MEMORANDUM

To: Billy Fields, Metro Public Works
Chip Knauf, P.E., Metro Public Works

From: Bob Murphy, P.E., PTOE
Preston Elliott, AICP
Kayla Ferguson, P.E.
Liesel Goethert, AICP

Date: January 12, 2018

RE: Slow Moving Vehicle (SMV) Traffic Study – Update

INTRODUCTION

In 2016, KCI Technologies, Inc. (formally known as RPM Transportation Consultants), completed the Slow Moving Vehicle Traffic Study at the request of the TLC and MPW. In light of continued development and traffic growth in the downtown core as well as in the number and types of "slow moving" vehicles, the purpose of this study is to expand the original analysis to include low speed vehicles (LSVs), while further evaluating the unique safety and operational aspects of these vehicle types.

The Transportation Licensing Commission (TLC) and Metro Public Works (MPW) seeks to provide a safe transportation system for all users. This includes the spectrum of for-hire vehicles operating on Nashville's roadways, specifically those considered as "slow moving". These vehicles blend both transportation and pleasure and are an important component to Nashville's tourism industry. Their limitations in terms of top traveling speeds and level of safety standards (which are lower than that of regular passenger vehicles), however, present unique safety challenges. As these vehicles currently share the same right-of-way with standard passenger vehicles, SUVS, commercial trucks, and buses in an urban environment, the TLC and MPW seek to better understand safety issues with specific slow moving vehicle (SMVs) operations. Horse carriages, pedicabs, pedal carriages, and low speed vehicles (LSVs) are included within this update.

It is important to note that while these slow moving vehicles meet the minimum federal safety standards, they are not in the same vehicle classification as regular passenger vehicles, and thus, have different safety standards. Being able to legally operate on public roadways does not

automatically translate into safe operations under all traffic conditions. Therefore, state and local governments are given the authority to restrict the operation of slow moving vehicles in order to promote a safe and/or efficient transportation system.

STUDY OVERVIEW

In 2016, KCI Technologies, Inc. (formally known as RPM Transportation Consultants), completed the Slow Moving Vehicle Traffic Study at the request of the TLC and MPW. These agencies sought to understand the extent of the SMVs currently operating on Nashville's streets and their related impacts, if any, to traffic flow and congestion. The Study specifically focused on vehicles that typically move slower than 15 mph, including horse carriages, pedicabs, and pedal carriages. Video data collected at key intersections during peak hours helped to quantify the volumes and speeds of these vehicles in operation. While observations largely revealed compliant behavior in terms of obeying traffic rules and regulations, these vehicles were observed to have much slower average speeds as they traveled through an intersection. Average speeds observed for each vehicle type, which ranged between 23% - 45% less than that of the average motor vehicle are provided in Table 1.

Table 1 Average Speeds Observed through Intersections

Slow Moving Vehicle Type	Average Speeds Through Intersections (2016)
Pedicab	7.2 mph
Pedal Carriage	5.7 mph
Horse Carriage	3.8 mph
Low Speed Vehicle (LSV)	*Not part of original SMV Traffic Study

The 2016 study presented recommendations for reducing the impacts of SMVs on traffic flow. Based on the recommendations of the study, the TLC subsequently restricted the operation of all SMVs during the weekday peak traffic flow periods, 7:00 – 9:00 am and 4:00 – 6:00 pm.

Given the low speeds of SMVs, in addition to other unique safety challenges mentioned in the Introduction section, the TLC and MPW desires to further understand the operations of these vehicle types and the potential vulnerabilities posed to operators and passengers. While additional types of SMVs exist in Nashville, SMVs collectively described in this report specifically refer to the four vehicle types listed in Table 1.

SLOW MOVING VEHICLE (SMV) SAFETY

The following section presents safety information through the lens of LSVs. Of the four vehicle types, these are capable of traveling the fastest and relatively, have the most safety measures. It can be assumed that, the three remaining vehicle types likely would fare worse than LSVs in crash scenarios.

The National Highway Traffic Association (NHTSA) established the Federal Motor Vehicle Safety Standard No. 500 for LSVs in 1998. At the time, these vehicles were primarily used for short trips in planned communities, such as those centered around golf courses, retirement communities, and institutional campuses. Mainly golf carts, these vehicles were providing trips for recreation, shopping,

and social purposes. Joyride, Cruzzin, Hee Hawlin and Music City Golf Carts are current operators of LSVs in Nashville. Over time, the use of these vehicles around the country has increased substantially to include a variety of transportation services in various settings and not just in the low-risk environments originally envisioned. For example in Nashville, these LSVs provide point-to-point transportation as well as tours throughout downtown Nashville and outlying areas close to downtown.

Safety Standard No. 500 established the LSV definition to include four-wheeled electric or gasoline powered vehicles capable of traveling above 20 mph but less than 25. Furthermore, LSVs must be equipped with basic safety features, such as seatbelts, headlamps, tail lights, rear-view mirrors and turn signals, but are not required to have airbags, bumpers or doors as they are envisioned to be used in low-risk environments. This distinction puts LSVs in a separate vehicle classification than regular passenger vehicles. For example, even the ultra-compact Smart car meets basic crashworthiness standards for passenger vehicles. Today, the federal LSV classification includes minitrucks, modified golf carts, and neighborhood electric vehicles (NEVs).

LSV weight, construction, and the lack of crashworthy design features, such as "crumple zones", create unique safety concerns when co-operating with regular passenger vehicles, including sports utility vehicles (SUVs) and commercial trucks. The Insurance Institute for Highway Safety simulated crashes between a GEM e2 (an LSV) and a Smart Fortwo car. The simulations showed that the LSVs did not perform well, as a side impact crash between a Smart car traveling at 31 mph and hitting a stationary LSV in its side resulted in detrimental impacts for the GEM test dummy, including the dummy's head almost striking the Smart car's windshield. Although belted, the dummy indicated measures that would translate into a "serious or fatal injury for real occupants". A similar collision with a much larger vehicle would undoubtedly result in similar, if not more severe outcomes.

Additionally, speed has been identified as a key risk factor in roadway traffic injuries, influencing both the risk of a roadway crash as well as the severity of the injuries that result from crashes. A basic goal of traffic engineering is to achieve uniform traffic flow as this enhances safety by minimizing speed differentials. Speed differentials, even between two regular passenger vehicles, create enhanced risk for a collision to occur, as illustrated in Figure 1. Similarly, the graph on the right illustrates the exponential increase in risk for a fatal collision, also between two regular passenger vehicles. Simply put, the greater the speed difference is between two vehicles that crash into each other, the greater the likelihood for serious or fatal injury. The lack of the ability to travel faster than 25 mph particularly puts LSVs at risk in shared roadway environments where other vehicles may be traveling at much higher speeds.

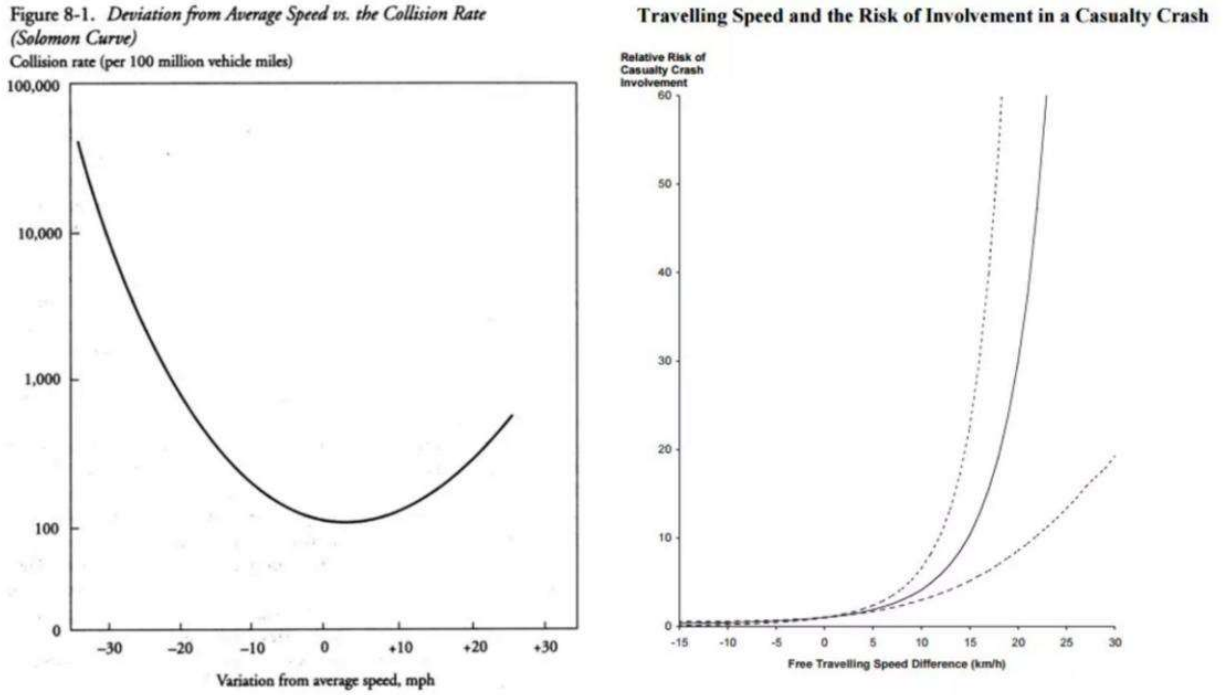


Figure 1 Speed Differentials and Crash Risks

The NHTSA does not have the legislative power to control where LSVs may be operated. Instead, state and local governments are in charge of establishing operating rules. According to the Tennessee Department of Transportation's (TDOT) website, "Tenn. Code Ann. § 55-8-191 allows low speed vehicles to be operated at a speed not exceeding twenty-five miles per hour (25 mph) only on streets where the posted speed limit is thirty-five miles per hour (35 mph) or less. A low speed vehicle is permitted to cross streets that exceed this thirty-five mile per hour limit". Materials state, that in the interest of safety, local governments, as well as TDOT, may further prohibit the operation of a LSV on any road within its jurisdiction.

EXISTING OPERATIONS AND CONDITIONS

While each vehicle type has unique rules and regulations regarding operations, a majority of the SMVs regardless, currently operate within the Low Speed Vehicle Service Area (shown in Figure 2) that Metro has established. LSVs are allowed to use any roadway with a posted speed of 35 mph or less within this area, except those identified as prohibited. LSV operations are further restricted by time and day. They cannot operate during the AM and PM peak hour timeframes, Monday through Friday, between 7:00-9:00 AM and 4:00-6:00 PM respectively. As shown in Figure 2, LSVs are allowed to travel on the majority of streets within the Low Speed Vehicle Service Area. The only exceptions are the interstate system, James Robertson Parkway, and segments of Rosa Parks Boulevard, Korean Veteran's Boulevard, Shelby Avenue, 21st Avenue, Broadway, Church Street, West End and Charlotte Pike.

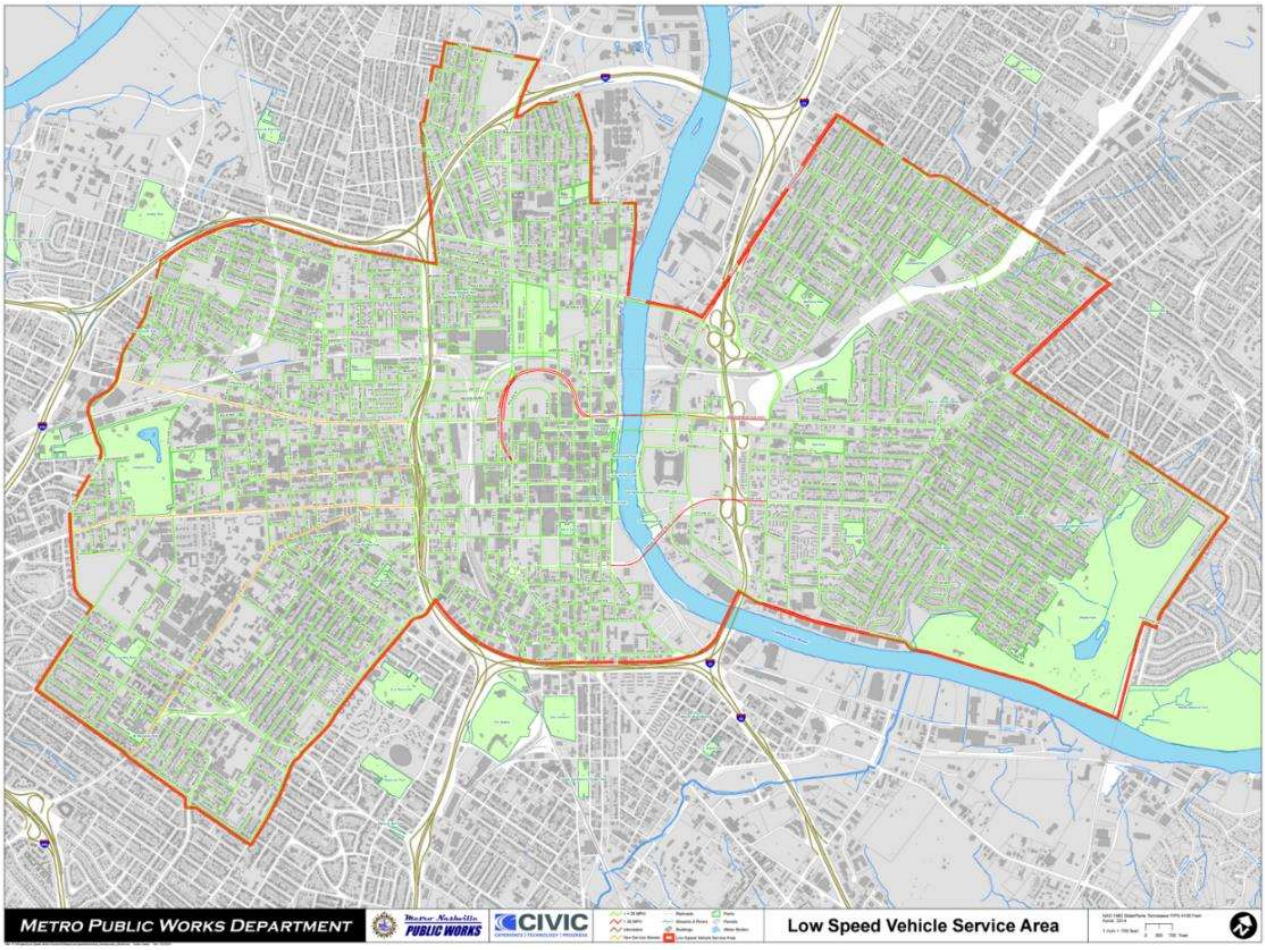


Figure 2 Existing Low Speed Vehicle (LSV) Service Area

This section presents information relating to two key elements central to this study. The first being the industry's goal to provide transportation for hire transport to, in, and around Nashville's most popular neighborhoods and destinations. Therefore, these destinations are identified and mapped. In addition, the number of existing SMV operators is updated. The second element is the TLC and MPW's goal to increase safety related to the use of these vehicle types. Therefore, roadway characteristics relating to the safety and/or operations of these vehicles are also provided.

