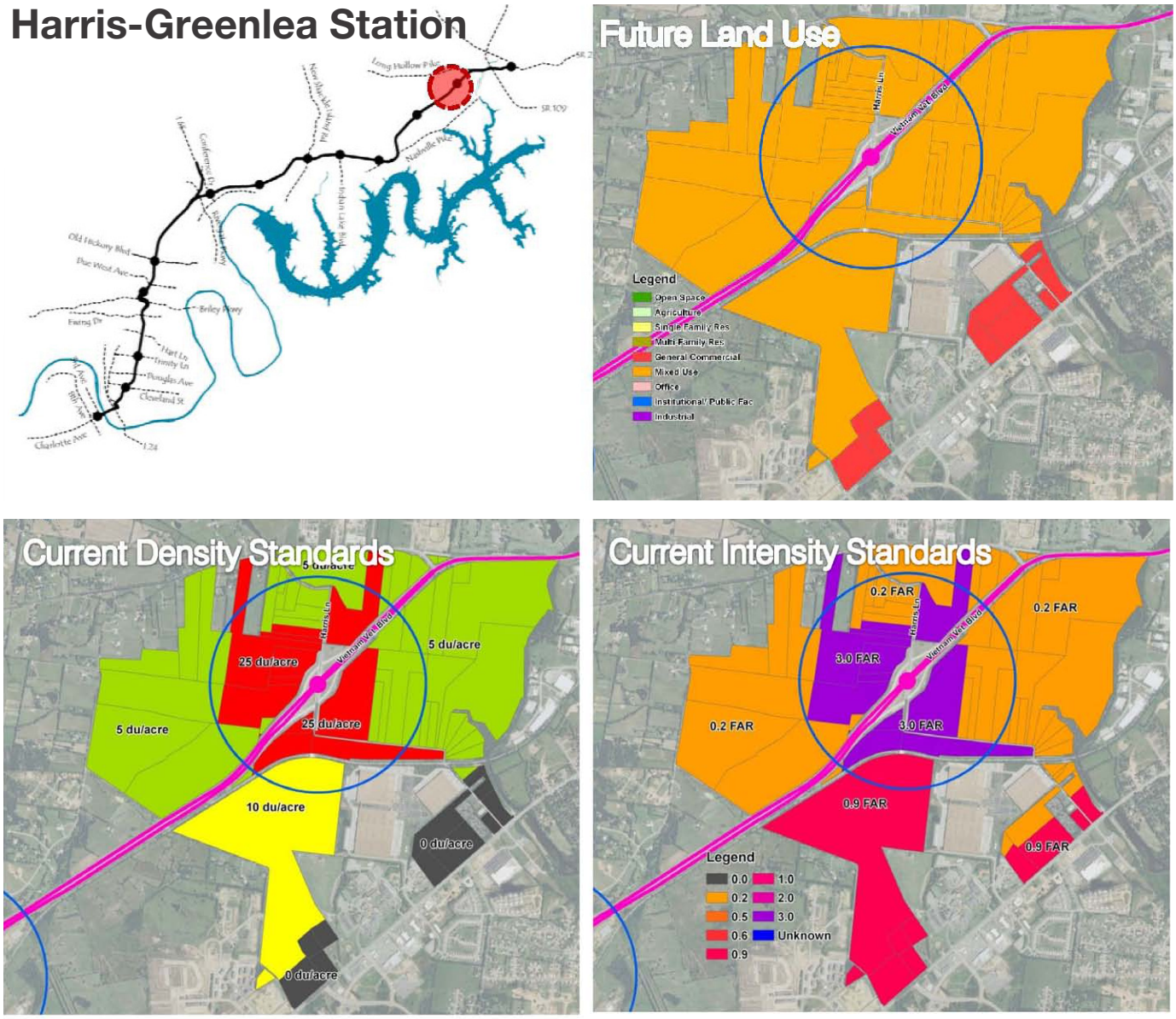






	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	15-20 units/acre minimum (net)	15-75 units/acre 24 units/acre (net) average	5-17 units/acre maximum
Non-Residential Density (FAR)	.50-.75 FAR minimum (net)	.25-1.0 FAR .40 FAR (net) average	.90 FAR Maximum

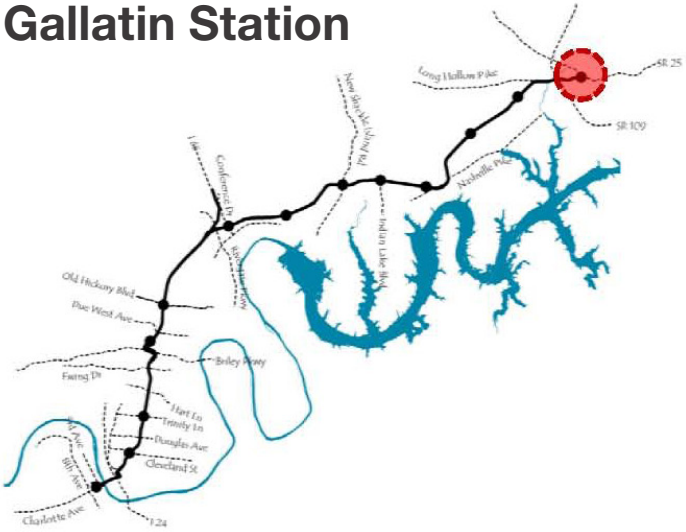
Figure 6.34: *Big Station Camp Station.*

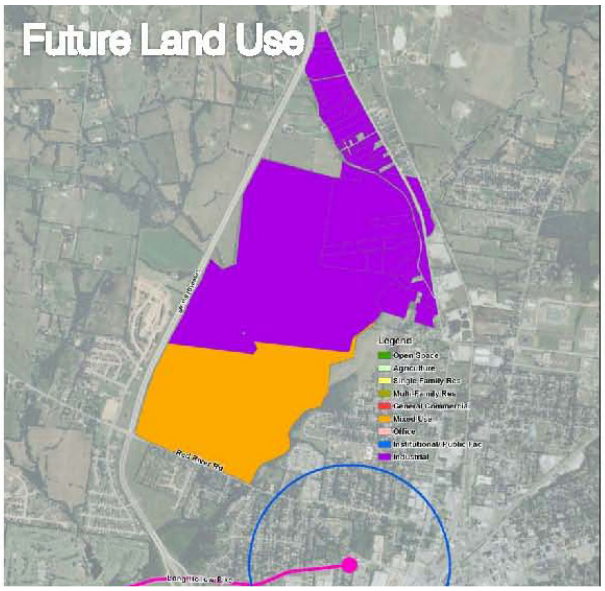


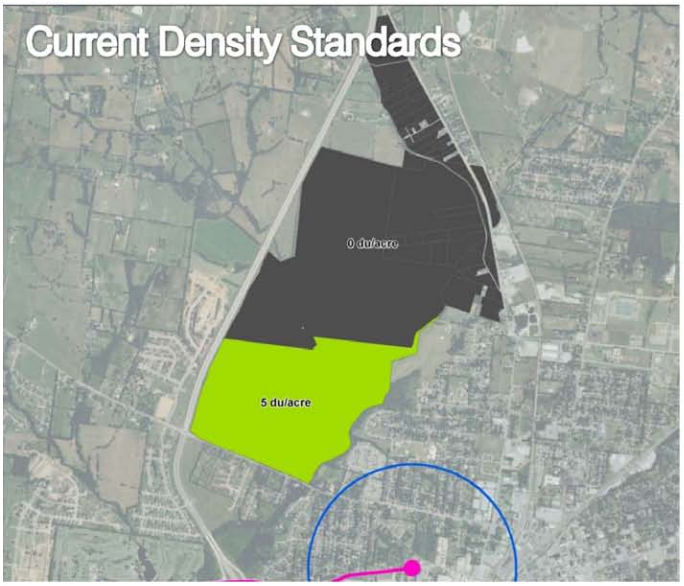
	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	15-20 units/acre minimum (net)	15-75 units/acre 24 units/acre (net) average	25 units/acre maximum
Non-Residential Density (FAR)	.50-.75 FAR minimum (net)	.25-1.0 FAR .40 FAR (net) average	.20-3.0 FAR Maximum

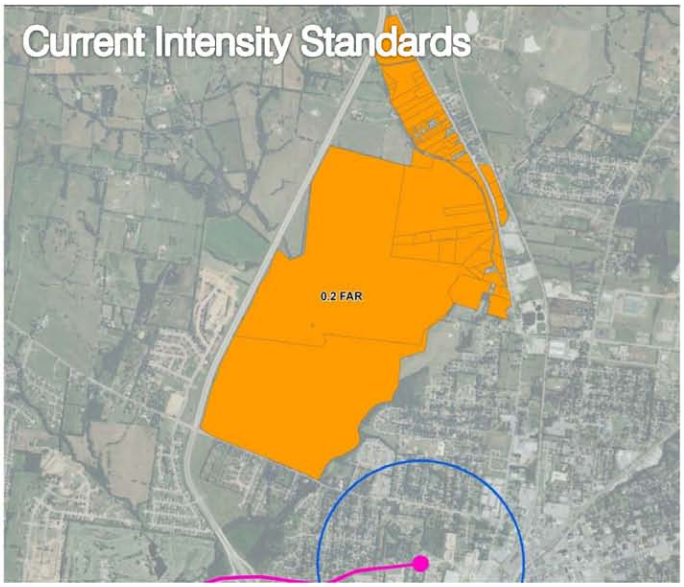
Figure 6.35: *Harris-Greenlea Station.*

Gallatin Station









	Generic TOD Density Goal	Station Specific TOD Scenario	Existing Standards
Residential Density (units/acre)	15-20 units/acre minimum (net)	15-75 units/acre 24 units/acre (net) average	5 units/acre maximum
Non-Residential Density (FAR)	.50-.75 FAR minimum (net)	.25-1.0 FAR .40 FAR (net) average	.20 FAR Maximum
Industrial Density (FAR)		**.40** FAR	**.20** FAR

Figure 6.36: *Gallatin Station.*

6.5. Station Area Redevelopment Case Studies

Transiit-oriented Development (TOD) is a land use approach which focuses development around transit nodes. TOD is recommended for areas to increase densities around transit nodes to help generate ridership, as well as to reduce urban sprawl. It is envisioned that such "smart growth" development patterns be employed in the study area in the future to help realize its full potential for LRT. Characteristics of TOD are described below, followed by an examination of what such developments might entail for he Nashville-Gallatin study area.

6.5.1. TOD Characteristics

Station-area development that is compact and dense relative to its surroundings

This does not mean that all TOD is uniformly big—far from it. There are varying degrees of density and compactness. Downtown Nashville looks very different from Hendersonville or the many local neighborhoods that can be served by transit. But compared to the surrounding areas, TOD seeks greater density for a simple reason—so that more people can live, work, shop, or go to school within walking distance of the station. In so doing, they drive less, use less gasoline, and save money.

A rich mix of land uses

TOD is often referred to as "place-making" or the creation of "transit villages"—livable places where the clustering of uses allows people to do what they need and want to do—live, work, shop, obtain services, go to school, use the library, have fun—more conveniently. The full menu of activities need not be found at every station. But a lively mix of uses strengthens the link between transit and development, as station areas become "24/7" places where people use transit at night and on weekends. Mixed-use stations and corridors also allow transit to function more cost-effectively. Combining transit origins like housing with transit destinations like jobs and schools allows the system to carry rush-hour commuters in both directions, serving more riders with the same fleet.

A great public realm

Transit-oriented development is pedestrian-oriented development, especially within the quarter-mile radius that most people will walk as part of a daily commute. In a TOD environment, a grid of small, navigable blocks has sidewalks throughout, with attractive amenities, lighting, and way-finding. The streets, sidewalks, plazas, and stations are safe, active, and accessible. There are no blank walls, and at street level there are shops, restaurants, and other active uses that bring the public realm indoors.

A new approach to parking

TOD does not mean "no cars". Even with high transit utilization, many people will come and go by automobile and need a place to park. But a defining characteristic of TOD is that it requires less parking than similar development in non-transit locations. Parking is shared as much as possible, taking advantage of dove-tailing uses and reducing further the actual number of spaces provided. And that parking which is required is designed so as not to dominate the visual or pedestrian environment.

FOUR PROTOTYPES

To understand how transit-oriented development might develop in the study area, four TOD prototypes were devised. It should be made clear that **the illustrative plans and explorations shown in the following section are not formal proposals for these actual locations. Rather, the prototypes should be seen broadly as conceptual examples of how sites within the corridor could be transformed into dense, transit-supportive developments.** The first, presented below, is located in Hendersonville, Tennessee, approximately 15 miles northeast of Nashville. While all protoypes have been conceptually designed, the Hendersonville site is accompanied by a fiscal and economic analysis to more fully explore the potential impacts such development might bring to the area.

6.5.2. Greenfield TOD Prototype

Greenfield Transit Oriented Development

The Hendersonville TOD prototype is classified as a greenfield transit oriented development. Greenfield (TODs) are planned districts built on undeveloped land. As with all TODs, permanent transit infrastructure (i.e. Bus Rapid Transit, Light Rail) is a central component of the area. Greenfields offer their own unique opportunities and challenges. These include:

- Large undeveloped parcels offer considerable flexibility in the form they can take.
- Site require new infrastructure and services to be provided for the development
- They are further away from urban centers
- Development eliminates existing landscape character and reduce open space within a community.

Like greyfield developments, greenfield TODs are not all alike and are heavily influenced by market forces that drive the mix of land uses within it.

Hendersonville TOD Concept Plan

The protoype Hendersonville TOD site spans 46 acres and portions of eight parcels of land, located between a limited access highway and major arterial roadway. These parcels are largely undeveloped with the exception of the Terrace at Bluegrass Assisted Living and Memory Care Community and Hendersonville Animal Hospital. The site is an extension of a planned office and retail development. The first phase of the project includes a retail center, office, and a public library. The concept plan is illustrated in figures 6.37 - 6.39.

A freight rail line bisects the site, creating two distinct development areas. The main street connects these two areas. Due to its high visibility from the highway, it is a desirable development location.

The plan is predicated on the presence of a future Bus Rapid Transit Line within the median of the limited access highway and/or a potential paralleling light rail line along the outside right-of-way of the highway. In addition, bus service is proposed to run on the major arterial to the south with direct access to the transit station via the TOD's main street. The light rail and bus rapid transit service proposed for the site are likely to represent the key catalyst for the development and absorption of residential and commercial product in the prototype program.

The transit station is located near the limited access highway on the north side of the site at the terminus of the main drive. Approximately, 85% of the development is within a 1/4 mile walking radius of the station (see Figure 6.37).

An internal shuttle connects the TOD to the other phases of the development. In addition to the proposed transit access, the site is currently reached from several major roads, including Vietnam Veterans Boulevard and Johnny Cash Parkway.

The real estate market has demonstrated that the potential for structured parking exists. As a result, the concept has relied heavily on structured parking. This has allowed for higher densities and more compact development to occur. Building heights range between three to five stories, with the highest densities located near the transit station.

The prototype development program calls for a mix of residential, commercial, and civic uses, as shown in Table 6.3.

Land Use Mix

The concept plan incorporates 195,000 sf of new commercial space. With the exception of the mezzanine retail space above the grocery store, commercial spaces are located on the first floor. Retail opportunities line the main street connecting the two distinct areas of the development. A medium-sized grocery store (40,000 sf) anchors the mixed-use concept at the intersection of the boulevard and the northsouth main street. An opportunity for a junior retailer (10,000-12,000 sf) is accommodated within the most southern portion of the development at the corner of the main street and the major arterial. The commercial space in the northern portion of the development is served by structured parking while the uses in the southern half are served by surface parking. Due to the mix of uses, availability of transit, and facilitation of pedestrian access, the development anticipates a reduction of at least 25% in the need for parking.

