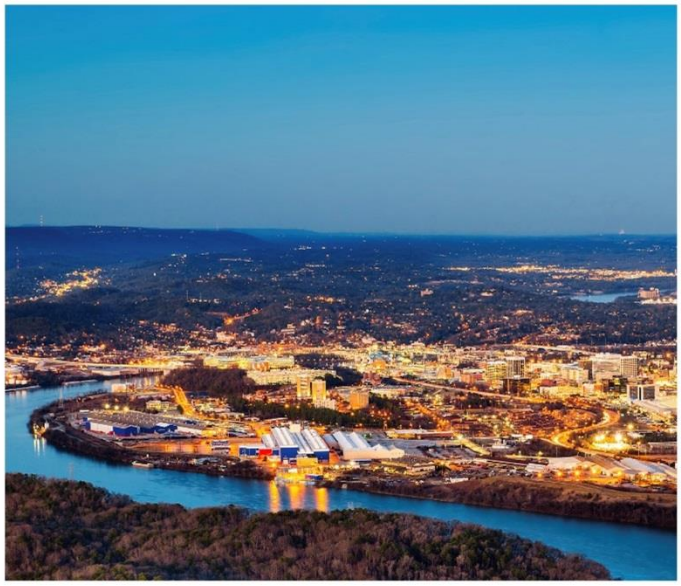
Rail Transit Feasibility Study



submitted for

City of Chattanooga

submitted by

Cambridge Systematics, Inc.

with

Gresham Smith & Partners

Kimley-Horn Associates

Younger Associates

September 2016

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1.0 Introduction

The City of Chattanooga has experienced an urban renaissance in the last 30 years. Emerging from a past of severe industrial air pollution, it has become a thriving and revitalized community that attracts young professionals who might otherwise have chosen Nashville, Austin or other "new economy" cities to make their homes and grow their families.. Downtown Chattanooga has added mixed-use developments, enhanced pedestrian and bicycle facilities, and enhanced green spaces. Also referred to as the "scenic city," most parts of Chattanooga are directly accessible to rivers and trails and the city has made efforts to ensure that its scenic quality is preserved. This is compatible with one of the city's other top priorities; namely, to reduce auto dependency and promote multimodal transportation options.

With this growth, roadway congestion has increased on the limited facilities that provide cross-regional travel, and topographic, together with financial and other constraints have and will continue to limit the expansion of highway facilities.

To ensure continued mobility and economic opportunity, and continuing a long-history of strategic, multimodal transportation planning and investment, the City of Chattanooga has conducted an initial feasibility study for reintroducing passenger rail service on 20-plus miles of existing rail corridors that have provided mobility over the past century. These corridors connect major employment and activity centers within the region, as well as historic parts of the city that have suffered from under-investment over past decades.

A RETURN TO RAIL

Chattanooga's railroad history began in 1850 with the arrival of the Western and Atlantic line, followed in 1858 by the East Tennessee, Virginia, and Georgia Railroad.

The City soon became the "gateway to the south" and maintained a dominant position as a transportation hub for many decades.

The city's intimate association with trains dates back to Glen Miller's "Chattanooga Choo Choo", which in 1942 became the first "gold"-selling record in the world.

Today, it is trucks and automobiles rather than railcars that dominate transportation in the region.

The City was awarded a Transportation Investments Generating Economic Recovery (TIGER) grant to investigate the feasibility of local passenger rail which opens the door to a return to passenger rail as part of the transportation mix that will support a vibrant economic future for Chattanoogans.

Although the concept of local passenger rail dates back a couple of decades, the subject of this study arose from the Chattanooga-Hamilton County/North Georgia Transportation Planning Organization (CHCNGA TPO) 2040 Regional Transportation Plan (RTP) process. As part of 2040 RTP development, a multiagency transit visioning workshop was convened in August 2012 to discuss overall transit needs in the region and to outline a long-range vision for transit in Chattanooga. At this event, participants representing the Regional Planning Agency, the Chattanooga Area Regional

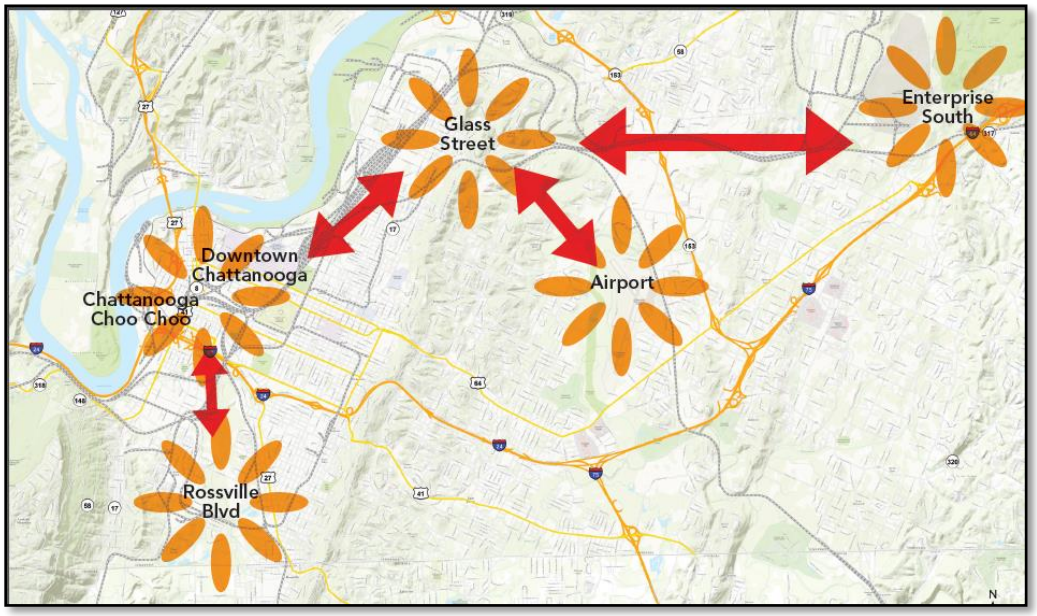
Transportation Authority (CARTA), the City and other partner agencies identified a project providing passenger rail on the historic Tennessee Valley Railroad corridor connecting downtown with the Airport and Enterprise South as a high priority for a balanced, multimodal transportation system to serve the City in the future.

The Tennessee Valley Railroad and East Chattanooga Belt Railway corridors are used by the Tennessee Valley Railroad Museum (TVRM) excursion trains and by infrequent freight delivery services to a small number of industrial customers in East Chattanooga. Many of the properties along the alignment are rundown or under-utilized and hence good potential candidates for redevelopment. Instead of a continuation of development along the region's arterial highways, this project as envisioned, would facilitate more compact and walkable higher-density commercial and residential development and redevelopment along the railroad ribbon, with direct and convenient pedestrian access from stations.

Briefly referred to as the "Chattanooga Way", the project would provide an opportunity to build upon a strong rail backbone in the region to enhance both mobility and economic development, and contribute to a vibrant future for Chattanoogans.

Figure 1-1 presents the passenger rail corridor previously identified during the 2040 RTP and identified in the TIGER grant application to FTA. The rail feasibility study, initiated in 2015, refines the initial rail corridor concept by identifying a range of feasible rail transit alternatives, including potential specific alignments and transit technology modes. The study area extends from south and west of downtown across the interstate and north into downtown, then following the Tennessee Valley and East Chattanooga Belt railroad rights-of-way to the northeast, past Missionary Ridge to the airport and continuing to the Enterprise South area.

Figure 1-1 Passenger Rail Study Corridor



2.0 Study Area Needs and Challenges

The first phase in this study was to identify and quantify where possible the mobility needs and challenges for the study area to assist in defining the project opportunities, constraints and goals.

From the outset, the study was intended to be conducted in an open and transparent public manner consistent with the City's approach on other projects.

2.1 Community Engagement and Coordination

Public engagement in the rail feasibility study process was critical to advancing discussion on alternative investment strategies to identify and address long-term mobility and economic development needs. A public involvement plan was developed for this study, which was adhered to throughout the study process, adjusted and amended as necessary. The plan is provided in Appendix A.

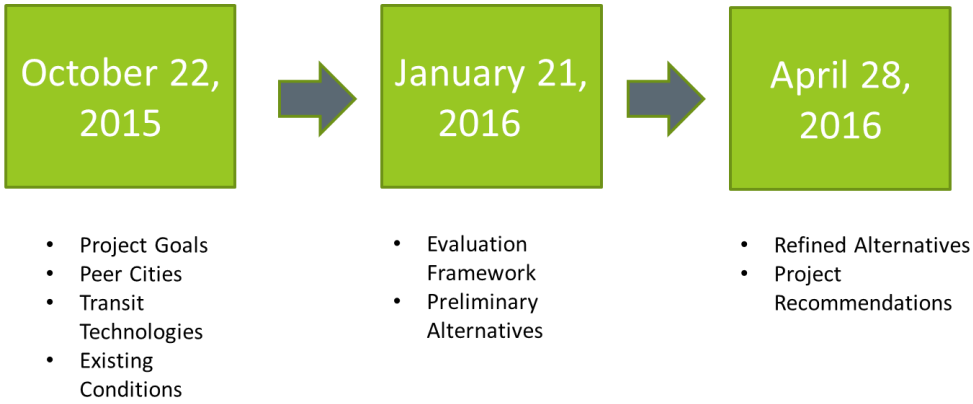
The public engagement process utilized proven techniques for reaching the public to develop an understanding of how passenger rail can provide a needed transportation alternative for many segments of the population, facilitate economic development, and improve quality of life for people living and working in the region. A variety of stakeholder groups were identified, with outreach methods targeted to the unique stakeholder needs and market characteristics of each. Input was ongoing, extensive, and imperative for the rail feasibility study process.

In total, engagement efforts resulted in:

- 600+ person email distribution list
- 30+ meetings
- 200+ meeting attendees, with evaluation forms completed by many
- 160+ stakeholders in-person
- 220+ web surveys

2.1.1 Public Meetings

A series of three public workshops was held to engage the public, stakeholders, businesses and neighborhood groups in visioning transit-ready development along the corridor. Workshops were held on October 22, 2015 (project goals and existing conditions); January 21, 2016 (preliminary alternatives evaluation); and April 28, 2016 (proposed alternative and project recommendations).



The first public meeting focused on the study background and goals, project purpose and need, existing conditions, review of peer cities and review of modes and technologies. The public participated in prioritizing the goals and objectives of the project. Eighty-eight members of the public attended the meeting and the total attendance including local officials and study team members was over 100 people.

The second public meeting provided a review of all public input received to date and conceptual alternatives (described in Section 3) and was attended by over 115 members of the public

At the third public meeting, input received to date was reviewed with more than 60 members of the public participating. At this meeting, a preferred alternative was presented including operating plans, economic impacts and transit oriented development options, and bicycle/ pedestrian network elements.

At each of these public meetings, attendees were asked to provide feedback on various topics presented to them using different methods:

- the first meeting used a live voting exercise using electronic keypads to obtain input on project goals and objectives,
- the second meeting also used electronic voting to provide input on their preferred alternative from a range of three presented, and
- the third meeting included voting with game money on how they would like to see financial resources allocated to the rail project as opposed to other transportation investment needs.

2.1.2 Stakeholder Engagement

A wide range of transportation and community stakeholder groups were engaged throughout the study process to ensure that the project team provided a high level of information to these folks, and similarly heard and digested their input on the problems, opportunities and recommendations. The focus was on the following different stakeholder groups:

- **Transportation Vision Committee.** Consisting of representatives from CARTA, Chattanooga Department of Transportation, Chattanooga-Hamilton County Regional Planning Agency, Tennessee Department of Transportation, City of Chattanooga, Tennessee Valley Rail

Museum, the group met periodically during the study to plan and evaluate public meetings as well as the technical aspects of the study.

- **Neighborhood Associations**. Identified through the City's neighborhood databases, current officers of several neighborhood groups along the study alignment were invited to targeted meetings as part of the October and January public meeting rounds, as well as to neighborhood and station area planning charrettes held in February and March.
- **Business Community Engagement.** Also through the City's economic development and community group databases, several dozen interested business people were invited to rounds of tailored stakeholder meetings in October and January, when two alternate times were offered to increase the opportunities for participation and to gain insights and input from the folks running businesses in the study area and along the potential project alignment.
- **Local Elected Officials.** A number of one-on-one briefings were conducted in November and December with senior elected officials representing the study area including a Senator and a Congressman. The briefings provided opportunities to uncover investment needs and to gather recommendations of these knowledgeable key stakeholders.
- **Foundations and Non-Profit Groups** representing downtown Chattanooga as well as environmental, economic and community development and educational interests were invited to targeted stakeholder meetings in October and January.

2.1.3 Agency Coordination

The rail feasibility study project team conducted regular project update meetings throughout the duration of the study with federal, state, and local agencies to ensure efforts were coordinated with other planning initiatives and conducted in a manner consistent with federal and state guidance and requirements. Partner and coordinating agencies in addition to the Chattanooga Department of Transportation (CDOT) included the following:

- Federal Transit Administration (FTA)
- Chattanooga Area Regional Transportation Authority (CARTA)
- Chattanooga-Hamilton County/North Georgia Transportation Planning Organization (TPO)
- Tennessee Department of Transportation

Monthly teleconferences were held prior to submission of monthly status reports to the Federal Transit Administration (FTA), as the grant awarding and oversight authority.

2.1.4 Traditionally Underserved Communities

An array of outreach tools were utilized to reach and engage segments of the population traditionally underserved by transportation and not frequently engaged in public planning.

- Public events were held in venues that are ADA compliant and served by public transit.
- Notices of public events were posted on CARTA buses and in locations that serve low-income and low English literacy populations.

- Notice of public events were distributed through the Chattanooga Neighborhood Services Department.
- Notices of public events and opportunities to provide input for the rail feasibility study were distributed to places of worship and community centers.
- Outreach was conducted in partnership with the City's Neighborhood Services.
- A project meeting/charrette was held at the East Chattanooga Youth and Family Development center within easy walk of the Glass Street neighborhood
- Accommodations were in place at each public event for persons with hearing and sight impairment and low English language literacy, a Spanish-speaking rail feasibility study team member was present for public meetings and forums as well as any special outreach to the Hispanic community.
- The option was provided for people to receive project information via text messages.
- Meeting and informational materials included a list of frequently asked questions and answers and a survey were provided in English and Spanish.
- Digital communications were utilized in reaching traditionally underserved communities.

2.1.5 *Railroads*

The rail feasibility study project team facilitated proactive outreach and engagement with railroads – including the following:

- Norfolk Southern,
- CSX,
- Hamilton County Rail Authority

The team conducted regular project update meetings to ensure consistency with railroad plans and requirements.

2.1.6 *Digital and Traditional Communications*

To allow the public to have continuous access to information about the rail feasibility study and ongoing opportunities to provide input, digital communication were utilized and updated regularly.

- Project web page www.chattanooga.gov/rail was maintained on the City of Chattanooga's web site to allow the public to sign up to receive information including meeting notices and meeting materials.
- Social Media was be used to provide information about rail feasibility study including Twitter and Facebook, with a Facebook project page and a webcast at the outset of the project.
- Emails to stakeholders and individuals were sent to those who signed up to receive information

Traditional communications also included:

- Official notice in The Chattanooga Times-Free Press, the newspaper of record
- Public service announcements to all media outlets in Hamilton County

2.1.7 Continuing Communications and Outreach

Following the completion of the Chattanooga Rail Implementation Study, continuing communication and outreach is recommended due to the level of interest in the project exhibited in the public involvement process.

- Maintain the www.chattanooga.gov/rail website, providing news and updates
- Continue to send periodic messages on Twitter and via text to maintain the contact database that was enlarged by the study, and provide updates on the Facebook page devoted to Chattanooga Rail.
- Provide easy access to the study for police, fire and other safety officials
- Conduct another round of stakeholder meetings for businesses, foundations and neighborhoods and add another stakeholder group for all parties interested in a bicycle/pedestrian network
- Keep the Transportation Vision Committee intact
- Hold post-study briefings for public officials

2.2 Prior Plans and Studies

A dozen studies completed in Chattanooga over the past decade have addressed transportation and community conditions and needs that are also addressed in this passenger rail feasibility study.

Table 2-1 provides a description of these plans and a brief description of their focus and findings. They are addressed in further detail in Appendix B.

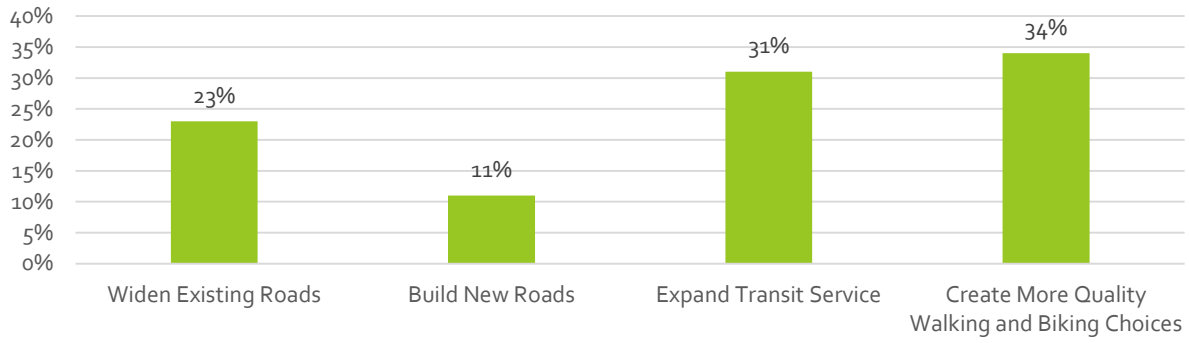
Table 2-1 Relevant Plans and Studies

Study (Year)	Author	Description
Mass Transit Alternatives (2009)	Chattanooga-Hamilton County Regional Planning Agency (CHCRPA)	Recommended improvements to alternative transportation modes, including developing criteria for when sidewalk construction is appropriate; identified areas that need sidewalk reconstruction; install "Trampe" bicycle lifts to assist bicyclists up hilly terrain; create transit "Ride Free Zones" in the CBD for employees to use for lunch and maybe entice them to ride daily commute; negotiate with major employers about dedicated commuter bus or van routes.
2035 LRTP Complete Streets Section (2010)	CHCRPA	Identifies benefits of complete streets and locations where are appropriate, and advocates for implementation. Provides guidance on how to measure the performance of complete streets.
On Board Transit Survey (2011)	CHCRPA	Summarizes the results of an on board transit survey distributed on CARTA buses. The results provided insight on the socioeconomic characteristics of transit riders, trip characteristics, and gathered feedback on the service.
Chattanooga Housing Study (2013)	CHCRPA	Evaluates overall housing and affordability across Chattanooga. Recommendations included implementing a targeted neighborhood revitalization strategy, developing an appropriate review process for developing infill sites, and formulating an urban land banking and redevelopment program.
Housing Affordability and Vacancy in the City of Chattanooga (2013)	CHCRPA	Investigated the cost of renting/owning a house with respect to income levels across Chattanooga. The most and least affordable neighborhoods and their vacancy rates were identified; also share of residents with a mortgage, no mortgage, and/or housing burdened.
Travel Demand Model Peer Review and 2040 RTP Travel Demand Model Documentation (2013)	FHWA	FHWA peer review evaluated the RPA integrated land use and travel demand model. Recommendations were used to update the travel demand model during the 2040 RTP, with enhancements to improve functionality, adding capabilities and refining the methodology.
The Chattanooga-Hamilton County 2040 Regional Transportation Plan (2013)	CHCRPA	The *2040 Regional Transportation Plan* identifies a mobility vision and establishes transportation priorities for the next 20+ years. In addition to summarizing the existing transportation conditions, the document guides transportation investment decisions based on forecast changes in population and employment.
Participation Plan for Transportation Planning (2013)	CHCRPA	Discusses the MPO procedures for participation and involvement of stakeholders in the transportation planning process. These procedures ensure consistency and completeness for all transportation documents and public forums.
Downtown Chattanooga Housing, Retail, and Office Market Opportunities (2014)	River City Company	For the River City Company, this study identifies current development trends in downtown Chattanooga, including the development needs and how these trends can affect real estate activity. Findings included a need to provide basic retail and community amenities and that there is strong interest to increase housing opportunities in the downtown area.
Chattanooga Complete Streets Policy City Ordinance (2014)	City of Chattanooga	Ordinance outlines the city's complete streets policy, focusing on multimodal transportation system accessibility for all residents. Transit is a large component of the ordinance as well as its connectivity to walking and bicycling.
Development of Form-Based Code (2015)	CHCRPA	Form-based codes are an alternative to traditional zoning regulations, based on the physical form, rather than individual uses. Form-based codes were prepared for five downtown neighborhoods, with the goal of making development easier and supporting the desire of downtown to be urban, high quality, and walkable.