EXISTING OPERATIONS

An important component of this study is understanding where, when, and how SMVs are currently operating within Nashville. This includes how many vehicles are on the roadway, how these vehicles travel on streets and through intersections, and when their volumes are highest. Table 2 provides a listing of the existing SMV operators, including the number of vehicle permits each operator has been granted. In total, 115 SMV permits have been granted.

Table 2 Existing Slow Moving Vehicle (SMV) Operators

Operators	SMV Type	Number of Vehicle Permits
Nashville Pedal Tavern	Pedal Carriage	10
Sprocket Rocket	Pedal Carriage	8
Country Music Crawler	Pedal Carriage	1
Nashville Pedi Cab	Pedi Cab	20
Music City Rickshaw	Pedi Cab	3
American Melody Carriages	Horse Carriage	1
Cumberland Carriage Tours	Horse Carriage	3
Hat Creek Carriage	Horse Carriage	4
Sugar Creek Carriage	Horse Carriage	5
Southern Comfort Carriage	Horse Carriage	4
JoyRide	LSV	38
Cruzzin'	LSV	10
Hee Hawlin'	LSV	4
Music City Touring	LSV	4
	TOTAL	115

To better understand SMV operations on downtown streets, during April and May 2017, video data was collected at several key intersections within the inner loop. The six intersections included:

- Broadway and 5th Avenue S
- Commerce Street and 3rd Avenue S
- Commerce Street and 2nd Avenue S
- Demonbreun Street and 2nd Avenue S
- Demonbreun Street and 5th Avenue S
- Demonbreun Street and 12th Avenue S

Using the captured video data, afternoon vehicle counts were recorded for the various types of SMVs. Timeframes for these counts include peak hour (4-6 PM) and non-peak hour times (3-4 PM and 6-7 PM). These timeslots were chosen based on when the greatest potential conflicts occur between slow moving and regular passenger vehicles as traffic volumes of any type are high. In addition to the SMV types, additional for-hire and regular passenger vehicles movements were also noted. Observed volumes are provided in Table 3.

Table 3 Peak Hour and Non-Peak Hour Counts

	Pedi-Cab	Pedal Carriage	Horse Carriage	LSV	Tour Bus	Motor Vehicles	Percent (%) SMV	Percent (%) Tour Bus
Peak Hours (4-6 PM)	1*	1*	0	10*	80	11,680	0.1%	0.7%
Non-Peak Hours (3-4 PM & 6-7 PM)	2	9	3	69	70	6,198	1.3%	1.1%

Values with asterisks in Table 3 denote violators of the time of day restrictions. Most of these occurred within a 15-minute timeframe after 4 PM/before 6 PM. Movements appeared as though vehicles were either returning to storage/parking destination or positioning themselves to begin operations at 6 PM in a desirable location. Table 4 describes the ratio of SMV types observed operating during the non-peak hours. As shown, the majority (83%) of SMVs are LSVs.

Table 4 Slow Moving Vehicle (SMV) Non-Peak Hour Percentages

	Percent (%) of SMVs Observed				Percent SMV (Average)	Percent SMV (High	Hourly SMV (High)
	Pedi-Cab	Pedal Carriage	Horse Carriage	LSV			
Non-Peak Hours (3-4 PM & 6-7 PM)	2%	11%	4%	83%	1.3%	4.2%	27

DESIRABLE DESTINATIONS

The TLC and MPW recognize that the industry model for many of the SMVs depends upon the locations they are able to serve. Therefore, this section identifies the top three most common destinations that SMVs desire to serve: hotels, tourist destinations, and bars. Instead of mapping individual bars, establishments with beer permits are used as a proxy. Figure 3 illustrates these three types of locations within the existing Service Area. A full-size version may be found in Appendix A.

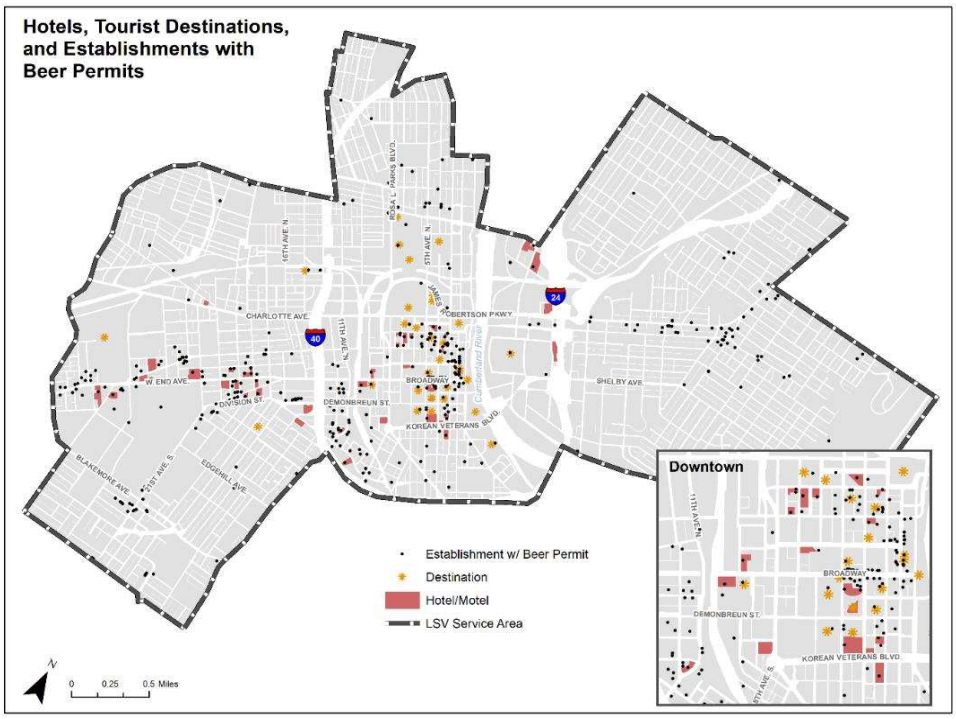


Figure 3 Desirable Destinations for Slow Moving Vehicles (SMVs)

EXISTING OPERATIONAL ISSUES AND CONCERNS

General issues and concerns currently associated with the operation of each type of SMV include the following:

Horse Carriages

- Impacts of horse carriages on vehicular operations, particularly as it relates to the startup and top speed limitations of horse carriages.
- Existing stand location on 2nd Avenue North just north of Broadway is not optimal given negative impacts to both motorized and non-motorized traffic flow and safety at this busy intersection during peak times. The first come, first serve nature creates incentive for carriages vying for a position to make undesirable movements through this intersection which ultimately negatively impacts traffic flow.
- Safety ramifications of speed differentials between horse carriages and other passenger and freight vehicles.
- Some undesirable safety and operational behaviors, such as pulling through a congested signalized intersection on a green and thus, blocking the opposing vehicular approaches' through movements once the signal phase changes.
- Conflicts caused by the presence of horse carriages in specific areas of the downtown (i.e., south/east of Broadway) given key destinations and their associated freight logistic needs, such as Bridgestone Arena, the Country Music Hall of Fame, and the Ascend Amphitheatre.
- Impacts on the horses themselves due to high levels of activity in the right-of-way, such as along Broadway, as well as the noise and visual stimulation that occurs.

LSVs

- Safety ramifications of speed differentials between LSVs and other passenger and freight vehicles.
- An increasing number of trips and vehicles in operation.
- Some undesirable operating behaviors, such as parking and/or loading and unloading in improper locations, such as in bike lanes, on-street parking spaces, and freight loading zones. Several LSVS were also observed not abiding by the restrictions set for passenger curb loading zones, which is as follows: "No person shall stop, stand or park a vehicle for any purpose or period of time other than for the expeditious loading or unloading of passengers in any place marked as a passenger curb loading zone during hours when the regulations applicable to such curb loading zone are effective, and then only for a period not to exceed three minutes."
- Differences in operating behaviors as it relates to point-to-point trips versus touring trips. LSVs providing tours tend to impede traffic flow and perform undesirable or illegal movements more often than those providing point-to-point trips.
- Impacts of LSVs on vehicular operations, particularly as it relates to the top traveling speed limitations of these vehicle types.

Pedal Taverns

- Impacts of pedal taverns on vehicular operations, particularly as it relates to the startup and top speed limitations of pedal carriages. The 2016 study showed that these impacts are especially problematic at intersections as it takes as much as four times as long for a pedal tavern as compared to a motor vehicle to travel through an intersection.
- Safety ramifications of speed differentials between pedal taverns and other passenger and freight vehicles, as well as pedal tavern passenger safety in general given exposure and lack of safety restraints.
- Noise generated from the occupants and sound systems of these vehicle types.

Pedicabs

- Impacts of pedicabs on vehicular operations, particularly as it relates to the startup and top speed limitations of pedicabs.
- Noise generated from the occupants and sound systems of these vehicle types.

EXISTING ROADWAY CONDITIONS

This section covers key roadway characteristics that impact the ability of SMVs to safely operate within the urban environment in and around downtown Nashville. These include speed limits, annual average daily traffic (AADT), and the number of travel lanes. In addition, roadway elevation profiles are evaluated given the unique limitations on horse-drawn carriages. This information aided in the identification of recommended adjustments to slow moving vehicle operations.

Posted Speed Limits

As previously described, high speed differentials increase risk and severity of crashes for both SMVs and regular vehicles alike. The map in Figure 4 illustrates speed limits according to TDOT's 2016 Tennessee Roadway Information Management System (TRIMS) GIS shapefile. Within the LSV Service Area, LSVs are already prohibited from using higher speed roadways, including Rosa L. Parks Boulevard, James Robertson Parkway, and Korean Veterans Boulevard. A full-size version of the map may be found in Appendix B.

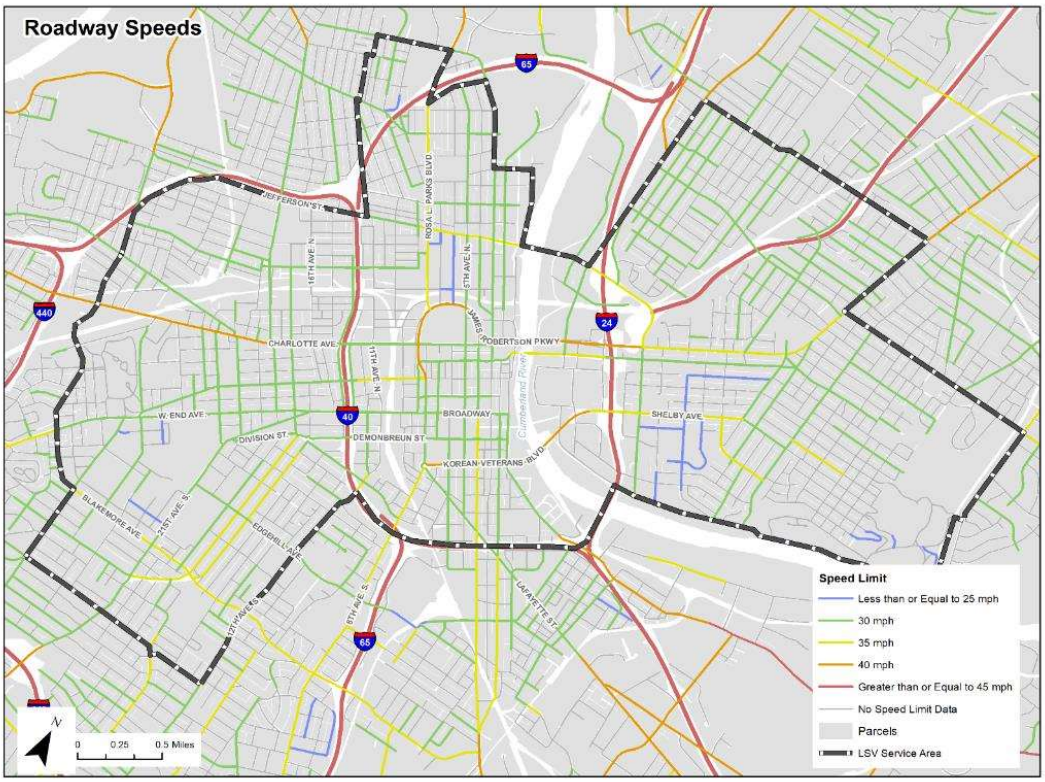


Figure 4 Posted Speed Limits

Lane Widths and AADTs

Traffic volumes and the number of travel lanes are also important roadway metrics for understanding SMV operations in shared roadway environments. High AADTs indicate roadways where SMV operations may be limiting the functionality of the transportation system during peak hours and where there is greater potential for conflicts between SMVs and other vehicles. In response to these issues/concerns, SMVs are prohibited to varying degrees from using certain specific roadways that move large amounts of traffic into and out of downtown. Time of day greatly influences traffic volumes and as previously mentioned, several vehicle types are also further prohibited from operating on any roadway whatsoever during certain hours (7:00-9:00 AM and 4:00-6:00 PM, Monday-Friday).

The number of travel lanes is also relevant when evaluating SMV operations. Having more than one lane allows for regular vehicles to safely pass SMVs that are either operating at a slower speed or

are loading/unloading passengers. The map in Figure 5 illustrates both the number of travel lanes and 2016 AADTs. These numbers were generated using TDOT count station information and the TRIMS shapefile. A full-size version may be found in Appendix C.