The concept also includes a total of 304,000sf of office. Of this total, approximately 65% is located in two 100,000 sf office

Table 6.3: Hendersonville (Greenfield) TOD Prototype Concept Plan Development Summary

Acres	45.9
Retail/Commercial	Approx. 195,000 sf
Office	Approx. 304,000 sf
Residential Units per Acre	17.6
Residential Units	808
Surface Parking	Approx. 750 spaces
Structured Parking	Approx. 1,650 spaces
On-street Parking	Approx. 300 spaces

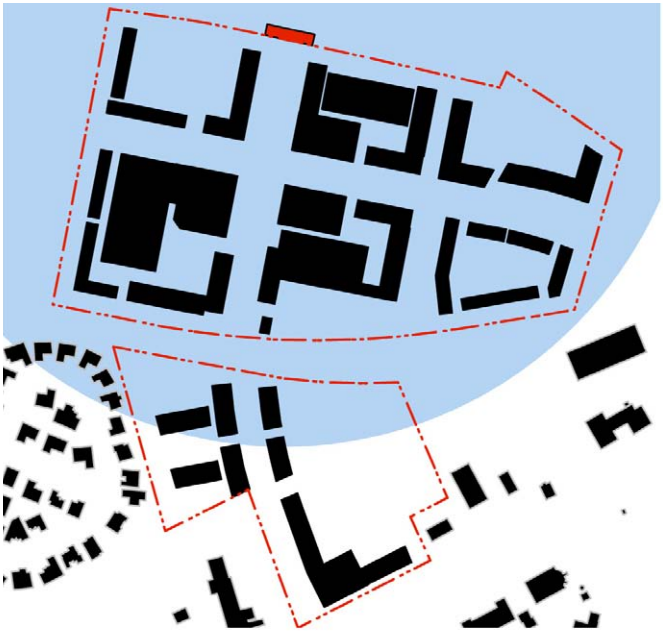


Figure 6.37: *Portion of the concept within 1/4 mile radius from transit station*

Figure 6.38: Greenfield Transit Oriented Development Concept - Hendersonville

Figure 6.39: *Greenfield Transit Oriented Development Concept Model - Hendersonville*

Figure 6.40: *Example of a Transit Station*

Figure 6.41: *Example of a Multi-story Office Building*

Figure 6.42: *Example of Residential Flats*

buildings anchoring two of the four corners at the intersection of the main street and boulevard near the transit station. They are served by two parking structures. The remaining office space is located within upper stories of retail buildings along the main street connecting the two halves of the development.

Residential units are comprised of loft style flats and 3-story townhouses. The overall development averages 17.6 residential units per acre. These architectural residential typologies offer the opportunity to maximize residential uses within close proximity of the transit station while minimizing building heights throughout the development. Parking needs for residential uses are primarily served by surface parking and garages internal to the town homes. Parking structures satisfy some of the parking needs specifically for units wrapping the parking structures.

A small 15,000 sf convention facility that can host community events and conferences is located on top of the grocery store. In addition, a small public pavilion is located within the park paralleling the freight rail line.

The Public Realm

The public realm is a critical component of any TOD. The series of spaces and streetscapes tie the development together and provide comfort for pedestrians to move about the site. The concept includes over 2.5 acres of park space.

The public realm of the street is the space between the buildings paralleling the right-of-way. The concept plan maintains a connection between the architecture and the sidewalk by locating the parking to the interior of the block or along the street. In addition, parallel parking and street trees are used to buffer pedestrians from vehicular traffic. Additional design elements such as defined crosswalks, pedestrian bulbs, and minimized corner radii are used to make the pubic realm safer for pedestrians and encourage walking within the development.

A central space is located within the median in front of the transit station. The roadways are designed to be blocked off for major events throughout the year.

Transportation Options and Connections

Transportation choice is also another critical component of any TOD. Mobility choices incorporated into the concept plan include walking, bicycling, driving, and transit.

Transit is provided in the form of local bus service, light rail, Bus Rapid Transit, and a local shuttle service (Figure 6.43). Together these options provide local and regional connections that can move people to and from the development. The transit station is designed to accommodate both Bus Rapid Transit on the upper floor and a potential light rail line on the lower floor. Access to

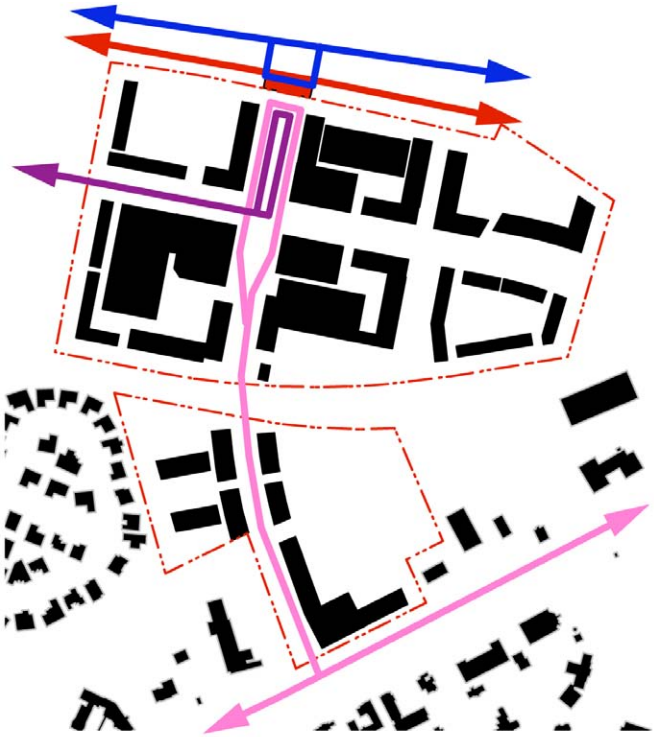


Figure 6.43: *Transit Options: Blue - Bus Rapid Transit; Red - Light Rail; Purple - Shuttle; Pink - General Bus Service*

Figure 6.44: *Bicycle Network: Green - Multi-use Path; Orange - On-street Facilities*

the station is provided on the south side of the building.

Five hundred parking spaces for commuters have been located in the parking garage west of the grocery store. In order to increase traffic and visibility for retailers, the spaces are not located directly adjacent to the station.

As in the greyfield concept plan (presented below), walking is encouraged through the established streetscape network and detailed environments. Sidewalk widths including appurtenance zones/buffer strips, the area between the sidewalk and the back of curb - in commercial and office areas - range from 14 ft to 16 ft between storefronts and the back of curb. This allows for comfortable sidewalks and areas for landscaping, street trees, outdoor dining, seating, and displaying merchandise. Streets trees in all areas are strongly encouraged. Their spacing typically ranges between 30 ft to 40 ft on center. Large shade tree species with upright branching characteristics are utilized in these areas.

A potential non-motorized connection to the development from the surrounding residential neighborhoods should be considered and discussed with the residents.

Bicycle infrastructure (Figure 6.44) includes a paralleling greenway that connects to the areas' overall greenway network. In addition, all transit is equipped to accommodate cyclists. All of these bicycle facilities increase the regional mobility of cyclists.

The vehicular network includes local, collector, and arterial streets. Lane widths meet local engineering standards.

Potential Economic and Fiscal Impacts

The potential economic impacts of the prototype transit oriented development (TOD) project in Hendersonville (presented above) were evaluated with respect to tax revenue streams including property tax, sales tax, income tax, and adequate facilities tax; the likely scale of tax increment financing (TIF) available to fund infrastructure improvements was also assessed.

The following methodology was used to estimate the fiscal and economic impacts of the prototype development:

- Establish existing market and assessed values of site based on real estate assessment data from the State of Tennessee Comptroller of the Treasury;
- Use prototype development program created by Hawkins Partners to determine land uses and scale of development;
- Apply unit costs for construction from the Marshall and Swift Cost Handbook to prototype gross building area to estimate total development cost;
- Determine market value of site after completion of development program by adding replacement cost of prototype buildings to existing land and improvement values;
- Calculate assessed value of site by applying State assessment ratios to market value by use;
- Determine annual real property tax for site by applying current Sumner County and Hendersonville tax rates to assessed value;
- Calculate increment between current real property tax for the site (base value) and real property tax after completion of the TOD, yielding funding stream for repayment of TIF bonds.

Related impacts, including construction and permanent employment gains, retail sales tax increases, and other qualitative issues, are also evaluated. Forecasts of demand for residential and commercial product were not developed as part of this exercise; typical stabilized occupancy rates and sales performance are assumed in tax revenue calculations.

Key Findings

Temporary Construction Impacts

- Total construction costs for the development are estimated at $216 million in 2015 dollars. Residential construction accounts for 39 percent of this total at $84 million followed by office construction at $62 million. Parking, landscaping, parks, and other site improvements account for $48 million of the total construction cost.
- Hard costs were assumed to account for 70 percent of total costs with the remaining 30 percent going to soft costs. Of these subtotals, labor was assumed to account for 60 percent of hard costs and 100 percent of soft costs or $91 million and $65 million (2015$), respectively. In all, the proposed development is forecast to account for 3,024 employee-years over the duration of planning and construction.

Table 6.4: Economic Impact Summary, Hendersonville TOD Protoype

	City of Hendersonville
Construction Period	
Total Estimated Full-Time Equivalent Jobs	3,024
Total Payroll	$155,860,023
Ongoing Operations	
Total Estimated Full-Time Equivalent Jobs	1,598
Total Payroll	$64,159,684

Source: AECOM, 2010

Table 6.5: Fiscal Impact Summary, Hendersonville TOD Prototype

	City of Hendersonville	Sumner County	State of TN	Total
Construction Period				
Total Estimated Tax Revenues	$1,159,209	$951,299	$3,606,428	$5,716,936
Ongoing Operations				
Estimated Annual Tax Revenues	$1,710,950	$1,543,344	$7,291,513	$10,545,807

Source: AECOM, 2010

- Applying current sales tax rates to materials purchased in-state, sales tax revenues are estimated at $3.6 million for the state and $1.2 million for Hendersonville.
- The adequate facilities tax rate in Sumner County is $0.40 per square foot for commercial space and $0.70 per square foot for residential space. In order to calculate the adequate facilities tax, an average size of 1,200 square feet was assumed for the rental units and an average size of 1,400 square feet for the for-sale units (both residential types assume a 95% efficiency factor). Based on these assumptions, a one-time adequate facilities tax of $951,299 has been derived.

Ongoing Impacts

- Sumner County and Hendersonville real property tax rates were applied to the prototype development program to determine the increment between existing real property tax revenues and revenues at stabilization for the TOD prototype. The proposed construction is forecast to generate an annual tax increment of $1.5 million for the County and $496,424 for Hendersonville at stabilization (2015$). In total, the study area parcels will generate $2.0 million in annual property tax revenues.
- Total on-site employment is estimated at 1,133 full-time equivalent jobs for the associated office space and 466 jobs attributable to the retail component. Total wages for on-site employment are estimated at approximately $64.2 million.
- The neighborhood serving retail was assumed to produce average sales per square foot volumes of about $250 to $275 per square foot on average, noting that this is an average and that sales will vary considerably by type of tenant. Grocery store sales were assumed at a higher average sales per square foot of $400 (based on current average grocery store volumes). Sales tax revenues are estimated at approximately $1.2 million for the city and $3.4 million for the state.
- State personal income taxes (at a tax rate of 6.00%) were calculated by estimating the number of employees per square feet of the different commercial uses, and applying average earnings data from the Tennessee Department of Labor and Workforce Development. Based on these assumptions, total state personal income tax revenues were estimated at about $3.9 million.
- Tax increment financing (TIF) may present an opportunity to defray a portion of the development costs forecast in this analysis. This funding mechanism allows the issuance of bonds to pay for public improvements as a means of spurring development within a designated "TIF district." The property tax increment of $1.9 million at stabilization suggests that over a 20-year term up to $38.3 million (2015$) may be applied towards repaying bonds.
- In addition to the more easily defined, direct quantitative impacts outlined above, transit oriented development also contributes to a variety of qualitative and indirect quantitative impacts, including household savings as a result of reduced commuting, improved air quality as a result of reduced emissions, and a decline in urban sprawl and the resultant increases in necessary infrastructure costs. Moreover, in many cases, parking requirements are reduced near transit oriented development, resulting in lower overall development costs and as a result, improving the development economics of the project.
- The Center for Transit Oriented Development (CTOD) has analyzed the increase in property values for sites located near transit stops. The study examines previous efforts to quantify property value impacts, reflecting a premium for those properties located in close proximity to a station. As might be expected, the extent of the impact varies greatly based on location and land use type. For example, for apartment, studies have shown a positive impact of between 4% for the San Diego Trolley to 45% for the Santa Clara County Light Rail.

Temporary Construction Economic and Fiscal Impacts

Temporary benefits are those that accrue to local and state governments during the construction phase. The primary economic benefits that will accrue to local government during the development of the TOD Prototype are employment, earnings, material sales, and a one-time adequate facilities tax.

Prototype Development Program

The Hendersonville TOD prototype development program includes 1,480,884 square feet of total new space. Approximately two-thirds of this space is comprised of residential units with 97 townhomes, 143 condominium units, and 569 rental apartments. These residential buildings are spread throughout the development and mixed in blocks with commercial and civic uses. Office space accounts for 304,470 square feet of rentable building area (RBA) while retail, including grocery, large format, and specialty retailers, accounts for 196,028 square feet of RBA. The development program includes 2,687 parking spaces of which 500 spaces are dedicated to transit users. (See Table 6.6, Development Program.)

Table 6.6: Development Program, Hendersonville TOD Prototype

Block	Retail - Large Format	Retail - Specialty	Office	Residential Units	Surface / On-Street Parking	Structured Parking
Block A	0	0	0	143	158	0
Block B	20,053	60,315	70,016	0	460	0
Block C	41,048	11,434	15,000	115	101	740
Block D	0	20,361	100,000	154	0	460
Block E	0	0	0	48	24	0
Block F	0	22,050	0	86	156	0
Block G	0	20,767	119,454	93	0	444
Block H	0	0	0	170	144	0
Total: TOD Prototype	61,101	134,927	304,470	809	1,043	1,644

Source: Hawkins Partners; AECOM, 2010

Prototype Construction Costs

Based on the development program above, AECOM Economics generated construction cost estimates for each building and use; site improvements and public realm cost estimates were developed by Hawkins Partners. For purposes of this study, construction costs and corresponding replacement values were inflated to the year 2015 to account for a mid-term project timeframe. The Marshall and Swift Cost Handbook served as the primary input for construction unit costs. These estimates are adjusted for location and capture all hard costs and a portion of soft costs, such as architecture and engineering, site preparation, overhead, and insurance; cost factors for contingency (10 percent) and additional soft costs (five percent) were applied to generate an "all-in" unit cost for each use.

Total construction costs for the development are estimated at $216 million in 2015 dollars. Residential construction accounts for 39 percent of this total at $84 million followed by office construction at $62 million. Parking, landscaping, parks, and other site improvements account for $48 million of the total construction cost. (See Table 6.7, Construction Cost by Space, 2015.)

Construction of a development on the scale of the Hendersonville TOD prototype results in significant gains to state and local economies in terms of temporary construction and planning employment and sales tax on construction materials.

To estimate temporary employment impacts resulting from construction of the development, AECOM Economics first divided total costs between hard costs, such as demolition, environmental remediation, landscaping, construction, and materials, and soft costs, such as architecture, engineering, and permitting. Hard costs were assumed to account for 70 percent of total costs with the remaining 30 percent going to soft costs. Of these subtotals, labor was assumed to account for 60 percent of hard costs and 100 percent of soft costs or $91 million and $65 million (2015$), respectively. Labor costs were then divided by the average annual wage for each sector to estimate the total number of employee-years generated. In all, the proposed development is forecast to account for 3,024 employee-years over the duration of planning and construction. (See Table 6.8, Construction Employment Impact in Employee-Years, 2015.)

