



LET'S MOVE   
**NASHVILLE**  
Metro's Transportation Solution

Health and Safety Memorandum

April 5, 2018



## TABLE OF CONTENTS

Executive Summary	2
Background	3
Physical Activity	3
Methodology	5
Safety	6
Avoided Vehicle Crash Injuries	6
Bicycle and Pedestrian Safety Improvement	8
Conclusion	9

## Executive Summary

The *Let's Move Nashville Transit Improvement Program* (TIP) is expected to provide significant, far-reaching health and safety benefits to the residents of Metro Nashville and Davidson County (Metro). All citizens of Metro would benefit from the improved infrastructure and fewer personal vehicles on the road.

The implementation of the TIP is expected to have a considerable impact on generating transit-oriented development (TOD), especially along high-capacity transit corridors. TOD tends to happen near transit stations due to increased economic and social activity. It results in mixed-use development, creating vibrant and connected communities.<sup>1</sup> Transit also tends to encourage “active transport,” defined as a mixture of walking and cycling. Active transport is enhanced around TOD because of the supporting amenities such as sidewalks, pedestrian crossings, lighting, etc. Increased physical activity from active transport would mean a healthier Davidson County due to decreased chronic diseases related to obesity and other inactivity-related health issues.

Transit is associated with a more active lifestyle because of the need to travel to and from transit stations. Health benefits from those people who are expected to switch from using their personal vehicle to transit are expected to amount to \$15.1 million annually upon the TIP's full implementation in 2033. In addition to encouraging wellness, making a variety of transportation options readily available is likely to decrease the number of motor-vehicle-related injuries and deaths.<sup>2</sup> Avoided car crash injuries are estimated to amount to \$15 million annually in risk-reduction benefits after the TIP's full implementation.

In addition to health and safety improvements, TOD tends to incite economic and social activity near transit stations. As TOD occurs along each corridor, residents living near high-capacity corridors (HCC) may also reap benefits that are not easily monetized, but valuable nonetheless. With increased pedestrian activity and improved lighting around transit stations, less crime is expected to occur, resulting in safer communities.

Expected health and safety benefits have been described qualitatively and quantitatively throughout this analysis to illustrate the TIP's role in improving the lives of the residents of Davidson County. While this analysis provides a snapshot of undiscounted benefits

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<sup>1</sup> Federal Transit Administration (2018) Transit-Oriented Development.

<sup>2</sup> Centers for Disease Control and Prevention (2018) CDC Transportation Recommendations.

during the TIP's first full year of service, 2033, annual benefits are expected to accrue beyond this single year.

## Background

Metro and the Metropolitan Transit Authority (MTA) are in the planning and development stages for significant improvements to Nashville's multimodal transportation infrastructure. The changes first proposed in the 25-year *nMotion Strategic Transit Plan* (September 2016) and the *nMotion High Capacity Transit Briefing Book* (August 2017) have been more fully articulated in the TIP. The TIP includes a combination of Light Rail Transit (LRT) and Rapid Bus infrastructure, along with improvements to the Music City Star (MCS) commuter rail and the local bus system to provide a robust, countywide, multimodal transportation network for residents, businesses, and visitors. In addition to the multimodal improvements provided by the TIP, the program would also serve to improve pedestrian infrastructure.

For the purpose of this analysis, the No-Build Scenario is considered to be a baseline scenario identical to today's transit network comprised of local MTA bus routes and the MCS commuter rail. The Build Scenario includes a combination of LRT and Rapid Bus infrastructure, increased service on the MCS commuter rail, improvements to the current bus routes, and four additional crosstown bus routes.

This analysis evaluates the expected health and safety benefits for Metro residents resulting from improvements provided by the TIP.

## Physical Activity

TIP-associated improvements would increase transportation options for Davidson County residents and visitors. These enhancements would encourage active transport throughout the city as transit users need to get to and from transit stops, thereby increasing levels of physical activity.