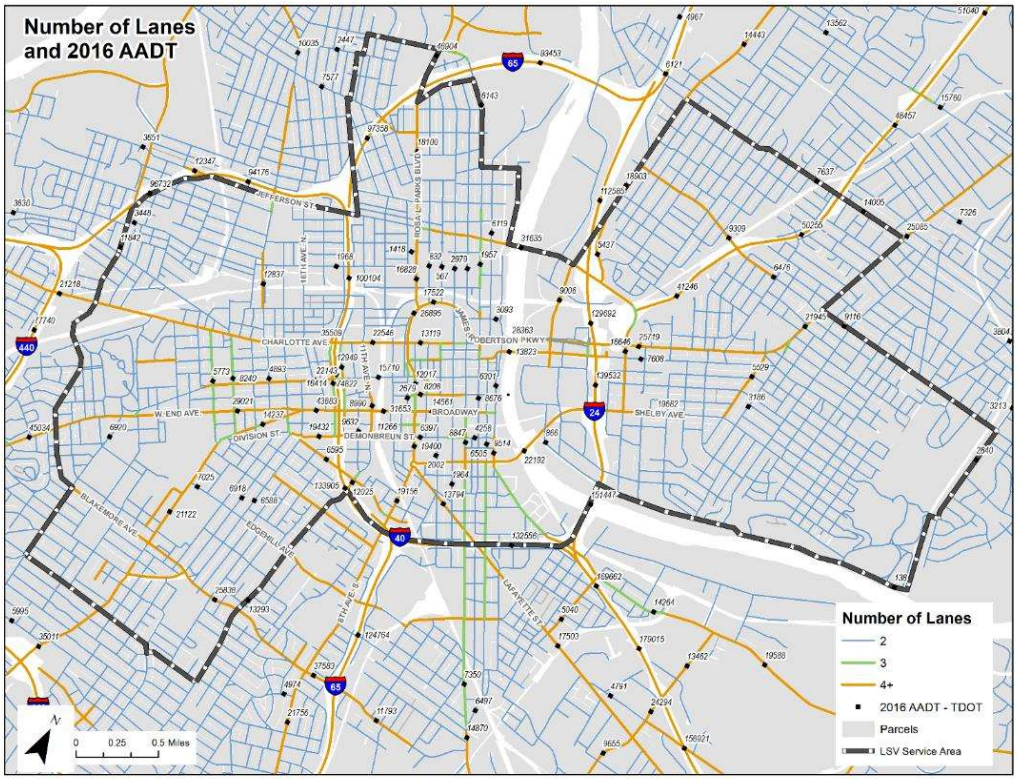
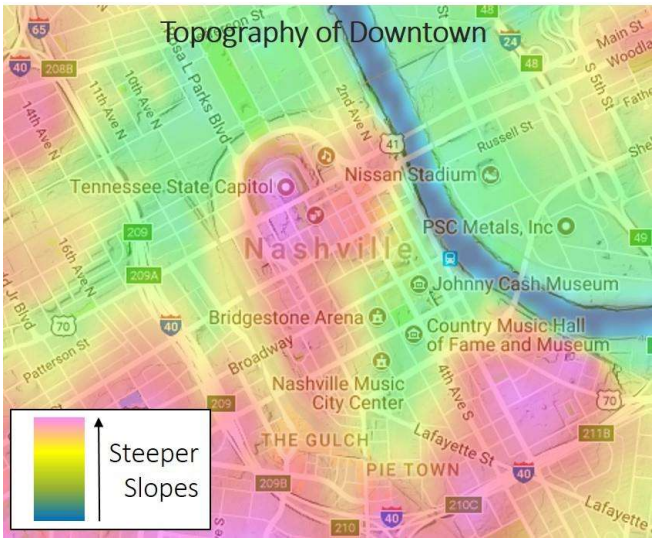


Figure 5 Lane Widths and 2016 AADTs

Elevation

Elevation and grade are important elements of the roadway network given human-powered and horse-drawn vehicles. Pedal carriages, specifically those without a motor assist, horse carriages, and pedicabs are all impacted by elevation gain/loss and grade. Steep inclines and declines can thus, increase conflicts and create unsafe conditions for these vehicles. Figures 6 and 7 illustrate the elevation profiles for the roadway network north of Broadway and east of 7th Avenue South. Graphs illustrating grades for these roadways are provided in Appendix D. This information was used when determining recommended horse carriage routes.



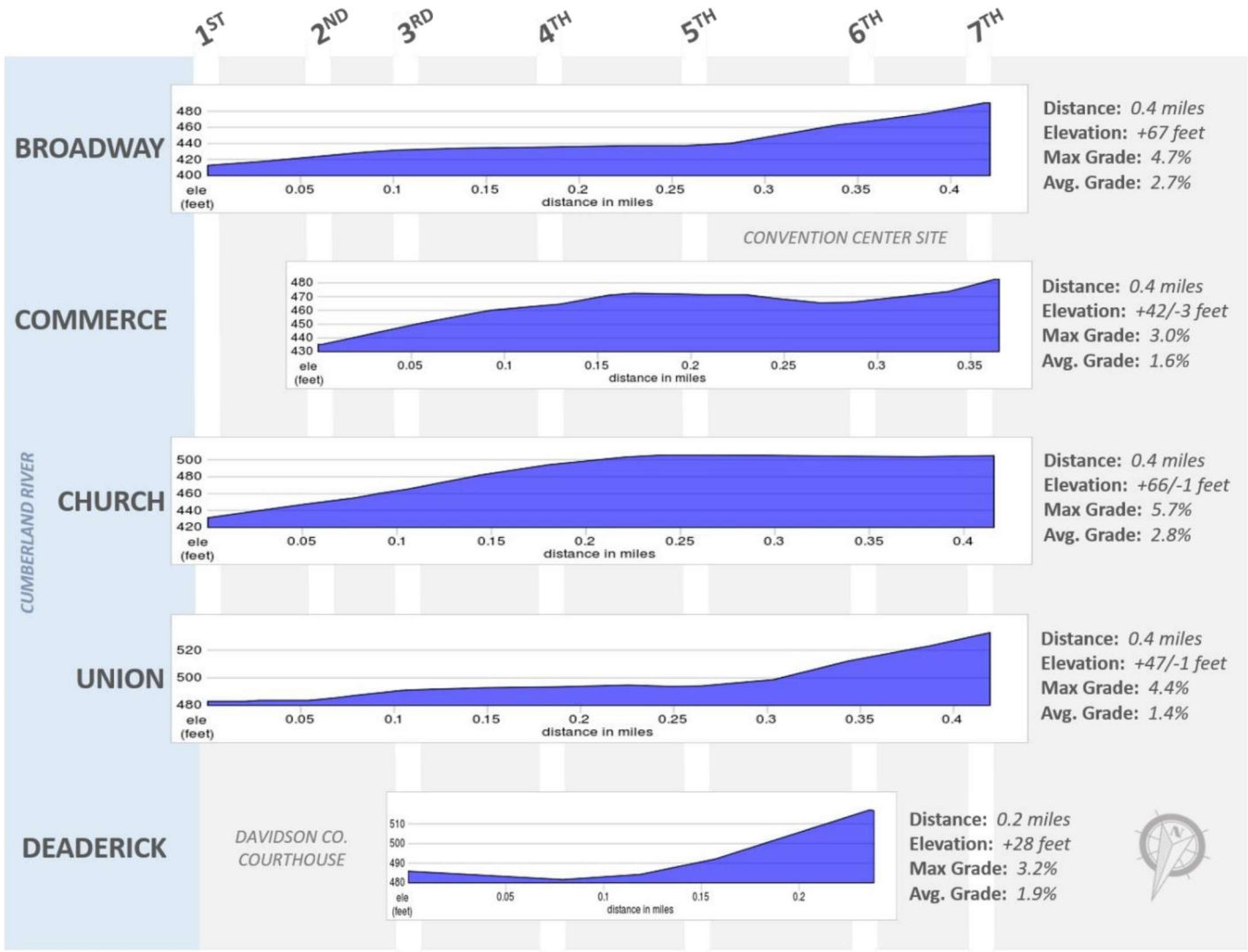


Figure 6 Elevation Profile – Broadway to Deaderick Street

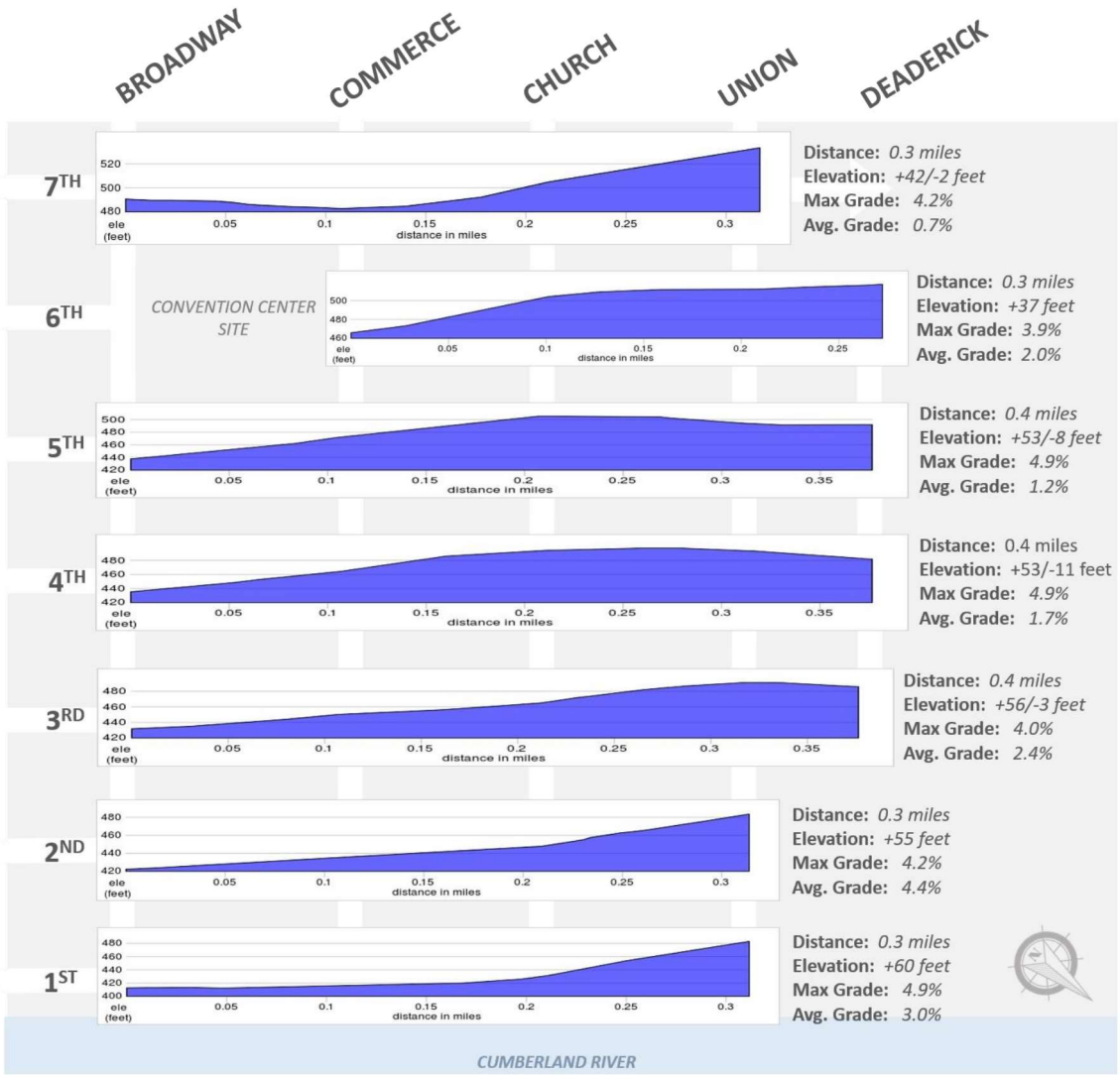


Figure 7 Elevation Profile – 1st Avenue North to 7th Avenue North

PEER CITY REVIEW

The original SMV Traffic Study included a peer city review in terms of how other communities have started to regulate the variety of SMV types. Specifically, the review focused on licensing and permitting and operating restrictions. The review was expanded to include LSVs as part of this update. Table 5 and 6 summarize how other cities are currently regulating (if allowed at all) pedal carriages, pedicabs, horse carriages, and LSVs by time of day and/or route.

Table 5 Regulate by Time of Day

	Regulate by Time of Day			
	Pedi-Cab	Pedal Carriage	Horse Carriage	LSV
Austin, TX		✓*	✓*	
Charleston, SC		*Does not allow*	✓	
Charlotte, NC				
Chicago, IL	✓	*Does not allow*	✓	✓**
Detroit, MI	✓	✓	✓	
Houston, TX			✓*	
Knoxville, TN	✓*	✓*	✓*	
Miami, FL	✓*	✓*	✓	
Minneapolis, MN		✓	✓	
New Orleans, LA			✓	
Portland, OR			✓	
San Diego, CA			✓*	✓*
Savannah, GA	✓	✓	✓	*Does not allow*
Tallahassee, FL	✓	✓		✓

**Approved schedule only*
***Yes, if impacts traffic flow*

Table 6 Regulate Routes

	Regulate Routes			
	Pedi-Cab	Pedal Carriage	Horse Carriage	LSV
Austin, TX	✓	✓	✓	✓
Charleston, SC	✓	*Does not allow*	✓	✓**
Charlotte, NC				
Chicago, IL	✓	*Does not allow*	✓	✓
Detroit, MI	✓	✓	✓	
Houston, TX			✓*	
Knoxville, TN	✓*	✓*	✓*	✓

Continued on following page

Miami, FL	✓	✓	✓	
Minneapolis, MN			✓	
New Orleans, LA		✓		
Portland, OR			✓	
San Diego, CA	✓	✓	✓	✓
Savannah, GA	✓	✓	✓	*Does not allow*
Tallahassee, FL			✓	

**Routes by approval only*
*** LSVs only allowed to be used between two properties owned by the same owner (ex: hotel to parking lot)*

The TLC and MPW further desire to understand how other cities use fees and other revenue generators to offset the administrative costs related to horse carriage operations. Review of peer city fee structures revealed a spectrum of costs, from no cost (other than typical business permits) to very high costs. A wide variety of fee types are also used by cities, including:

- Application Fees / Certificate Fees
- Horse License/Operating Fees
- Driver License Fees
- Carriage License Fees
- Veterinarian Fees (Horse Inspection)
- "Per Ride" Fees
- Sanitation Clean-Up Fees
- Ground Transportation Tax
- Touring Fees

Instead of simply identifying each city's fee formula, approximate annual revenue generation is estimated for each community using an example of one company who is operating one carriage. It should be noted that several values, such as the cost for a veterinarian, are held constant for the purpose of estimating. Nashville's current estimated cost is also provided.