Construction materials were assumed to account for 40 percent of hard costs, approximately $61 million (2015$); as the large majority of materials will be available through in-state distributors, 85 percent of the materials cost would be subject to state and local sales tax. Applying current sales tax rates to materials purchased in-state, sales tax revenues are estimated at $3.6 million for the state and $1.2 million for Hendersonville. (See Construction Table 6.9, Sales Tax Impact, 2015.)

Adequate Facilities Tax

Sumner County collects a one-time adequate facilities tax for all new residential and commercial construction. The tax is authorized by the state and gives local government the opportunity to decide for themselves whether or not they want to charge the tax. The adequate facilities tax rate in Sumner County is $0.40 per square foot for commercial space and

Table 6.7: Construction Cost by Space, 2015, Hendersonville TOD Protoype Improvements

Block	Name	Use Type	Gross Sq. Ft. / Spaces	All-In Unit Cost	Total Cost
Block A	Building A	Residential	151,252	$98.91	$14,959,704
Block A	Surface Parking	Parking Spaces	158	$1,837.26	$290,287
Block B	Building A	Retail - Specialty	24,150	$124.08	$2,996,501
Block B	Building A	Retail - Large Format	20,053	$110.98	$2,225,439
Block B	Building A	Retail - Specialty	20,053	$124.08	$2,488,150
Block B	Building A	Office	37,792	$203.61	$7,694,951
Block B	Building B	Retail - Specialty	16,112	$124.08	$1,999,156
Block B	Building B	Office	32,224	$203.61	$6,561,232
Block B	Surface Parking	Parking Spaces	460	$1,837.26	$845,141
Block C	Building A	Retail - Large Format	41,048	$102.94	$4,225,442
Block C	Building A	Office	15,000	$209.33	$3,139,929
Block C	Building B	Retail - Specialty	11,434	$103.98	$1,188,927
Block C	Building B	Residential	14,926	$73.12	$1,091,400
Block C	Building B	Residential	79,080	$73.12	$5,782,385
Block C	Building C	Residential	56,286	$112.23	$6,317,027
Block C	Surface Parking	Parking Spaces	101	$1,837.26	$185,564
Block C	Structured Parking	Parking Spaces	740	$19,217.76	$14,221,146
Block D	Building A	Office	100,000	$203.61	$20,361,322
Block D	Building B	Retail - Specialty	20,361	$103.98	$2,117,171
Block D	Building B	Residential	25,417	$73.12	$1,858,509
Block D	Building B	Residential	137,337	$73.12	$10,042,177
Block D	Structured Parking	Parking Spaces	460	$19,217.76	$8,840,172
Block E	Building B	Residential	114,129	$112.23	$12,808,798
Block E	Surface Parking	Parking Spaces	24	$1,837.26	$44,094
Block F	Building A	Retail - Specialty	22,050	$103.98	$2,292,796
Block F	Building A	Residential	66,150	$73.12	$4,836,934
Block F	Building B	Residential	57,555	$112.23	$6,459,448
Block F	Surface Parking	Parking Spaces	156	$1,837.26	$286,613
Block G	Building A	Office	100,000	$203.61	$20,361,322
Block G	Building B	Retail - Specialty	9,727	$124.08	$1,206,914
Block G	Building B	Office	19,454	$203.61	$3,961,092
Block G	Building C	Retail - Specialty	11,040	$103.98	$1,147,958
Block G	Building C	Residential	26,036	$73.12	$1,903,770
Block G	Building C	Residential	72,174	$73.12	$5,277,413
Block G	Structured Parking	Parking Spaces	444	$19,217.76	$8,532,688
Block H	Building A	Residential	180,044	$73.12	$13,164,943
Block H	Surface Parking	Parking Spaces	144	$1,837.26	$264,566
Site Improvements					$14,491,176
Total: TOD Prototype					$216,472,254

Source: Hawkins Partners; Marshall & Swift; AECOM, 2010

Table 6.8: Construction Employment Impact in Employee-Years, 2015, Hendersonville TOD Prototype Improvements

Type	Hard Costs		Soft Costs		Total Employment
	Labor Cost 1/	Emp. 2/	Labor Cost 3/	Emp. 4/	
Office	$30,628,180	646	$21,877,272	373	1,019
Retail	$12,275,713	259	$8,768,367	149	408
Apartment	$21,539,461	454	$15,385,329	262	716
Townhome	$10,799,061	228	$7,713,615	131	359
Condominium	$6,404,997	135	$4,574,998	78	213
Public	$5,149,485	109	$3,678,204	63	171
Site Improvements	$4,121,450	87	$2,943,893	50	137
Total: All Costs	$90,918,347	1,917	$64,941,676	1,107	3,024

1/ Labor cost at 60% of total hard costs

2/ Employee-years Construction (NAICS 23) sector at annual wage of $47,422 (2015$)

3/ Labor cost at 100% of total soft costs

4/ Employee-years Architectural and Engineering Services (NAICS 5413) sector at annual wage of $58,662 (2015$)

Source: Bureau of Labor Statistics; Hawkins Partners; Marshall & Swift; AECOM, 2010

Table 6.9: Construction Sales Tax Impact, 2015, Hendersonville TOD Prototype Improvements

Type	Hard Costs		Tennessee Sales Tax		Local Sales Tax		Total Sales Tax
	Tot. Materials 1/	TN Materials 2/	Rate	Tax	Rate	Tax	
Office	$20,418,787	$17,355,969	7.00%	$1,214,918	2.25%	$390,509	$1,605,427
Retail	$8,183,809	$6,956,238	7.00%	$486,937	2.25%	$156,515	$643,452
Apartment	$14,359,640	$12,205,694	7.00%	$854,399	2.25%	$274,628	$1,129,027
Townhome	$7,199,374	$6,119,468	7.00%	$428,363	2.25%	$137,688	$566,051
Condominium	$4,269,998	$3,629,498	7.00%	$254,065	2.25%	$81,664	$335,729
Public	$3,432,990	$2,918,042	7.00%	$204,263	2.25%	$65,656	$269,919
Site Improvements	$2,747,633	$2,335,488	7.00%	$163,484	2.25%	$52,548	$216,033
Total: All Costs	$60,612,231	$51,520,396		$3,606,428		$1,159,209	$4,765,637

1/ Materials cost at 40% of total hard costs

2/ Materials sales within Tennessee at 85% of total materials costs

Source: Hawkins Partners; Marshall & Swift; AECOM, 2010

$0.70 per square foot for residential space. In order to calculate the adequate facilities tax, an average size of 1,200 square feet was assumed for the rental units and an average size of 1,400 square feet for the for-sale units (both residential types assume a 95% efficiency factor). Based on these assumptions, a one-time adequate facilities tax of $951,299 has been derived. (See Table 6.10 Adequate Facilities Tax.)

Ongoing Economic and Fiscal Impacts

Permanent benefits are those that will be achieved once the transit-oriented development has been built, the space is fully occupied, and stabilized sales and occupancy levels have been achieved. It is assumed that a transition time will be required to achieve stabilization. The benefits covered in the analysis include property taxes, retail sales, and employment and earnings. In addition, AECOM also looked at the TIF potential as a result of accruing property tax revenues.

Table 6.10: Adequate Facilities Tax (one-time), Hendersonville TOD Prototype	
Commercial Development Program	
Grocery/Other Retail (sq ft)	61,101
Specialty Retail (sq ft)	134,927
Office (sq ft)	304,470
Total (sq ft)	**500,498**
Residential Development Program	
Total Units	809
Rental Units	
Total Rental Units	566
Average Size (square feet)	1,200
Efficiency Factor	95%
Total Estimated Square Feet	**715,300**
For-Sale Units	
Total For-Sale Units	243
Average Size (square feet)	1,400
Efficiency Factor	95%
Total Estimated Square Feet	**357,700**
Grand Total Residential	**1,073,000**
Sumner Co. Adequate Facilities Tax	
One-Time Tax Rate	
Per Commercial Square Foot	$0.40
Per Residential Square Foot	$0.70
Tax Revenues	
Commercial	$200,199
Residential	$751,100
Total	**$951,299**

Source: Sumner County; AECOM, 2010

Market Value and Assessed Value of Prototype

The Hendersonville TOD prototype is proposed to be built on vacant land spread over eight parcels. This study assumes that existing improvements on these parcels will not be affected by the proposed development. The study area parcels total 134 acres and currently have a combined market value of $14.0 million; land value accounts for 66 percent of this total as six of eight parcels are unimproved. Based on State standards, the ratio of market value to assessed value varies by property use with commercial parcels assessed at 40 percent of market value and residential parcels assessed at 25 percent of market value. Current assessed value is $4.1 million for the study area parcels. (See Table 6.11, Market and Assessed Value, Current and 2015, Hendersonville TOD Prototype Parcels.)

The market value of the prototype development program was calculated based on the replacement cost of improvements; this replacement cost is equal to the total construction cost of the development. Office, retail, and apartment uses are assessed at 40 percent of market value while townhomes and condominiums are assessed at 25 percent of market value. Public areas, including parks, gardens, and transit parking, as well as circulation infrastructure are assumed to be publicly owned and assessed at zero percent of market value. (See Table 6.12, Market and Assessed Value, 2015, Hendersonville TOD Prototype Improvements.)

Adding the value of the development prototype to the existing land and improvements yields a total market value of $233 million (2015$). Based on the assessment ratios listed above, the assessed value of all study area parcels and improvements will total $76.4 million; a gain of about $71.6 million in 2015 dollars over existing values.

Real Property Tax Revenue and TIF Potential

Existing taxes on real property are calculated based on the assessed value of the land and improvements of the eight study area parcels. This property tax is levied by Sumner County and Hendersonville and dedicated to respective general funds. The most recent property tax rates (2009) were applied to the assessed value of the land and improvements on the study area parcels to set a base for comparison against the prototype development program; Sumner County property tax rates are $2.0208 per $100 assessed value and Hendersonville tax rates are $0.6500 per $100 assessed value. At existing levels of assessed value, the study area parcels generate $82,936 for Sumner County and $26,667 for Hendersonville. (See Table 6.13, Real Property Tax, Current and 2015, Hendersonville TOD Prototype Parcels.)

Sumner County and Hendersonville real property tax rates were then applied to the prototype development program to

Table 6.11: Market and Assessed Value, Current and 2015, Hendersonville TOD Prototype Parcels

Parcel No.	Market Value			Assessed Value	
	Land	Improvements	Total	Percent	Assessment
146 062.01	$619,000	$0	$619,000	25%	$154,750
146 061.02	$348,400	$0	$348,400	25%	$87,100
146 061.01	$94,000	$93,700	$187,700	25%	$46,925
146 061.00	$216,000	$4,661,800	$4,877,800	40%	$1,951,120
Lot 41	$1,927,300	$0	$1,927,300	19%	$357,025
Lot 42	$1,428,100	$0	$1,428,100	25%	$357,025
Lot 43	$475,100	$0	$475,100	25%	$118,775
145 044.02	$4,125,600	$0	$4,125,600	25%	$1,031,400
Total: All Parcels	$9,233,500	$4,755,500	$13,989,000		$4,104,120
Total: Escalated to Start Year	$10,704,157	$5,512,928	$16,217,085		$4,757,800

Source: State of Tennessee Comptroller of the Treasury, Real Estate Assessment Data; AECOM, 2010

Table 6.12: Market and Assessed Value, 2015, Hendersonville TOD Prototype Improvements

Type	Replacement Cost / Market Value			Assessed Value	
	Hard Cost	Soft Cost	Total Cost	Percent	Assessment
Office	$51,046,967	$21,877,272	$72,924,239	40%	$29,169,696
Retail	$20,459,522	$8,768,367	$29,227,889	40%	$11,691,156
Apartment	$35,899,101	$15,385,329	$51,284,430	40%	$20,513,772
Townhome	$17,998,434	$7,713,615	$25,712,049	25%	$6,428,012
Condominium	$10,674,994	$4,574,998	$15,249,992	25%	$3,812,498
Public	$8,582,475	$3,678,204	$12,260,679	0%	$0
Site Improvements	$6,869,083	$2,943,893	$9,812,976	0%	$0
Total: TOD Prototype	$151,530,578	$64,941,676	$216,472,254		$71,615,133

Note: Market value of TOD Prototype Improvements calculated based on replacement cost valuation approach

Source: Hawkins Partners; Marshall & Swift; State of Tennessee Comptroller of the Treasury; AECOM, 2010

Table 6.13: Real Property Tax, Current and 2015, Hendersonville TOD Prototype Parcels

Parcel No.	Market Value	Assessed Value	Sumner Co. Prop. Tax		Hendersonville Prop. Tax		Total Real Property Tax
			Rate 1/	Tax	Rate 1/	Tax	
146 062.01	$619,000	$154,750	$2.0208	$3,127	$0.6500	$1,006	$4,133
146 061.02	$348,400	$87,100	$2.0208	$1,760	$0.6500	$566	$2,326
146 061.01	$187,700	$46,925	$2.0208	$948	$0.6500	$305	$1,253
146 061.00	$4,877,800	$1,951,120	$2.0208	$39,428	$0.6500	$12,682	$52,111
Lot 41	$1,927,300	$357,025	$2.0208	$7,215	$0.6500	$2,321	$9,535
Lot 42	$1,428,100	$357,025	$2.0208	$7,215	$0.6500	$2,321	$9,535
Lot 43	$475,100	$118,775	$2.0208	$2,400	$0.6500	$772	$3,172
145 044.02	$4,125,600	$1,031,400	$2.0208	$20,843	$0.6500	$6,704	$27,547
Total: All Parcels	$13,989,000	$4,104,120		$82,936		$26,677	$109,613
Total: Escalated to Start Year	$16,217,085	$4,757,800		$96,146		$30,926	$127,071

1/ Real property tax rate per $100 assessed value

Source: State of Tennessee Comptroller of the Treasury, Real Estate Assessment Data; AECOM, 2010

Table 6.14: Real Property Tax, 2015, Hendersonville TOD Prototype Improvements

Type	Market Value	Assessed Value	Sumner Co. Prop. Tax		Hendersonville Prop. Tax		Total Real Property Tax
			Rate 1/	Tax	Rate 1/	Tax	
Existing Land & Improvements	$16,217,085	$4,757,800	$2.0208	$96,146	$0.6500	$30,926	$127,071
TOD Prototype							
Office	$72,924,239	$29,169,696	$2.0208	$589,461	$0.6500	$189,603	$779,064
Retail	$29,227,889	$11,691,156	$2.0208	$236,255	$0.6500	$75,993	$312,247
Apartment	$51,284,430	$20,513,772	$2.0208	$414,542	$0.6500	$133,340	$547,882
Townhome	$25,712,049	$6,428,012	$2.0208	$129,897	$0.6500	$41,782	$171,679
Condominium	$15,249,992	$3,812,498	$2.0208	$77,043	$0.6500	$24,781	$101,824
Public	$12,260,679	$0	$2.0208	$0	$0.6500	$0	$0
Site Improvements	$9,812,976	$0	$2.0208	$0	$0.6500	$0	$0
Subtotal: TOD	$216,472,254	$71,615,133		$1,447,199		$465,498	$1,912,697
Total: Full Site	$232,689,339	$76,372,933		$1,543,344		$496,424	$2,039,768

1/ Real property tax rate per $100 assessed value

Source: State of Tennessee Comptroller of the Treasury, Real Estate Assessment Data; AECOM, 2010

determine the increment between existing real property tax revenues and revenues at stabilization for the TOD prototype. The proposed construction is forecast to generate an annual tax increment of $1.4 million for the County and $465,498 for Hendersonville at stabilization (2015$). In total, the study area parcels will generate $2.0 million in annual property tax revenues. (See Table 6.14, Real Property Tax, 2015, Hendersonville TOD Prototype Improvements.)