2.3 Regional Mobility Choices

As noted above, the Chattanooga 2040 RTP addressed the passenger rail concept, identifying the preliminary purpose and need for potential passenger rail service in the region. The RTP points to the need for a more balanced and cost-effective transportation system. **Expanded transit service was cited by nearly one third of 2040 RTP survey respondents as the most cost-effective type of investment moving forward.** This was a striking result given that 70 percent of respondents are not current transit users, but indicated they would likely use transit if it were high-speed or passenger rail. (2040 RTP).

Figure 2-1 Survey Response to "What will provide the biggest bang for the region's bucks?"



Source: CHCRPA 2040 RTP

The 2040 RTP also began to build connections between improved access to transit and economic opportunity and growth for the region. Throughout much of the region, current transit coverage is sparse: just one in five homes is within walking distance (¼ mile) of a CARTA transit stop and one in three is within a one-mile bike ride of a transit stop; only half the jobs are transit- accessible. Many disadvantaged areas with transit dependent populations have little or no transit access, limiting cost-effective means to access employment and driving up overall transportation cost burden. The average household transportation cost for the CHCNGA TPO region is 32.4 percent of median income, more than twice what the Center for Neighborhood Technology suggests is affordable. Generally speaking, transportation costs are highest for households in places that are least accessible and have the fewest options (walking, biking and transit in addition to auto) available, placing a disproportionately high level of cost burden on disadvantaged populations.

2.4 Existing Rail Infrastructure

As part of the rail feasibility study, a detailed assessment was conducted of existing rail infrastructure along the proposed passenger rail corridor to determine the feasibility of potential passenger rail service. The work is documented in Appendix C. The Tennessee Valley Rail Museum (TVRM) operates and maintains two rail lines within the rail feasibility study area, the TVRM railway and East

Chattanooga Belt Railway (ECTB). These two rail lines were identified as viable rail corridors for future passenger service. The termini for sections studied are as follows:

- TVRM – from the eastern museum / storage facility (near the intersection of Cromwell Rd and Jersey Pike) to the western museum facility / maintenance yard (near the intersection of North Chamberlain Avenue and Crutchfield Street)
- ECTB – from the TVRM western museum facility / maintenance yard (near the intersection of North Chamberlain Avenue and Crutchfield Street) to the intersection of S. Holtzclaw Avenue and 13th Street
- Chattanooga Choo-Choo – The loop track owned by the Chattanooga Choo-Choo and confined to its property

With uncertainty regarding comingling of passenger and freight service along active freight lines (e.g. Norfolk Southern, CSX, etc.), an assumption was made that any utilization of these corridors would be on new parallel tracks. Therefore a detailed assessment of existing infrastructure was not performed for active freight lines. A detailed summary of existing rail infrastructure for the TVRM, ECTB, and Chattanooga Choo Choo lines is provided in Table 4.1.

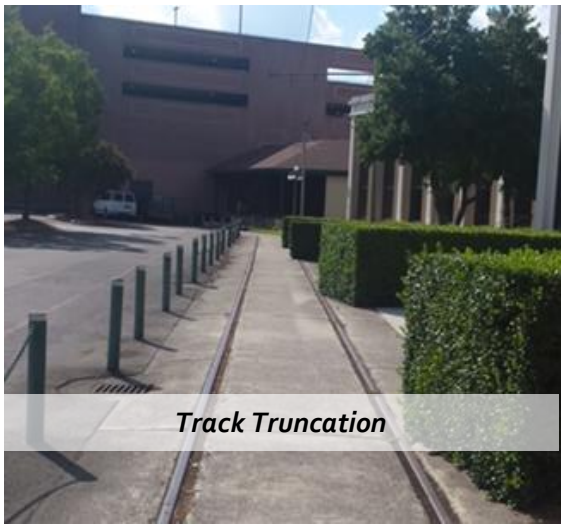
Key challenges associated with existing rail infrastructure include:

- Use of the Missionary Ridge Tunnel
- Linking future rail service between downtown Chattanooga and the ECTB
- Linking future rail service between the TVRM and Enterprise South

Select opportunities include:

- Well maintained rail facilities along the TVRM and ECTB sections
- Ample ROW along the ECTB and TVRM rail corridors
- Existing grade separations over rivers, streams, roadways, and railways

Figure 2-2 Example Rail Infrastructure Assessment Categories



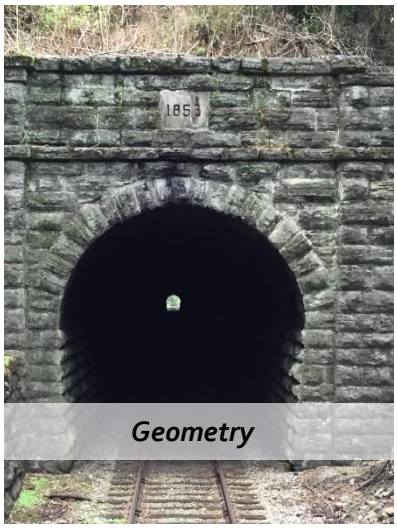


Table 2-2 Infrastructure Assessment Summary

Conditions Category	TVRM	ECTB	Choo-Choo
Track Mileage	4.7	6.0	1.3
Existing Right-of-Way (feet)	80 to 350	50 to 160	N/A*
Track Material	Gauge bolted rails on wood tie and ballast	Gauge bolted rails on wood tie and ballast	Mix of wood tie and ballast and embedded tracks
Track Condition	• Good condition • Receives routine maintenance	• Good condition • Receives routine maintenance	• Ballasted track in state of disrepair • Bolted rails out of tolerance for gauge and horizontal geometry • Embedded tracks in good shape but no stray current protection and have been truncated by construction
Sidings	2 siding locations adjacent to main track	3 siding locations adjacent to main track	None
Siding Lengths (feet)	800 and 1,000	420, 500, and 1,000	N/A
Number of Switches	15	6	3
Number of Signals (Rail Use Only)	None	10	None
Number of Signals (Vehicle Use)	1	3	None
Horizontal Geometry	• Majority single tracked • Sections of pocket track, sidings, and spurs	• Majority single tracked • Sections of pocket track, sidings, and spurs	• Single tracked • Self-contained
Track Elevation Range (feet above sea level)	695 to 743	660 to 734	669 to 678
Clearances Issues	Historical tunnel under Missionary Ridge may require additional vertical clearance	None**	None
Grade Separations	4	None	None
At-Grade Crossings	1	21	None
Power Supply	None***	None***	Overhead Contact System (not operational)
Utilities	None	• Power Lines • Roadway Traffic Signals at intersections and crossings	None

* The Chattanooga Choo Choo's loop right-of-way is confined to the property that the track lies upon

** Power lines cross track but these do not interfere with existing rail operations and appear to have more than required horizontal and vertical clearance

*** All rail vehicles that operate along the TVRM and ECTB are self-propelled and no power is supplied except to the signal and gate system.

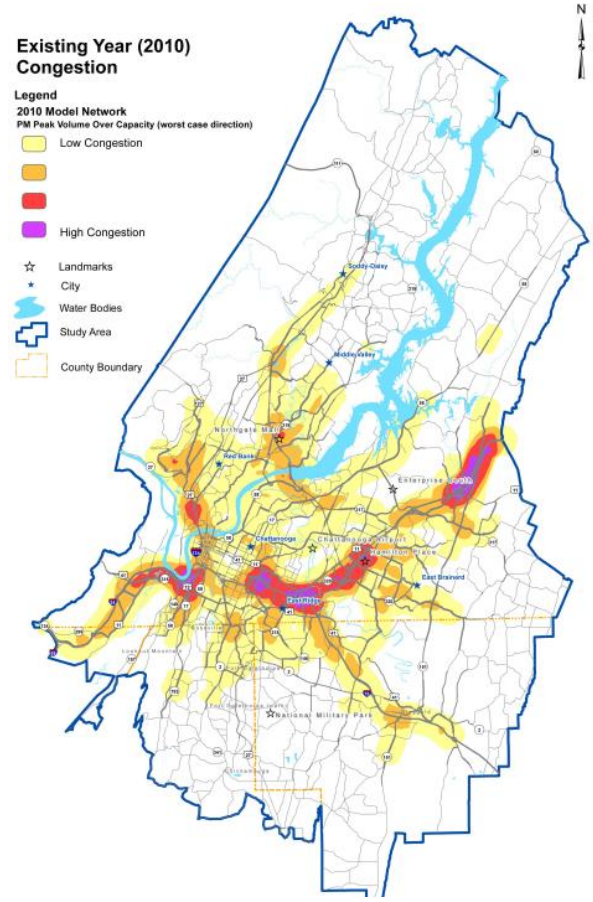
2.5 Travel Conditions

Roadways. Traffic congestion in Chattanooga is mostly limited to the I-75 and I-24 corridors during the peak periods. For the passenger rail study area, traffic congestion is limited to constrained hotspots identified as purple and red in the figure to the right.

On the other hand, the passenger rail study corridor potentially provides a good alternative to traversing Missionary Ridge on the north side to avoid the I-24 ridge congestion to the south. While the northern option does not serve all the same destinations as the southern route, it opens access to some new ones, and potentially increases travel options for those with no access to a private automobile who live or work in parts of East Chattanooga.

Transit. East Chattanooga is well served by several bus routes – notably including 3, 4, 5, 7, 8, 10 (multiple), 19 and 28 – that provide headways of 15 to 90 minutes (most around 30 minutes) and service spans of 14 to 20 hours a day. While coverage is good, frequencies tend to be limited, and travel times are long and can be unreliable. Weekend service is substantially less.

The roadway network that serves the largest activity centers within the study area – downtown, the airport and Enterprise South – consists primarily of four corridors: I-24, Lee Highway, Wilcox Boulevard Tunnel, and Glass Street/Bonny Oaks Drive. Each roadway is congested and provides limited opportunities for capacity improvements in the foreseeable future



East Chattanooga was served by streetcar and bus service; however, currently there is limited bus service and no streetcar service. A new urban passenger rail service would add to the mobility options of a number of East Chattanooga communities that have seen a lack of infrastructure investment.

2.6 Economic Conditions

2.6.1 Property Values Along Rail Corridor

Appendix D documents a property value baseline established as part of this study by investigating the type and value of existing properties along the rail corridor, which was then used to identify areas for

which there is still opportunity for further development. Two major components of property value are the type of property (residential, retail, industrial, etc.) and geographic location. High-value property types include public institutions, residential, entertainment, and office space. Low-value property types include industrial properties, undeveloped land, and some retail space.

The impact of property type is displayed in the following table, which lists the average appraised value per square foot in the City of Chattanooga for each of seven property types.

Table 2-3 Average Value per Square Foot by Property Type

Property Type	Value per Square Foot*	Value Compared to All Property Types**
Public Institutions	$65.80	+27%
Residential	$65.47	+27%
Entertainment	$60.97	+18%
Office	$60.82	+18%
Retail	$41.13	-20%
Undeveloped Land	$32.23	-38%
Industrial	$23.27	-55%
All Property Types	**$51.73**	**+0%**

* (Building Appraised Value) / (Building Square Footage)
** 100% - (Property Type Value per Square Foot) / Average Value per Square Foot)
Source: Hamilton County Tax Assessor's Office

Average property value in the City of Chattanooga is $51.73 per square foot. Within a ½ mile radius of the proposed rail corridor, property values average $35.64 per square foot – 31% less than the average for the city. The lower property values are indicative of underdevelopment around the rail corridor.

Average property values were also calculated for each of the potential station areas, defined by a ½ mile radius. Of these areas, only the Chattanooga Choo Choo Area has property values higher than the average for the city. Excluding the Chattanooga Choo Choo Area, the other station areas have property values averaging $28 per square foot.

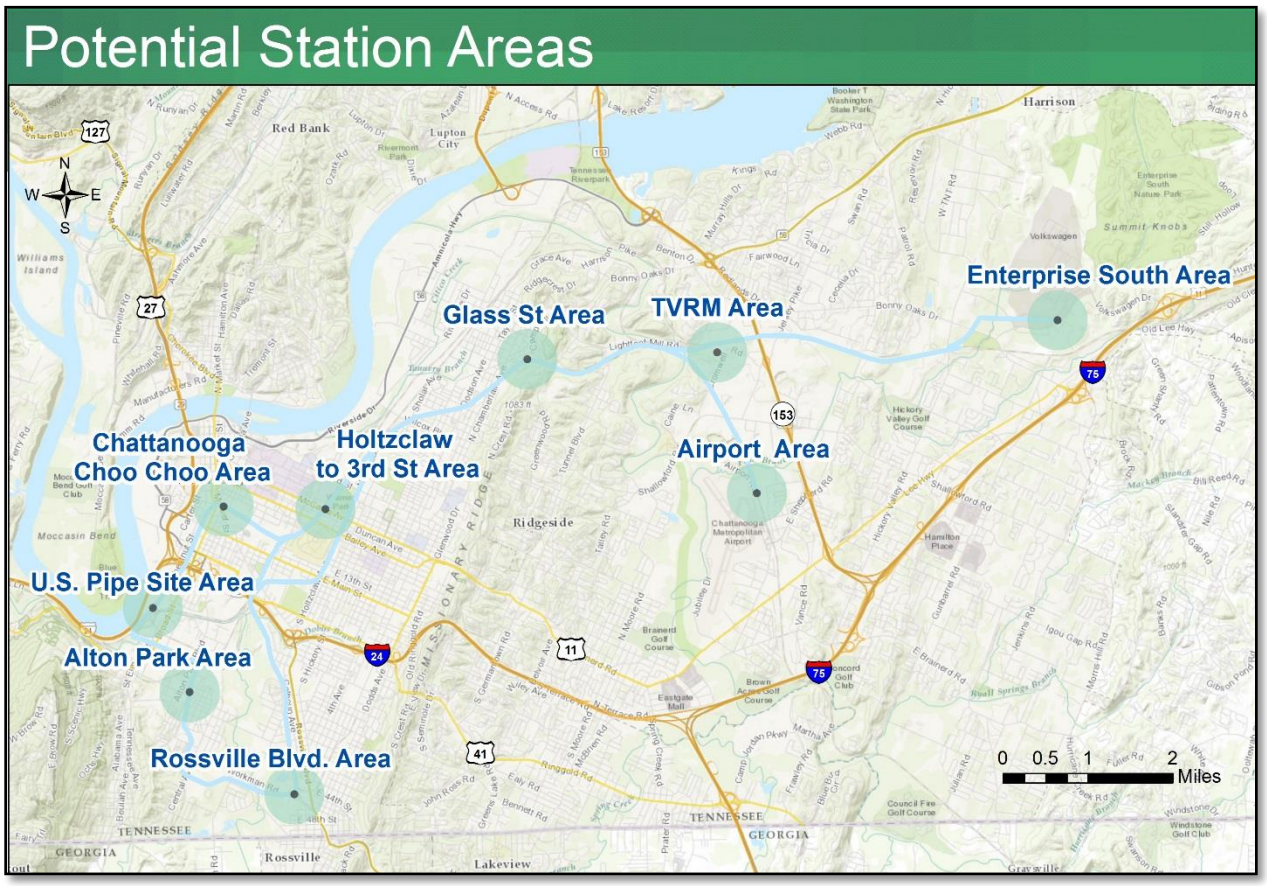
Table 2-4 Property Value per Square Foot by Potential Station Area

Geography	Value per Square Foot*	Value Compared to City Average
City of Chattanooga	$52	+0%
Chattanooga Choo Choo Area	$54	+4%
Holtzclaw to 3rd Street Area	$45	-14%
Alton Park Area	$35	-32%
Glass Street Area	$27	-48%
Airport Area	$26	-50%
Rossville Blvd Area	$19	-64%
US Pipe Site Area	$17	-67%
Enterprise South Area	**	**
All Potential Development Areas	**$44**	**-15%**

* (Building Appraised Value) / (Building Square Footage)

** The Enterprise South Development Area only includes values for the 6,776 square feet of residential development reported by the Hamilton County Tax Assessor's Office. All other properties in the area is assigned a value of $0.
Source: Hamilton County Tax Assessor's Office

Figure 2-3 Potential Station Areas



2.6.2 Impact of Property Type

Because some property types tend to have a lower value per square foot than others, the property values in an area can be skewed one way or the other based on the mix of property types in that area. As noted above, the property values around the rail corridor are 31 percent lower than the average property in Chattanooga. For the same properties in the rail corridor, the impact of property type decreases values by 21 percent. This is included in, and partially explains the 31 percent total drop in property value. The negative impact of property type means that the properties built around the rail corridor have a mix that trends towards the lower-value property types.

The impact of property type on property values for each potential station area has been estimated. For all of the potential station areas combined, the impact of property type decreases values by about 10 percent. This can be attributed to the higher proportion of low-value property types around the station areas. In the City overall, 37 percent of the building square footage is composed of low-value property

types. Around the potential station areas low-value property types make up 46 percent of the square footage.

The mix of property types varies considerably from one potential station area to another. The Glass Street, Holtzclaw, and Chattanooga Choo Choo station areas have a higher proportion of high-value property types than average (77%, 78%, and 64% respectively). The U.S. Pipe Site, Airport, and Rossville Blvd. development areas have a higher proportion of low-value property types than average (86%, 77%, and 77% respectively).

2.6.3 Impact of Location

After accounting for property type, property values are driven by location. The effect of location can be seen through a change in property values across all property types. Along the rail corridor each property type is, on average 13 percent below the city average for that type of property.