Table 7 Example Annual Estimated Revenue

	Estimated Revenue from One Company Operating One Horse Carriage (Per Year)
Charleston, SC	$50,000
Savannah, GA	$19,098
Chicago, IL	$1,825
Minneapolis, MN	$960
Nashville, TN	$495
New Orleans, LA	$360
Knoxville, TN	$325
Portland, OR	$275
Detroit, MI	$200
Orlando, FL	$125
Austin, TX	$50

Before describing Charleston's very high operating costs, it is worth noting that the city has very strict regulations in regards to tour vehicles, in general. A tourism management division within the City of Charleston is responsible for issuing all permits, making tour zone assignments, and enforcing code violations for all touring vehicle types. The community seeks to proactively preserve the historical ambience of its downtown and this extends to for-hire horse carriage operations. In addition, the City heavily regulates these vehicles to avoid litter and waste issues, animal cruelty concerns, traffic and pedestrian flow conflicts, and negative impacts "on the tourism industry and economy of the city". All of these efforts, however, require funds to offset the administrative and sanitizations costs associated with these operations.

Based on the high demand for tour vehicles within the city's core, a $17,500 annual license fee is required annually for a carriage to operate within the central loading zone in the historic downtown. Sanitation fees are split among the horse carriage companies, which were estimated to be approximately $33,000 per company. Additional annual fees and regulations raise the estimated cost to around $50,000 per year.

SMV CONCLUSIONS AND RECOMMENDATIONS

Both route and regulation recommendations are provided in this section. Recommendations are presented for the SMVs as a whole as well as for each SMV type. Proposed recommendations are based upon the data collected and evaluated, observations made, and review of peer city regulations.

Permitting of SMVs

Through the analysis and observations conducted for this study, it is clear that SMVs are impacting traffic flow on Nashville streets. This is primarily due to the traffic speed differentials between the SMVs and motor vehicles as well as the lower acceleration speeds associated with SMVs. To avoid further degradation of traffic operations due to SMVs, it is recommended that the current permit cap for SMVs be maintained.

Horse Carriages

Planning considerations for horse carriage routes include stand locations, the topography of downtown streets, the desire for companies to be highly visible to tourists, and the need for attractive streetscapes and destinations that appeal to tourists. Recommendations are as follows:

- Stand Location: Observations of existing horse carriage operations at the current designated carriage stand on 2nd Avenue identified traffic operation and safety issues, which were largely attributed to the overall traffic congestion and pedestrian activity that takes place at the adjacent intersection and the limited availability of space for carriages at the stand.

  Potential options to reduce the negative impacts of horse carriage operations include enhanced enforcement and improved stand management, further limiting the number of carriages in operation at any one time, relocation of the stand to a less impactful site and establishing alternate routes and stands. These options are described in detail below:

- Stand Relocation: Relocating the stand from its current location on 2nd Avenue would be beneficial in order to reduce traffic operation and safety issues on 2nd Avenue and at its intersection with Broadway. Two locations were identified for relocating the stand, on the east side of 1st Avenue just south of Broadway and on the north side of Broadway, just west of 1st Avenue. These two optional locations are shown in Figure 8.
- Stand Relocation Alternative - Enforcement Assistants: Instead of relocating the existing loading/unloading stand, using staff to manage the carriage stand is also an option. Staff members could either be a Metro or Nashville Downtown Partnership employee and would help regulate the flow of carriages into the stand and into travel lanes, as well as enforce other TLC regulations. The stand would be treated similarly to a taxi stand with a first-in, first-out queueing model. Parking and/or loading zone spaces (either at the existing or potential locations) could be leased to carriage companies as a means of generating revenue to help offset the administrative costs associated with staffing the carriage stands. Figure 8 illustrates the existing most common routes taken by horse carriages relative to highly desirable corridors (based on exposure to tourists and number of key destinations) as well as the existing and potential stand locations if relocation is desired.

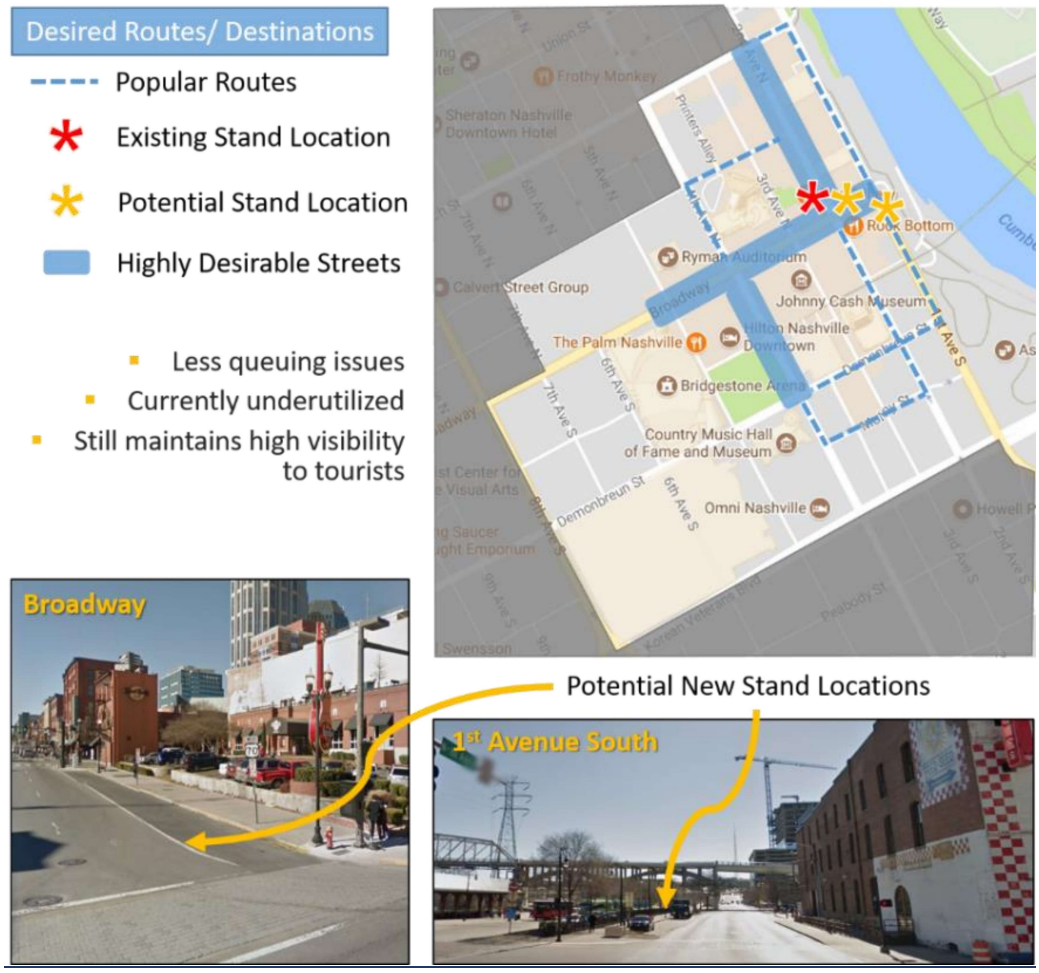


Figure 8 Existing and Potential Horse Carriage Stand Locations

- Number of Carriages in Operation: Limiting the number of horse carriages in operation, whether on the streets at one time or by stand location, could improve operations and safety at carriage stands. At times, the current stand cannot adequately accommodate the carriage demand. The first-in, first-out queuing model can, especially when demand is high, negatively impact operations and safety for all transportation users. This is especially true at the current stand location on 2nd Avenue North, where horse carriage movements have operational and safety impacts on the Broadway/2nd Avenue South intersection. Therefore, providing a carriage limit for stands (or for those operating on roadways at one time) would help to reduce these conflicts.
- Noise Restriction: No ordinance currently exists that regulates noise levels. While typically not associated with noisy operations, application of a noise restriction is possible for this vehicle type to maintain consistency between all types of slow moving vehicles.
- Recommended Routes: Revised carriage routes are recommended in order to lessen the impacts on traffic flow. Figure 9 illustrates the potential routes designated for horse carriage operations within Nashville's downtown core. A full-size map is provided in Appendix E.

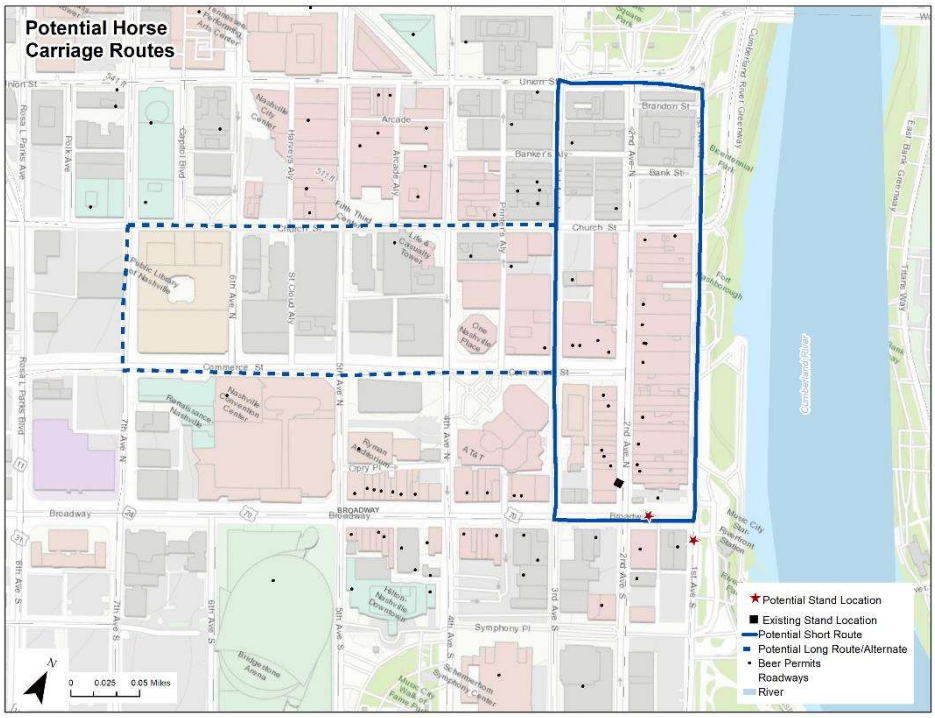


Figure 9 Potential Horse Carriage Routes in Downtown Nashville's Core

- Additional Alternate Routes: Downtown Nashville's core, specifically within and adjacent to Lower Broadway, holds many recreational and social events that require roadways to be shut down. Therefore, providing alternate routes for horse carriage operations, as opposed to simply restricting use during these occurrences, would be beneficial for horse carriage companies. Due to slope concerns on the northern and western side of Downtown and a desire to keep horse carriages north of Broadway to minimize traffic impacts, alternate routes (illustrated in Figure 10) are identified that maintain a high degree of exposure to tourists, while providing a route that is both visually appealing and relevant to tourism destinations in the city. Coordination with special

events at Nissan Stadium, First Tennessee Park, and Bicentennial Capitol Mall State Park events would be required.

Regardless of special events in and around the Lower Broadway area, these routes could be made available on Friday evenings, Saturdays, and Sundays (when games/large events are not being held at First Tennessee Park and Nissan Stadium). These routes offer a low traffic volume environment (during off-peak times) for these carriages to operate, while offering their own unique riding experience of the city.

- Maintain Existing Permit Levels: It is recommended that the number of permits currently allocated to horse carriages (17) be maintained and not expanded.

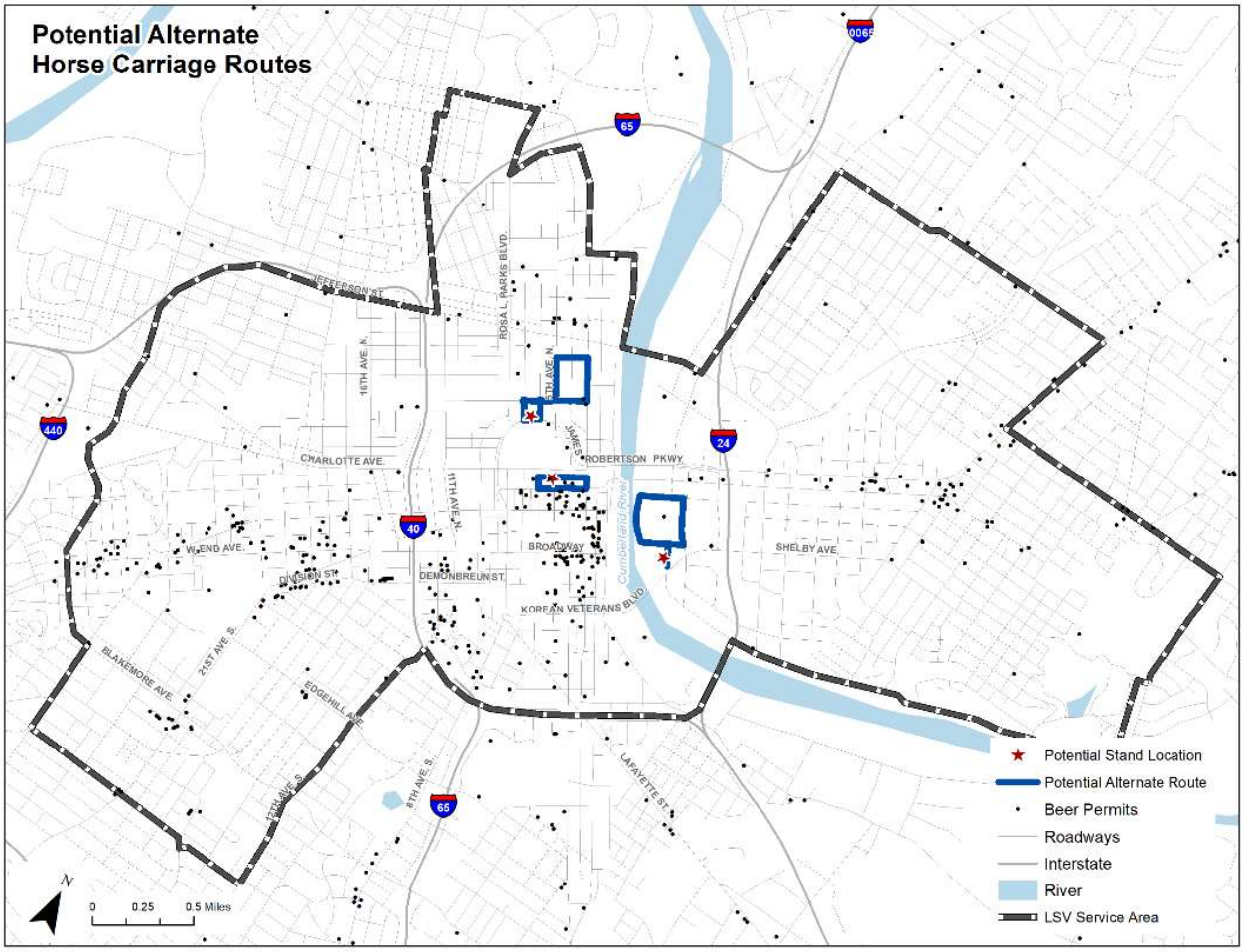


Figure 10 Potential Alternate Horse Carriage Routes

LSVs

Planning considerations for LSV routes include desirable destinations for both tourists and residents alike, traffic volumes, and posted roadway speeds. Recommendations for these vehicle types include:

- LSV Equipment: As previously described, the NHTSA has established Federal Motor Vehicle Safety Standard No 500 (49 CFR 571.500) to address the operation of LSVs on public streets. In terms of vehicle equipment, this standard states the following:

  "Each low-speed vehicle shall be equipped with:
  (1) Headlamps
  (2) Front and rear turn signal lamps
  (3) Tail lamps
  (4) Stop lamps
  (5) Reflex reflectors: one red on each side as far to the rear as practicable, and one red on the rear
  (6) An exterior mirror mounted on the driver's side of the vehicle and either an exterior mirror mounted on the passenger's side of the vehicle or an interior mirror
  (7) A parking brake
  (8) A windshield that conforms to the Federal motor vehicle safety standard on glazing materials (49 CFR 571.205)
  (9) A VIN that conforms to the requirements of part 565 Vehicle Identification Number of this chapter, and
  (10) A Type 1 or Type 2 seat belt assembly conforming to Sec. 571.209 of this part, Federal Motor Vehicle Safety Standard No. 209, Seat belt assemblies, installed at each designated seating position."

  It is recommended that all LSVs operating within Metro Nashville conform to these vehicle equipment standards.

- Enforce Alcohol Restrictions for Passengers: Current LSV regulations specify that "a certificate holder or LSV driver violates [the ordinance] if he or she provides, stocks, or otherwise permits any alcoholic beverage in the LSV". Several observations were made of LSV passengers drinking alcoholic beverages.
- Restrict Operations: Either reaffirm roadways that are currently prohibited (based on speed, volume, etc.) in the LSV Service Area or restrict operations to specified routes. Operations could further be restricted by prohibiting tours and only allowing point-to-point transportation. Potential routes, if LSVs are to be restricted to specific roadways, are illustrated in Figure 11. A full-size version may be found in Appendix G. These routes were developed giving greater considerations for roadway characteristics, including traffic volumes, posted speeds, and the number of travel lanes, while ensuring key destinations and/or neighborhoods are able to be served. These key destinations and neighborhoods include 5 Points in East Nashville, Downtown, Midtown and the Gulch, the Vanderbilt and Belmont University districts, Hillsboro Village, Germantown, Marathon Village, and the Fisk University campus.

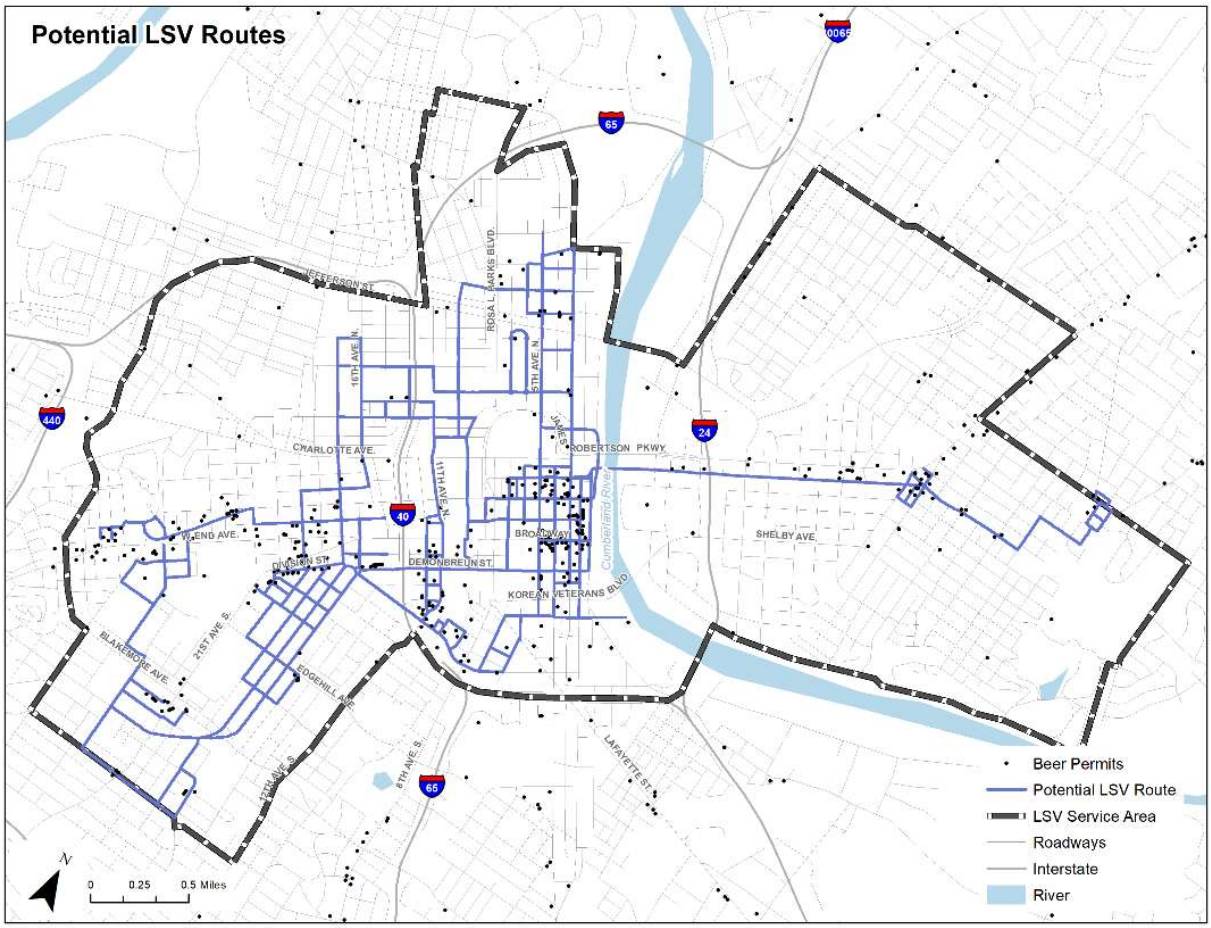


Figure 11 Potential LSV Routes

Along with route designation, Metro could consider providing a one-block "buffer" around identified routes to be used when roadways are closed for construction, special events, or other activities that may require a detour from the restricted route network. This would not, however, allow LSVs to use roadways within the Service Area that are prohibited based on posted speed limits or high traffic volumes, such as West End Avenue, Charlotte Avenue, or James Robertson Parkway.

- Prohibit Restrictions of Traffic Flow: There are already Metro Code provisions for restricting traffic flow when loading and unloading; however, ordinance language could be expanded to specify no stopping on tour routes, if touring is allowed.
- Monitor and/or Enforce Operations: Requiring GPS units on LSVs could potentially act as an important tool in monitoring the operations of these vehicles, including enforcement as well as better understanding where, when, and how these vehicles are operating.
- Education and Enforcement of Parking and Passenger Loading and Unloading: Based on observations, education for LSV operators and/or enforcement regarding the parking of their vehicles, as well as the loading and unloading of passengers could be beneficial. Existing loading zones are classified into two types for either passenger or freight loading and unloading. As stated in the Passenger Curb Loading Zone regulations, if in a passenger loading zone, the loading and

unloading of passengers must transpire in three minutes or less. Freight loading zones are designated for the "unloading and delivery or pickup and loading of freight and merchandise" only. LSVs were observed to be in violation of these time and use restrictions. Furthermore, education and enforcement could be helpful in regards to ride solicitation activities, as these should not impede traffic flow or impact legal parking capabilities in on-street parking spots.

- Noise Restriction: A restriction on noise levels, similar to those for pedal carriages, should be considered for LSVs. Some LSVs play music loudly through speakers, while others speak through a microphone to engage passengers and/or give touring information.
- Maintain Existing Permit Levels: It is recommended that the number of vehicle permits currently allocated to LSVs (56) be maintained and not expanded.

Pedicabs

Planning considerations for pedal carriage routes include desirable destinations, roadway grades, and areas to load and unload passengers. Recommendations for these vehicle types include:

- Consider Requiring Motor-Assist Capabilities: While many cities require pedicabs to be unassisted only, some do allow for pedicabs equipped with electric assist motors. Minneapolis, specifically, allows for these capabilities given the hilly terrain of the city. Requiring motor-assist capabilities should be further explored as it would assist pedicabs in reaching traveling speed more quickly from a stopped position as well as when traveling up hilly terrain.
- Noise Restrictions: Consider adding a noise provision for pedicabs.
- Alcohol Provisions: Consider expanding ordinance language to mirror that of the LSVs. The ordinance currently prohibits operators from "providing or stocking any alcoholic beverage", while for LSVs, operators are in violation if the operator "provides, stocks, or otherwise permits any alcoholic beverage in the LSV".
- Maintain Existing Permit Levels: It is recommended that the number of permits currently allocated to Pedicabs (23) be maintained and not expanded.

Pedal Carriages

Planning considerations for pedal carriage routes include desirable destinations, roadway grades, and areas to load and unload passengers. Recommendations for these vehicle types include:

- Consider Requiring Motor-Assist Capabilities: Pedal carriages equipped with motor-assist have much faster top travel speeds (approximately 25 mph for some). As indicated in the original SMV Traffic Study, pedal carriages have a very slow travel speed through intersections, especially when starting from a complete stop. Motor-assist capabilities could assist vehicles in reaching higher speeds while passengers still pedal.
- Enforcement of Noise Restrictions: Current pedal carriage regulation states that "no music or amplified sound shall be played, nor yelling or conversation be conducted, on a pedal carriage in such a manner that it would violate the Excessive Noise ordinance codified at Metropolitan Code of Laws Section 11.12.070." Many pedal carriages, however, were observed playing loud music with some carrying raucous, loud passengers and/or groups of passengers.

- Restrict Routes: It is recommended that pedal carriages be limited to specific routes, similar to LSVs, based on traffic volumes, posted speeds, and the number of travel lanes. Recommended routes are illustrated in Figure 12. It is proposed that these vehicle types be allowed to request additional routes with the TLC. A full-size map is provided in Appendix H.
- Maintain Existing Permit Levels: It is recommended that the number of permits currently allocated to pedal carriages (19) be maintained and not expanded.