Tax increment financing (TIF) may present an opportunity to defray a portion of the development costs forecast in this analysis. This funding mechanism allows the issuance of bonds to pay for public improvements as a means of spurring development within a designated "TIF district." In subsequent years, as developments within the district are completed and assessments rise, new property tax increments are used to pay down the initial debt. Tennessee legislation permits the use of property tax TIF by housing authorities and industrial redevelopment authorities; sports authorities and tourism redevelopment zones may use sales tax revenues towards TIF. For the prototype development program, this financing could be constructively applied to infrastructure, streetscaping, parking, and other public realm improvements.

The property tax increment of $1.9 million at stabilization suggests that over a 20-year term up to $38.3 million (2015$) may be applied towards repaying bonds. Please note that stabilization indicates full completion of development program and absorption to typical frictional vacancy rates; demand and absorption were not forecast in this study and are likely to lag behind completion of construction.

Employment and Earnings

Total employment benefits attributable to the ongoing operations at the proposed development are based on commonly accepted employment ratios by land use type (e.g. 250 square feet of required space per office employee). Total on-site employment is estimated at 1,133 full-time equivalent jobs for the associated office space and 466 jobs attributable to the retail component. Total wages for on-site employment are estimated at approximately $64.2 million. Wages are based on a wage and salary survey for the state of Tennessee by the Tennessee Department of Labor and Workforce Development. (See Table 6.15, On-Site Employment Projections.)

Retail Sales Tax

Sales taxes generated by the retail space located within the proposed mixed-use development were determined by applying anticipated sales per square foot to the proposed square footage. The current sales tax rate for the state is 7% (for retail sales with food and food ingredients taxed at 5.50%), with an additional local tax rate of 2.25%.

Table 6.15: On-Site Employment Projections, Hendersonville TOD Prototype

Office Employment	Total
Total Office Space (SF)	304,470
% Occupied	93%
Total Occupied Office Space (SF)	283,157
Estimated On-site Employment @ 250 SF/Employee	1,133
Retail Employment	**Total**
Total Retail Space (SF)	196,028
% Occupied	95%
Total Occupied Retail Space (SF)	186,227
Estimated On-site Employment @ 400 SF/Employee	466

Source: AECOM, 2010

The neighborhood serving retail was assumed to produce average sales per square foot volumes of about $250 to $275 per square foot on average, noting that this is an average and that sales will vary considerably by type of tenant. Grocery store sales were assumed at a higher average sales per square foot of $400 (based on current average grocery store volumes). Additionally, since some prepared food items are anticipated to be among the merchandise, the proportion taxable was estimated at 90 percent (for grocery store sales only).

Sales tax revenues are estimated at approximately $1.2 million for the city and $3.4 million for the state. (See Table 6.16, Forecast Retail Sales and Sales Tax Revenues.)

Earnings and Employment Taxes

On-site Employment

The analysis looked at potential taxes generated by new on-site employment. State personal income taxes (at a tax rate of 6.00%) were calculated by estimating the number of employees per square feet of the different commercial uses (as described earlier), and applying average earnings data from the Tennessee Department of Labor and Workforce Development. It was assumed that on-site employment represents net new employment for the state. Based on these assumptions, total state personal income tax revenues were estimated at about $3.9 million. (See Table 6.17, Estimated Personal Income Tax Revenues table.)

Table 6.16: Forecast Retail Sales and Sales Tax Revenues, Hendersonville TOD Prototype	
Commercial Sales Tax Revenues	
Stabilized Sales Productivity Target - Grocery Store	$400
Square Feet	41,048
Estimated Gross Annual Sales	**$16,419,200**
Stabilized Sales Productivity Target - Specialty/Convenience Retail	$250
Square Feet	134,927
Assumed Occupied Space at 95%	128,181
Estimated Gross Annual Sales	**$32,045,163**
Stabilized Sales Productivity Target - Drug Store/Other Convenience	$275
Square Feet	20,053
Estimated Gross Annual Sales	**$5,514,575**
Total Retail Sales	**$53,978,938**
Sales Tax Rate	
City	2.25%
State - retail	7.00%
State - food and food ingredients 1/	5.50%
Estimated Annual Sales Tax Revenues	
City	$1,214,526
State	$3,441,932
TOTAL	**$4,656,458**
1/ Assumes that 90% of grocery sales are food and food ingredients	
Source: State of Tennessee; AECOM, 2010	

Other Impacts – Transit Oriented Development

In addition to the more easily defined, direct quantitative impacts outlined above, transit oriented development also contributes to a variety of qualitative and indirect quantitative impacts, including household savings as a result of reduced commuting, improved air quality as a result of reduced emissions, and a decline in urban sprawl and the resultant increases in necessary infrastructure costs. Moreover, in many cases, parking requirements are reduced near transit oriented development, resulting in lower overall development costs and as a result, improving the development economics of the project.

Table 6.17: Estimated Personal Income Tax Revenues, Hendersonville TOD Prototype

	Employment	Average Annual Salary / Wages 1/	Total Payroll	State Personal Income Tax Rate	Annual Personal Income Tax Revenues
Office	1,133	$45,936	$52,028,418	6.00%	$3,121,705
Retail	466	$26,057	$12,131,266	6.00%	$727,876
Total	1,598		$64,159,684		$3,849,581

1/ Wages based on Tennessee Department of Labor and Workforce Development Quarterly Census of Employment and Wages. Retail wage based on average annual wage for all retail trade jobs and office based on average annual wage for all professional and business services jobs.

Source: Tennessee Department of Labor and Workforce Development; AECOM, 2010

Table 6.18: Property Value Premiums Near Transit Stops

Land Use	Property Value Premium	Transit System
Single Family Residential	+2% (within 200 ft. of station) to +32% (within 100 ft. of station)	San Diego Trolley/St. Louis Light Rail
Condominium	+2% to +18% (within 2,600 ft. of station)	San Diego Trolley
Office	+9% (within 300 ft. of station) to +120% (within 1,300 ft. of station)	Washington Metrorail/VTA Light Rail
Retail	+1% (within 500 ft. of station) to +167% (within 200 ft. of station)	BART/San Diego Trolley

Source: Center for Transit-Oriented Development; AECOM, 2010

The Center for Transit Oriented Development (CTOD) has analyzed the increase in property values for sites located near transit stops. The study examines previous efforts to quantify property value impacts, reflecting a premium for those properties located in close proximity to a station. As might be expected, the extent of the impact varies greatly based on location and land use type. For example, for apartment, studies have shown a positive impact of between 4% for the San Diego Trolley to 45% for the Santa Clara County Light Rail. Property values near proposed transit stops have also increased as a result of land speculation. (See Table 6.18, Property Value Premiums Near Transit Stops.)

Other potential benefits include increasing the marketability of new residential and office space as consumer preferences shift and individuals are willing to pay premiums (e.g. higher rents) for locations near transit stops. The introduction of transit also increases the likelihood that higher density development will be permitted through the introduction of higher density zoning near transit stops. Reduced parking requirements, higher density allowances, and increased sales prices and/or rents can also reduce subsequent developer costs, increasing project feasibility.

In many cases, transit-oriented development is viewed as desirable by the local or regional community, with the public sector offering financial support through subsidizing development or providing funding mechanisms for new infrastructure. It is often necessary to put together a funding package for new transit that involves a variety of sources, including the private sector, responsible transit agency, local government, state government, etc.

6.5.3. Greyfield TOD Prototype

Greyfield Transit Oriented Development

In addition to the greenfield example at Hendersonville, a greyfield Transit Oriented Development prototype was developed using Madison as an example location and assuming service by local Bus Rapid Transit (BRT). Greyfield TODs are developments within existing urbanized areas that are supported by permanent transit infrastructure such as platforms or stations for BRT and Light Rail Transit (LRT). Within areas served by transit, they offer an opportunity to upgrade transit service and utilize existing infrastructure while enhancing prosperous areas that offer densities, a mix of uses, and/or destinations that are characteristic of successful TODs.

Upgrading transit infrastructure can facilitate the redevelopment of existing areas. As with most infill development (development that fills in or redevelops vacant or underutilized land) it is difficult to assemble large properties. Due to common constraints, the existing development patterns can make it difficult to establish an ideal urban environment. Examples of constraints include:

- Existing street network can limit the establishment of marketable block sizes
- Limited right-of-way width reduces transit infrastructure options
- Location of existing buildings can disrupt ideal blocks and interior parking opportunities
- Existing development has been developed at lower than desirable densities for transit oriented development

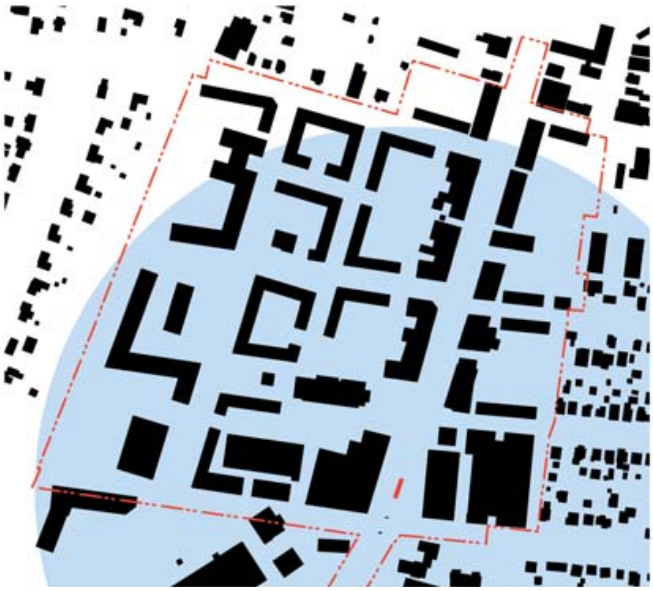


Figure 6.45: *Portion of Concept within 1/4 mile Radius from Transit Platform*

Like each area of the City, not all transitoriented developments are alike. Each one has its unique qualities and challenges. While transit infrastructure and/or other public investments can be a catalyst for new development, ultimately each instance is heavily influenced by market forces. The real estate market strongly drives the mix of uses and potential businesses within a TOD. The market often will dictate the level of intensity the TOD can successfully support.

Greyfield Concept Plan

The greyfield TOD shown encompasses nearly 63 acres (Figure 6.45 - 6.48). It illustrates TOD infill opportunities within a typical established but aging low density commercial thoroughfare corridor primarily comprised of a mix of one-story buildings. While the area's transportation options include walking and bus service, access is focused on the automobile. As is typical of many thoroughfare commercial areas outside of the downtown core, the economies of the real estate market limit the ability to utilize parking garages, due to higher cost per space that

Table 6.19: Greyfield TOD Prototype Concept Plan Development Summary (Madison)

Acres	62.8
Retail/Commercial	203,000 sf
Office	108,000 sf
Residential Units per Acre	13.2
Residential Units	831
Surface Parking	1,388 spaces
Structured Parking	420 spaces
On-street Parking	232 spaces