For all potential station areas together, the impact of location is a decrease in value of 5 percent. This is heavily skewed by the high volume of square footage around the Chattanooga Choo Choo Development Area. For all other potential station areas, the impact of location is estimated to be a decrease in value of 36 percent.

Property Values Along Corridor

Overall, property values along the rail corridor and within the proposed station areas are lower than those of the rest of the City.

This is due to a combination of the impact of location and the impact of low-valued property types.

With the exception of the Chattanooga Choo Choo Development Area, property values are lower than the City average regardless of property type for all of the development areas.

For three development areas, property values are driven down by a high proportion of low-value property types.

The rail corridor provides an opportunity to target areas of underinvestment for development both through a move towards high-value property types and an increase in property values generally.

The following table reflects property values as well as the impacts of location and property type on value. Averages for the City of Chattanooga, the proposed rail corridor, and each potential development area are displayed.

Table 2-5 Property Values by Potential Station Area

Geography	Value per Square Foot*	Value Compared to City Average	Impact of Property Type on Value	Impact of Location on Value
City of Chattanooga	**$52**	**+0%**	**+0%**	**+0%**
Rail Corridor	**$36**	**-31%**	**-21%**	**-13%**
All Potential Development Areas	**$44**	**-15%**	**-10%**	**-5%**
Areas Less Chatt. Choo Choo	**$28**	**-45%**	**-15%**	**-36%**
Chattanooga Choo Choo Area	$54	+4%	+4%	+0%
Holtzclaw to 3rd Area	$45	-14%	+11%	-22%
Alton Park Area	$35	-32%	+0%	-32%
Glass Street Area	$27	-48%	+14%	-55%
Airport Area	$26	-50%	-39%	-17%

Geography	Value per Square Foot*	Value Compared to City Average	Impact of Property Type on Value	Impact of Location on Value
Rossville Blvd. Area	$19	-64%	-36%	-43%
U.S. Pipe Site Area	$17	-67%	-41%	-45%
Enterprise South Area	**	**	**	**

* (Building Appraised Value)/(Building Square Footage)
** The Enterprise South Development Area only includes values for the 6,776 square feet of residential development reported by the Hamilton County Tax Assessor's Office. All other properties in the area is assigned a value of $0.
Source: Hamilton County Tax Assessor's Office

2.6.4 Labor Pool Location and Educational Attainment Along Corridor

One of the goals of the rail corridor program is to provide connectivity between workers and potential places of employment. In this section the location of workers' residences relative to the locations of employment is discussed.

Chattanooga is a net importer of workers. This is common when a city is the largest employment center in the immediate region. According to the U.S. Census Bureau, within the City of Chattanooga there were 158,212 jobs in 2012. However, there were only 65,144 workers living in the city. This means that 93 thousand workers had to travel from outside the city limits to fill those jobs. This is a ratio of 0.41 workers in Chattanooga for every job.

Within the rail corridor, there were 54,122 jobs and only 8,857 workers. This means that 45,000 workers came from outside the rail corridor to fill the jobs within it. This is a far higher rate of worker import than that of the City of Chattanooga. This means that in general, the rail corridor includes many centers of employment but a disproportionately low number of workers' residences.

If the geographic area is restricted to the potential development areas only, the number of jobs drops to 18,795. There were 2,887 workers living within the development areas, resulting in a ratio of 0.15 workers per job, which is roughly the same as within the rail corridor overall.

Table 2-6 Workers per Job

Geography	Jobs*	Workers**	Workers per Job
City of Chattanooga	158,212	65,144	0.41
Rail Corridor	54,122	8,857	0.16
All Potential Development Areas	18,795	2,887	0.15

* Count of jobs at employment location
** Residential count of workers
Source: US Census Bureau, 2012

Areas with a higher ratio are more residential in nature. Areas with a lower ratio are more commercial in nature. Based on the ratio of workers to jobs, the Glass Street and Alton Park station areas are

dominantly residential. The Enterprise South, U.S. Pipe Site, Chattanooga Choo Choo, and the Airport development areas are generally commercial in development.

Table 2-7 Workers to Job Ratio by Development Area

Geography	Workers per Job
Glass Street Area	4.12
Alton Park Area	1.37
Rossville Blvd. Area	0.31
Holtzclaw to 3rd Street Area	0.22
Airport Area	0.07
Chattanooga Choo Choo Area	0.07
U.S. Pipe Site Area	0.03
Enterprise South Area	0.00

Source: US Census Bureau, 2012

This analysis provides input into the station area land use mix targets, which is addressed in Section 4.3. Achieving the right jobs-housing balance for each station area will ensure more livable and sustainable neighborhoods, improve economic opportunity and minimize commute trip lengths whether they be by car, rail or another mode of transportation. It also highlights the importance of connecting residential areas with few jobs (e.g. Glass Street) with those that have jobs but no nearby residents.

2.7 Mobility Needs and Opportunities

A number of factors point to the opportunity for restoring passenger rail service in the Chattanooga region as an alternative to traditional passenger vehicle travel. The following conditions summarize the need for this proposed transit investment as developed through the rail feasibility study:

A car-dominated transportation environment. Despite Chattanooga being the site of the country's first free all-electric zero-emissions bus service, and new investments in CARTA and Bike Chattanooga, the city and region remain essentially automobile-dominated, with less than four percent of the population commuting to work by non-auto modes. This situation severely disadvantages those who can't afford a car, don't drive, or are too young to drive.

Topography that restricts transportation alternatives. Like much of Tennessee, Chattanooga is severely impacted by topography that prevents direct connections between many activity centers. That applies to the downtown-airport-Enterprise South connection. However, the link provided by the existing tracks of the East Tennessee Railroad has the potential to provide a relatively direct and quick connection via rail.

Significant employment growth in and around Enterprise South and downtown. The construction and now expansion of the Volkswagen assembly plant, the Amazon distribution facility and numerous other new businesses has created hundreds of new jobs in this area, bringing significant peak hour traffic and congestion. The trend is anticipated to continue as new automobile suppliers and other

businesses continue to be attracted to this activity center. New means to get employees – particularly from areas of low economic opportunity – and goods to and from this area are required if it is to sustain continued growth.

Growth at the airport and nearby. As a result of national and international visitors to Volkswagen and other area businesses, the Chattanooga airport has experienced significant growth in passenger and cargo volumes in the past decade, and has been working hard to provide great service to its customers. New businesses continue to move into the commercial district near the airport, which provides close proximity to both Enterprise South and downtown.

Underutilized railroad transportation assets. Although the railroads used to move enormous quantities of freight through Chattanooga, volumes have been on a steady decline for much of the past fifty years. This has left much of the railroad infrastructure – owned by several different companies – severely underutilized. These rights-of-way could provide significant passenger capacity, thereby relieving congested highway corridors that will not be widened due to various constraints.

Congested traffic conditions on Interstates 24 and 75. Despite the decline in railroad traffic noted above, highway traffic volumes have been on a steady incline for many years, particularly on Interstate 24 through Chattanooga. If drivers could ride transit to reach destinations such as Enterprise South or the Airport congestion could be reduced.

Passenger rail service would potentially serve existing and future mobility needs, encourage efficient and sustainable land use patterns, and support local economic activity and improve quality of life.

2.8 Project Goals and Objectives

Project Principles

Project Principles are consistent with those of the City of Chattanooga, the U.S. Department of Transportation (DOT) and the Federal Transit Administration (FTA), and include:

- **State-of-Good-Repair Benefits** due to the improvement of existing, but underutilized, freight rail infrastructure.
- **Sustainability** associated with transit rather than gasoline-powered private automobiles, resulting in cleaner air and accrued health benefits from walking to/from transit.
- **Quality of Life** associated with an attractive transportation mode alternative to travel in the central and east core areas, as well as walkable areas that typically develop around stations.
- **Safety Enhancements** through reduced automobile vehicle miles traveled and reduced congestion.

Goals and Objectives

Project goals and objectives were identified and prioritized in the open process of the public meeting series, with voting occurring in the first meeting

Public voting on relative priority between project goals is shown in the summary table below:

Meeting 1 voting results: Project goal priorities	
Economic Development	32%
Transportation	30%
Land Use	19%
Environment	19%

Consistent with the "Within Community" and "Community to Region" goals and objectives of the 2040 Regional Transportation Plan, and working with the project study partners and with the input of stakeholders and public through the series of public meetings, the following goals and objectives were established for this project, with goals stated as prioritized on the basis of public voting (see table below) at the first public meeting:

1. **Economic Development and Redevelopment**

   - **Support regional economic growth** in the short- and long-term by connecting neighborhoods with downtown, the airport, and Enterprise South to facilitate travel for commuters, residents and visitors.

   - **Connect and re-envision neighborhood centers** along the alignment and catalyze or support local redevelopment plans with excellent access to stations for non-automobile modes.

   - **Promote equitable transportation access and benefits** for all in the study area.

2. **Transportation**

   - **Provide a reliable and attractive transportation alternative** to support mobility in downtown and east Chattanooga that provides access to existing and future jobs and activity centers, reduces reliance on private automobile travel, and attracts new transit riders to the system.

   - **Integrate Pedestrian Investments.** Facilitate development of places with high concentrations of pedestrian activity as well as biking, park-n-ride, transit, and carpooling that would benefit from frequent transit service.

   - **Improve management of roadway congestion in the core and East Chattanooga areas.** Leverage existing and underutilized transportation assets to increase travel capacity and relieve peak period congestion on existing roadway corridors.

   - **Deploy Electric Vehicle Technology**, as appropriate, to leverage local zero-emission electric transit vehicle experience.

3. **Land Use**

- **Coordinate Land Use and Transportation Investments** at strategic locations to provide the density necessary to support premium transit service.
- **Provide efficient jobs-to-housing connections** and support efficient land use patterns.
- **Ensure consistency with local land use plans.**

4. **Environment and Sustainability**

- **Minimize adverse impacts** to the natural and built environment.
- **Develop a financially feasible and sustainable mobility solution** that serves the Chattanooga community.
- **Support active healthy lifestyles** by reducing dependence on private automobile travel and encouraging alternative modes.
- **Promote environmental benefits** including improving air quality by reducing future vehicular emissions.

In addition, voting at the third public meeting reflected investment preferences from those in attendance between investments in passenger rail versus other transportation investments, or investing in non-transportation priorities (such as education, parks and recreation etc.), labelled "No-Build". This exercise was conducted to help the City assess the appetite for this and other transportation projects relative to other city-wide priorities and projects.

Meeting 3 voting results: Investment priorities (votes)	
Passenger Rail	212
Multimodal transportation investment	177
Trails	115
Roads	57
No-Build	28

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3.0 Project Alternatives

A number of project alternatives were developed to respond to the identified transportation conditions, needs, and opportunities and project goals and objectives addressed through public and stakeholder input. These alternatives were designed to provide a mix of solutions that could be compared against each other to identify a preferred solution that would meet project goals in a balanced way. Each alternative was developed to address these elements:

- Mode and technology (vehicle type)
- Alignment (route)
- Service description

3.1 Transit Technologies

Choosing an appropriate transit technology for the study corridor depends upon the project's goals, mobility needs, alignments considered, and public opinion.

Table 3-1 below provides a description of numerous transit vehicle technologies that could address future needs. Appendix E presents a summary of transit vehicle alternatives evaluated as part of the study.

Currently, the TVRM and ECTB rail corridors operate a variety of Federal Railroad Administration (FRA) compliant historic rail vehicles and provide freight access to adjacent industrial sites. Additionally the Chattanooga Area Regional Transit Authority (CARTA) operates fixed route bus service, shuttle service, express service, and a historic funicular within the study area. Outside of the historic Incline Railway funicular service, CARTA does not operate any other form of rail transit.

Some of the vehicle technologies considered would meet current FRA standards (i.e. commuter rail, rapid rail, intercity rail) but other "smaller" technologies would not (i.e. light rail, streetcar, or historic/heritage trolley). Any consideration of non-FRA compliant transit technologies would require either a waiver from the FRA or new infrastructure constructed parallel to existing track, either within existing right-of-way(s) or on new location.

Table 3-1 Transit Technology Descriptions

Transit Technology	Description
Light Rail Transit	The American Public Transit Association (APTA) defines LRT as "An electric railway with a 'light volume' traffic capacity compared to heavy rail. Light rail may use shared or exclusive rights-of-way, high or low platform loading and multi-car trains or single cars". Light rail is an intermediate rail transit between heavy rail and streetcars. In recent years, light rail vehicles and modern streetcars have become more interchangeable meaning vehicle manufactures have been producing vehicles that can operate at a variety of speeds and within different settings (urban, suburban, rural, off-street, on-street, etc.).
Modern Streetcar	Streetcars are rail transit vehicles designed for local traffic movement and are typically powered by electricity from overhead catenary wire. They often serve dense urban areas but have the flexibility to operate in a variety of scenarios (similar to LRT). Streetcars most traditionally have operated in mixed traffic conditions but can operate on dedicated guideways. Technology is being developed to allow "off-wire" operations, in which portions of the guideway do not require overhead power supply.
Commuter Rail	The American Public Transit Association (APTA) defines commuter rail as "…long-haul rail passenger service operating between metropolitan and suburban areas, whether within or across the geographical boundaries of a state, usually characterized by reduced fare for multiple rides, and commutation tickets for regular, recurring riders." Commuter Rail can operate along existing freight tracks with freight trains if cars meet FTA safety standards (i.e., are FRA compliant).
Historic / Heritage Trolley	Historic/heritage trolley's (also referred to as historic streetcars) are rail transit vehicles designed for local traffic movement and are powered by electricity from overhead catenary wire. Either replicas or refurbished vehicles are used (typically from the late 19th and early 20th century). These vehicles typically operate in dense urban areas with frequent stops, similar to the modern streetcar.
Rapid Rail	Sometimes called Diesel Multiple Units (DMUs), these vehicles are similar to commuter rail but with lower capacity used for providing passenger service on medium distances. Rapid Rail vehicles are self-propelled, typically powered by diesel. Rapid Rail can operate as a single unit or multiple units based on demand. Limited options exist in U.S. for FRA-compliant vehicles, limited DMU applications in active freight corridors.
Intercity Rail	Intercity rail is similar to commuter rail in terms of overall characteristics. Intercity rail typically connects more cities within regions, states, and other geographies than commuter rail, providing more continuous longer-haul service. Amtrak is the typical operator for this service.
Bus	Buses are typically single-decked transit vehicles designed to carry multiple passengers and operate in mixed traffic conditions. However, some buses may maybe double decked or articulated to provide additional passenger capacity. Buses can serve both short haul and long haul trips and are typically used by cities to provide greater transit coverage within a service area. When buses operate in a dedicated guideway with signal priority it is commonly referred to as Bus Rapid Transit (BRT).

3.2 Passenger Rail Alternatives

In response to the agreed-upon project goals and objectives and the existing transportation conditions in the study corridor, the study team, in conjunction with CDOT and other project partners, agreed on an array of **three project alternatives** as illustrated and described below.

Features common to all alternatives: The following features would be common to each alternative

- **Service Description** – each alternative offers approximately the same service levels which includes 30-minute frequency in morning and afternoon peak periods, with up to two hours between trains in midday and evening periods and on weekends.

- **Existing transit connections** – access provided by almost all existing CARTA routes at the rail stations including downtown connections via Market and Broad Streets.
- **Coordinated rail-bus transfers** to minimize delay for transferring passengers.
- **Real-time passenger information** integrated with trip planning and mobile apps.
- **A non-motorized connection network** providing access to pedestrians and cyclists
- **Missionary Ridge Tunnel** – this section of the alignment is utilized in all alignments and will need to accommodate the continued operation of the TVRM trains.
- **Park and Ride Facility** – commuter parking will be provided at the existing TVRM museum through the addition of new parking spaces on the existing property.
- **TVRM Maintenance Facility** – maintenance of the proposed transit vehicles will occur at the existing TVRM facility on the west side of Missionary Ridge. Varying degrees of modification will be required based on the chosen vehicle technology.

It should be noted that no project alternatives included service in South Chattanooga, which had been anticipated at the outset of the study (see Figure 1-1). This was due to the lack of sufficient density of transit trip generators in this area currently or per known future plans.

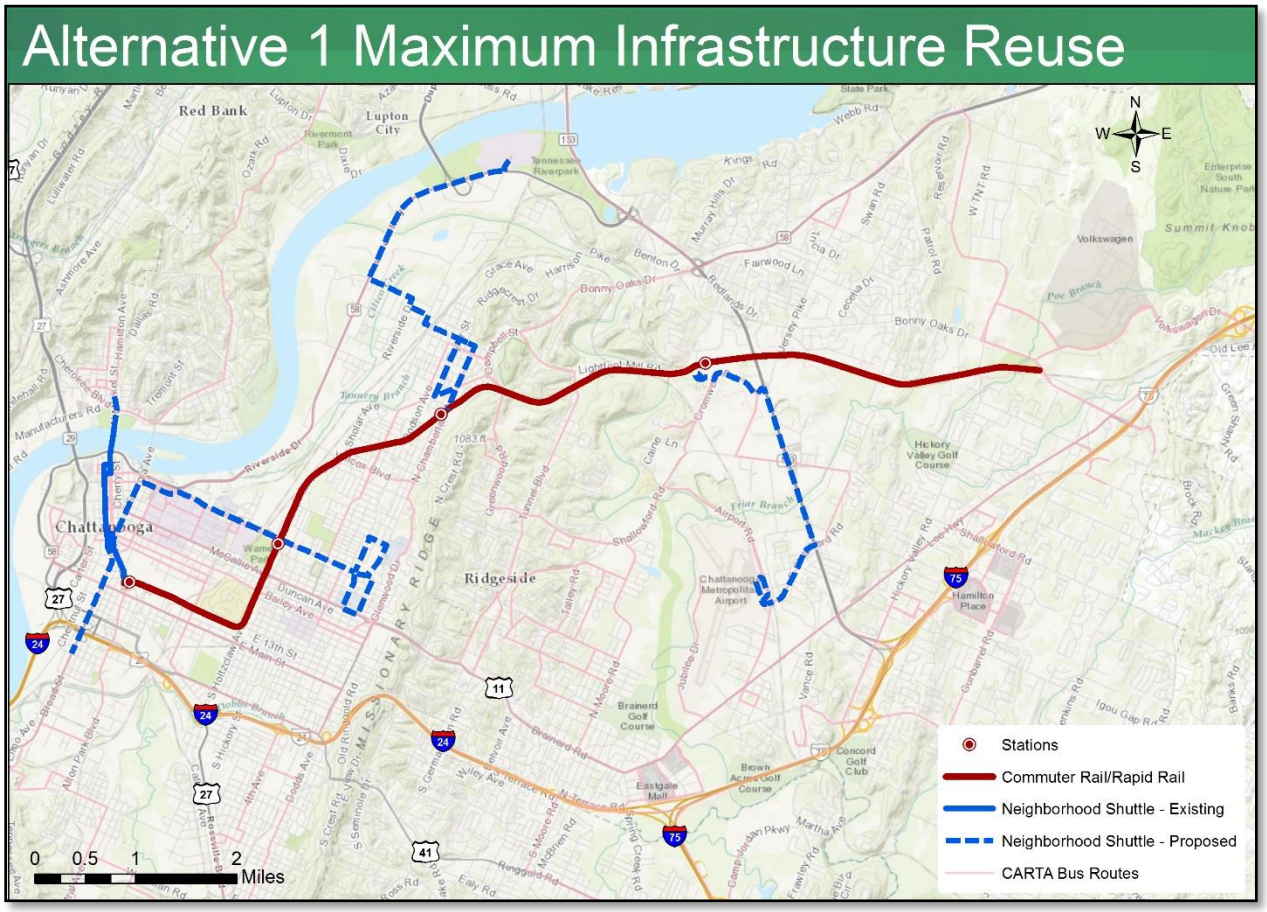
Table 3-2 Transit Technology Characteristics Summary