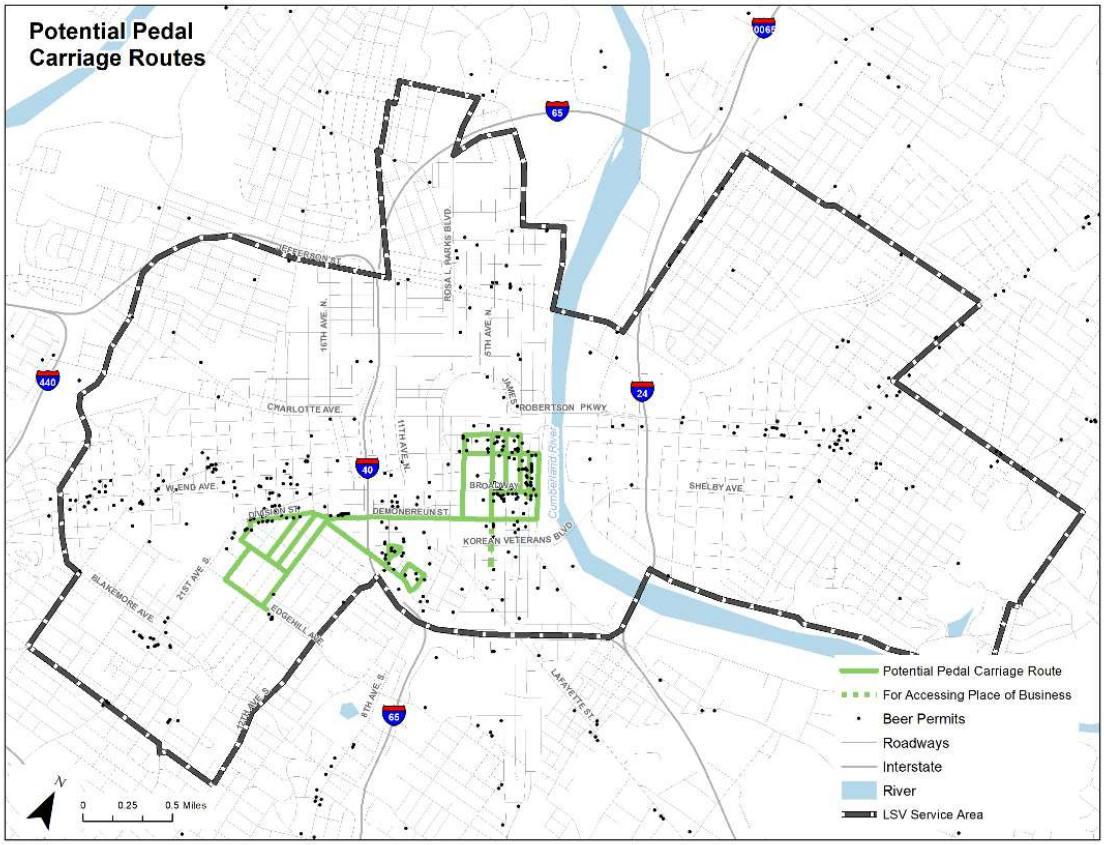


Figure 12 Potential Pedal Carriage Routes

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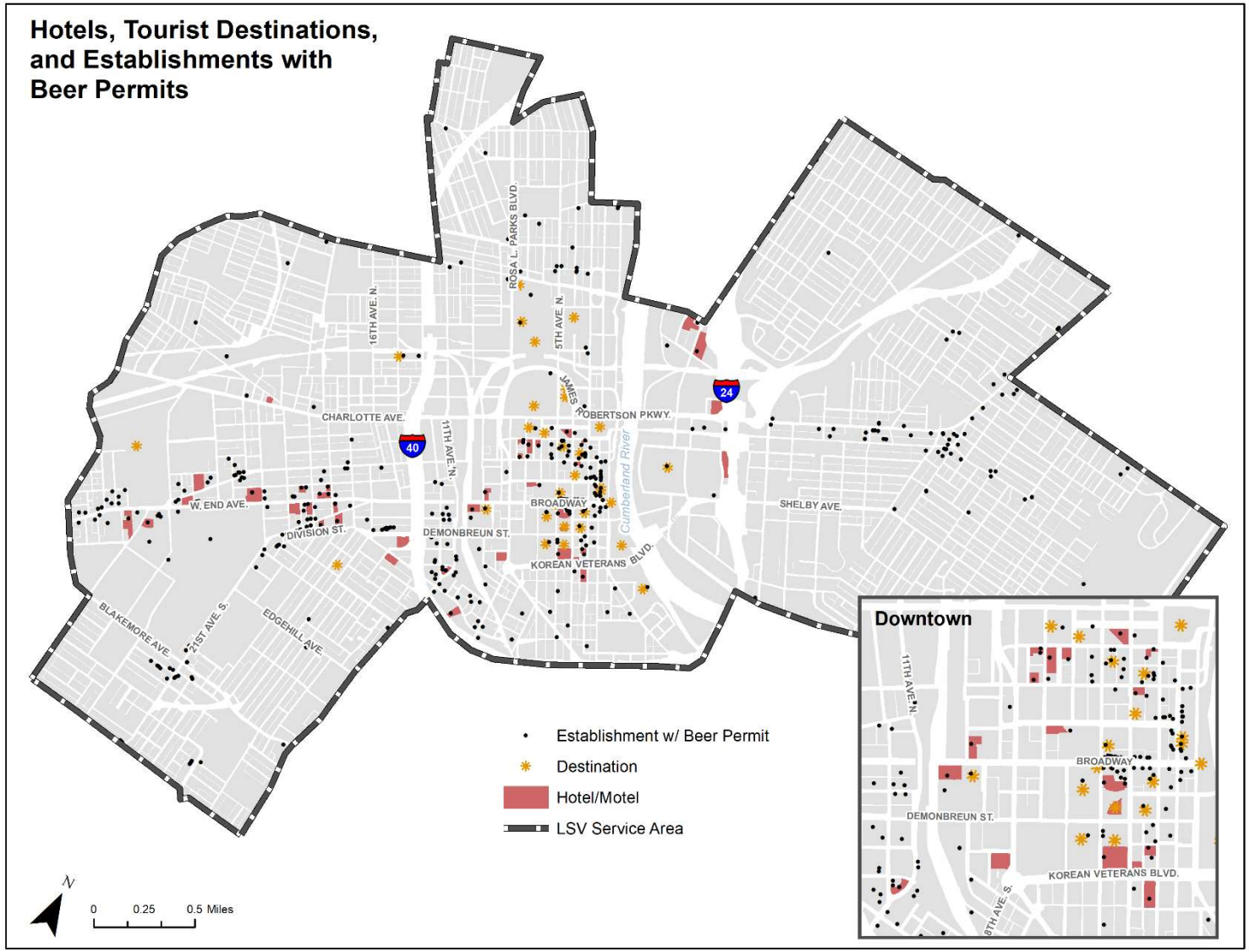
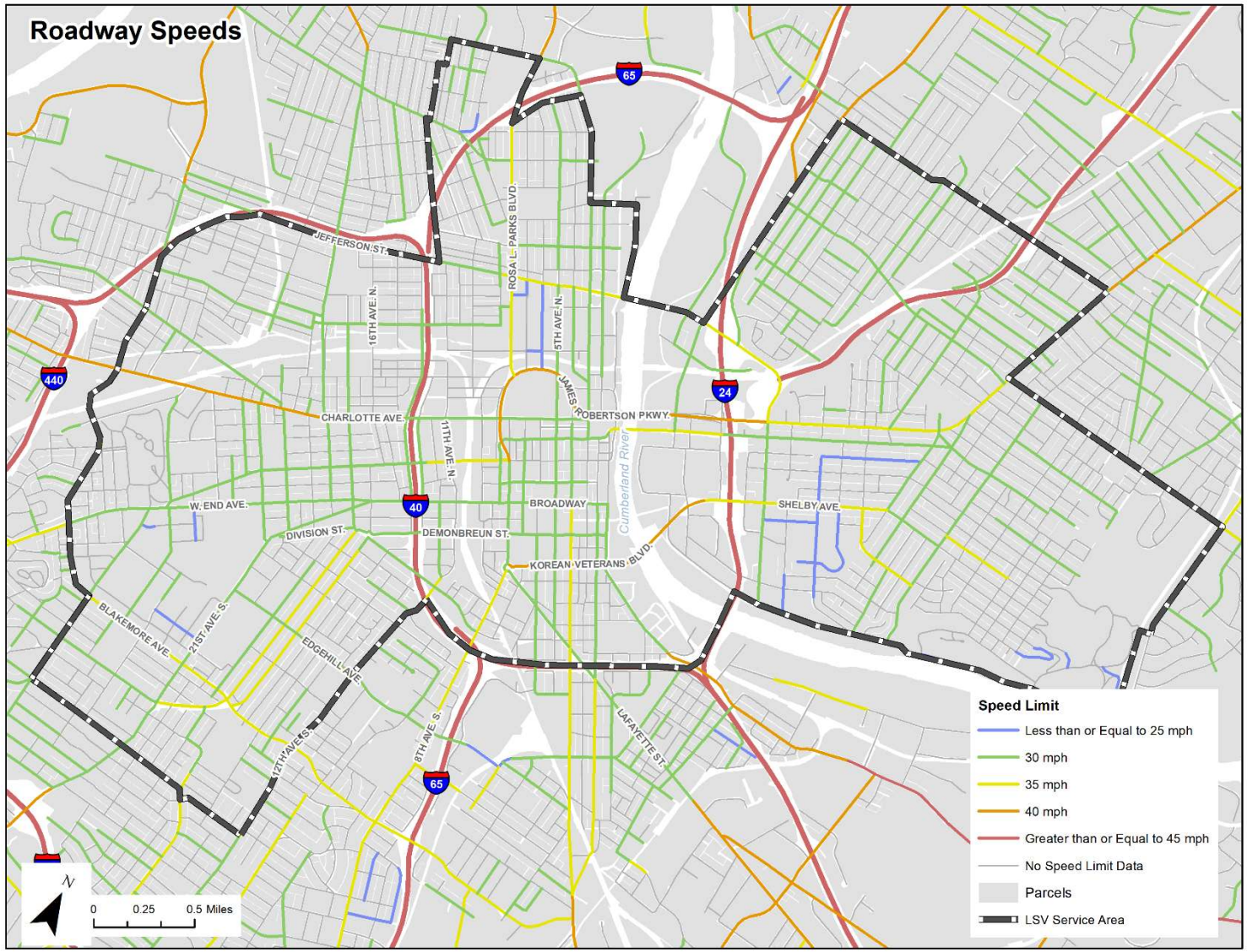
Appendix A

Hotels, Tourist Destinations, and Establishments with Beer Permits


Hotels, Tourist Destinations, and Establishments with Beer Permits
ROSA L. PARKS BLVD.
16TH AVE. N.
5TH AVE. N.
JAMES ROBERTSON PKWY.
CHARLOTTE AVE.
11TH AVE. N.
Cumberland River
W. END AVE.
DIVISION ST.
DEMONBREUN ST.
BROADWAY
KOREAN VETERANS BLVD.
SHELBY AVE.
BLAKEMORE AVE.
21ST AVE. S.
EDGEHILL AVE.
40
24
Establishment w/ Beer Permit
Destination
Hotel/Motel
LSV Service Area
N
0
0.25
0.5 Miles
Downtown
11TH AVE N.
BROADWAY
DEMONBREUN ST.
KOREAN VETERANS BLVD.
8TH AVE. S.

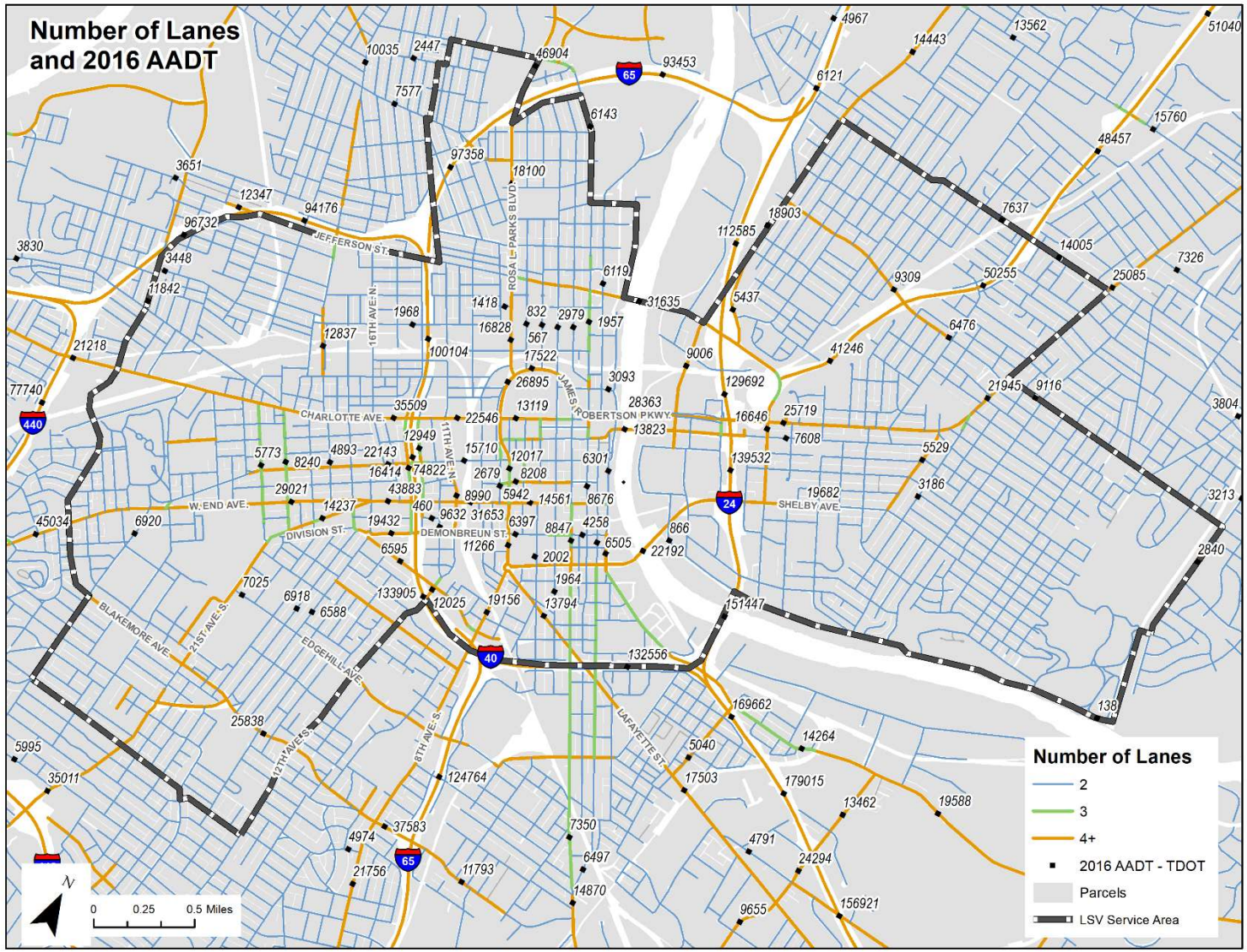
Appendix B

Posted Speed Limits


Roadway Speeds
JEFFERSON ST.
ROSA L. PARKS BLVD.
16TH AVE. N.
5TH AVE. N.
JAMES ROBERTSON PKWY.
CHARLOTTE AVE.
11TH AVE. N.
Cumberland River
W. END AVE.
BROADWAY
SHELBY AVE.
DIVISION ST.
DEMONBREUN ST.
KOREAN VETERANS BLVD.
BLAKEMORE AVE.
21ST AVE. S.
EDGEHILL AVE.
12TH AVE. S.
8TH AVE. S.
LAFAYETTE ST.
65
440
40
24
N
0
0.25
0.5 Miles
Speed Limit
Less than or Equal to 25 mph
30 mph
35 mph
40 mph
Greater than or Equal to 45 mph
No Speed Limit Data
Parcels
LSV Service Area

Appendix C

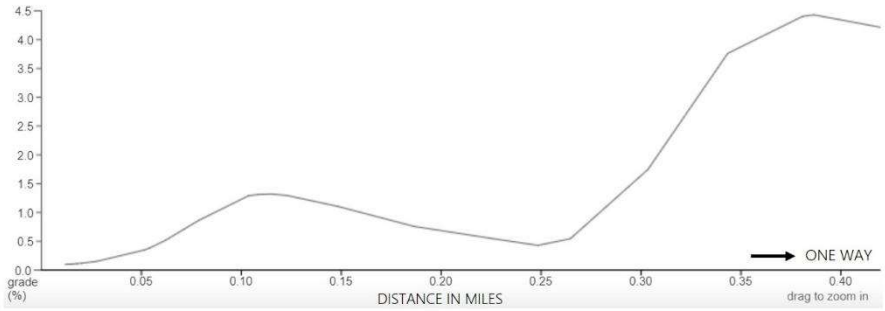
Number of Lanes and AADT


Number of Lanes and 2016 AADT
Number of Lanes
2
3
4+
2016 AADT - TDOT
Parcels
LSV Service Area
0 0.25 0.5 Miles
JEFFERSON ST.
CHARLOTTE AVE.
W. END AVE.
DIVISION ST.
DEMONBREUN ST.
ROBERTSON PKWY.
SHELBY AVE.
JAMES ROBERTSON PKWY.
ROSA L. PARKS BLVD.
16TH AVE. N.
11TH AVE. N.
BLAKEMORE AVE.
EDGEHILL AVE.
12TH AVE. S.
8TH AVE. S.
LAFAYETTE ST.
65
40
24
440