Figure 6.46: *Example of 4-story Residential Flats*

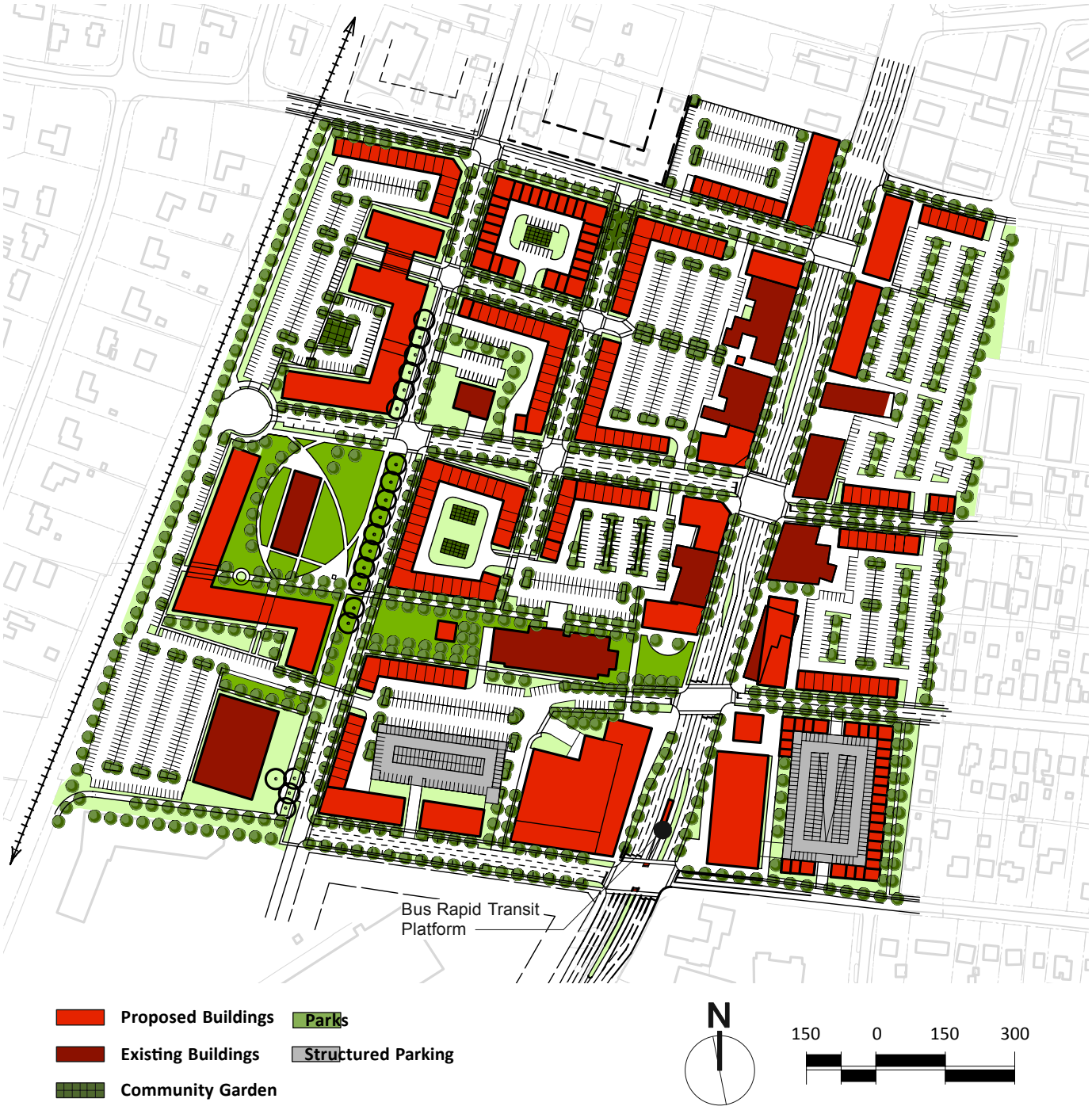


Figure 6.47: Greyfield Transit Oriented Development Concept - Madison

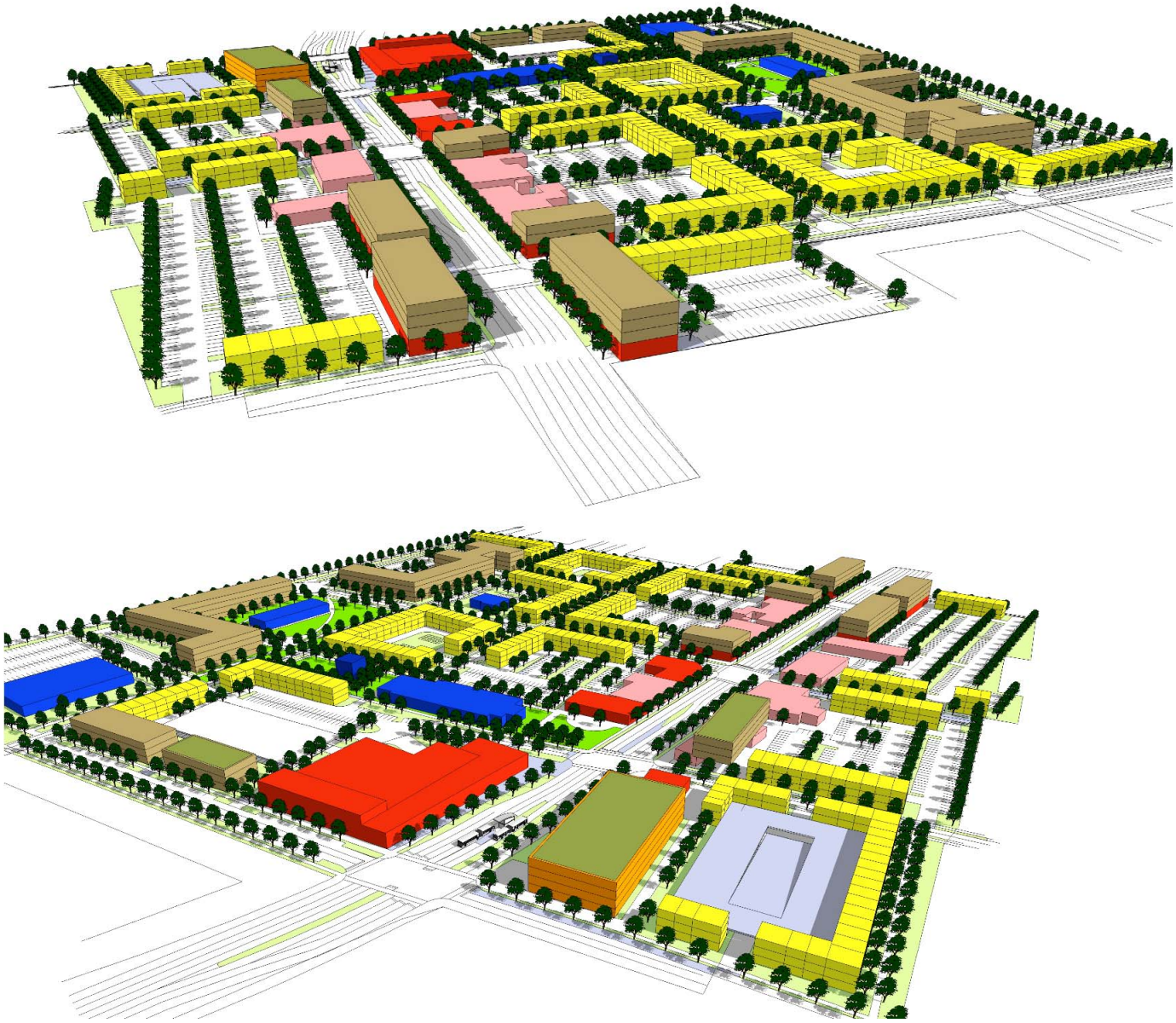


Figure 6.47: Greyfield Transit Oriented Development Concept Model - Madison

Figure 6.49: *Example of a Bus Rapid Transit Platform*

Figure 6.50: *Example of a Corner Grocery*

Figure 6.51: *Example of a 4-story Office Building*

cannot be supported by current lease rates. As a result, the development densities shown are moderate but appropriately scaled to the existing context. Building heights range between one and four stories.

The development embraces the Bus Rapid Transit line and includes a permanent platform in the median (An example of a median platform is shown in Figure 6.49.) The platform is located on the periphery of the development near one of the major intersections. The preferred location would have been one that was more centrally located. However, the existing buildings constricted the right-of-way to point that could not accommodate the necessary width. Despite its location on the periphery, over 85% of the development is within 1/4 mile of the platform (See Figure 6.45).

Land Use Mix

The concept plan comprises 203,000 sf of retail of which nearly 78,000 sf is existing. Commercial uses are located on the first floor and focused around the Bus Rapid Transit line. New retail opportunities replace less desirable building patterns while capitalizing on the older commercial buildings that offer greater opportunity to establish a cohesive urban fabric that promotes walking and supports retail viability. They also ground the development within its historic context while the building fabric adds authentic context.

A large retailer (i.e. grocery store) is located directly adjacent to the BRT platform. Due to the limited number of pedestrian entrances into the larger use, its façade is wrapped by smaller commercial uses as a means of increasing activity on the street. The larger retailer can serve as an anchor for all of the development and help generate additional traffic for the smaller retailers within the corridor.

Commercial/retail uses are served by interior parking centered within each block and on-street parking. Access points are provided along the streetscape for pedestrians to access parking areas. Due to the mix of uses, proximity to the BRT line, and the availability of sidewalks and bicycle facilities, the area can anticipate reducing parking needs by at least 25%.

A single 108,000 sf multi-story office building anchors the opposite corner from the large retail anchor. This provides opportunities for additional business activity and jobs within the area. The office building is served by a 2-story parking structure wrapped by residential units.

Residential units are comprised of loft style flats and 3-story townhouses. The development averages 13.2 units per acre. This mix of units ranges between 1 to 3 bedroom units. The residential flats offer opportunities to increase the number of units within close proximity to the transit line. They are served

by surface parking behind the units. The townhouse typology is selfparked within internal garages on the 1st floor with some visitor parking in the interior blocks. This allows for amenities such as space for outdoor activities or community gardens to be located in the center of the block.

Various existing public uses such as a senior center, library, and fire station anchor the development and many of its public spaces.

The Public Realm

The TOD would not be complete without special attention to the public realm. The greyfield TOD concept includes detailed streetscapes and over four acres of park space. All of these elements help tie the uses together by providing spaces for people to enjoy and encouraging them to get out of their cars and walk to destinations throughout the area.

The public realm of the street is the space between the buildings paralleling the right-of-way. The concept plan maintains a connection between the architecture and the sidewalk by locating the parking to the interior of the block or along the street. In addition, parallel parking and street trees are used to buffer pedestrians from vehicular traffic. Defined crosswalks, pedestrian bulbs, and minimized corner radii are used to reduce traffic speeds and shorten distances for pedestrians.

The formal public space is centrally located and provides easy access from the Bus Rapid Corridor to the residential neighborhoods and greenway connections along the exi sting rail line. The library splits this space and becomes an important focal point. A small pocket park provides public space directly adjacent to the BRT line. Restaurants are encouraged to occupy the space with outdoor seating. The larger park space provides opportunities for events, community gardens, playgrounds, and passive recreational activities.

Transportation Options and Connections

A number of transportation choices are integral to the greyfield concept plan. These include transit, walking, biking, and driving. For any successful TOD it is important to provide as many connections to the surrounding context as possible in order to maximize mobility for all residents. These transportation choices need to go beyond the borders of the TOD and encourage additional improvements within the area.

With the concept plan, transit is provided in the form of local bus service, local Bus Rapid Transit, and a local circulator that connects residents from the neighborhoods beyond the TOD while also providing regional access for those who live in the TOD. The raised Bus Rapid Transit platform is located in the median of the major arterial and includes the addition of two

Figure 6.52: *Example of Commercial Streetscape*

Figure 6.53: *Example of Pedestrian Bulbs at Crosswalk*

dedicated 11 ft lanes. The platform is access via crosswalks at the intersection.

Walking is encouraged through the established streetscape network and detailed environments. Sidewalk widths including appurtenance zones/buffer strips, the area between the sidewalk and the back of curb, in commercial and office areas range from 14 ft to 16 ft between storefronts and the back of curb. This allows for comfortable sidewalks and areas for landscaping, street trees, outdoor dining, seating, and displaying merchandise. In residential areas, the sidewalk and apertance zones/buffer strips narrow to 10 ft. Streets trees in all areas are strongly encouraged. Their spacing typically range between 30 ft to 40 ft on center. Large shadetree species with upright branching characteristics are utilized in these areas.

Bicycling opportunities are provided by a greenway paralleling the railroad which provides opportunities to connect to future greenways within the area. Interior streets are designed to comfortably accommodate cyclist. Bicycles are encouraged on the BRT; providing increased mobility for cyclists.

The vehicular network includes local, collector, and arterials streets. Lane widths meet local engineering standards.

6.5.4. End of Line TOD Prototype

A park and ride lot is envisioned at the end of the North East Corridor (Figure 6.54). The terminus includes a transit station for the bus rapid transit and/or light rail line and a parking lot. The location of the facility takes advantage of its proximity to a major intersection along the limited access highway. It has been internalized into the development area in order facilitate future development around it.

Due to its current relative isolation, no development is proposed on the site in the first phase and all parking is provided exclusively for commuters. This could include both commuters using the transit line and/or those participating in carpooling. The parking capacity at the end of line facility is 390 vehicles (4.7 acres). The concept anticipates future development on the site as the market for the area matures (see figures 6.55 and 6.56 for potential future development at the site). The location of the drive aisles are designed to allow for future high-density development and parking structures to replace the surface parking while keeping the entry drives and associated streetscape. The size of the transit station can accommodate up to 8,000 sf of retail associated with the commuter traffic.

The parking lot incorporates a series of sidewalks through out the parking lot to increase pedestrian safety to the facility. Additionally green infrastructure elements (i.e. bioretention, pervious pavements) are used to mitigate the developments impact and manage the stormwater on the site.

In an effort to increase transportation choices, a greenway connects the transit station to nearby development (i.e. employers) and bike lockers within the transit station are provided.

The two large vacant areas on the site can be used to expand the parking lot or park and recreation facilities for the community (i.e. baseball fields, playground).

Figure 6.54: *End of Line Concept Plan*

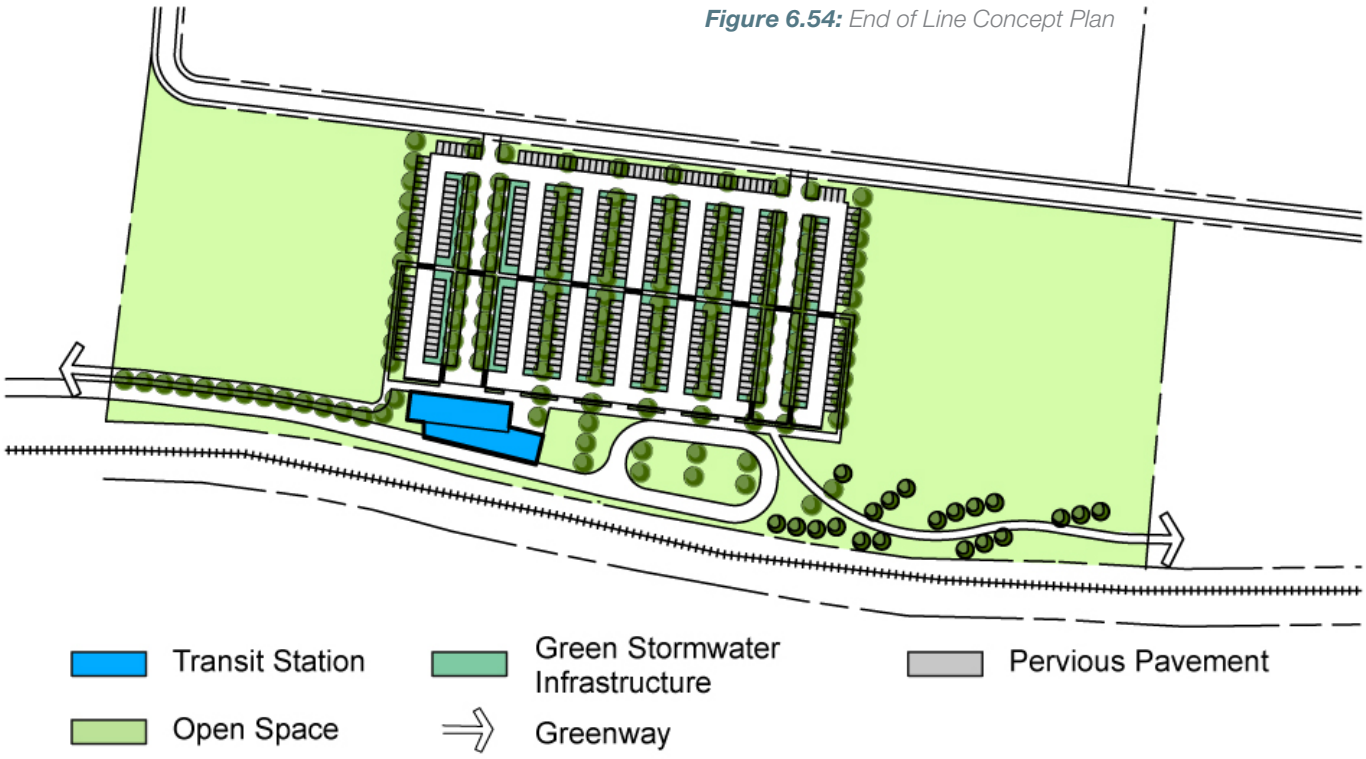


Figure 6.55: *Possible Evolution of End of Line Concept TOD with Ball Fiields*

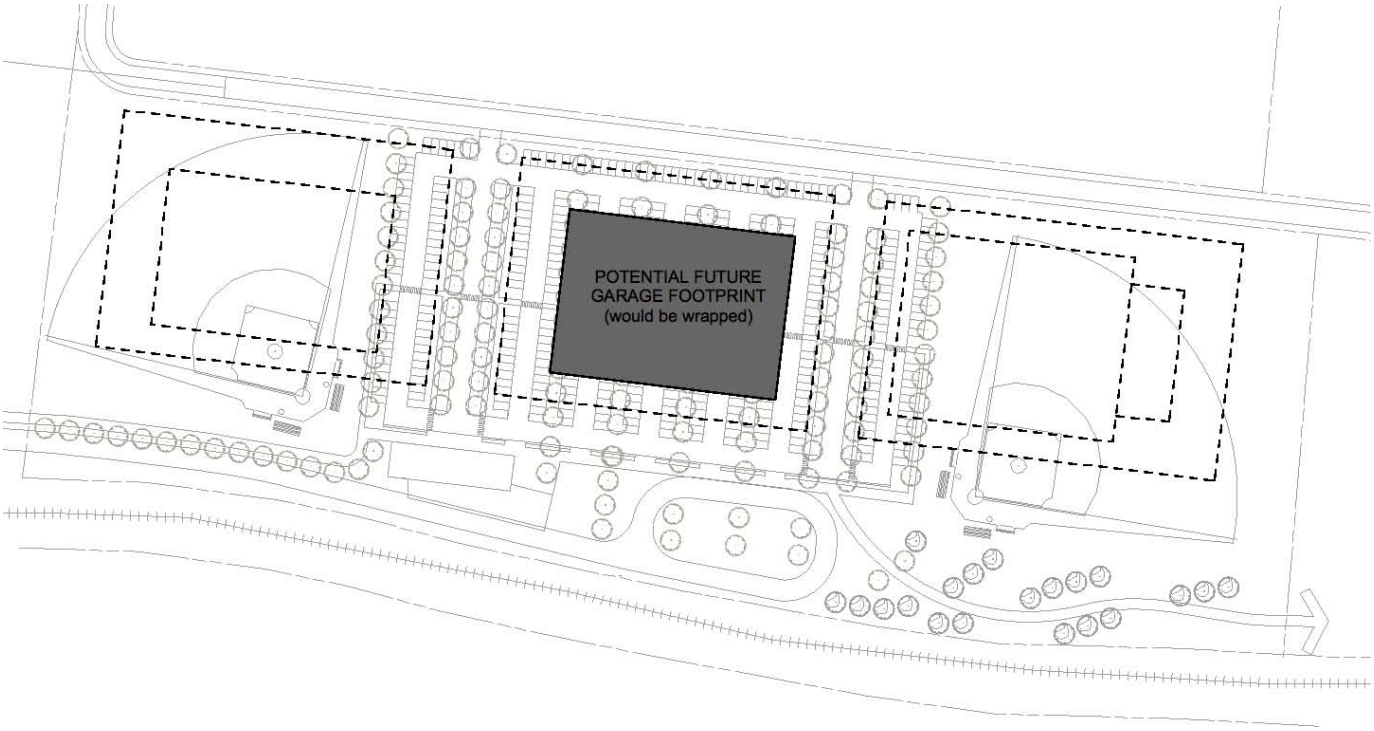


Figure 6.56: *Possible Evolution of End of Line Concept TOD with Parking Garage and Building Envelopes*

6.6 Potential Costs

The cost of the LRT Alternative described in Section 4 is approximately $2 billion in current dollars. Adding four stations, which we would recommend to maximize ridership and economic development opportunities, would add approximately $35 million, for a total $2,035,000,000 total capital cost (in 2010 dollars). Light rail costs elsewhere in the country have been in the range of $50 million to $100 million per mile, and this cost estimate falls well within that range at approximately $66 million per mile. The two most recent systems, in Charlotte and Virginia, had capital costs at or just over $50 million per mile. The Hiawatha LRT in Minneapolis, which has ballasted track, embedded track, flyover structures, and a section of tunnel, all of which drive up costs, had a cost of $99 million per mile.