Characteristics	LRT	Modern Streetcar	Commuter Rail	Historic / Heritage Trolley	Rapid Rail	Intercity Rail	Bus
Typical Vehicle Length	82 to 95 feet per car	60 to 82 feet	90 to 105 feet per car	40 to 70 feet per car	85 to 135 feet per car	Varies	40 to 60 feet
Minimum Turning Radius (feet)	82 to 150	60 to 82	140 to 460	40 to 50	250 to 300	140 to 460	40 to 70
Typical Vehicle Capacity (persons)	190	120	100 to 230	40 to 60	100 to 140	100 to 230	50 to 90
Service Frequency (minutes)	10 to 30	8 to 30	20 to 30	10 to 15	15 to 30	Varies	5 to 30
Average Operating Speed (mph)	20 to 60	6 to 12 (max is 45)	30 to 79	6 to 12 (max is 25)	25 to 40	30 to 80	15 to 20 in mixed traffic, up to speed limit
Average Station Spacing (miles)	½ to 1	¼	2 to 5	¼	2 to 5	10 to 50	Varies
Interoperability	• Shared and dedicated lanes • On-Street and Off-Street	• Shared and dedicated lanes • On-Street (typically) and Off-Street	• Dedicated right-of-way • Can utilize existing freight corridors	• Shared and dedicated lanes • On-Street (typically) and Off-Street	• Shared or dedicated lanes • In-Street and separate right-of-way • Can use existing freight corridors (limited)	• Dedicated right-of-way • Can Utilize existing freight corridors	• Shared and dedicated lanes • On roadways only
Power Supply	Electric motor powered by catenary wire or battery	Electric motor powered by catenary wire or battery	Diesel engine	Electric motor powered by overhead wire or battery	Typically diesel	Typically Diesel	Varies; diesel, natural gas, electric, hybrid-electric
Cities with Technology	Charlotte, Norfolk, Minneapolis	Atlanta, Portland, Seattle	Minneapolis/St. Paul, Nashville, Salt Lake City	New Orleans, Memphis, Tampa	Austin, Denton County (Texas), Oceanside (CA)	Throughout the United States	Throughout the United States

3.2.1 Alternative 1: Infrastructure Reuse

Focusing on the existing East Chattanooga Belt Railway (ECTB) and Tennessee Valley Rail Museum (TVRM) alignments, this option would connect the Chattanooga Choo Choo rail station/hotel in downtown to Enterprise South Industrial Park. This alternative would leave downtown through the Choo Choo property, cross under the existing NSR and CSX mainline tracks, heading north along Holtzclaw Avenue past the Chattanooga Zoo, follow the existing ECTB rail corridor through the Glass Street neighborhood, it would then travel east through the historic Missionary Ridge rail tunnel to the Tennessee Valley Rail Museum (TVRM), transition to the CSX access spur and finally end near the existing soccer fields at Enterprise South Industrial Park.

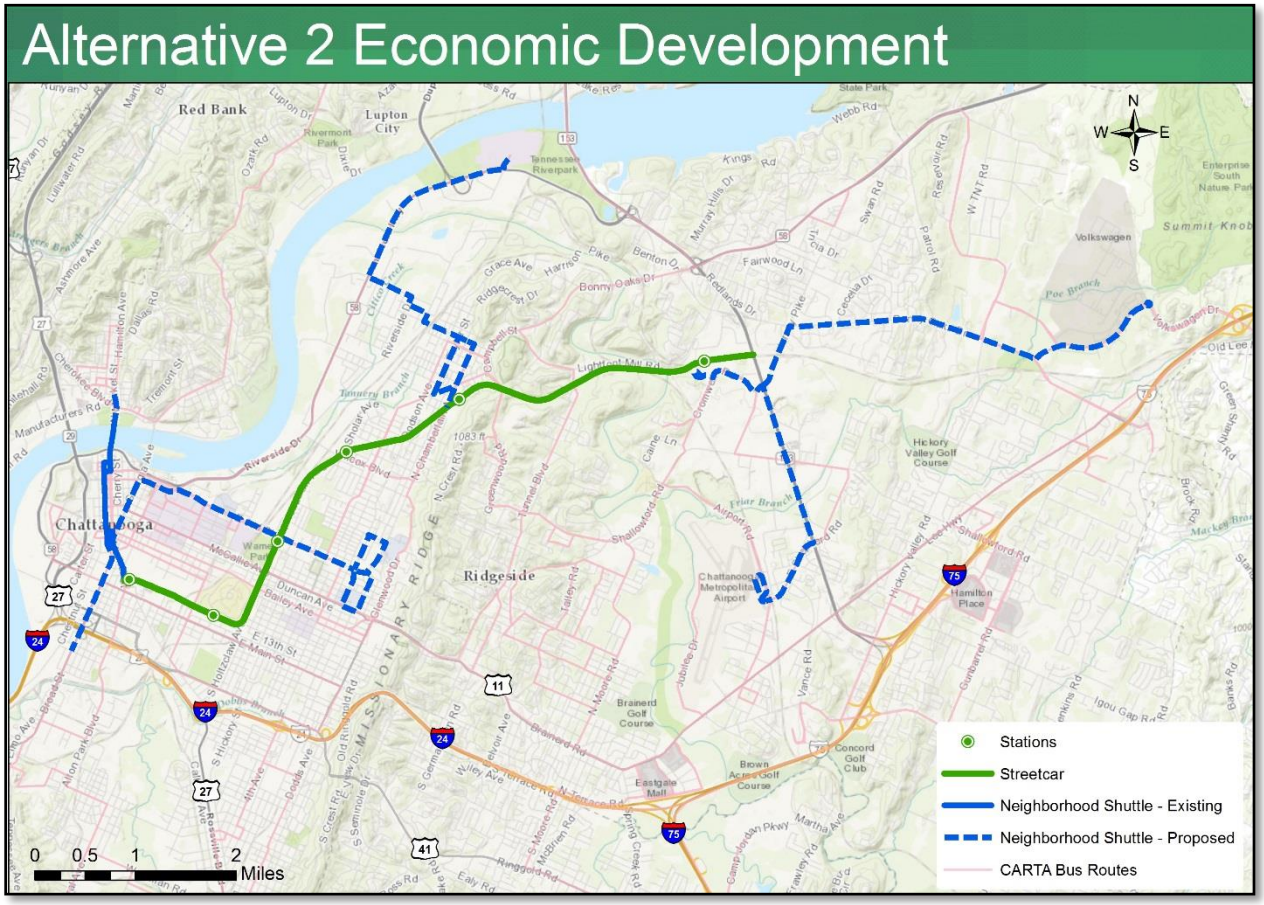
The technology selected for this alternative is a diesel commuter rail vehicle that would utilize the existing freight tracks for most of the alignment. New ballasted single track sidings would be required for about 25% of the length in order to maintain existing freight operations along with transit operations. This option would require the construction of an underpass under the existing CSX/Norfolk Southern tracks in downtown near 13th Street as well as new ballasted track from Holtzclaw to Central Avenue. Some maintenance and restoration would be required for the existing Missionary Ridge tunnel in order to accommodate the passenger rail.



Five (5) passenger rail stations are proposed along this alignment, based on local land uses, rail and road infrastructure and travel time considerations. A park-and-ride lot at TVRM would be utilized to accommodate drive-access to the rail line. The total alignment length would be approximately 10.5 miles. Travel time from Finley Stadium to Enterprise South is estimated to be 29 minutes. Neighborhood shuttle bus routes would be utilized to make connections to Memorial and Parkridge Medical Centers, Chattanooga Metropolitan Airport, and Chattanooga State College.

3.2.2 Alternative 2: Economic Development

The second alternative was focused on maximizing the economic development potential of a rail investment. Rail service under this alternative would follow the same alignment as Alternative 1 from downtown, east around the National Cemetery and through the Missionary Ridge Tunnel however this alternative terminates at the TVRM and service to Enterprise South is provided by shuttle bus. The technology chosen for Alterative 2 would be Light Rail Transit (LRT) which offers a smaller, quieter vehicle than diesel commuter rail.



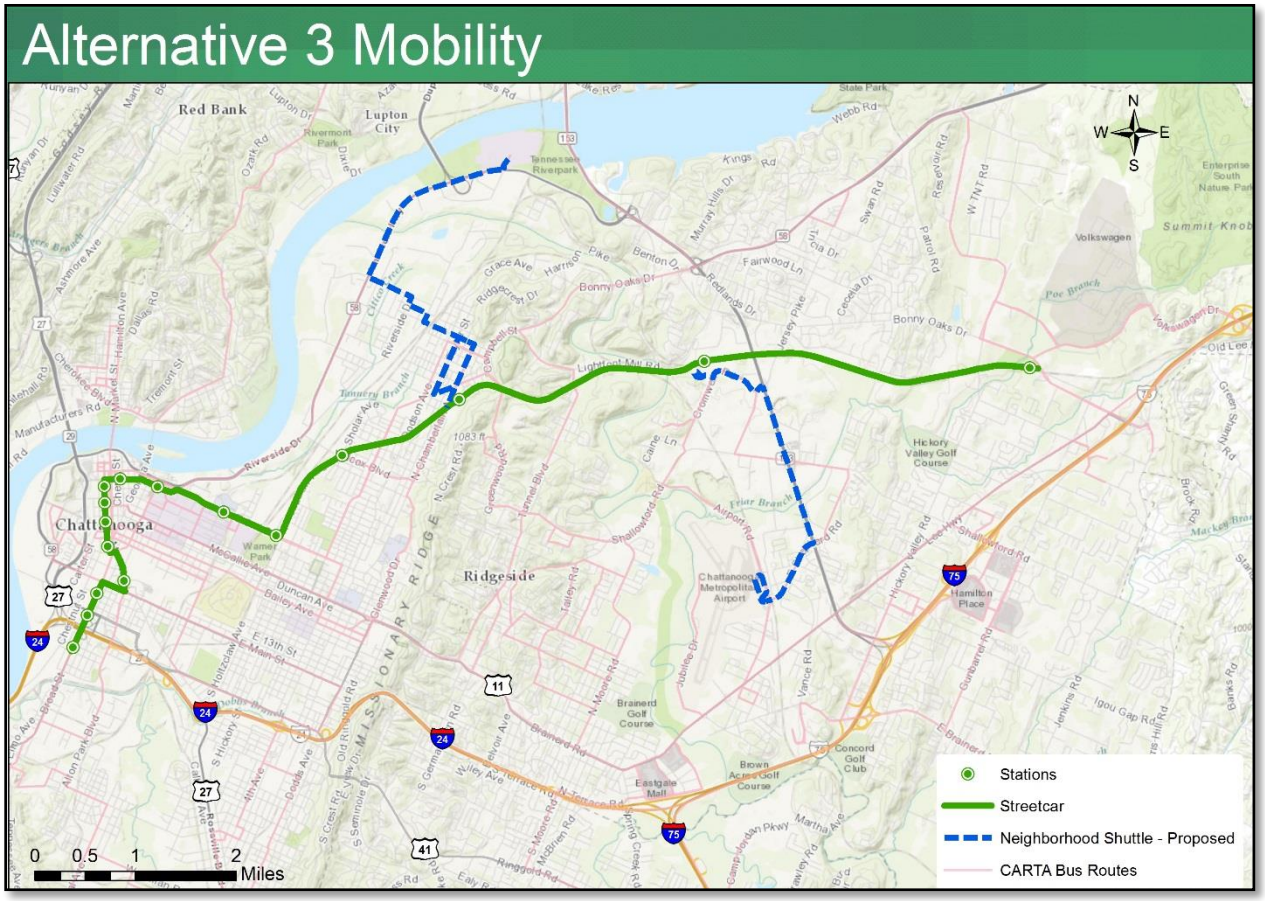
Light rail has shown to attract a higher level of property development and associated economic development than commuter rail as well. This alternative terminates at TVRM due to a conflict between light rail technology and the existing heavy rail technology operating in the CSX and Norfolk Southern

corridors which run east of TVRM to Enterprise South. Shuttle bus services would operate between TVRM and Enterprise South Industrial Park to provide that connection further to the east. This alignment would utilize the existing freight tracks and would require the same amount of new track construction as Alternative 1. The light rail technology would require more infrastructure overall to power the vehicle along the alignment via overhead wires. It should be noted that light rail vehicles would be required to operate “off-wire” through the Missionary Ridge Tunnel due to vertical clearance limitations. Additionally, compatibility issues exist between the remaining overhead wire and the historic steam locomotives that the TVRM operate on the line. More extensive modifications to the existing maintenance facility would be required to accommodate the modern fleet of electrically powered light rail vehicles.

This truncated rail alignment would be approximately 7 miles in total length. Neighborhood shuttle bus routes would be utilized to make connections to Memorial and Parkridge Medical Centers, Chattanooga Metropolitan Airport, and Chattanooga State College. Travel time from Finley Stadium to Enterprise South is estimated to be 36 minutes.

3.2.3 *Alternative 3: Mobility*

This alternative builds on Alternative 2, using the same light rail technology and focuses on improving mobility between downtown and Enterprise South. The connection between the the Zoo and downtown would be replaced instead by an on-street alignment along 3rd Street on the bridge over the railroad mainline, east to Broad Street, then south past the Choo Choo, ending at Broad Street/25th Street south of Interstate-24. At the east end Alternative 3 extends rail service from TVRM to Enterprise South, making the assumption that sufficient separation could be achieved by acquiring additional right-of-way from CSX. This alternative would allow for a one-seat ride from south of downtown, past the Chattanooga Choo Choo, through the heart of downtown, and all the way to Enterprise South.



For the in-street running sections, the alignment would have one track in each direction that shared a lane with vehicular traffic. After crossing Holtzclaw Avenue the guideway would become exclusive ballasted track (existing ECTB track) and mostly double track. Single track segments would be necessary through the tunnel and on the spur track to Enterprise South. Twelve stations are proposed for Alternative 3, the majority on downtown streets. More extensive modifications to the existing maintenance facility would be required to accommodate the modern fleet of electrically powered light rail vehicles.

This alignment would be approximately 12.5 miles in total length. Travel time from Finley Stadium to Enterprise South is estimated to be 32 minutes. The in-street running train on 3rd and Broad streets would directly connect higher-density employment nodes in the downtown, including the University of Tennessee at Chattanooga.

3.3 Evaluation of Project Alternatives

3.3.1 Evaluation Criteria

To complete a comparative evaluation of the alternatives relative to the identified project goals and objectives, the project team identified a list of eight criteria, listed below. These criteria were selected to address the project's Goals and Objectives, and were measured through both quantitative and qualitative metrics.

Table 3-3 Quantitative Alternative Evaluation Measures

Project Objectives	Evaluation Measures
Promote economic development	Building value in ½ mile of stations
Provide transportation alternative	Ridership
Ensure financial feasibility	Capital cost
	Operating cost (annual)
Promote equitable transportation options	Population in ½ mile of stations
	Low income households in ½ mile of stations
	Jobs in ½ mile of stations
Support environmental sustainability	Environmental impact

Additional **qualitative** measures considered in the evaluation of alternatives included:

- Technology compatibility with existing rail operations: TVRM and class 1 railroads
- Technology compatibility with built and human environment: business and residential
- Fuel: electric versus diesel technology
- Operation in dedicated running way or on-street shared with traffic

Ridership Forecasting

The project team used the Simplified Trips-on-Project Software (STOPS) v1.50 to predict transit ridership of three study alternatives.

An overview of the ridership forecasting effort involving the STOPS model is provided in Appendix F. A key input to the model is the service plan assumed for each alternative.

Table 3-4 Project Service Span and Headways

Component	Alternative 1	Alternative 2	Alternative 3
Service Span	6 am - 11 pm		
Peak Headways			
Rail/Streetcar	30	15	10
Downtown shuttle	10	10	--
Suburban shuttle	30	30	20
Midday Headways			
Rail/Streetcar	120	30	15
Downtown shuttle	15	15	--
Suburban shuttle	60	60	60
Evening Headways			
Rail/Streetcar	--	30	15
Downtown shuttle	15	15	--
Suburban shuttle	60	60	60

Ridership Results

Table 3-5 provides a summary of the 2040 daily ridership of three project alternatives on built network. The row "Rail" shows ridership in the rail transit segment of each alternative. Downtown shuttle summarized ridership in shuttle bus routes in downtown area of each alternative. Suburban shuttle include shuttle bus routes connecting the Chattanooga State College, the Airport, and Enterprise South Industrial Park.

- **Rail ridership:** Alternative 3 is predicted to have the highest rail transit ridership – 2,500 daily riders using the commuter rail. Alternative 1 and Alternative 2 are expected to have 1,400 and 1,550 riders using their streetcars respectively.
- **Alternative total:** The difference between total ridership of the three project alternatives are relatively small, with Alternative 3 having the highest ridership of 2,560 and Alternative 1 having the lowest of 2,150.
- **New system trips:** Adding new transit service may increase ridership on the existing transit network. As shown in Table 3-5, Alternative 3 is able to bring more new riders to the system than others. Comparing to 2040 no-built transit network, adding Alternative 3 is predicted to bring 4,350 more daily unlinked passenger trips to the system, including 2,560 trips on the project routes and 1,790 new trips on other CARTA routes.

Table 3-5 Projected Future Ridership

Daily Unlinked Passenger Trips (2040)	Alternative 1 Infrastructure Reuse	Alternative 2 Economic Development	Alternative 3 Mobility
Rail	1,400	1,550	2,500
Downtown Shuttle	700	700	-
Suburban Shuttle	50	150	50
Alternative Total	2,150	2,400	2,560
New System Trips	2,200	3,900	4,350

Transportation Impacts

The alignment for the proposed rail project does not closely correlate with Chattanooga's areas of traffic congestion – which are focused on the I-24 and I-75 corridors, particularly over Missionary Ridge and on the south edge of the central City. This is not coincidental – the primary goal of the study was economic development, with transportation following closely behind.

Travel time onboard the train from the Choo Choo station to the TVRM terminus is estimated to be 25 minutes. This does not compare well with private automobile travel time, due largely to the time impacts of station dwell time along the route.

As a consequence, the new service offered by this project is not anticipated to have a significant impact on areas of existing and projected **congestion**. On the other hand, the project does provide new transportation options and capacity in the severely congested Enterprise South Industrial Park (ESIP) area, although that depends on bus connections from the TVRM station terminus of the rail service.