Appendix D

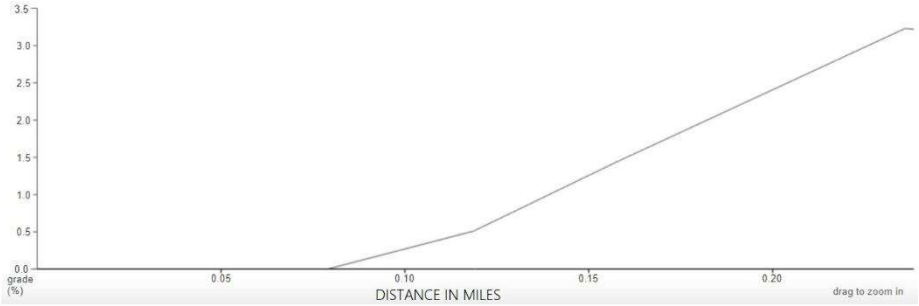
Roadway Grades

UNION: 1ST → 7TH



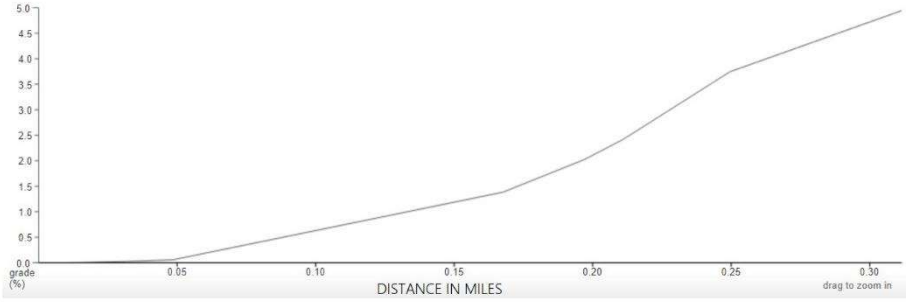
Distance:	0.4 mi
Elevation:	+ 47 / - 0 ft
Max Grade	*4.4 %*
Avg. Grade	1.4 %

DEADERICK: 3RD → 6TH



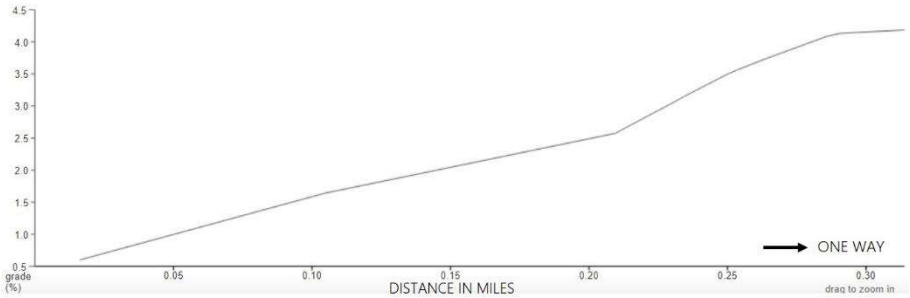
Distance:	0.2 mi
Elevation:	+ 28 / - 0 ft
Max Grade	*3.2 %*
Avg. Grade	1.9 %

1ST: BROADWAY → UNION AVE



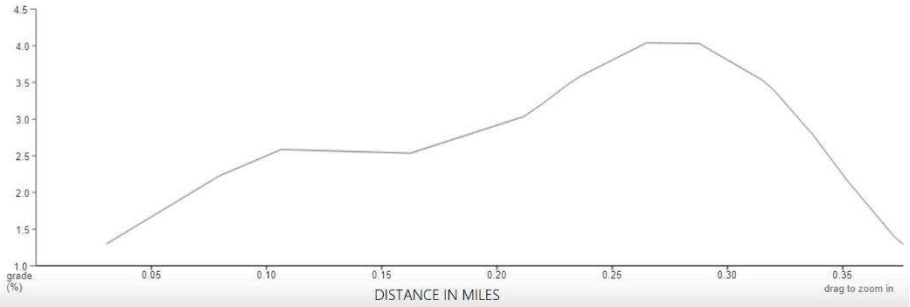
Distance:	0.3 mi
Elevation:	+ 60 / - 0 ft
Max Grade	*4.9 %*
Avg. Grade	3.0 %

2ND: BROADWAY → UNION AVE



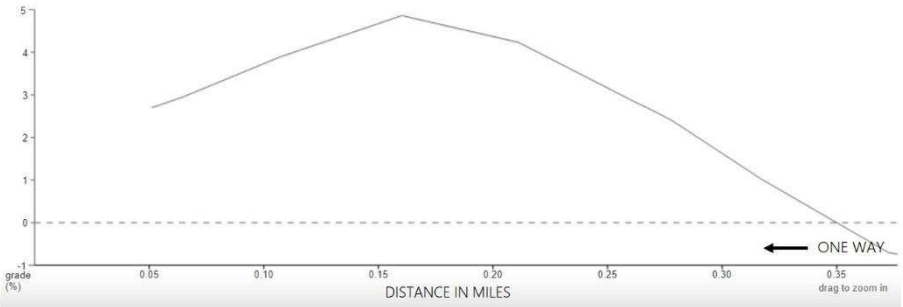
Distance:	0.3 mi
Elevation:	+ 55 / - 0 ft
Max Grade	*4.2 %*
Avg. Grade	4.4 %

3RD: BROADWAY → DEADERICK AVE



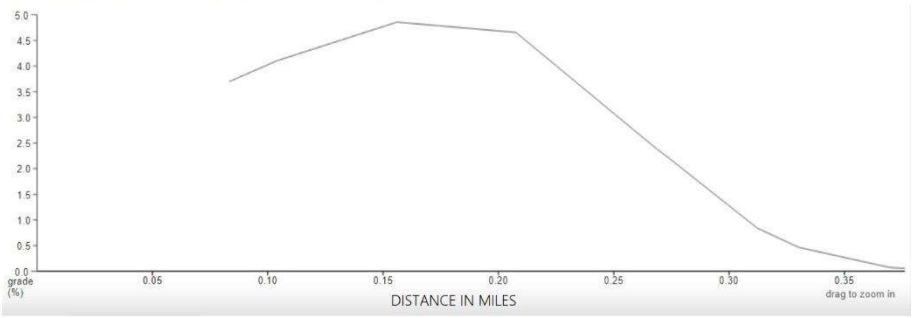
Distance:	0.4 mi
Elevation:	+ 56 / - 3 ft
Max Grade	*4.0 %*
Avg. Grade	2.4 %

4TH: BROADWAY → DEADERICK AVE



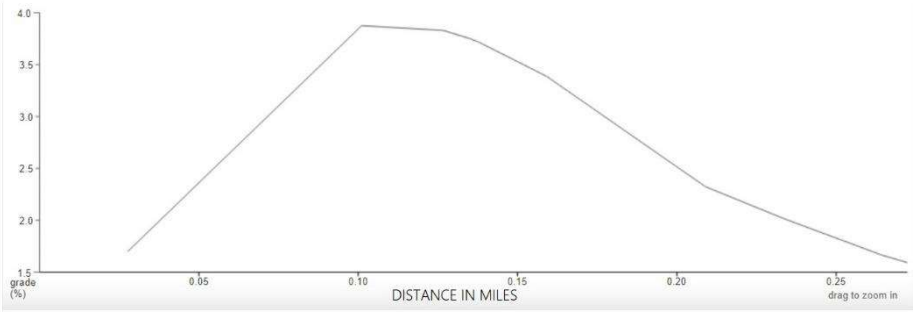
Distance:	0.4 mi
Elevation:	+ 53 / - 11 ft
Max Grade	*4.9 %*
Avg. Grade	1.7 %

5TH: BROADWAY → DEADERICK AVE



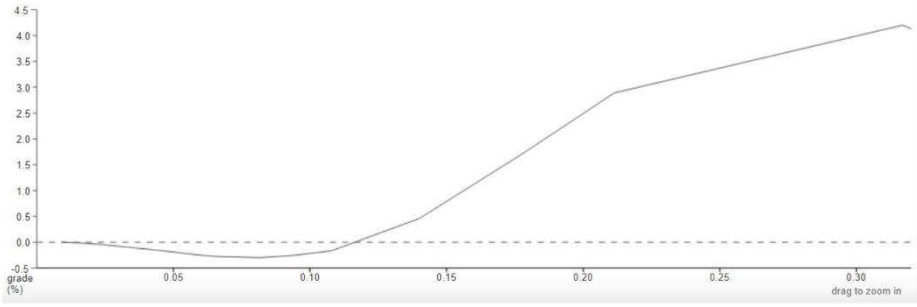
Distance:	0.4 mi
Elevation:	+ 53 / - 8 ft
Max Grade	*4.9 %*
Avg. Grade	1.2 %