This would obviously be a very substantial investment in transit in the Northeast Corridor, and would probably be undertaken in phases. Almost all new transit systems are funded with help from the Federal Transit Administration's New Starts or Small Starts programs, which generally require a 50% local match. (See Section 7 for a discussion of current trends in federal funding.) The local match could come from a special sales tax in the region to support transit, which would require a referendum under state law. Other sources of funding could include a tax increment finance (TIF) district, which would use increased tax revenues from transit-supportive development to fund the transit.

7.0 Next Steps

Figure 7.1: Future land use policies are important to guide current development patterns to be supportive of premium transit.

Figure 7.2: Lindbergh Center Transit-Oriented Development, Atlanta, Georgia. Future land use policies enabled a highly transit-supportive redevelopment of formerly underutilized land.

Apart from the requirements of a formal alternatives analysis and the refinement of the transit corridor concepts discussed in this study, the Northeast Corridor communities will need to begin developing strategic approaches to securing capital funding and for orienting future land development on the corridor to make investments in transit successful. This section of the study discusses the current funding environment as well as the corridor's current land use and development policy framework and presents options for how the Northeast Corridor jurisdictions may move forward in planning for premium transit.

7.1. Summary of Short-term and Long-Term Northeast Corridor Transit Visions

As discussed in other sections of this study, the recommendation for the Northeast Corridor is to define higher-capacity premium light rail transit (LRT) as a long-term vision to be pursued with a shorter-term strategy of preparing the corridor for transit and implementing a less capital-intensive form of premium bus rapid transit (BRT). This Section describes several considerations related to funding and local government planning to begin pursuit of the short-term strategy.

7.1.1. Federal Financing Trends

Conventional federal funding assistance for new major investment in transit fixed guideway capital projects is through the Federal Transit Administration's New Starts program. Since the late 1990s, the federal government's level of assistance in new capital projects has typically been 50 percent of the total cost, with the remaining 50 percent of funding originating at state and local government levels. In recent years, the United States Congress has appropriated around $2 billion per year to the New Starts program, yet applications for funding assistance have consistently exceeded this amount, leading to a highly competitive process for funding awards.

The current legislation authorizing federal transportation funding, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), expired in late 2009 and has been extended through special acts of Congress. Although a need for transportation infrastructure spending beyond recent levels has been widely acknowledged, both for expansions to the transportation system and for maintenance of existing facilities, no new ideas for development of additional funding sources to meet these needs have been advanced to a public policy level. Current transportation funding through motor fuel taxes and special Congressional appropriations from the general fund have maintained this base level of funding commitment from SAFETEA-LU, though they have not generally been applied to new funding levels beyond that.

While the New Starts program is likely to remain the primary mode of federal transit funding into the foreseeable future, it is clear that demand for its funds exceeds availability and that local transit agencies wishing to utilize this funding assistance must demonstrate that transit benefits, especially relative to cost, reflect a mix of ridership-generating land uses and operational characteristics.

Reconfiguring the Distribution of Current Funding

Although not currently established as a funding option through federal legislation and policy, one option currently being discussed is an infrastructure bank program that could apply to any transportation capital projects, not just transit. Under such a program, local governments and transit agencies may be eligible for funding under more flexible terms than the New Starts program but would be obligated to repay the initial capital assistance to the federal government. One example of this concept in practice is the recent transit expansions in Los Angeles, which has secured funding commitments from the federal government under terms that it repay this assistance over 30 years through revenue from a dedicated sales tax increment for transit. The argument made in support of this method of financing is that it allows the local transit system to realize the benefits of capital expansion in the short term (namely increased ridership and the fare revenue that it brings, along with the forestalling of increases in construction costs by building a more complete project up front) and uses the dedicated revenue stream to pay off the initial investment over time, as opposed to programming periodic expansions to the transit system when the revenue source generates sufficient funds for each increment.

7.1.2. Local and Other Financing Options

Successful implementation of mass transit plans in the Northeast Corridor will need to include a financial strategy that combines funding from a variety of sources including federal grants through the MPO from the Federal Highway Administration and the Federal Transit Administration, state funding from the Tennessee Department of Transportation, dedicated local or regional funding from an agreeable tax base, and private-sector contributions to help construct stations and sidewalks in adjacent areas. In addition, a strategy that incorporates transit elements into other transportation improvements (e.g., roadway upgrades) will increase the opportunity for successful implementation. As funding for the entire corridor may not become available at one time, decision-makers should consider phasing the construction by segment. For example, an initial phase could be constructed between downtown Nashville and Hendersonville's Indian Lake Village where the majority of ridership would be captured, with later phases completing the alignment between Hendersonville and Gallatin.

As described previously, under current national policy conditions, neither BRT nor LRT in the Northeast Corridor is likely to strongly compete for federal New Starts or Small Starts funding. Nevertheless, even if federal funding were

to be secured, the region would need to identify sources of funding for the "local match" (the percentage generally required by federal funding sources from local project proponents). As in most areas of the state and region, Northeast Corridor local government budgets are challenged and funding for transit system construction and/or operations is unlikely. This section describes other potential local funding sources. In the Charlotte and Denver cases highlighted in Section 6, each city established funding through bonds to be repaid by local-option sales taxes. Although each received Full Funding Grant Agreements from the Federal Transit Administration, the level of progress that they have been able to make in continuing to implement their long-range transit plans has been tied to the viability of these local funding sources. This suggests that creating and sustaining local financing at reliable levels is essential to realizing transit projects, regardless of the level of federal assistance.

The current climate of federal transportation funding has pointed to an increased need for state and local governments to assume greater responsibility in securing funding for transit projects. The best way to sustain funding for transit at the local level is to establish a dedicated funding source. Dedicated funding means providing a reliable source of annual revenues that provides support to transit operations and capital costs. Revenues, which can be implemented in a variety of ways, are established on the front-end, by a legislative body or by the voters, to be dedicated for transit without being subject to the same kind of discretion associated with general fund revenues. This approach reduces the annual burden placed on local governments to find funding for public transportation and minimizes the uncertainty for public transit customers, operators, and the business community looking to invest along fixed transit routes.

Many regions around the country, including Charlotte, St. Louis, Denver, Phoenix and Houston, have successfully funded new or improved light rail systems through funding mechanisms (usually a form of dedicated tax) approved by regional voters. According to the The Center for Transportation Excellence (http://www.cfte.org/), careful planning and a strong public advocacy campaign are essential to the success of transportation referenda. Other keys to successful efforts cited by CFTE include:

- Providing voters with "take it or leave it" propositions, not allowing voters to separate issues or projects within issues.
- Developing grassroots election support as well as professional management.
- Linking specific projects with the funding request.
- Focusing on the short-term and immediate time frames.

Coordinating Implementation: Denver's T-REX Project

Transit systems are among the greatest local- and regional-level infrastructure investments made today, but they do not need to be (and indeed seldom are) implemented at once, or independently of other transportation capital investments. Denver's T-REX implementation program, a partnership of the Colorado Department of Transportation and the Regional Transportation District, allowed the region's light rail program to be expanded along with highway capacity in a way that coordinated efforts and reduced cost and inefficiency.

This happened not only under a partnership of highway and transit agencies, but also through use of a design-build contract that allowed construction to proceed in phases after engineering details had been worked out. More significantly, however, it helped to ensure the expansion of the Denver light rail system: through joint planning and project programming with a major highway capacity project, the transit component of T-REX had an easier time securing state and federal funding assistance than if it were advancing as a stand-alone project.

Evolution of Premium Transit: VIVA in the Greater Toronto Area

The York Region of Greater Toronto is served by Viva, a system of five bus rapid transit routes complementing local service. Its development came in response to a need to address roadway congestion on regional roads, but it was developed as premium transit in order to reduce travel times along main corridors and improve the transit experience for riders.

Viva's expansion program is called VivaNext and envisions a series of evolutionary steps to enhance transit service in its area. These include already-funded expansions of the Toronto Transit Commission's Yonge and Spadina subway lines north into the York Region, the construction of dedicated rapid bus lanes (beyond the current use of queue-jumper lanes at intersections) and the possible conversion of these lanes to light rail guideways into the future. The importance of this example is that Viva has been planned and developed on widely useful sets of transit planning and transit-oriented design principles and that will work with less-expensive, more easily implemented transit technologies but that will continue to support transit as more advanced, permanent technologies are introduced in the future.

- Presenting voters with simple issues, not too complicated to comprehend
- Clearly answering the voter's question: "What's in it for me?"
- Including a regional balance of transportation options.
- Showing accountability. No "blank check" proposals.
- Providing adequate funding for the proposed projects in the plan.

According to CFTE, every urban area that has attempted to pass dedicated transit revenue has succeeded on the second or third attempt.

Re-scope Planned Projects

The MPO's 2035 Regional Transportation Plan, adopted in December 2010, includes three roadway projects that could provide additional opportunities to advance mass transit initiatives in the Northeast Corridor. However, such projects would need to be re-scoped in order to incorporate the recommendations for this study.

Such changes to project scope usually occur when a region demonstrates an interest and willingness to pursue high-capacity transit solutions to mobility needs; they will in turn perform feasibility studies for transit (such as this study) that evaluate specific corridors for transit investment. The Northeast Corridor's opportunities for ways to coordinate between a conventional vehicle mobility-based improvement and the addition of transit are the Ellington Parkway and Vietnam Veterans corridors; instead of defining projects in these corridors strictly for vehicular mobility, the region should focus on adding transit capacity within the existing rights-of-way and improving vehicular traffic flow through improvements to the design and operations of the existing vehicular lanes. This specifically include modifications to interchange ramps, straightening of bends and curves, widening of clearance zones to aid in incident response, and the addition of ramp metering at strategic locations to improve the spacing of automobiles. Table 7.1 provides examples of the three projects previously idenfitied in Section 5.2 as potential candidates for a broadened project scope that would accommodate transit capital investment.

Funding for Transit in the Nashville Region

The public meetings in the Northeast Corridor revealed that local support for transit is strong. Local funding will require building upon this support and educating the general population about the potential benefits of transit to the region. Fortunately, several organizations in the region are in place to help make the case for transit and provide the public advocacy that will be necessary to fund and implement a new transit system. These organizations include, in addition to the MPO, the Metropolitan Transit Authority and Regional Transportation Authority. In addition, in response to the lack of a funding source for transit in the region, the business community and citizens have formed the Middle Tennessee Transit Alliance, which has taken and will continue to take a leadership role in advocating for regional dedicated transit funding. The Transit

Table 7.1: Potential Changes in Scope to Projects in the 2035 Regional Transportation Plan

2035 RTP Project ID	Project	Current Status	Proposed Changes	Project Examples *(not discussed elsewhere in chapter text)*
1012-218	Widening of Ellington Parkway from 4 to 6 lanes	Preliminary Engineering and Right-of-Way acquisition is completed for the construction of 2 additional vehicle lanes. Funding for construction is scheduled for the 2025 horizon year of the 2035 Plan.	The project should be re-evaluated and engineered to convert the two additional lanes to transit facilities, with light rail being the long-term vision.	MBTA (Boston) Silver Line: outer lane used for transit in conjunction with parallel capacity projects on other roads
1052-179	Widening of Vietnam Veterans Parkway from 4 to 6 lanes	Funding for the project is scheduled for the 2035 horizon year of the 2035 Plan.	This project should be accelerated and re-designed to accommodate the first phase of dedicated-lane transit. The project should seek to improve vehicular traffic flow with the existing lanes by addressing the congestion caused by curves and the design and placement of interchange ramps.	US 36 BRT/ Managed Lane Project, Boulder, Colorado.
1053-264	New interchange on Vietnam Veterans Parkway at Forest Retreat Road	Funding for the project is scheduled for the 2035 horizon year of the 2035 Plan.	This project should be evaluated as a fully dedicated interchange for transit and/or carpools. At minimum, the interchange should consider providing dedicated slip ramps for transit vehicles.	MARTA (Atlanta) North Springs Station bus/HOV access ramps from GA 400 freeway

Alliance was created and is supported by citizens, businesses and civic organizations in order to facilitate discussion and understanding of plans for mass transit in the region. The Alliance fosters education across the region about the economic value of mass transit investments. Through these communication and education efforts, the Alliance will actively participate in the steps necessary to secure dedicated revenues for mass transit investments in the months and years ahead.

Enabling Legislation

On July 14, 2009, Tennessee Senate Bill 1471 (House Bill 1263) was signed into law by Governor Phil Bredesen establishing the necessary legal framework that will allow local governments and regions to take steps to provide dedicated funding sources for transit. The law allows for the creation or expansion of regional transportation authorities (RTAs) in Tennessee's large urban areas. It also provides the opportunity to dedicate a regional revenue source from a menu of funding options, subject to voter approval or approval by local governing bodies, in order to expand transit services and to support existing and future state and federal Investments. In addition, the law allows an RTA to receive dedicated funding through an act of the General Assembly following a request from local legislative bodies or an advisory vote of the people. RTAs can issue bonds to fund capital expenditures. increased state funding for transportation infrastructure. The success of this legislative effort is an indication of the broad support among public and private sector interests for regional coordination of planning, funding, and implementation of a regional mass transit plan. Mass transit is essential to the mobility, economic growth and prosperity, and environmental sustainability of growing metropolitan regions.

The ability to provide a dedicated funding source for operations is important because federal policy requires transit to have a stable, dedicated source of local/regional funding to be eligible for large capital grants.

Currently available and alternative funding options are described below.

Currently Available Revenue Sources

Local Option Gasoline Taxes

Counties, municipalities and metropolitan governments are authorized under Section 67-3-101 to 67-3-1013 of the Tennessee Code Annotated to impose a local gasoline tax to support local public transportation services.

Imposition of the tax requires a majority vote in public referendum. The tax revenue depends on tax rate, driver sensitivity to price, administrative costs, population, and real travel patterns.

This is probably the best potential source of local revenue for development and operation of a transit system in the Northeast Corridor. A successful referendum would require careful planning and campaigning to demonstrate the benefits of the proposed system, with emphasis on travel-time savings, convenience, economic development benefits, and modernity.

However, the economic downturn of the late 2000s has underlined several limitations of relying on sales taxes as a funding source. First and foremost, this revenue source is entirely dependent on consumer spending; the reduction in spending that has resulted from the recession has directly impacted sales tax receipts and, by extension, the working budgets that transit agencies have available for capital expansion. It is common even for transit systems not pursuing major capital expansion projects to rely on sales tax revenue for operating budgets as well (one example is MARTA in Atlanta); declines in this revenue likewise affect the operating potential of these agencies. In addition, sales taxes may be politically vulnerable when the benefits of their intended use are not immediately apparent. In the case of transit projects, especially those reliant on the generation of sufficient construction funds over time through a sales tax, the effects of an economic downturn may create political pressure to alleviate sales tax burdens when the sales taxes have not been in effect long enough to generate the funds needed for a project.