Travel demand modeling completed for a parallel project for the ESIP area by the Regional Planning Agency reported a reduction of eight percent (8%) in vehicle delay in the ESIP study area when compared to conditions without the project.

Operating Costs

Following the FTA requirements and general industry practice, the project team developed a simple cost allocation model to estimate operations and maintenance (O&M) cost with three cost categories:

- Vehicle operations ($/vehicle hours)
- Vehicle maintenance ($/vehicle miles)
- Non-vehicle maintenance and general administration ($/peak vehicle)

The model was developed separately by mode. Bus O&M model was developed using the three-year average unit cost (2011 through 2013) computed from CARTA's operating and service data in NTD. Commuter rail and streetcar models were established using national average costs in NTD. Unit costs were then inflated to 2015 dollars using Consumer Price Index (CPI) data from the Bureau of Labor Statistics (BLS). Table 3-6 summarizes the unit costs from O&M models of all three modes.

Table 3-6 Operations And Maintenance (O&M) Model - Unit Cost

Cost Category		Vehicle Operations $/vehicle hour	Vehicle Maintenance $/vehicle mile	Non-Vehicle Maintenance & General Administration $/peak vehicle (year)
Unit Cost	Bus	$62.30	$1.32	$65,369
	Commuter Rail (diesel)	$249.76	$4.14	$317,683
	Streetcar (electric)	$71.35	$6.05	$272,062

Capital Costs

A high level capital cost comparison was performed to identify order of magnitude differences between each alternative. Major project elements were quantified for each alternative and applied to unit costs developed from industry averages and experience on similar systems. "Soft costs" were applied to the

base capital costs to account for contingency, engineering and administration, testing, surveys, legal, and construction administration. The costs presented are in current year dollars and should be escalated to the mid-year of construction date once it is identified. Cost for real estate and railroad usage is not included in this estimate.

Project elements examined include:

- New ballasted track
- Refurbish existing freight track
- Bridges and retaining walls
- Maintenance on existing Missionary Ridge Tunnel
- Underpass for NSR/CSX
- Stations
- Roadway restoration
- Utility relocation
- Park and ride lot
- Provisions for "off-wire" operation
- Power, signaling and communication systems
- Expansion / modifications to existing maintenance facility
- Rolling stock

Table 3-7 includes the summary capital costs for each alternative.

Spatial Analysis of Demographic Data

The remaining evaluation criteria – Population in ½ mile of stations; Low income households in ½ mile of stations; Jobs in ½ mile of stations and Building value in ½ mile of stations – were computed using GIS spatial analysis with datasets obtained from the Regional Planning Agency and Hamilton County. The results are presented in Table 3-7.

Environmental Screen

A desktop Environmental Screening Analysis was performed on the three alternatives. The purpose of the analysis was simply to determine if there are any potential environmental issues that could prevent the implementation of each alternative. The alternatives were not compared against one another, but rather give a pass or fail determination since there is relatively little difference in environmental impact between alternatives. Full details for the analysis can be found in the *Environmental Screening Analysis* (May 2016) in Appendix G, which provides a summary of the high-level environmental analysis conducted to evaluate potential natural and human environmental features. The alternatives considered were examined for potential impacts with the following areas.

Natural Environmental Features:

- Streams
- Wetlands
- Floodplains
- Protected Species

Human Environmental Features:

- Environmental Justice
- Historic Features
- Parks and Recreational Areas
- Noise/Vibration
- Public Involvement

The studied rail alignments cross multiple flowing bodies of water, some of which are considered to be impaired waters with others being listed as High Quality Waters. No wetlands included in the National

Wetland Inventory (NWI) were identified along the proposed alignments. The proposed rail alignments traverse multiple FEMA regulated floodplains. Threatened and endangered species surveys will identify if any potential habitats exist along the rail alignments.

According to Census data, multiple areas are made up of a mix of minority and low-income populations. Numerous historic features and districts are located along or adjacent to the studied rail alignments, including the Missionary Ridge Tunnel. Areas designated as park and open space are located in the vicinity of the proposed rail alignments. Multiple noise sensitive areas including parks, cemeteries, churches, and residences are located throughout the studied rail corridor. In order to gain the input and opinions of the general public, extensive public involvement efforts are anticipated.

Although potential impacts may exist, the level of impact for each alternative seem to in-line with other similar rail projects and the likelihood that suitable mitigations can be identified is high. Based on the studies performed to date, it is anticipated that an Environmental Assessment will provide the necessary level of environmental documentation to satisfy NEPA requirements for the proposed rail project.

3.3.2 Summary Evaluation Results

The table below provides the summary results of the quantitative evaluation of three project alternatives.

Table 3-7 Alternatives Evaluation Summary Results

MEASURE	Alternative 1 Infrastructure Reuse	Alternative 2 Economic Development	Alternative 3 Mobility
Total Ridership (rail & bus)	2,150	2,400	2,560
Capital Cost (millions)	$110	$134	$157
Operating Cost/year (millions)	$9.8	$11.4	$9.6
Δ Station area population (thousands)	9.4	17	26
Low income population (thousands)	3,800	4,100	2,700
Δ Station area jobs (thousands)	16	22	17
Δ Building Value (millions)	$470	$580	$1,145
Environmental Screening	Pass	Pass	Pass

Δ represents "delta", the change in value between the status quo case and the build case which increases population and employment density within the ½ mile radius rail station catchment areas.

As can be seen in Table 3-7, there is not a great difference in the quantitative results between alternatives, and in fact the alternatives to some extent ended up reflecting increments upon each other – with increasing costs, and generally increasing impacts in terms of potential people or passengers served or impacted. For this reason, it was elected not to attempt to 'sum' these measures into a consolidated metric to point to a preferred alternative, and instead to work with project partners to weigh up evaluation factors and trade-offs to identify a preferred alternative.

3.4 Preferred Alternative

The process to identify a preferred alternative included reflecting back on the project's principles, goals and objectives (Sec 2.8) and gathering input from all participants in the study process including the following:

- Results of the quantitative and qualitative technical analysis
- Input from the public participating in the study process
- Stakeholder input
- Partner agency input and discussions (including Hamilton County Rail Authority, TVRM and Norfolk Southern and CSX railroads)
- Discussion amongst members of the study technical and advisory teams

Summary Considerations

Alternative 1 relies on heavy rail which can be developed at the lowest capital cost in the shortest timeframe, and is compatible with existing TVRM train operations.

Alternative 2 relies on electric light rail technology with lower noise and emissions impacts, and brings highest greater economic benefits to the community, but has a higher cost and implementation timeframe, would have negative impacts to businesses and homes along its on-street running alignment, and would be incompatible with existing TVRM train operations

Alternative 3 expands on the light rail mobility benefits of Alternative 2, but extends the one-seat ride potential of the project beyond TVRM to a station serving the Enterprise South Industrial Park, although at increased cost. The same compatibility issue with TVRM would also be extended in the corridor east of TVRM where CSX and NS railroads run parallel and currently serve the VW assembly plant.

As noted in the section above, the alternatives analysis results reflected to some extent a series of increments. The large separators between alternatives were identified as the following:

- Rail technology (heavy rail or light rail/streetcar)
- Operating right-of-way (existing rail ROW; operate on-street; combination)
- Impacts to traffic
- Impacts to residences and businesses (from on-street rail operations)
- Capital cost considerations, and
- Operating cost considerations

The preliminary evaluation results - focusing on quantified analysis - were presented to the study advisory team and to the public and stakeholders at the January 21-22 meetings. Participants at the meeting were asked to vote for their preference. The results are tabulated below, indicating a clear preference for Alternative 1.

Table 3-8 Public Input Results on Preferred Alternative

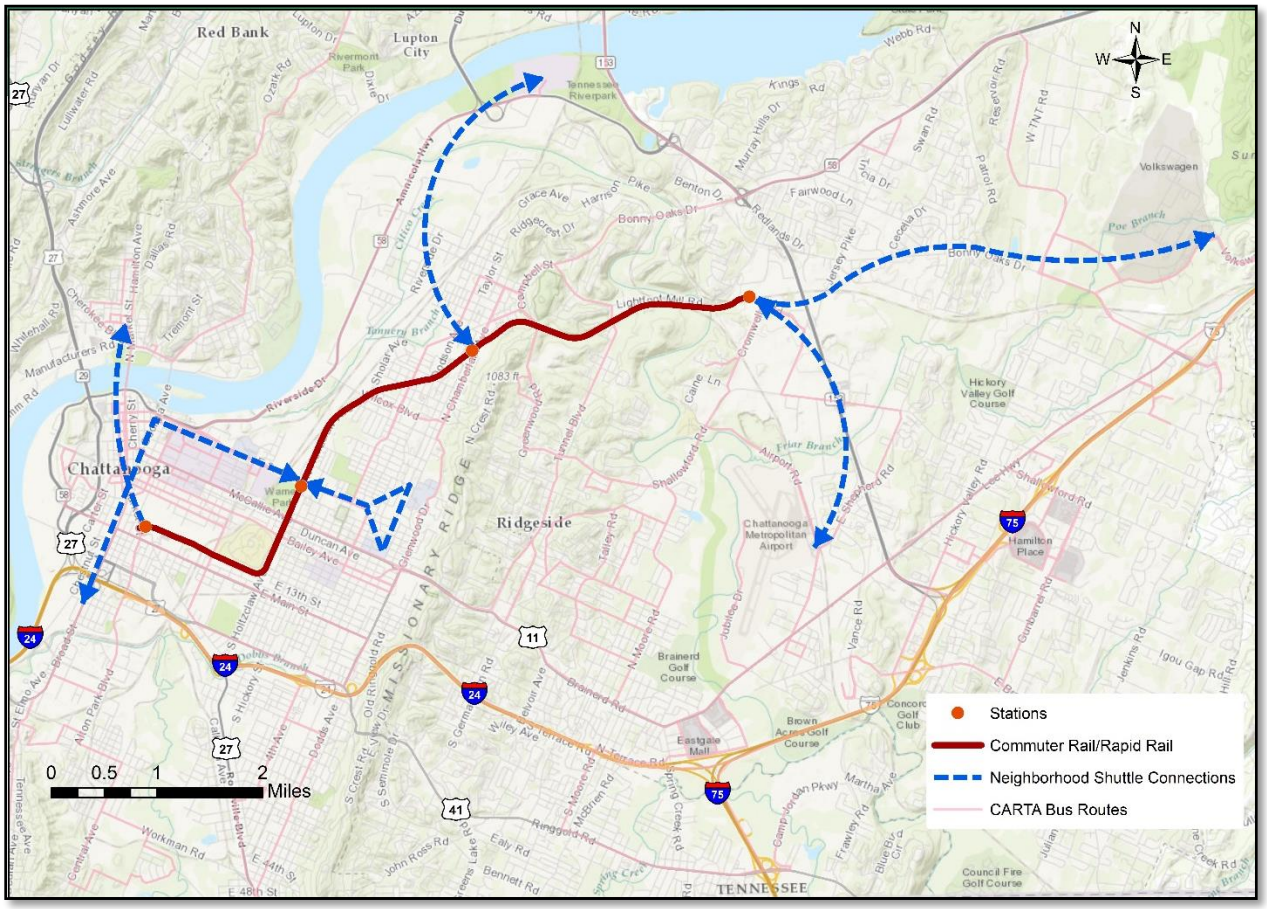
January Public Meeting Voting Results	Alternative 1 Infrastructure Reuse	Alternative 2 Economic Development	Alternative 3 Mobility
Points	156	134	123
Differential	+30%	+10%	

Discussions amongst the project and advisory teams both before and after the public meeting came to the same consensus in selecting Alternative 1 (with modifications) as the preferred alternative that best addressed a combination of project goals and evaluation measures. The selection is described below:

Alternative 1 was recommended as the preferred alternative with the **following modifications**

- Truncate the route at the Tennessee Valley Rail Museum; add shuttle circulator to serve Enterprise South and intermediate destinations.
- Increase station area residential and employment densities consistent with light rail station assumptions.

Figure 3-1 Preferred Alternative



3.4.1 Passenger Experience

Ensuring a positive experience for users of the system is important, both for retaining existing riders and for attracting new ones. Transit rider experience is measured by quality of the in-vehicle experience; quality of the waiting and boarding experience; safety and security of waiting riders; and wayfinding ability.

The re-introduction of passenger rail service in Chattanooga will provide a significant enhancement in passenger experience compared with the existing transit system.

- **Quality of in-vehicle experience:** the rail vehicles proposed for the service – modern diesel multiple unit (DMU) trains – provide a very attractive rider experience, starting with easy step-free boarding, full ADA accessibility, large windows, a quiet comfortable ride, comfortable seats, on-board space for bikes, next-stop information and amenities such as wifi depending on agency preference.
- **Quality of the waiting and boarding experience:** the stations proposed for this service will be of a high quality, integrated with the local neighborhood community, high quality design and architectural finishes, good lighting, access and amenities such as bicycle parking.
- **Safety and security of waiting riders:** assured through security staff, monitoring by video, ample lighting, available emergency phones etc, all passengers will be made to feel safe and comfortable at all station facilities.
- **Wayfinding ability:** ample wayfinding materials will be integrated throughout the passenger experience, including on-board, at stations, and through mobile applications and signage around the stations.

4.0 Study Recommendations

4.1 Rail Service

The recommended implementation project is a modification on Alternative 1 that would use diesel-powered heavy-rail technology connect the Chattanooga Choo Choo to the Tennessee Valley Rail Museum via interim stops at the Zoo and Glass Street. Revised project evaluation measures for the project are presented below.

Table 4-1 Preferred Alternative Evaluation Measures

Evaluation Measure	Result		Evaluation Measure	Result
Rail Ridership	500		Low income households served	3,600
Total Ridership (rail & bus)	750		Connected jobs (thousands)	11,000
Capital Cost (millions)	$124		New building value (millions)	$532
Operating Cost/year (millions)	$3.40			

Land use modifications were applied to this alternative to increase station area population and employment densities to more closely reflect those of the light rail technology Alternatives 2 and 3. The service plan described below was identified based on ridership modeling for assumed future land use densities, as well as references to existing and planned CARTA operating plans, and the Nashville Music City Star commuter rail service.

Table 4-2 Service Plan Description

Service Plan				
Vehicle Technology	Diesel multiple unit train (DMU)		Span of Service	12 hours: 7:00 am – 7:00 pm
Trains/day	22		Travel time end-end	28 minutes
Frequency (peak)	30 minutes		Fare (full)	$2.00
Frequency (off-peak)	120 minutes			

4.1.1 Short-term Operating Plan

The first phase of project implementation would begin service at a station located in the vicinity of Main Street/Central Avenue, rather than at the Choo Choo station. This is due to the expense and environmental and engineering complexity of building a grade-separated crossing of the Norfolk-Southern mainline to the east of the Choo Choo. Initial cost estimates for this underpass are $24.3M, and the timeframe for design, environmental clearance, maintenance of traffic and construction would add significantly to the schedule for initial service.

4.2 Shuttle Bus Connections

The preferred alternative includes shuttle bus connections between the rail stations and the following activity nodes:

- Temporary connection between Phase 1 station at Main St/Central Ave and Choo Choo
- Broad Street, extending to North Shore (existing electric shuttle service)

- South Broad Street – Georgia Avenue – 3rd Street to Memorial and Parkridge medical centers
- Chattanooga Community College (via Wilder Street and Amnicola Highway)
- Airport
- Enterprise South circulator

These shuttles will reflect the following characteristics:

- Timed transfers with departing and arriving trains to minimize wait time for transfers
- Electric propulsion technology (preferred)
- Free transfers to/from rail service may be considered

Additional transit connection options for the Shepherd area that includes the Airport and Enterprise South were addressed in a supplemental meeting with CDOT and CARTA and are summarized in Appendix H.

4.3 Stations Areas

Passenger rail is a major, fixed investment that fundamentally changes the accessibility of areas in which stations are located. As a result, it has the potential to be a catalyst for growth and, in many cases, redevelopment and revitalization.

The preferred alternative includes four station locations and a plan for an interim location at Central Avenue near Main Street. These locations were chosen in the light of a number of factors, including land availability, proximity to existing population and employment, redevelopment potential and urban design qualities.

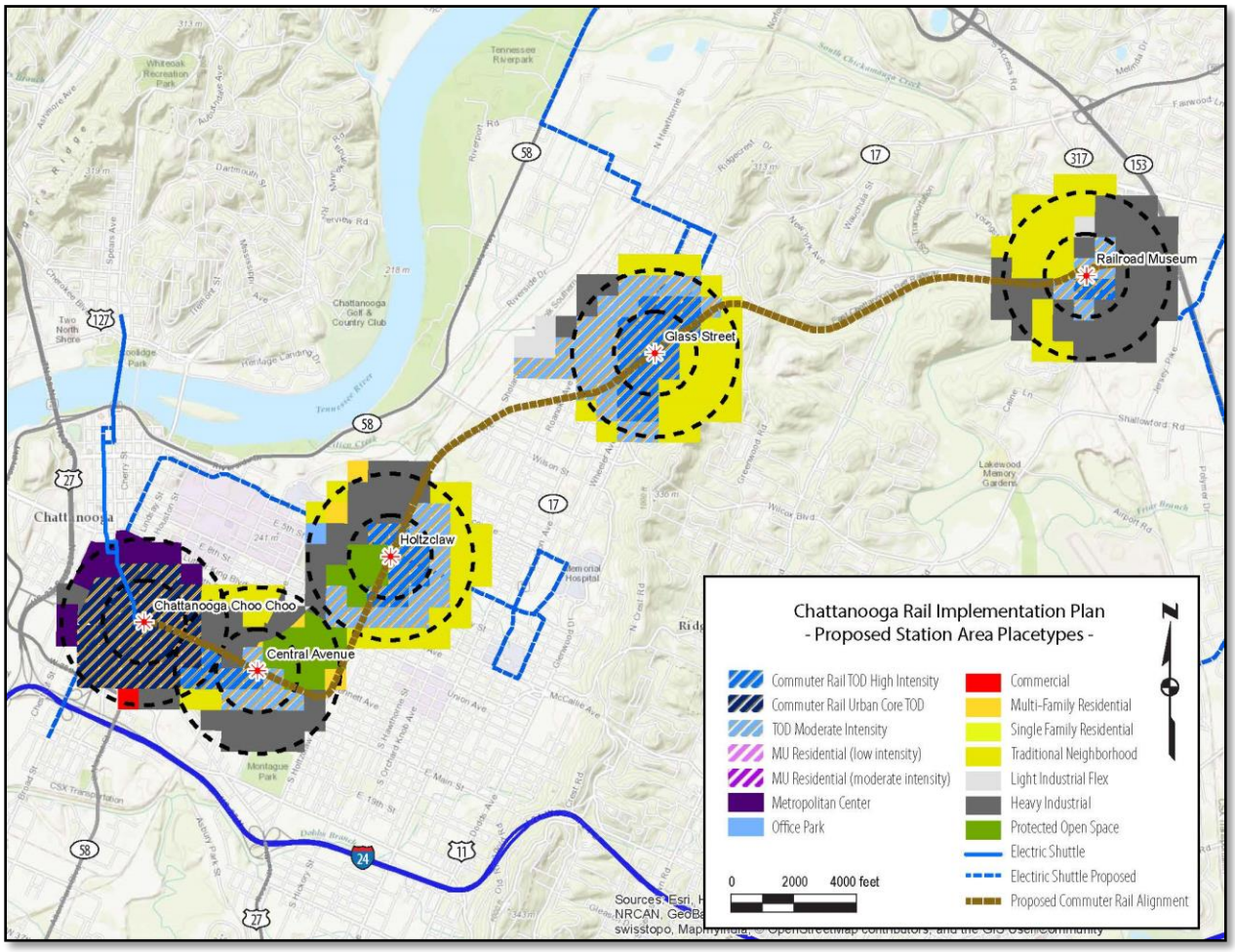
The study team modeled build-out conditions around each station area to get a sense of the development potential. The model uses "placetypes" which describe the type, character and quantity of growth, along with information on vacant and redevelopable land, to estimate development potential.