6TH: COMMERCE → DEADERICK AVE



Distance:	0.3 mi
Elevation:	+ 37 / - 0 ft
Max Grade	*3.9 %*
Avg. Grade	2.0 %

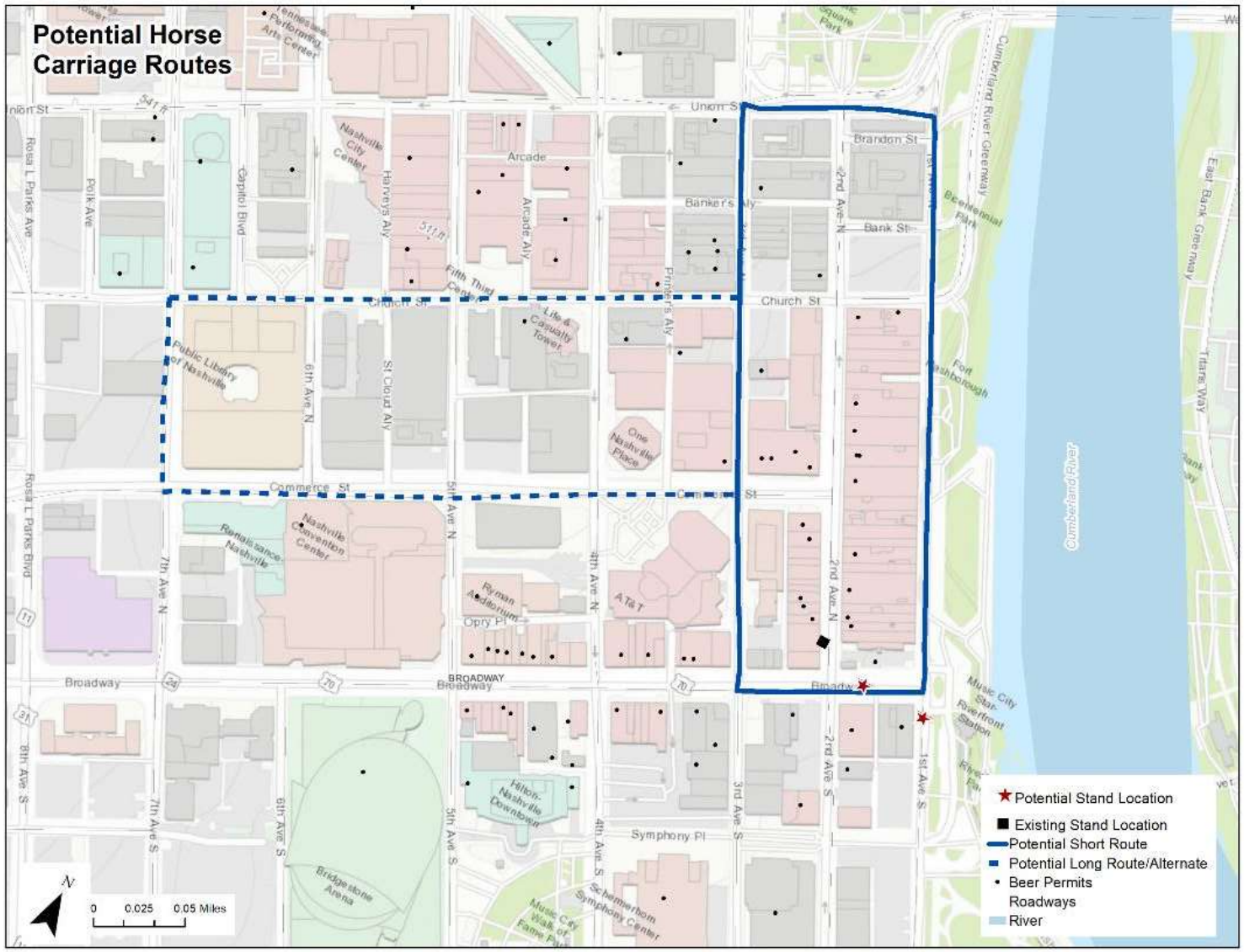
7TH: BROADWAY → UNION AVE



Distance:	0.3 mi
Elevation:	+ 42 / - 2 ft
Max Grade	*4.2 %*
Avg. Grade	0.8 %

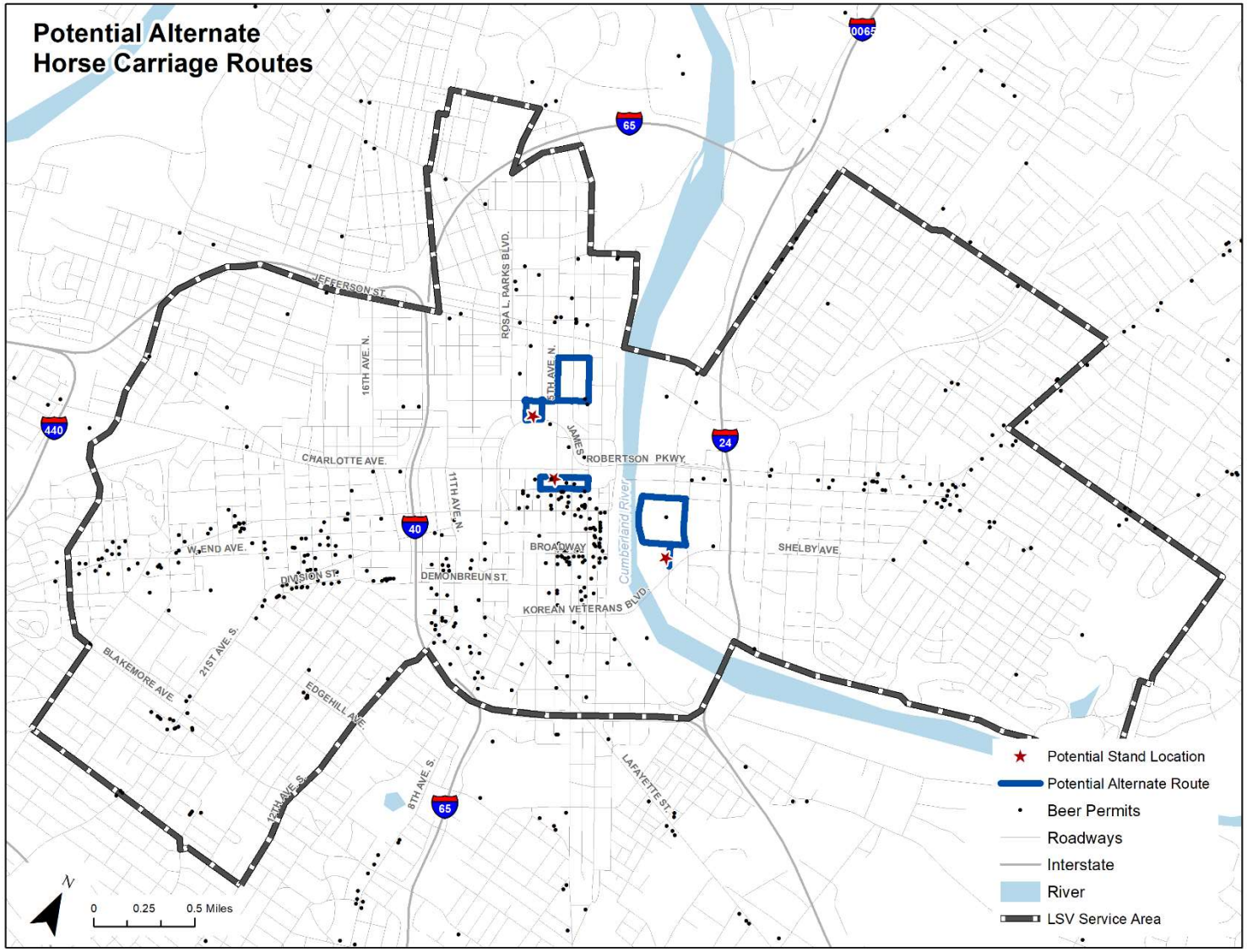
Appendix E

Potential Horse Carriage Routes in Downtown Nashville's Core


Potential Horse Carriage Routes
Union St
Brandon St
Bank St
Church St
Commerce St
Broadway
Arcade
Nashville City Center
Harveys Alley
Arcade Alley
Banker's Alley
Printer's Alley
Fifth Third Center
Life & Casualty Tower
Public Library of Nashville
St Cloud Alley
One Nashville Place
Nashville Convention Center
Renaissance Nashville
Ryman Auditorium
Opry Pl
AT&T
Hilton Nashville Downtown
Symphony Pl
Bridgestone Arena
Schermerhorn Symphony Center
Music City Walk of Fame Park
Cumberland River Greenway
Bicentennial Park
Fort Nashborough
Cumberland River
East Bank Greenway
Titans Way
Music City Star Riverfront Station
Rosa L Parks Ave
Rosa L Parks Blvd
Polk Ave
Capitol Blvd
6th Ave N
7th Ave N
5th Ave N
4th Ave N
2nd Ave N
1st Ave N
8th Ave S
7th Ave S
6th Ave S
5th Ave S
4th Ave S
3rd Ave S
2nd Ave S
1st Ave S
N
0 0.025 0.05 Miles
Potential Stand Location
Existing Stand Location
Potential Short Route
Potential Long Route/Alternate
Beer Permits
Roadways
River

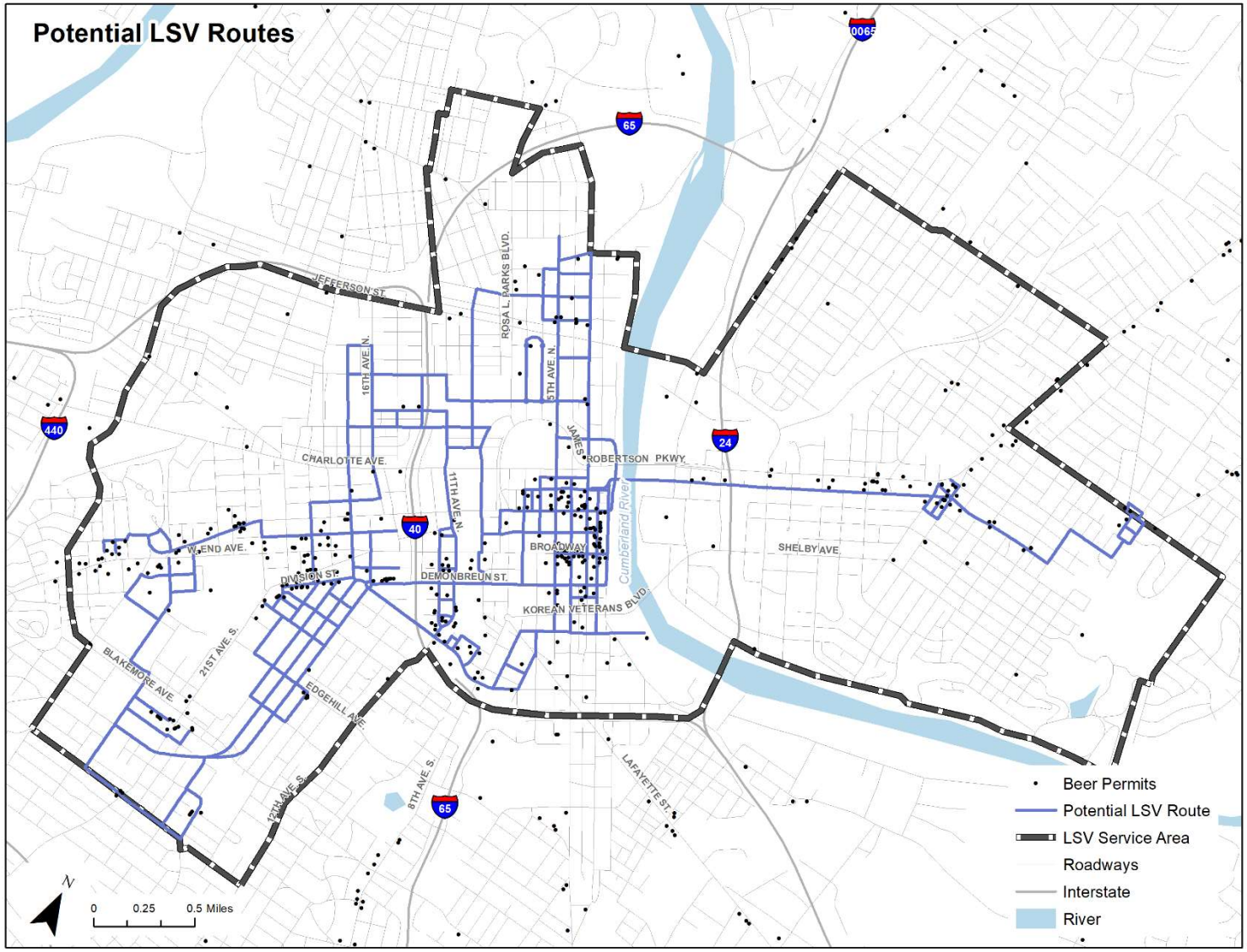
Appendix F

Potential Alternate Horse Carriage Routes


Potential Alternate
Horse Carriage Routes
JEFFERSON ST.
16TH AVE. N.
ROSA L. PARKS BLVD.
6TH AVE. N.
JAMES ROBERTSON PKWY.
CHARLOTTE AVE.
11TH AVE. N.
Cumberland River
W. END AVE.
DIVISION ST.
DEMONBREUN ST.
BROADWAY
SHELBY AVE
KOREAN VETERANS BLVD.
21ST AVE. S.
BLAKEMORE AVE.
EDGEHILL AVE.
12TH AVE. S.
8TH AVE. S.
LAFAYETTE ST.
65
40
440
24
0065
N
0
0.25
0.5 Miles
Potential Stand Location
Potential Alternate Route
Beer Permits
Roadways
Interstate
River
LSV Service Area

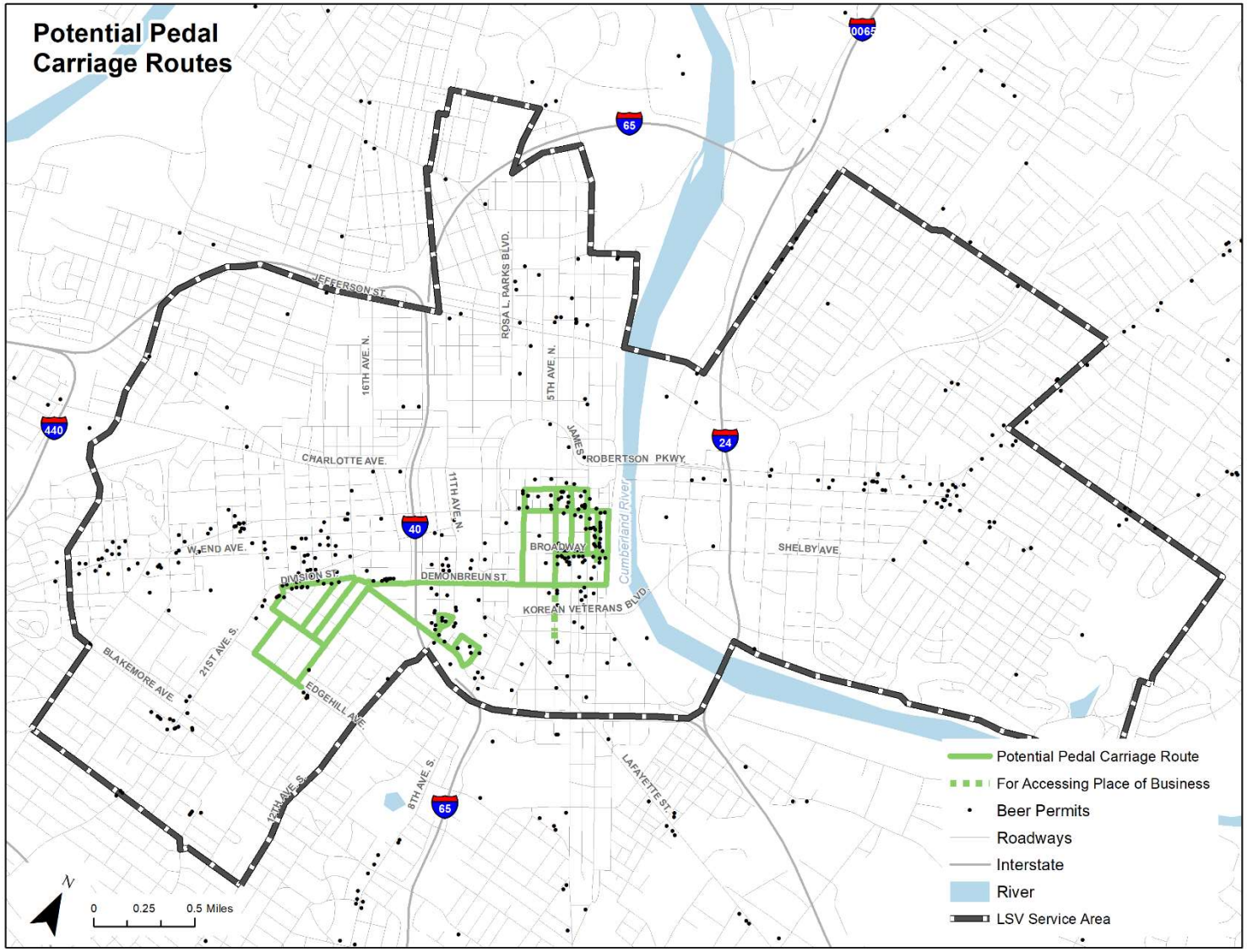
Appendix G

Potential LSV Routes


Potential LSV Routes
65
440
40
24
JEFFERSON ST.
CHARLOTTE AVE.
W. END AVE.
DIVISION ST.
DEMONBREUN ST.
BROADWAY
JAMES ROBERTSON PKWY.
SHELBY AVE
KOREAN VETERANS BLVD.
Cumberland River
ROSA L. PARKS BLVD.
16TH AVE. N.
15TH AVE. N.
11TH AVE. N.
21ST AVE. S.
BLAKEMORE AVE.
EDGEHILL AVE.
12TH AVE. S.
8TH AVE. S.
LAFAYETTE ST.
N
0
0.25
0.5 Miles
Beer Permits
Potential LSV Route
LSV Service Area
Roadways
Interstate
River

Appendix H

Potential Pedal Carriage Routes


Potential Pedal Carriage Routes
JEFFERSON ST.
16TH AVE. N.
ROSA L. PARKS BLVD.
5TH AVE. N.
JAMES ROBERTSON PKWY.
CHARLOTTE AVE.
11TH AVE. N.
Cumberland River
BROADWAY
W. END AVE.
DIVISION ST.
DEMONBREUN ST.
KOREAN VETERANS BLVD.
SHELBY AVE
21ST AVE. S.
BLAKEMORE AVE.
EDGEHILL AVE.
12TH AVE. S.
8TH AVE. S.
LAFAYETTE ST.
440
65
40
24
0065
N
0
0.25
0.5 Miles
Potential Pedal Carriage Route
For Accessing Place of Business
Beer Permits
Roadways
Interstate
River
LSV Service Area