Special Assessment Districts

Special Assessment Districts are designated areas within which commercial and residential property is assessed a charge sufficient to defray the costs of capital improvements that benefit the property within the district. Transportation Development Districts (TDDs) are one example of these districts used to finance transportation improvements. The TDD has the power to issue bonds to pay for construction that can benefit the area instead of waiting for the local jurisdiction to fund the project.

Property owners in the Northeast Corridor could choose to form a Special Assessment District to fund construction and operation of a transit system.

Impact and Utility Fees

This one-time fee is imposed by local governments on new developments to help pay for the capital facilities to serve the new development. To implement an impact fee, it must be demonstrated that 1) improvements are necessary and are caused by the new development, 2) each developer is being charged a fair share of the cost of the improvements, and 3) funds to be collected are being used in close proximity to the new development and for the intended purposes only. These fees are enacted by local ordinance. Impact fees would not be

sufficient to pay for a new transit system, but could contribute to funding.

Alternative Revenue Sources

Due to the current economic situation, the development of more innovative funding strategies at the local level could be considered, particularly for use beyond those public finance options conventionally used earmarked for infrastructure. As discussed previously, the dedication of a portion of sales taxes to funding transit has seen limited returns as the recession has cut into consumer spending. Likewise, the traditional use of municipal bonds for major capital projects has been compromised by the credit crisis of the late 2000s and faces greater demand as local property and sales tax revenues have declined in the recession of the same period. Few cities have demonstrated the political will to consider payroll taxes as a potential source of revenue for transportation (Portland is a notable exception, although this tax is levied at a regional level and is argued to be offset by the lack of a sales tax in the state of Oregon) and this number is likely to remain small into the future. However, certain cities are demonstrating successful innovation. The region may therefore wish to explore other sources of local funding not currently used or authorized in Tennessee.

Tax Increment Financing (TIF)

The use of property-based tax-increment financing (TIF) for more advanced infrastructure projects, as in the case of the Atlanta BeltLine trail and transit concepts, could be offered as an alternative to sales taxes as a way of generating revenue for repayment of bonds or other government financing. Currently, tax increment financing in Tennessee is available only to housing authorities for redevelopment of blighted areas. Use of TIF for financing transit in the Northeast Corridor would therefore require a change in Tennessee law.

In other states, however, the TIF mechanism can be used to finance infrastructure, including transit. When a TIF district is designated, property tax revenues that go to the general fund from the district are "frozen" as of the date of designation. In subsequent years, the same amount of property tax revenue goes to the general fund, but any increased property tax revenue goes toward infrastructure and other improvements within the district. Forecasts of TIF revenues can allow the TIF administrator to issue bonds for infrastructure construction, essentially borrowing from future tax revenue streams. The TIF is usually established for a fixed time period, such as 30 years, after which all tax revenues revert to the general fund.

The use of TIF as a transit financing tool underscores the importance of increasing value of the assets and resources funding transportation through taxation. In other words, when this revenue is derived from property taxes, the transportation investment needs to add value to property to ensure a reliable channel of debt servicing. This provides an incentive for transit capital projects to be as context-aware and community-enriching as possible.

One of the reasons for interest in the Atlanta BeltLine project beyond the city of Atlanta itself is its potential for success in using infrastructure (or at least the promise of it) as a way to generate economic development and bolster the tax base. This is particularly noteworthy in Atlanta's case because the historically industrial land uses immediately adjacent to the BeltLine corridor of mostly unused railroads are in close proximity to single-family neighborhoods and have lacked the transportation access needed to accommodate more intense development. BeltLine transit investments, if successful, could set a precedent for how transit is coordinated with land development planning in American cities in the future.

This is not to suggest, however, that an 'if you build it, they will come' approach to transit investment and private development is a sufficient strategy on its own. Transit must be prioritized to serve urban environments with an existing propensity for population and employment density (and consequently ridership), and cannot be relied on purely as a catalyst for development. Local governments can and must prepare for successful transit by developing transit-supportive land use and development policies focused in the areas of transit corridors and stations.

Local or Regional Dedicated Funding for Mass Transit

Dedicated funding means providing a reliable source of annual revenues that provides support to transit operations and capital costs. It does not necessarily mean "new" or "increased" funding, but the expansion of existing transit service will necessitate new revenue. Revenues, which can be implemented in a variety of ways, are established on the front-end, by a legislative body or by the voters, to be dedicated for transit without being subject to the same kind of discretion associated with general fund revenues. This approach reduces the annual burden placed on local governments to find funding for public transportation and minimizes the uncertainty for public transit customers, operators, and the business community looking to invest along fixed transit routes.

State Infrastructure Banks

State infrastructure banks (SIB) are essentially revolving accounts that function similar to a traditional bank. These banks - which are set up by each state - may be funded using federal dollars, state dollars or a combination of both. As with traditional banks, SIBs can provide a variety of funding mechanisms such as loans and credit assistance for transit projects.

Transportation Infrastructure Finance and Innovation Act

This provision of SAFETEA-LU helps local jurisdictions focus on finding other means of financing larger-scale projects. More specifically, the idea is to shift the jurisdiction's mindset away from always using direct funding by the federal government toward realizing the potential money available from private capital leveraged by federal loan guarantees. These programs and options allow governments to finance projects and are able to start at a quicker pace instead of waiting years to get to the front of the line for federal funding and matches.

The Transportation Infrastructure Finance and Innovation Act (TIFIA) promotes using public-private financing options to fund transportation projects. These financing options include direct loans, loan guarantees, lines of credit, recognition of donated funds, property, in-kind contributions, and joint public-private financing of transit-oriented community economic development surrounding public transit properties. Projects such as transit, highways, and inter-city rail can be financed during planning, design work, environmental mitigation, construction, buying real property, reconstruction, and rehabilitation. All projects funded under TIFIA must be included in the Transportation Improvement Program and be approved by the local planning process.

Local Financial Forecasts

The 2035 Regional Transportation Plan provided a financial plan that includes forecasts of likely local revenues from various sources. Included here is information about programs that may be used to help fund transit in the Northeast Corridor.

Short-Term Revenue Projections, 2011-2015

Short-term revenue projections for TDOT-managed federal funds (e.g., IM, NHS, STP, etc.) were provided by TDOT and generally equal the programmed expenditures for the same period of time. MPO-managed federal funding sources (e.g., urban STP, FTA Section 5307, etc.) are generally assumed to grow at 3 percent per year above the observed 2010 appropriations and are added to carry-over balances of unobligated funding from prior years. Specific assumptions for each MPO-managed federal grant source follows:

- Urban FHWA STP – 3 percent annual growth starting in FY 2012 for allocations to the Nashville-Davidson Urbanized Area.
- Local Urban FHWA STP – TDOT has published a four-year award cycle for local STP funds for use by urban areas of 5,000 to 50,000 in population. No additional growth beyond TDOT's estimates for FYs 2010 through 2013 has been assumed. Local STP revenues for FYs 2014 and 2015 are assumed to be the annual average of the allocation for FYs 2010 through 2013.
- Large Urban Transit FTA Section 5307 – 3 percent annual growth starting in FY 2011, with an increase in the base funding amount in FY 2013 to $16 million due to the area's eligibility for the bonus awarded to areas with commuter rail service and a population of 750,000 or more.
- Bus and Rail Facilities/ Transit Earmarks FTA Section 5309 –Earmarks are contingent upon requests of the Tennessee Congressional delegation. The short-range forecasts include only those earmarks already identified; national trends are de-emphasizing and in many cases doing away with local earmarks.

Land Use and Transportation Connection

The relationship between transportation policy and land use and urban design policy is critical. Block sizes, street spacing, land use mix, intensity and density all have a profound impacts on the viability transportation choices and the kinds of transportation investments that make sense for a community. For many years, this relationship was poorly understood by planners and decision-makers, and the result has been decades of inefficient and expensive infrastructure systems driven by the proliferation of low density sprawl. **It is essential that the interrelatedness of transportation and land use decisions be addressed in future planning endeavors in the Nashville region.**

Mid- and Long-Term Projections, 2016-2035

While the process for predicting the funding levels for the mid- and long-term horizons is similar to that used for the short-term, the results come with significantly reduced certainty as laws may change or revenue sources are added or deleted. The following describes the set of assumptions used to project future federal grant sources:

- National Highway System (NHS) - For the mid-term, revenues are expected to equal the cost estimates associated with the projects TDOT will sponsor during the 2025 horizon. For the long-term, revenues are equal to a 4 percent per year growth in revenue beginning with a 2010 base year assumption of $25,000,000 per year in funding for projects in the greater Nashville region. This program could be used to help with HOV lane development on SR 386/SR 6.
- High Priority Projects (HPP) – HPP funding is made available through congressional earmarking and

is contingent upon requests of the Tennessee Congressional delegation. As noted above, the future of earmarks is unknown.

- Congestion Mitigation Air Quality (CMAQ) – Revenues are expected to grow by 4 percent per year beginning with a 2010 base year assumption of $3,800,000.
- TDOT Surface Transportation Program - For the mid-term, revenues are expected to equal the cost estimates associated with the projects TDOT will sponsor during the 2025 horizon. For the long-term, revenues are equal to a 4 percent per year growth in revenue beginning with a 2010 base year assumption of $27,000,000 per year in funding for projects in the greater Nashville region.
- Other TDOT Federal Funding – Other federal grant programs administered by TDOT that are not individually identified in the revenue projections (e.g., Transportation Enhancements, Safe Routes to School, Highway Safety Improvement Program, etc.) are assumed to be part of this category. Revenues are expected to grow by 4 percent per year beginning with a 2010 base year assumption of $10,000,000.
- MPO Surface Transportation Program - Revenues are expected to grow by 4 percent per year beginning with a 2010 base year assumption of $21,687,884 which reflects a combination of the individual MPO STP funding pots (e.g., Nashville-Davidson UZA STP, Murfreesboro UZA STP, local STP, etc.) which are expected to merge due to urban area expansion prior to the year 2025.
- FTA Section 5307 Large Urban Area Transit – Revenues are expected to grow by 4 percent per year beginning with a 2013 base year assumption of $19,000,000 which reflects a combination of the individual 5307 funding pots (e.g., Nashville-Davidson UZA, Murfreesboro UZA, etc.) which are expected to merge due to urban area expansion prior to the year 2025. 2013 is used as the base year since the region is expected to become eligible for a fixed-guideway bonus starting after the results of the 2010 Census are finalized.
- FTA Section 5309 Bus and Rail Facilities/ Transit Earmarks – Revenues are expected to grow by 4 percent per year beginning with a 2010 base year assumption of $5,000,000 and an additional $2,000,000 starting in 2016 for rail modernization. Earmarks are contingent upon requests of the Tennessee Congressional delegation.

7.2. Policy Recommendations

7.2.1. Current Policy Gaps

In general, the land use policies in the jurisdictions that would be responsible for planning station areas for the Northeast Corridor are reasonably well-suited to accommodating development that supports premium transit. Nashville-Davidson County has set a notable precedent, throughout the metropolitan region but also within the United States, for organizing land use and development policy around a more comprehensive definition of urbanism and character of the built environment than basic definitions of land use and intensity. Both Hendersonville and Gallatin have taken similar approaches to crafting land use policy. As a result, many of the station areas located along the Northeast Corridor, as defined in the discussion of potential light rail transit station areas in Section 6 and also in potential station locations for the Preferred Alternative bus rapid transit corridor, have policies and development standards already in place that will allow a form of development and a balance of uses amenable to transit.

However, the corridor does have locations suggesting potential for policy change in the long term, especially where residential districts are adjacent to or in close proximity to transit stations. The dynamic between promoting greater densities and a wider range of uses to support transit and preserving and protecting established residential neighborhoods from character-altering development is challenging to address, and it surfaces as a major land use planning factor with nearly any new transit project. Although this study does not recommend land use changes that would impact lower-intensity neighborhoods, the places where these neighborhoods are in close proximity to the transit corridors analyzed in this study are identified in this Section so that planners and officials of the corridor communities better understand the potential challenges in future corridor planning.

Overall, the land use policies of the corridor jurisdictions generally emphasize character, or the way that the built environment accommodates the role of a particular area of a community in that community's range of economic and social functions, over strict definitions of use and intensity. Nonetheless, there are some locations where the general guidance on allowed intensities is likely to yield less development in station areas than what would be considered optimal to make these areas self-supporting (and to generate transit ridership and maximize returns on a capital investment in transit infrastructure). These are discussed in detail in Section 6 for the conceptual station locations for the LRT alternative, and although they are oriented to a higher 'target' level of

intensity (and thus potential ridership) for that particular transit technology, these concerns are pertinent to any premium transit alternative and are reiterated in this Section.

Land Use Policy

Throughout the corridor, the level of attention in policy to urban design and physical form of the built environment varies. As stated previously, the corridor jurisdictions generally have progressive policies that consider where and how land uses can be combined, how to apply flexibility in site development, and how to structure land development in such a way that it reduces a need for vehicle trips. The degree to which this translates to actual development regulation varies, dependent largely on the strength of the supporting zoning ordinances. The following section identifies some of the key components of the land use policies of the corridor's five jurisdictions.

Nashville Land Use Policy and Community Character Manual

Nashville has, for nearly two decades, been governed by a progressive set of land use policies that not only specify intended future uses for a particular land use classification but also delineate urban design principles intended to define urban forms appropriate to the role that each land use district is envisioned to serve in the city's built environment.

Recently, the Metropolitan Planning Commission of Nashville-Davidson County has begun using its Community Character Manual (CCM) as the primary land use policy document for the combined city-county. The CCM is a part of Nashville's Concept 2010 comprehensive plan, replacing an earlier policy document that more closely resembles a future land use plan oriented to governing land use and density (the Land Use Policy Application, or LUPA). The primary difference between these two documents is that the Community Character Manual seeks to emphasize the character and form of development as part of a coherent district, where use and intensity are regulated, but not as the only criteria of a particular district. The LUPA did pay attention to the form of development, but it did not specify a range of intensities and community areas distinguishing between rural, suburban and urban development.

The CCM and its predecessor were both based on the concept of the built environment transect that has grown in use with the New Urbanism movement in town planning and urban design. This describes the various development patterns of a region from the most rural to the most urbanized areas and assigns general attributes of the massing and placement of buildings relative to streets and open space. In general, most of the area of Nashville-Davidson County within the Northeast Corridor is in more urbanized areas, suggesting that the CCM and Nashville's overall planning policy framework have identified this corridor as one area of the city where future development will be concentrated.

Hendersonville Character Areas

The City of Hendersonville also uses a system of character areas to define a variety of land uses that are desired for future development. The existing land use components of these vary, although the overall intent of each character area designation is to guide future development in forming recognizable districts of the city.

The Hendersonville Plan's Land Use element describes the character areas, and its Implementation element specifies the relationship between these character area definitions and the City's zoning ordinance.

Generally speaking, the land use element of the Hendersonville comprehensive plan recognizes traditional neighborhood development and the need to coordinate density with urban design, but these concerns are not supported by strong policy that clearly defines the City's vision for land use and development. In particular, the potential for development of a premium transit corridor is not mentioned in the land use policies. Future revisions or iterations of the Hendersonville plan should approach such possible transit investment as an opportunity to define land use policy with more specific objectives.

Gallatin Land Use and Urban Design Policy

Gallatin's land use policies are organized in a similar manner to Hendersonville's and Nashville's, with an emphasis on character of distinct parts of the city over specific land uses and development standards. As with the other jurisdictions, its land use policies are supported and implemented by zoning and development regulations.

Urban Design Policy

Throughout the corridor, the level of attention in policy to urban design and physical form of the built environment varies. Some jurisdictions have progressive policies that consider building form and are supported by detailed land use regulations intended to promote walkable, compact form that is the foundation of transit-oriented development, where other jurisdictions have future land use policies that are not strongly supported by current zoning.