Placetypes modeled for the preferred alternative are identified in Table 4-3 and Figure 4-1. The placetype designations are sensitive to the surrounding context and consistent with recent plans and the Regional Planning Agency's regional development intensity sectors. Generally speaking, development types become more intense and employment-oriented as they get closer to the urban core of downtown.

Table 4-3 Placetype Overview

Placetype	Land Use Mix					Net Density (dwelling units per acre)	Net Intensity (floor area ratio)
	Residential	Office/ Retail	Industrial	Park/ open space	ROW/ infrastructure		
Metropolitan Center	45%	30%	0%	5%	20%	67	2.0
Commuter Rail Urban Core TOD	42%	34%	0%	4%	20%	47	1.7
Commuter Rail TOD (High Intensity)	57%	18%	0%	5%	20%	28	0.6
TOD (Moderate Intensity)	55%	12%	0%	10%	23%	19	0.4
Office Park	0%	70%	0%	5%	25%	NA	0.4
Commercial	0%	70%	0%	5%	25%	NA	0.3
Light Industrial Flex	0%	20%	55%	0%	25%	NA	0.2
Heavy Industrial	0%	0%	75%	0%	25%	NA	0.3
Multi-Family Residential	70%	0%	0%	5%	25%	35	NA
Traditional Neighborhood	73%	0%	0%	5%	22%	6	NA
Single Family Residential	70%	0%	0%	5%	25%	5	NA
Protected Open Space	0%	0%	0%	100%	0%	NA	NA

Figure 4-1 Station Area Placetypes



Collectively, the station areas are estimated to include total population of approximately 12,000 and employment of approximately 10,000 at buildout. This represents roughly 17 percent and 14 percent of Hamilton County's projected population and employment, respectively, by the year 2040.

Table 4-4 Station Area Population and Employment at Buildout

Station Area	Population	Employment		Total	Population	Employment
Chattanooga Choo Choo	4,490	7,320		2040 Regional Projections	115,400	83,700
Central Avenue	900	230		2040 Hamilton Co. Projections	71,000	71,500
Holtzclaw	1,780	320				
Glass Street	3,880	1,820		% of Regional Total	**10.3%**	**11.9%**
Railroad Museum	890	260		% of Hamilton Co. Total	**16.8%**	**13.9%**
Total	**11,940**	**9,950**				

Station Area Plan Details

Land uses adjacent to rail stations can support the system by providing both an immediate ridership base and dynamic, interesting places for people to live, work and visit. Thoughtfully planned station areas can leverage the value created by transit accessibility into viable, livable anchors in the community.

For the Chattanooga Rail Feasibility Study, station area concept plans are developed for three proposed station areas, including Central Avenue, Holtzclaw Avenue and Glass Street (the recent form-based code developed for downtown Chattanooga will drive development for the Chattanooga Choo Choo station area). The purpose of the station area plans is to illustrate what develop could look like at a finer level of detail. Ultimately, they serve as a guiding framework for future station area planning efforts.

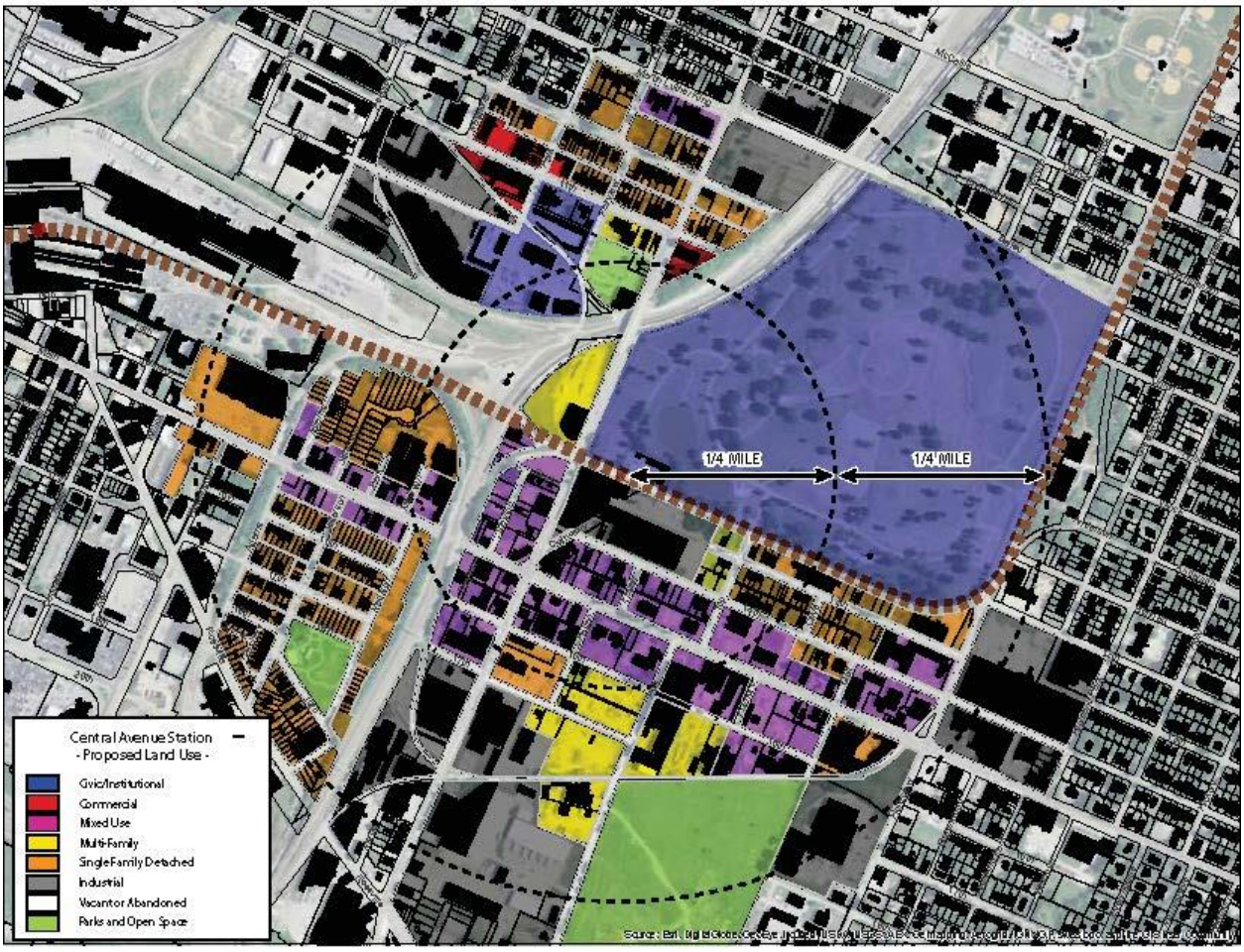
Particular focus is given to areas that are currently underdeveloped or ripe for redevelopment, such as vacant or underutilized commercial or industrial development, lots with substandard or blighted structures, and vacant lots. In some cases assumptions are made that future market conditions might result in the sale and redevelopment of some occupied parcels.

Existing single-family residences, institutional uses (e.g. parks, churches, schools), and some business developments are exempted from redevelopment assumptions, as these uses are well-established and generally not assumed to be candidates for redevelopment in conceptual-level planning. Rather, it is assumed that single family neighborhoods would be stabilized and improved by proximity to rail and other redevelopment.

Main St. /Central Ave.

This station is temporary and will be replaced when the rail line is extended to its ultimate destination: the Choo Choo. The concept is focused on keeping this area relevant and viable after the station is defunct by establishing a direct link to the Choo Choo station location, which is roughly one half mile away. This is accomplished through the continued redevelopment of Main Street as a mixed use street leading from Holtzclaw Avenue in the east into downtown and the Choo Choo station, with a mix of one and two-story retail, office and multi-family buildings. Additionally, a pedestrian/bike trail will connect the station area to the Choo Choo. The blocks to the south of Main Street could redevelop as two to four story multi-family. The Central Avenue development concept is depicted in Figure 4-2.

Figure 4-2 Main/Central Station Area Development Concept

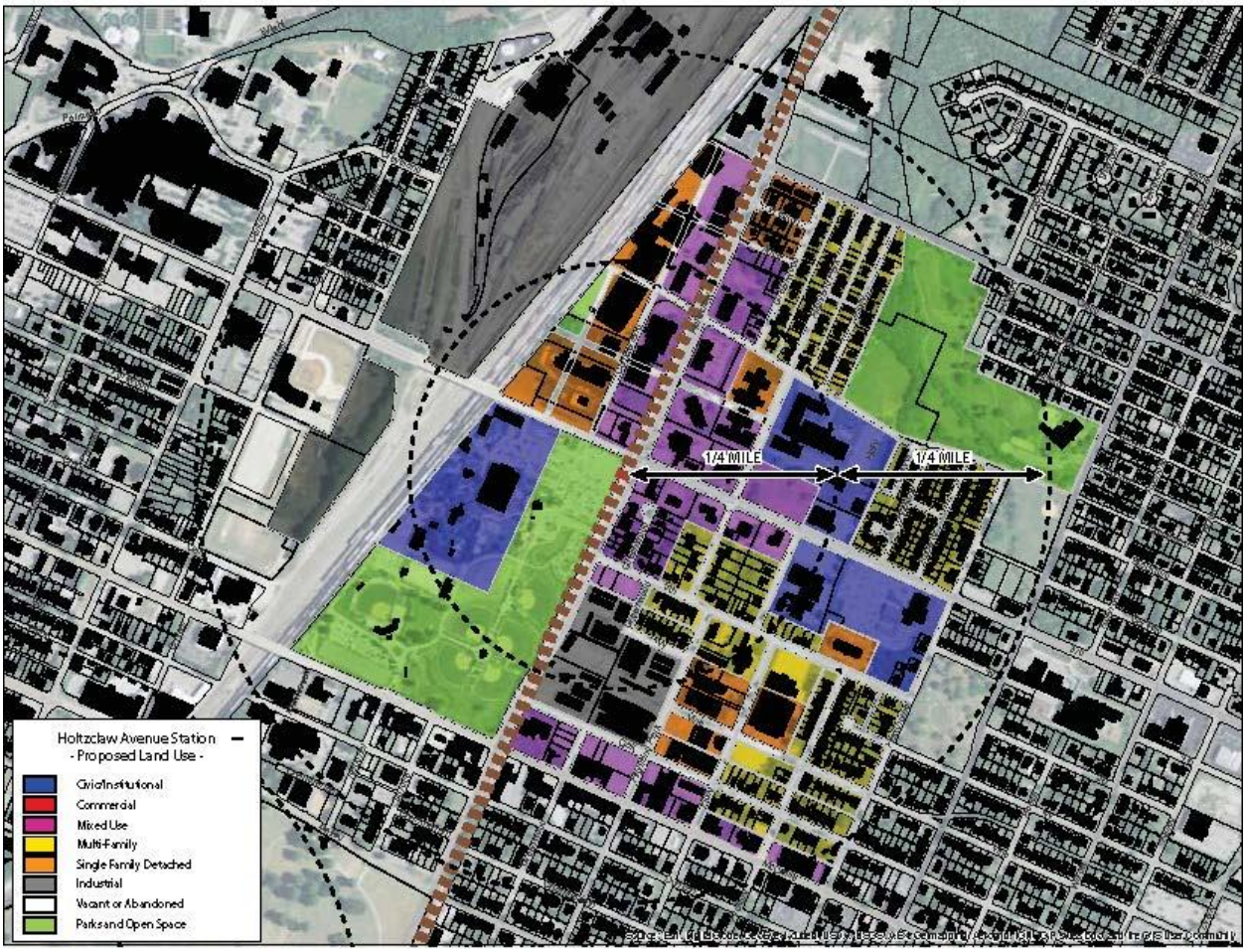


Holtzclaw Avenue

The Holtzclaw Avenue station is co-located with the Chattanooga Zoo and Warner Park, which hosts many athletic tournaments and UT Chattanooga sports teams. This station will serve as an important point of access for event spectators, zoo visitors and park patrons at a location where parking shortages occur during popular events. See Figure 4-3 below.

Beyond the park and zoo, this station area is envisioned to have a significant residential focus, providing housing for downtown (just a short train or shuttle ride away) as well as the Erlanger Hospital and UT Chattanooga campuses not less than a mile away via Third Avenue. The blocks surrounding the station near the intersection of Holtzclaw Avenue and Third Avenue are proposed to transition from suburban commercial and low intensity government uses into mixed used residential, characterized by three to five story apartment and condo buildings with ground floor retail and service uses. Mid-rise multi-family buildings are proposed for the institutional and commercial uses in the blocks surrounding. An additional row of residential mixed use development is proposed along the McCallie Avenue corridor east of Holtzclaw Avenue. Existing single family neighborhoods, which are relatively stable, would be preserved as would Orchard Park Middle School and Orchard Park Baptist Church.

Figure 4-3 Holtzclaw Avenue Station Area Development Concept



Glass Street

The Glass Street station is located along Chamberlain Avenue, equidistant from the intersection of Chamberlain and Glass Street, seen as the heart of the Glass Street neighborhood and the old Buster Brown factory site, which is showing signs of new life as an incubator for start-up businesses. Connections from the Glass/Dodson intersection are provided via Cheek and Crutchfield streets. The presence of a rail station is seen as an important catalyst to build on the momentum created by the Glass Street Collective and other initiatives.

The proposed land use concept for the Glass Street station area – shown in Figure 4-4 – builds on the neighborhood's two emerging anchors: the Glass Street corridor will continue to redevelop and intensify as mixed use commercial development between Dodson Avenue and Chamberlain Avenue. The Buster Brown site is envisioned to become a training and employment center for the surrounding community. The existing structure will remain intact, while the existing parking lot and surrounding blocks will experience infill and intensification as three to four story apartment and condo buildings. The existing single family neighborhoods will be preserved and stabilized. A massing diagram is shown in Figure 4-5 and a rendering of Chamberlain Avenue is shown in Figure 4-6.

Figure 4-4 Glass Street Station Area Development Concept

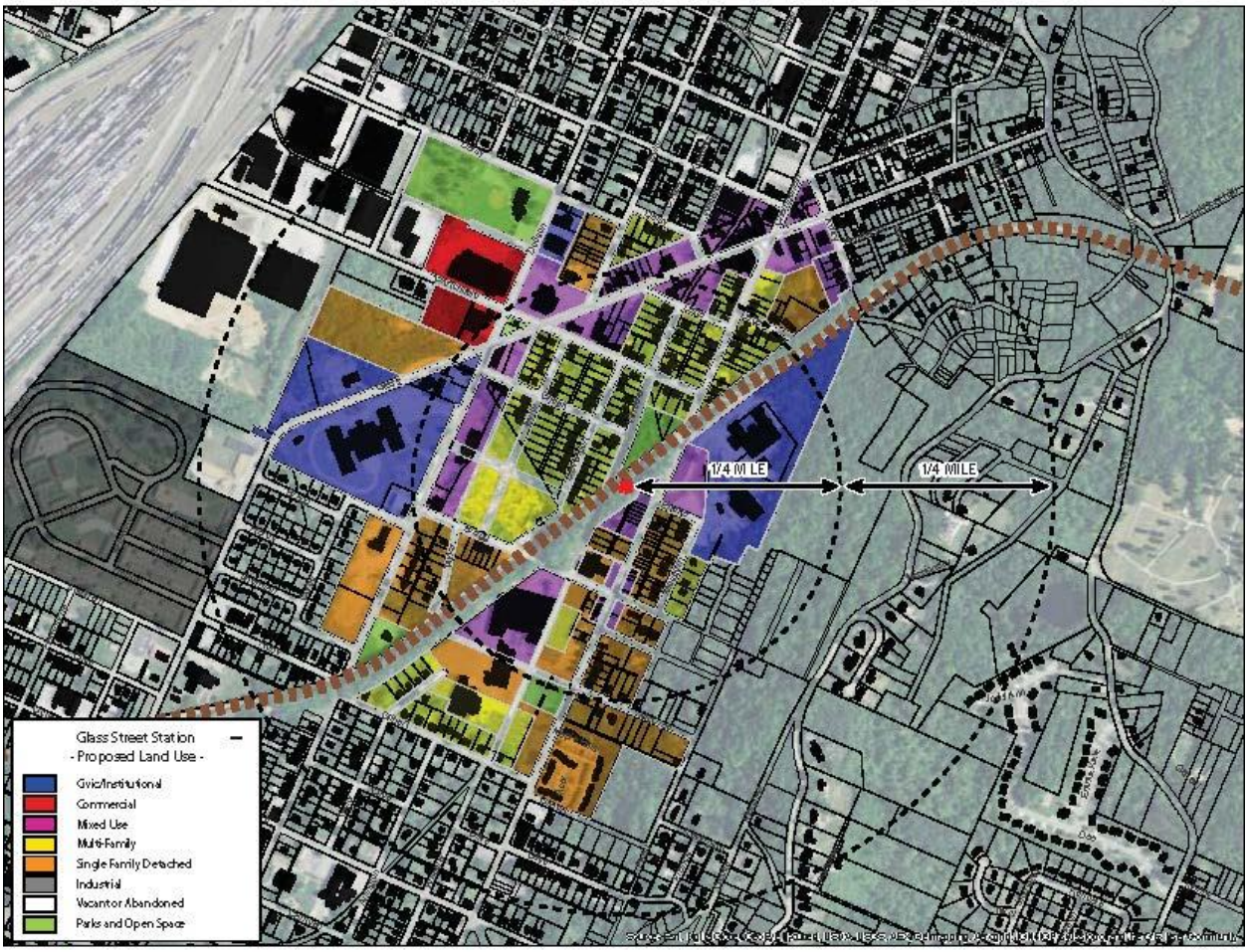
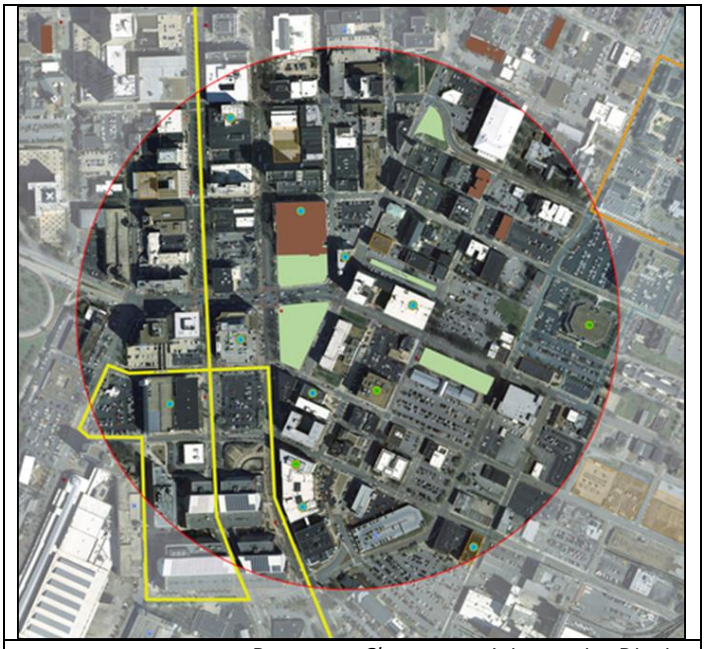


Figure 4-5 Glass Street Station Area Massing Diagram image

Figure 4-6 Glass Street Avenue Station Area rendering of Chamberlain Avenue

4.3.1 *Station Area Branding and Identity*

Station areas can become more attractive for new investment and activity if they establish a unique identify or "brand." For example, the City has created an Innovation District in the heart of downtown described as a "catalytic mix of start-up businesses, business incubators & accelerators alongside innovation economy generators & amenities - available in a dense, walkable urban core." It is bundled with a series of attractors, including robust bicycle, pedestrian and transit connections, public art and a series of regular and "pop-up" events such as musical performances, guest speakers, markets and group exercises. The Chattanooga Innovation District was recently featured in the New York Times for its ability to drawn in young tech-savvy entrepreneurs and spur investment.



Downtown Chattanooga's Innovation District

What follows are some potential branding ideas for each of the station areas that were identified at some point during the planning process. These should in no way be considered as final, but rather discussion-starters for more detailed future station area planning efforts.

The Choo Choo station area can build on the nostalgic rail brand.

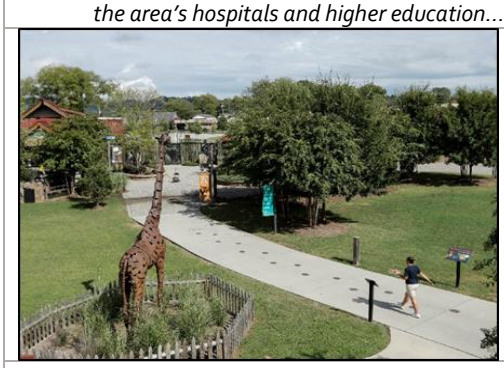
Choo-Choo/Central Avenue

The Chattanooga Choo Choo (and Central Avenue) station area can build on the existing "Choo Choo" brand by creating a sense of nostalgia for rail. Beginning with the interim Central Avenue station, it can also identify as a gateway into downtown.

The Holtzclaw station area can brand identify with the area's hospitals and higher education…

Holtzclaw Avenue

The Holtzclaw Avenue station area could leverage its proximity to UT Chattanooga and Erlanger, Parkridge and Memorial hospitals – "meds and eds" – with a focus on providing multi-modal connections, student housing and associated retail and medical office. Another route is to focus on proximity to the zoo and strategic location relative to the parks central to the City, including Warner Park, the National Cemetery and Montague Park.



…or it can build on its adjacency to the zoo and several parks.

Glass Street

The Glass Street station area has already begun cultivating an environment as an artist and creative community through the Glass Street collaborative. The station area planning effort can simply expand on this effort, building a "brand" for Glass Street as a place for arts and culture. Additionally, the Buster Brown site provides an opportunity to expand on this notion by developing as a center for artisan production

The Glass Street station area has already begun cultivating an environment as an artist and creative community.

4.4 Non-Motorized Network

The proposed rail alignment creates a continuous, linear right-of-way from beginning to end that can be leveraged to help facilitate last mile connections to and from the rail service. This valuable transportation asset provides mobility opportunities not just for rail, but for non-motorized transportation in the form of a parallel system of pedestrian and bicycle paths, sidewalks and transit stops to facilitate transfers.

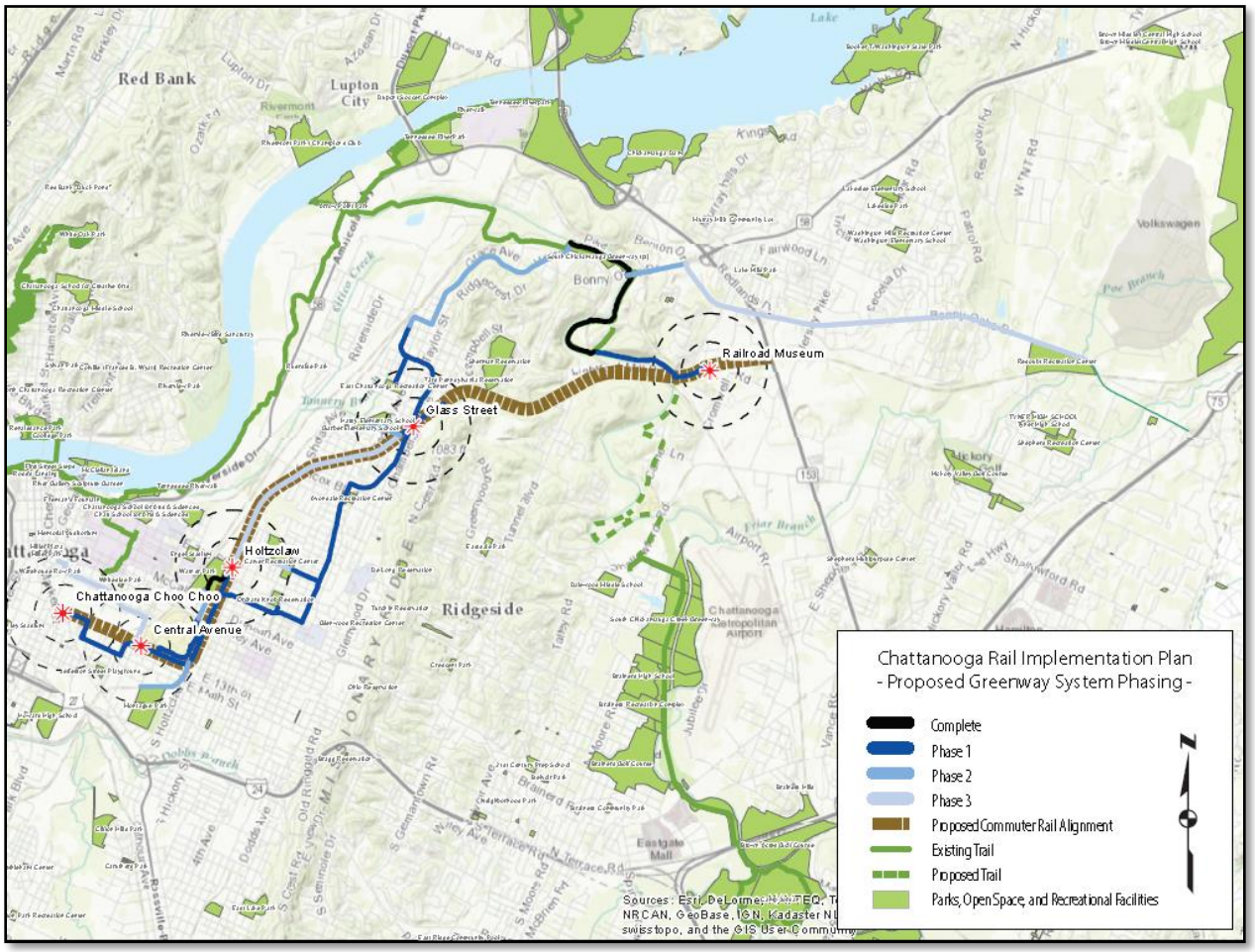
Rail-with-trail has been implemented successfully in places such as Denton County, Texas (A-Train) and Charlotte (South Corridor light rail). One of the most well-known and successful examples is the Beltline in Atlanta. A multi-use trail system has been built in advance of a planned rail system and it is already drawing significant amounts of new development as a highly sought-after "brand" in the Atlanta region.

A linear, multi-use non-motorized facility is proposed to run parallel to the proposed rail alignment, creating a true, multi-modal trail. The non-motorized portion of the trail system can potentially be built in advance of the rail portion, providing an important mobility option, building a sense of anticipation for rail and beginning to catalyze redevelopment and generate new investment.

The proposed trail alignment, facility types and phasing are depicted in Figure 4-7. This system was assembled with the following principles in mind:

- Continuity – The non-motorized portion runs parallel to the rail portion wherever possible. However, in situations where ROW and topography are limiting factors, the two diverge. Additionally, maintaining an off-road trail is a priority, but ROW limitations necessitate on-street facilities in some locations.
- Trail and bicycle network integration – The system weaves together existing and proposed elements of other trail and bicycle networks, including the City of Chattanooga's Bicycle Network Implementation Plan, the Rails-To-Trails Conservancy's proposed trail system and the Trust for Public Land.
- Linear park system – The system connects existing parks, such as Warner Park, the National Cemetery and Monatgue Park, creating a true linear park network for Chattanooga.

Figure 4-7 Proposed Multi-modal Trail Element



4.4.1 Last Mile Connections: Complete Streets

Many rail systems don't realize their full potential because they lack connectivity to the surrounding land uses and activities. These "last mile" connections are critical because all transit riders are cyclists or pedestrians at the beginning and of each trip. Complete streets – streets that accommodate all potential users regardless of mode or ability level – are essential to making stations integral to their neighborhoods.

Two types of station area connections have been identified for the preferred alternative. At the regional level (a roughly three mile radius around station areas), the City's Bicycle and Pedestrian Action Plan serves as a basic framework for station connections.

In the immediate area around each station (approximately one half-mile radius) a more fine-grained complete streets network is proposed. A system of bicycle lanes, marked routes, new sidewalks and streetscape enhancements provide direct, multi-modal connections to stations, complement proposed redevelopment and support a human-scale environment. Station area complete streets connections for the Central Avenue, Holtzclaw Avenue and Glass Street stations identified in Figure 4-8, Figure 4-9 and Figure 4-10 respectively.

Figure 4-8 Complete Streets Connections: Main/Central Station

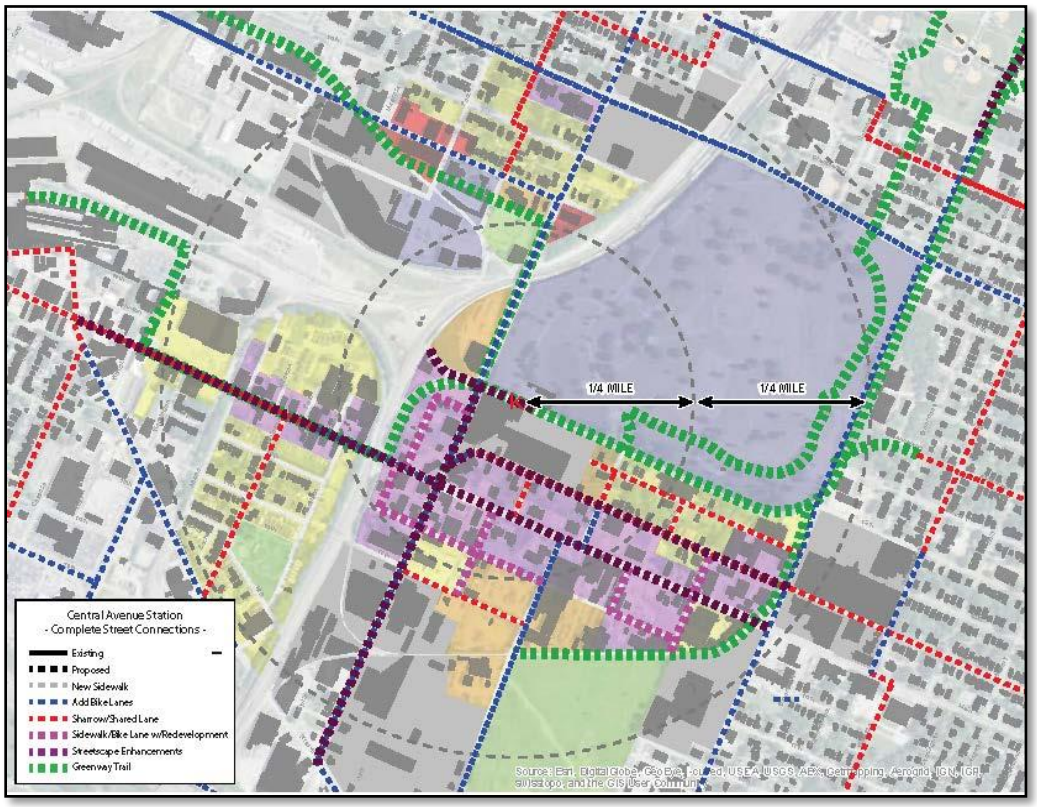


Figure 4-9 Complete Streets Connections: Holtzclaw Avenue Station

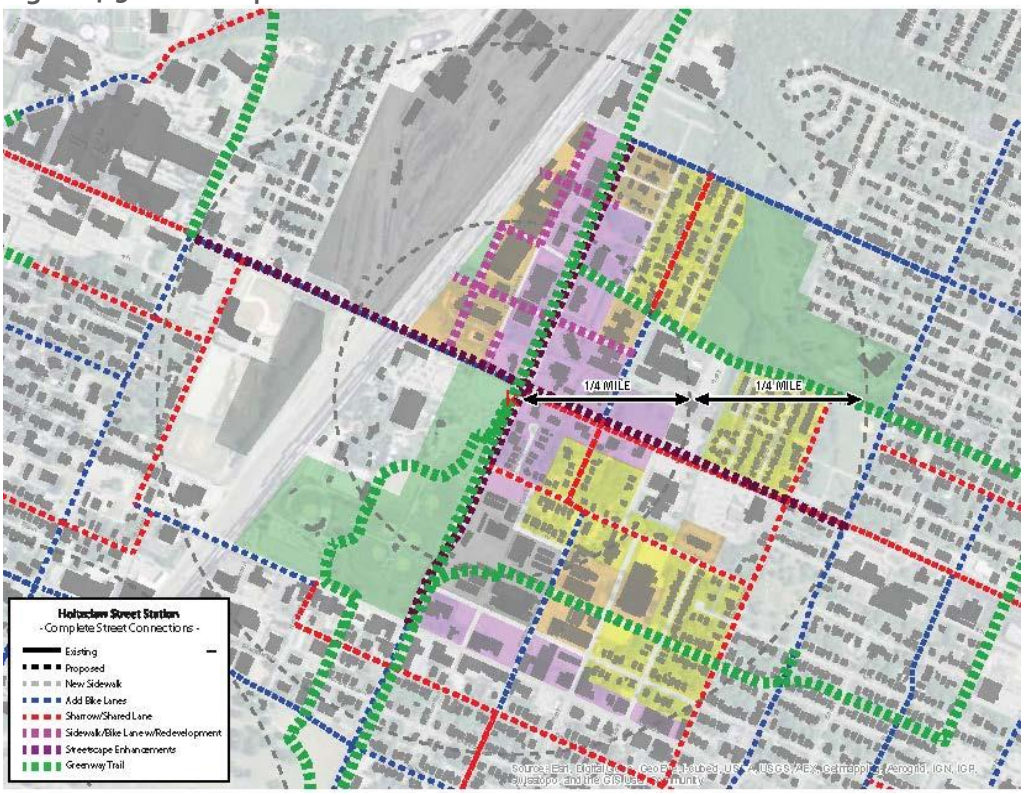


Figure 4-10 Complete Streets Connections: Glass Street Station

5.0 Project Implementation

5.1 Project Phasing and Schedule

As is common for projects of this nature, funding and permitting constraints indicate a preference for construction in incremental phases. Through phasing, portions of the overall vision can be put in place that:

- Minimize infrastructure to initiate service
- Introduce the project and concept to the community
- Build development density that is required to support ridership goals, and
- Procure rolling stock from other transit properties

A summary of project implementation steps is presented below.

Table 5-1 Project Implementation Milestones

Project	Description	Duration (months)	Cost (m)
Inter-Local Agreements	Develop Inter-local agreement between CDOT, CARTA, HCRA and TVRM on project development and service operation.	6	$0
Station Area Plans and Policy and Regulatory Changes	Establish a vision and plan for each station area. Implement policy and regulatory changes to facilitate TOD.	18	$0.8
Phase 1 Trail Segments (Design and Construction)	Work with Trust for Public Lands and other trail partners to implement Phase 1 trails – Choo Choo to Central Avenue to Holtzclaw/3rd; rail to trail through Orchard Knob, Chamberlain Ave. to Glass Street; to NPS trail & Boyce Station via rail alignment; E Chatt. Rec. Center; completion of South Chick Greenway to Rail Museum station.	36	$4.8
NEPA Document Preparation and Finding of No Significant Impact (FONSI) for Rail	Conduct environmental study according to the National Environmental Policy Act (NEPA). Anticipated class of action in for Environmental Assessment (EA). Receive FONSI from the FTA for the entire rail transit project from TVRM to the Chattanooga Choo Choo.	18	$1.0
Preliminary Engineering (Rail Improvements)	Develop 30% design plans for the rail station improvements for both phases of the project. This will define the project limits to be considered as part of the NEPA process.	18	$1.0
Final Design Phase 1 Rail	Prepare final procurement documents for track, station, tunnel and signaling improvements. Prepare vehicle procurement specifications.	12	$5.6
Phase 2 Trail segments	Continue work with trail partnerships to implement Phase 2 trails – Alternative alignment through National Cemetery and Warner Park; spur to Montague Park; Glass St. spur to Hardy/Garber Elementary; Boyce	18	$1.5

Project	Description	Duration (months)	Cost (m)
	Station to South Chick Greenway via Dodson Ave.; connector from South Chick Greenway to Bonny Oaks.		
Procure DMU rail vehicles	Includes two service vehicles and one spare. Used vehicles may be considered, at some cost saving. This procurement would be partially funded through the first federal funding request.	24	$27.0
Construct Phase 1 Rail	Construction of all the necessary infrastructure elements to enable operation of a rail transit system between the TVRM and Central Avenue. This project would be partially funded through the first federal funding request.	18	$36.5
Construct Station Area Capital Improvements	Design and construction of publically-funded capital improvements to support access to rail stations identified in station area plans (cost tbd)	18	$0
Phase 3 Trail segments	Continue work with trail partnerships to implement Phase 3 trails – Central Ave connector to Bessie Smith Center; rail-with-trail from Holtzclaw to Glass St.; Bonny Oaks Drive (with TDOT road widening).	18	$1.9
Delivery of DMU rail vehicles	Take delivery and initiate service testing of vehicles. Includes two service vehicles and one spare. Used vehicles may be considered.	9	$1.1
Initiate Rail Service Phase 1	Initiate operation of the passenger rail system between TVRM and Central Avenue. Op cost $5.4 m annually	12	$0
Final Design Phase 2 Rail	Prepare final procurement documents for track, station and underpass/bridges. Extensive coordination with CSX and NS railroads to maintain service during construction.	18	$4.2
Construct Phase 2 Rail	Bridges under Central Avenue and NS and spur tracks; assumes transition to 10' depth.	18	$47.4
Initiate Rail Service Phase 2	Extend rail service to Choo Choo; new track and station; Testing and service expansion Op cost $5.6 m annually	12	$0
Total			$132.8

5.2 Funding

The over $100 million cost of this project will require significant new financial resources and a funding strategy, which will extend into annual operating and maintenance costs. Funding will have to come from a range of sources. Most similar projects in the USA rely on a combination of federal, state and local funding. Table 5-2 provides a snapshot of funding sources potentially available for a project like this, consistent with the Fixing America's Surface Transportation (FAST) Act of 2015. Table 5-3 presents a list of possible sources for funding the on-going operations and maintenance of the system into the future.