Nashville Urban Design Overlays

To support its land use policies, Nashville uses a series of urban design overlay districts to augment conventional zoning requirements with a series of form-based standards and specifications, allowing the city to better implement the general form and characteristics of the CCM districts. This is

intended to preserve community character and aesthetics, but in the districts within station areas it also serves to promote a pedestrian-friendly built environment, arrange development intensity in such a way that built form is compact. The intent of these overlay areas has conventionally been to facilitate implementation of the land use districts defined in the Land Use Policy Application.

Gallatin Community Design Policies

Gallatin seeks to support its land use policies with a policy and ordinance framework that protects established community character and shapes the character of emerging community areas through urban design. One general objective among these policies is that new development be compatible with adjacent buildings in scale, building, massing, setback, and architectural details. Though this is clearly intended for preservation of existing character and urban form, it may limit the potential for transit-supportive land development if that development presents a significant change from surrounding building context. Given Gallatin's status as the end of the transit corridor and that stations will be located in and adjacent to its historic downtown, future policy revisions should incorporate more specific direction on how development can appropriately respond to potential transit investment.

Gallatin's urban design policy framework gives the City's planning commission authority to consider and accept plans that are not in strict compliance with its policies. This kind of flexibility is useful for accommodating the kind of fundamental change in urban fabric and community character that premium transit may bring, although it does not adequately articulate a vision for how this transit would best serve and fit into the Gallatin community. Ongoing comprehensive plan revisions should define this in policy.

Transportation Policy

It is important for both the regional long-range transportation plan and for local jurisdictions' comprehensive plans to emphasize a high priority for advancement of Northeast Corridor transit investment. To this end, ongoing revisions to the Nashville region's long-range transportation plan should continue to emphasize the corridor as a major regional priority. At the local level, this initiative should be expressed not only as a part of the transportation policy framework, but also in other comprehensive plan policies to which transportation decisions are related (such as those governing future land use, affordable housing and economic development).

The local land use and development policies in Nashville, Hendersonville and Gallatin emphasize desires for supporting transportation infrastructure, especially streets and sidewalks. They pay attention to block sizes and street spacing, the provision of sidewalks, and the need for other pedestrian infrastructure such as intersection crosswalks. These are all highly important components of a strong pedestrian realm that is crucial to a successful transit system.

The plans for Hendersonville and Gallatin identify a need for regional transit connections to the rest of the greater Nashville region.

At the time of development of these plans, this mobility study was still in progress and specific information on alternatives and alignments was not included in local comprehensive planning efforts. As the comprehensive plans and jurisdictional transportation plans are updated, specific attention should be given to the transit corridors to identify the following:

- Capital projects for improving pedestrian infrastructure to enable and facilitate transit access.
- Policies supporting public transit expansion and defining priorities for capital improvements around station areas to facilitate development
- Policies identifying community needs and desires for supporting transit service (outside of the premium transit of the Northeast corridor).
- Regulatory policies, including alternative zoning districts and zoning overlays, specifically designed to implement transit-supportive land use densities and urban design

7.2.2. Recommended Policy Changes

Policy Recommendations Matrix

Table 7.2 details land use policy and general planning approaches to supporting transit, respectively. Table 7.2 identifies the different future land use/character area classifications in each jurisdiction with a station area defined in the LRT or Preferred BRT alternatives. Although portions of the actual corridor may pass through Goodlettsville and unincorporated Sumner County, land use policies in these jurisdictions are not reviewed at the same level of detail. Instead, general guidance is offered on the appropriateness of the land uses in those jurisdictions lying in the Northeast Corridor area to premium transit.

Table 7.2 discusses other local and regional policies intended to shape future transportation mode choice, travel patterns, and the integration of public transit into the Northeast Corridor communities. It offers guidance on the strength of these policies and potential refinements to the policies for future revision cycles.

Table 7.2: Land Use Policy Recommendations Matrix

City	Land Use Plan	Governing Land Use Category	Land Use Standards	Urban Design Standards	Appropriateness to Transit Service and Recommendations for Modification
Nashville-Davidson County	**Land Use Policy Application Structure Plan**	Downtown Core (DC)	A wide range of land uses typical in downtown urban core districts is allowed, including offices, retail, dining, entertainment, high-intensity residential and public benefit/public service uses.	Standards are specified to be consistent with highest transect category (T6: Urban). Buildings are built to the public right-of-way, facades at street level maintain pedestrian scale, sidewalks of adequate width for pedestrian circulation are to be provided.	No significant changes needed. Policy enables intensity and use balance to support high-capacity transit.
		Neighborhood General (NG)	Although primarily oriented to single-family residential and neighborhood commercial land uses, some multi-family uses are supported and allowed densities are higher than in other single-family areas, largely a function of smaller lot sizes.	Standards are compatible with more intense, urban transect categories (T4 and T5). Site-specific parameters such as setbacks and lot widths may vary. Generally established neighborhoodswill not support significant land use change.	Successor policies and supporting ordinances or regulations may consider defining transitional standards allowing higher densities that are appropriate to neighborhood context near transit stations.
		Neighborhood Center (NC)	Generally provides the non-residential components that complement neighborhoods.	Shallow setbacks or no setback are specified, along with alley access to properties and parking located behind buildings or on street.	Future policies incorporating neighborhood activity center areas should provide guidance on maximizing development yield while preserving neighborhood fit and attention to context characteristics; these may consider parking reductions, especially for small-scale uses, near transit stations.
		Industrial (IN)	Typical industrial land uses permitted, although a broad range, with both light and heavy manufacturing, storage, distribution, contractor businesses and physical plants.	Setbacks are allowed to vary based on building type and location. Front-loading property access is acceptable.	Although industrial areas are typically not highly transit-supportive, generally little change is needed in successor policies; due to the nature of industrial areas, truck access demand is likely to be high, although policies currently emphasize integration into surrounding use areas and character districts.
		Office Concentration (OC)	Seen as an 'office submarket' land use with appropriate complementary uses (such as restaurants and higher-intensity residential) allowed.	Little direction is provided. Policies offer flexibility to differentiate these uses from more conventional office districts and to emphasize important connections to expressways and highways.	Successor policies guiding office-oriented development could specify stronger urban design standards facilitating pedestrian access to transit and to other land uses within the district. Office is a major transit-oriented land use and office districts offer high potential for transit ridership.

Table 7.2: Land Use Policy Recommendations Matrix (continued)

City	Land Use Plan	Governing Land Use Category	Land Use Standards	Urban Design Standards	Appropriateness to Transit Service and Recommendations for Modification
Nashville-Davidson County	**Land Use Policy Application Structure Plan**	Residential Medium Density (RM)	Target densities of 4 to 9 dwelling units per acre. Generally applied to existing, established neighborhoods in the Northeast Corridor. Only residential, civic and open space uses are supported.	Street onnectivity is emphasized, although site-specific development standards encourage deeper setbacks and larger lot sizes.	RM districts are generally less amenable to transit-supportive densities, although they are often designated in established neighborhoods. Consider augmenting successor policies on development to include pedestrian connections to transit; add policies intended to identify new pedestrian connections to transit for existing neighborhoods
		Retail Concentration Community (RCC)	Primarily non residential uses, mainly retail; scale is emphasized as smaller than that of a regional shopping mall. Policies seek to avoid big-box retail, but do indicate importance of location on the regional highway system.	Pedestrian connections are emphasized to encourage 'park once' pedestrian circulation. Parking in front of buildings is allowed.	Scale and limited uses are unlikely to support transit well without added intensity; successor policies may consider the addition of office uses to expand the land use offerings and increase potential for these areas to generate transit ridership
		Retail Activity Center (RAC)	Retail-focused centers anchored by regional malls. Uses include retail, office, high-density residential and public uses.	Policy calls for detailed design plans. RACs are designated in Nashville's Concept 2010 plan and are intended to be developed with detailed master planning efforts. Policy specifically calls for a high level of pedestrian connectivity to facilitate internal trip capture and non-vehicular connection between uses.	Policy emphasizes a need for mass transit service to these land use districts. Successor policies should emphasize meaningful transit connection principles and provide guidance on how to integrate parking facilities intended for transit into an overall area development master plan.

Table 7.2: Land Use Policy Recommendations Matrix (continued)

City	Land Use Plan	Governing Land Use Category	Land Use Standards	Urban Design Standards	Appropriateness to Transit Service and Recommendations for Modification
Nashville-Davidson County	**Community Character Manual**	Transect District T6 (Core)	The Core transect district supports a variety of land uses that promote walking and other non-vehicular trips. It is generally reserved for downtown Nashville and is intended to feature the greatest intensity of development of the entire metropolitan area.	Urban design standards generally feature high levels of pedestrian access and walkability, suggesting strong transit connection potential to come from future development.	No significant changes recommended; Metro Planning Council currently in process of adopting CCM to replace LUPA
		Transect District T5 (Center)	Centers are intended for 'secondary cores' throughout the region and generally support transit through high intensity development and mixed uses.	Urban design standards generally feature high levels of pedestrian access and walkability, suggesting strong transit connection potential to come from future development.	No significant changes recommended; Metro Planning Council currently in process of adopting CCM to replace LUPA
		Transect District T4 (Urban)	The Urban transect district supports a variety of land uses that promote walking and other non-vehicular trips. It features an urban mixed use corridor land use type intended to balance traffic movement with pedestrian circulation and access, as well as public transit accommodation.	Because of the variety of character types associated with this transect, the primary direction provided for urban design is consistency and coherence throughout each character area. In the case of Urban Mixed Use Corridors, this involves uniform building heights, massing and location should be consistent.	No significant changes recommended; Metro Planning Council currently in process of adopting CCM to replace LUPA

Table 7.2: Land Use Policy Recommendations Matrix (continued)

City	Land Use Plan	Governing Land Use Category	Land Use Standards	Urban Design Standards	Appropriateness to Transit Service and Recommendations for Modification
Hendersonville	Hendersonville Land Use and Transportation Plan	Regional Activity Center / MU	3 to 15 residential units per acre; 0.35 to 2.0 FAR for non-residential uses	Connectivity is emphasized, though only moderately; typical street spacing is every 800 to 1,500 feet. Building heights are 1 to 6 stories	Successor policies may consider smaller block faces along transit corridor streets to ensure that street spacing do not impair pedestrian access to transit. Densities are more likely to support transit, although they could be increased to offer better support (see station area analyses in Section 6).
		Suburban Neighborhood / IPF	1 to 4 dwelling units per acre in single-family; 8 to 12 units in multi-family.	Grids and connectivity are encouraged, but typical street spacing is envisioned as 1,500 to 3,000 feet.	Successor policies may consider (off-street) pedestrian connection requirements in station areas to ensure that larger blocks and greater street spacing do not impair pedestrian access to transit. Overall, densities are likely to be too low to support transit, although these have likely established in policy to respond to established neighborhood patterns.
		Employment Center / Office	No residential uses envisioned; 0.2 - 0.5 FAR for non-residential uses	Street connectivity is not emphasized; typical street spacing is 1,300 to 1,500 feet. Building heights range from 1 to 4 stories.	Character area does not provide strong guidance for urban form; precedents cited by policy are a more conventional suburban form and are not likely to be transit-supportive. Successor policies should consider more specific guidance on urban design that promotes pedestrian access and circulation.
		Employment Center / GC			
		Suburban Center / GC	No residential uses envisioned; 0.2 - 0.5 FAR for non-residential uses	Street connectivity is not emphasized; typical street spacing is 1,300 to 1,500 feet.	Successor policies may consider (off-street) pedestrian connection requirements in station areas to ensure that larger blocks and greater street spacing do not impair pedestrian access to transit. Overall, densities are likely to be too low to support transit; policies may consider increases of intensity in station areas.
		Suburban Center / Office			

Table 7.2: Land Use Policy Recommendations Matrix (continued)

City	Land Use Plan	Governing Land Use Category	Land Use Standards	Urban Design Standards	Appropriateness to Transit Service and Recommendations for Modification
Gallatin	**Gallatin on the Move Land Use and Transportation Plan**	Neighborhood Center	0.35 FAR, similar mix of uses to downtown, although residential types are typically more limited to townhomes and small multifamily buildings	Street connectivity and lower level of service thresholds are emphasized.	FAR is low for supporting transit, although the scale of land area on which this district is applied is limited. Transit support is likely to come from downtown district in Gallatin.

Table 7.2: Land Use Policy Recommendations Matrix (continued)

City	Land Use Plan	Governing Land Use Category	Land Use Standards	Urban Design Standards	Appropriateness to Transit Service and Recommendations for Modification
Gallatin	**Gallatin on the Move Land Use and Transportation Plan**	Suburban Neighborhood - Revitalization	Primarily residential land uses; 1 to 3 units per acre.	Connectivity not strongly emphasized. Block sizes are specified as long, but regularity of the street network is not specified as important.	Not likely to support transit. Successor policies needing to continue addressing existing neighborhoods may consider guidance for non-street pedestrian connections allowing these established neighborhoods access to transit.
		Commercial Corridor	0.75 FAR; residential mix limited to apartments and townhomes, with office and retail vertical mixed encouraged.	Street connectivity is emphasized, although medium levels of service are still desired.	Densities not likely to be highly supportive of premium transit; future policies may consider provisions for higher intensity or a bonus system around station locations.
		Emerging Walkable Community	Oriented primarily to residential uses, though intended to provide for efficient infrastructure use and support future transit investment. Overall densities from 3 to 8 units per acre.	Block sizes and street connectivity are emphasized, though block sizes are large (2,000 to 3,000 feet for block perimeter).	Though intended to balance residential preferences with a need to better utilize infrastructure, densities remain low for supporting transit. Future policies may consider density increases in transit station areas with guidance for transitions to established neighborhoods.
		Broadway/ Tobacco Warehouse	1.0 FAR, industrial-commercial mix of land uses. This is a unique area of historically industrial land uses and older industrial and commercial buildings. Little change is expected in this area, and indeed it is less likely to accommodate change than a more conventional downtown district.	Urban design emphasizes build-to lines, pedestrian access, side and rear access for parking and service vehicles and preserving historic character of older industrial buildings	No significant changes recommended; successor policies may consider greater intensity provisions in station areas.
		Downtown	5.0 FAR, Vertical mixed use that includes a variety of residential types, commercial, office, and public/institutional uses	Network connectivity is emphasized, along with direct property access from streets and alleys. Transportation policy suggests that vehicle congestion and lower levels of service are acceptable.	No significant changes recommended; successor policies may consider expansions of downtown district policy and standards for new developments to allow intensity.

7.3. Conclusion

This study has successfully concluded that there is strong support in the Northeast Corridor for transit, and a transit system in the corridor will achieve a host of economic development, transportation, and quality-of-life goals. The Northeast Corridor Study has established two complementary transit visions. In the short-term, the region will work toward implementing a bus rapid transit system, while simultaneously pursuing a long-range vision for light rail transit Ellington Parkway/SR 386. While there is strong local support for a Light Rail Transit system in the Northeast Corridor, local jurisdictions and citizens must take several actions if it is to become a reality:

- Conduct a robust public education campaign to build support and make sure the entire community understands the benefits of transit
- Revise land use plans and policies to allow for greater density and transit-supportive mixed land uses
- Provide economic incentives for private developments that will support transit
- Leverage federal and local funds creatively to provide infrastructure that will support transit
- Build a Bus Rapid Transit System on SR 386/SR 6 that will provide congestion relief, attract transit-supportive development, and build ridership
- Monitor land uses and transportation patterns and revisit transportation modeling on a regular basis, for example every five years, to evaluate the feasibility and potential competitiveness of a Light Rail Transit System

Regional public officials, stakeholders, and citizens have come together to form a transit vision for the Northeast Corridor. Though much work remains to be done, this study provides a critical first step and a guiding framework to making transit a reality in the Northeast Corridor.