Table 5-2 Potential Capital Funding Sources

	Funding Source	Description
FEDERAL	FTA Section 5309 Fixed Guideway Capital Grant Program	The New Starts Program funds competitive projects with capital costs exceeding $250 million, with a limit of up to 50 percent of capital cost. Small Starts funds fixed guideway projects with capital costs up to $250 million with the contribution limited to $75 million.
	USDOT Competitive Grants	For the past few years, USDOT has issued notices of availability for competitive grants applications include six rounds of Transportation Investment Generating Economic Recovery (TIGER) grants in addition to grants for State of Good Repair; Urban Circulators; and Bus and Bus Livability.
	Surface Transportation Program (STP)	The program provides flexible funding for projects that preserve and improve the conditions and performance on any Federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects.
	Congestion Mitigation and Air Quality (CMAQ) Improvement Program	For areas that are not in compliance with national ambient air quality standards, funds are available for transportation projects that contribute to the attainment or maintenance of the standard. To be eligible, projects must demonstrate effectiveness in reducing air pollution, and be included in the MPO's current LRTP and TIP.
	Transportation Infrastructure Finance and Innovation Act (TIFIA) [Finance only]	TIFIA provides Federal credit assistance for eligible projects of regional and national significance. The TIFIA program is designed to fill market gaps and leverage substantial private Program and other non-federal co-investment by providing supplemental and subordinate capital to projects
STATE	State General Funds	Transportation projects may be appropriated through a state's general fund on a project-by-project basis. The funds may come from a variety of sources including property, sales and income tax.
	Rental Car Taxes	States may authorize local implementation of rental car excise taxes, which are assessed on a percentage or flat-fee basis.
LOCAL	Local Option Sales Tax	Local option sales taxes are taxes imposed by a jurisdiction on itself for retail goods and services to pay for capital projects.
	Property Taxes	Property taxes can fund transit improvements, both at the county and/or city level.
	Parking Fees	Already used in Chattanooga. Agency levies taxes on their parking facilities to generate funds for congestion, air pollution and sprawl mitigation measures.
	Payroll Taxes	Employer, or payroll, taxes are levied on a corporation's gross payroll within a transit district and could be employed and administered by a state agency. These taxes must be authorized at the state level, and are usually subject to voter approval at the local level. This source may require a change in state laws.
	Value Capture / Tax Allocation Districts (TADS)	Special taxation districts are created to finance a wide range of projects, including public transportation and assess an extra levy on property owners within a district in order to finance special projects.
	Corridor Improvement District	A Corridor Improvement District is designed to assist economic development and redevelopment in established commercial districts. It allows communities to combine tax dollars from a variety of sources to leverage economic development dollars to make capital improvements.
	Hotel/Motel Taxes	States may authorize local implementation of hotel/motel taxes, which are assessed on a percentage basis.
	Joint Development / Private Participation	Funding support from the private sector reflects a combination of businesses within an existing improvement or assessment district agreeing to add funding for a streetcar project as part of the district's existing expenditure plan; partnerships with a local energy provider; and donations.
	"Sin" Taxes	Applied to particular goods and activities, such as alcohol, tobacco, and gambling. They are intended to be a disincentive to certain behaviors, yet they have the potential to raise considerable revenue for states and local governments.
	Impact Fees (TIF)	An impact fee is imposed to assess the cost of new capital improvements upon new developments that utilize the improvements. Impact fees may only be used for capital improvements - operations, maintenance, and repair work are not permitted.

Table 5-3 Potential Operating/Maintenance Funding Sources

Funding Source	Description
Fare Revenue	Includes all fares received from passengers, paid either in cash or through pre-paid tickets, passes, etc. An initial order of magnitude on the potential level of fare revenue that corridors would generate is provided by reviewing the existing fare box recovery ratio for MARTA (approximately 22%). Fare box recovery ratio is the share of total operating costs fare revenues cover. In future phases of the project development process, detailed ridership projections will be developed which will allow for the identification of potential fare revenue estimates.
City General Funds	Once the passenger rail operating plan and annual O&M costs are finalized, the City could provide an annual operating subsidy for the project. This could be a specified annual amount or annual percent share of O&M costs.
Parking Fees	A parking fee is a tax or surcharge levied on paid parking. The fee could be applied within the City limits or along the specific rail corridors for the use of off-street commercial or employer provided parking spaces. If applied within the passenger rail corridors, there would be some degree of relationship between traffic and parking within the corridor relative to parking requirements and parking tax.
Reallocation of Existing Fixed Route Bus Service Costs within the Corridor	A key planning component of the project development process is the development of an integrated service plan that reflects the incorporation of the proposed passenger rail line into the existing bus route network. An outcome of this service plan could be the reduction of fixed route bus service hours and miles reflecting the elimination of duplicative services with the rail line or the reorientation of bus service to use the rail as a circulator and distributor. The operating cost savings from this reduction could be reallocated to support operating costs related to the implementation of the rail.
Local Option Sales Tax	Local option sales taxes are taxes imposed by a jurisdiction on itself for retail goods and services to pay for capital projects.
Joint Development Lease Fees	Joint development includes transit projects that are integrally related to and co-located with other transit- oriented development. Lease fees resulting from joint development may be used to fund eligible operating expenses.
Naming Rights/Sponsorships	This potential source reflects a form of revenue participation provided through the provision of equity investments for a project. In return, sponsors receive a combination of advertising, promotion of image, and/or a commitment that their products will be used by the entity they are sponsoring. Sponsorships have become an increasingly important mechanism for funding large public projects, such as stadiums, aquariums, and rail transit projects that attract large attendance and/or provide high visibility.
Advertising Revenue	This could include revenues derived from advertisements placed inside and/or outside the vehicles; at stations; and/or in schedules, maps, flyers, and other promotional materials. Additionally, a potential emerging source of advertising revenue is from smart phone apps that provide passengers with real time travel information.
Hotel/Motel Taxes	States may authorize local implementation of hotel/motel taxes, which are assessed on a percentage basis.
Realty Transfer or Mortgage Fees	A fee imposed upon the recording of deeds evidencing transfers of title to real property based on the assessed valuation of the property and paid upon the recording of deeds.

5.3 Economic Development

The economic impacts of public transit projects fall into several categories:

- The short-term stimulus from the capital investment and construction,
- Benefits and cost savings experienced by the direct users of the new transit project,
- The improvements to the transportation system overall, which are a benefit for the people and businesses that don't directly use the project,

- The effects of transit oriented development,
- And finally, these benefits must be offset by the increase in taxes used to fund the project.

Each of these impact categories are described in the following section.

5.3.1 Short-Term Stimulus

During the initial period of capital investment and construction of a public transit project, there is a stimulating effect on the local economy. This presents itself in several ways:

- An increase in employment as local workers are employed in the construction process,
- Increased revenue for local construction and supply firms,
- The increased consumption felt throughout the local economy generally as the employed workers and firms spend their additional income.

5.3.2 Direct User Impacts

The users of the new transit service will experience a number of benefits and reductions in costs:

- Those users who own a car or truck but choose to use transit to travel, will see decrease in the expenses of maintaining and operating their vehicle (since the overall miles traveled will reduce), as well as a decrease in parking expenses.
- Some users will choose to stop their use of a personal vehicle altogether, and in so doing avoid the expenses associated with ownership, which is generally estimated to be between $9,000 and $12,000 per year (AAA, 2015).
- For those users who do not have a car, the transit project will provide increased mobility and better access to potential employers.

All users will experience the benefit of increased safety, since rail has a better safety record than travelling by car, truck, or even bus.

5.3.3 Non-User Impacts

It is expected that public transit projects will have two main impacts for the parties that do not use transit themselves:

- Because of the increased mobility of transit users, employers located along the corridor will have an increased labor pool from which to draw employees.
- Transit ridership will remove drivers from the roads. This will cause a decrease in congestion on the roadways, dependent on the volume of ridership. A decrease in congestion will generate the following savings for those still using the highway and road system:
    - Peoples' time is valuable, and reduced congestion will lead to a reduction in the time spent sitting in traffic.
    - This reduced time in traffic will also reduce vehicle maintenance costs and spending on gasoline.
    - The reduction in gasoline consumption will reduce emissions.

- Also, the reduction in traffic will reduce the number of traffic accidents.
- Reduced congestion will reduce demand for future new roads and road widening projects.

5.3.4 Transit Oriented Development

A differentiator between fixed investment transit (like stations and rail line for street cars or commuter rail) and transit without fixed investment (like busses), is that transit with fixed investment is more conducive for transit oriented development. The main benefits associated with transit oriented development are as follows:

- New development can be more easily directed, allowing city planners to target specific areas.
- Land uses change from the lower value and lower density types (such as industrial and warehousing) to higher density and higher value land use types (such as residential or office space).
- The increase in density has a number of benefits:
  - Efficient use of space, reduction in sprawl,
  - Increased walkability in the neighborhoods around the development areas, and
  - The creation of activity and employment centers.
- The increase in destinations and housing along the transit corridor serves to further increase ridership, which in turn increases the benefits to the new riders as well as the non-users (described above).

5.3.5 Benefit and Cost of Investment

The benefits of the transit program must be compared to the expected costs of the projects, both initial and ongoing. These costs will be funded in part through federal and state money, but also through local funds which is discussed above in section 5.3.

The Atlanta Beltline (www.beltline.org) is a great example of an integrated multimodal public transportation infrastructure asset that has potential parallels with the Chattanooga rail project. The plan calls for a ring of transit service around the central city to be operational by 2022, but starting in 2010 the project has focused on developing a multi-use trail, connected to surrounding neighborhood land uses and integrated with existing transit service. Between 2006 and 2015 more than $775 million in new private development has been attracted to communities within a half mile of the eastside trail – including residential townhouses, condos and apartments, offices and commercial developments and redevelopment projects.

5.3.6 Development Requirements

In order to maximize the benefits of the project, and make it a viable option, certain target development levels must be met along the corridor and around the station areas. Based on the developed buildout scenarios for Alternative 1, the following increases above the jobs and building square footage should be met by a target date of 2040.

Measure	Base Projected Increase by 2040	Buildout Scenario Increase by 2040	Increase Above Baseline
Jobs (thousands)	11.3	29.2	17.9
Building Square Footage (millions)	6.7	15.8	9.1
Building Value (millions)*	$297	$828	$532

5.4 Next Steps

5.4.1 Engage Public and Stakeholders

The visits to Peer Rail Cities conducted by City staff in 2015 presented a clear and consistent message: smaller cities that have successfully implemented passenger rail service have all relied heavily on sustained engagement and advocacy from the public and business coalitions.

5.4.2 Station Area Implementation

The proposed stations described in this plan are more than just conduits for moving passengers to and from passenger rail vehicles. When done well, the station areas can serve as neighborhood focal points generating change, revitalization and economic development. Thoughtful planning and implementation is essential.

This study sets a general framework for the development of stations and station areas. However, in order to fully implement the station areas and catalyze growth, further action is necessary. Proposed activities to implement the station areas are organized into three distinct tracts:

- Planning and Visioning
- Policy and Regulation
- Capital Improvements and Infrastructure

Planning and Visioning

The Planning and Visioning Tract sets the vision for how each station area can transform to support access to multi-modal transportation and economic development. It forms the basis for the Policy and Regulatory Tract and the Capital Improvements/Infrastructure Tract. It includes the following elements:

- Market Study: Provides context for housing, retail and office markets. Includes prescriptive guidance for number of units by type (single family, townhome, apartment, condominium), office and retail square footage and submarkets, rents and price points.
- Vision, Land Use and Multi-modal Transportation Plan: Builds on the initial station area planning effort and market analysis. Establishes overall vision and "brand" for each station area, including major activities and character. Makes parcel-specific prescriptions for land use, including type, density and FAR, public realm/open/civic space and streetscape. Identifies multi-modal connections in each station area, including trails/greenways, bicycle lanes, sidewalks, CARTA routes and new street connections. Identifies state and federal grant opportunities.
- Parking Study: Identifies parking maximums and minimums based on land use recommendations. Determines whether parking can be absorbed by private development or

public investment is required. Develops strategies for reduction in parking through shared use and shifts to other modes.

- Value Capture Study: Building on the market study and land use plan, determines potential of value to be captured by public finance mechanisms generated by rail/station and related public investment.
- Affordable Housing Study: Determines feasibility of affordable housing and suggested mix (affordable vs. market rate) within each station area. Identifies strategies for inclusion of affordable housing concurrent with private development.

Efforts associated with the Planning and Visioning Tract should occur as soon as possible so that the subsequent tracts can begin prior to station design.

Policy and Regulatory

The Policy and Regulatory Track: builds on the recommendations of the Planning and Visioning Track by creating the necessary tools for implementation. This includes land use, economic development and financing. Elements include:

- Form-based Code: Implements the Land Use Plan through land development regulations that guide urban form, character and street relationships. Both the development of form-based code and its formal adoption are included within this tract.
- Value Capture Tools: Building on the findings and recommendations of the Value Capture Study, creates tools, such as tax increment financing (TIF), designed to help pay for necessary infrastructure upgrades.
- Incentives: Develops incentives to encourage private sector development, including affordable . Includes monetary incentives such as the Reinvesting in Neighborhoods tax rebate tool and regulatory incentives such as density bonuses.
- Joint Development: Establishes a framework for public-private partnerships to encourage new growth and development around station areas. Could include land purchase/acquisition, incentives, targeted land uses, pursuit of grant opportunities and assignment of and/or creation of responsible City agency.

It is important that these policies and tools be in place as soon as possible to take advantage of any early momentum gained by the development of the trail and station area planning effort itself.

Capital Improvements and Infrastructure

The Capital Improvements and Infrastructure Tract translates the recommendations of the Planning and Visioning Tract into a specific plan for public infrastructure around stations. The infrastructure is intended to support both access to rail stations and well as new development around station areas. Thus, it can be seen as an important catalytic element to economic development. The Capital Improvements and Infrastructure Tract includes:

- Stations: Any station-related items not otherwise addressed by the rail planning design itself. This could include items such as bicycle lockers and parking or other amenities.

- Parking: Shared parking to support mixed-use development, whether surface or structured.
- Civic space: Parks, plazas, fountains and other public gathering spaces.
- Sidewalks, bikeways and greenways: Bicycle and pedestrian connections from the surrounding neighborhood to the station not addressed through street improvements or through redevelopment.
- Streetscape: Lighting, landscaping, street furniture and other enhancements not covered through street improvements or through redevelopment.
- Signage/wayfinding: Signage for motor vehicles and bicyclists/pedestrians to navigate both to the stations and from the station to important destinations.
- Street improvements: Upgrades and new street connections to improve motor vehicle access to stations (if necessary), to activate surrounding land use for new development and to create a human-scale block system.

Ideally, this tract would occur concurrent with the station design (for coordination purposes) and with the Policy and Regulatory Tract so that any proposed financing mechanisms are structured properly.

5.4.3 Pursue Funding Strategies

The $130+ million capital price tag for this project clearly would require a substantial increase in available capital funding for public transportation projects for Chattanooga.

Most new transit systems use a combination of federal, state, regional, and local funding to pay for the capital costs to implement a project. Some of these funds are available, while others do not currently exist locally due to current legislation but may become available for use in the future. Table 5-2 presents potential federal funding sources that reflect the most recent Funding America's Surface Transportation (FAST Act) federal surface transportation legislation.

Implementation of the passenger rail system will also result in an increase of transit operating costs for the Chattanooga region. Similar to capital costs, long term operating funding will likely reflect a combination of multiple sources. However, it is critical to initiate the discussions among the public and private partners that would benefit from the proposed service to identify which potential sources have the most political support to carry forward for further evaluation. The fares collected on the rail system are used to fund the operating costs, but typically only cover a fraction of the total cost. Table 5-3 provides potential operating funding sources that could be pursued. The majority of the new passenger rail lines opened or nearing completion utilize a variety of federal, state, regional and local funding sources. These systems utilize a variety of sources to fund operating costs based on local policies and legislation in place.

5.4.4 Invest in Regional Transit

The preferred alternative for passenger rail in Chattanooga identified in this study would only succeed when carefully integrated with enhancements to the CARTA bus system, as well as other public transportation providers, Network Transportation Providers (such as Lyft and Uber) and multimodal travel facilities and options – specifically bicycle paths, sidewalks and trails.

5.4.5 *Design and Build Passenger Rail*

As funding becomes available it may be advantageous to build the preferred rail alignment in incremental phases. Through phasing, portions of the overall vision can be put in place that incrementally realize the full vision and build public excitement and encourage private investment.

- Track Rehabilitation – Local investment in routine track and crossing maintenance can be focused within the project limits. These improvements will be limited in nature due to the relatively good condition of the existing track.
- Passenger Stations – With minimal relative investment, passenger stations could be constructed along the existing track. Attention should be paid to ensuring compliance with Americans with Disabilities Act Guidelines. Scaled back service could be initiated using existing museum trains once stations are constructed at the TVRM, Glass Street and 3rd Street.
- Rolling Stock – Procurement of modern coaches and locomotives should be considered in advance of full system roll out. Opportunities should be monitored for purchasing surplus equipment from other larger transit operators. Often equipment becomes available that may need a mid-life overhaul. Larger agencies may find it advantageous to sell the equipment off rather than rehabilitate. Chattanooga could potentially take advantage of this opportunity to pick up a bargain on coaches or even locomotives.
- New Track Construction – The construction of new track will likely be the largest capital investment associated with the project and would likely occur in conjunction with federal funding. Alternative 1A envisions a slightly scaled back project that does not quite make it all the way to the Chattanooga Choo Choo. In this scenario the end of line station would be located at Central Avenue near Main Street. Shuttle bus service would be provided to connect to the downtown network.
- Maintenance Facility Upgrades –At the point where rolling stock is purchased, modifications to the existing TVRM maintenance facility will be required. The majority of the machining equipment and service bays will be suitable for the new modern passenger rolling stock, however some vehicle specific equipment may be necessary. Additional tracks for storage of new rolling stock will be required.
- NSR/CSX Underpass and Connection to Chattanooga Choo Choo – On full implementation of the project, a new underpass will be constructed under the existing NSR and CSX freight tracks and a new station will be constructed on the site of the Chattanooga Choo Choo.