A lack of physical activity is a major contributor to the rise in obesity, diabetes, heart disease, stroke, and other chronic health conditions in the U.S. Currently 26% of Metro's population is classified as obese.<sup>3</sup> The average annual cost of obesity-related medical issues is \$1,429 per person, which translates into an estimated \$255 million per year in obesity-related health care costs that accrue to society.<sup>4</sup> To lower the risk of all-cause mortality, cardiovascular disease, type 2 diabetes, stroke, and depression, *The*

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<sup>3</sup> Rogers, T B (2012) Communities Putting Prevention to Work Behavioral Risk Factor Surveillance Survey Davidson County, TN 2011.

<sup>4</sup> R. International (2009) Obesity Costs U.S. About \$147 Billion Annually, Study Finds.

*Physical Activity Guidelines for Americans* from the U.S. Department of Health and Human Services recommend walking 150 minutes per week, or 22 minutes per day.<sup>5</sup>

Research from other cities indicates that those who live around transit stations tend to walk more and that there is a positive correlation between transit stop proximity and the amount walked per day. One such study compared pedestrian traffic before and after the opening of a new LRT station, finding that those living within walkable distances from a station, defined as a half mile radius, walked more than those who did not live within a walkable distance. Walking increased not only to and from the station, but also along the corridor as well. The observation indicates that there is an increased level of economic and social activity around stations. People living a quarter- to half-mile from a station saw an increase of 44% more walking after construction of the LRT station.<sup>6</sup> Another study found that rail commuters (1) walk an average of 30% more steps per day, (2) reported having walked for a period of 10 minutes or more, and (3) were four times more likely to walk 10,000 steps during a day than car commuters.<sup>7</sup>

Through the observed effects of transit's impact on physical activity elsewhere, it is expected that individuals choosing to switch to transit as a result of the TIP would increase their physical activity. TOD expected to occur along the corridors would also increase levels of physical activity for residents, especially those living in direct proximity to the corridors. According to the Nashville Area Metropolitan Planning Organization's (MPO) Land Use Model, by 2033 about 170,000 people will be living along the nine proposed high-capacity transit corridors. If the area along each corridor were to develop in a transit-oriented manner, these areas would be expected to densify further and even more neighboring residents could enjoy the benefits that occur with this type of development.

Disadvantaged populations would find transit improvements to be particularly beneficial because these citizens are more likely to walk to public transit. The American Public Health Association found that people were more likely to walk to transit if they were from disadvantaged communities in large urban areas with access to rail systems. Transit walkers in large urban areas with rail systems were 72% more likely than those without

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<sup>5</sup> U.S. Department of Health and Human Services (2008) *Physical Activity Guidelines Advisory Committee Report*.

<sup>6</sup> Huang, R, Moudon, A V, Zhou, C, Stewart O T, and Saelens, B E (2017) *Light Rail Leads to More Walking Around Station Areas*. *Journal of Transport and Health*. ( 6), 201-208.

<sup>7</sup> Wener R E, and Evans G W (2007) *A Morning Stroll: Levels of Physical Activity in Car and Mass Transit Commuting*. *Environment and Behavior*. 39(1), 62-74.

a rail system to walk 30 minutes a day or more.<sup>8</sup> Since disadvantaged populations are more likely to use transit, it is also likely to be particularly beneficial to these populations already at greater risk of obesity.<sup>9</sup>

The increased physical activity associated with transit use would significantly improve the health of Davidson County residents, particularly as related to obesity. A study conducted for a mixed-use neighborhood along Salt Lake City's light rail line found that obesity was much higher among non-riders (65%) than new riders (26%) and continuing riders (15%).<sup>10</sup> With the improved transit service associated with the TIP, individuals choosing to switch from automobiles to transit would likely increase their average level of physical activity, improving health in the county.

## Methodology

To highlight the potential TIP-related health improvements for Metro residents, benefits associated with increased walking resulting from the use of transit were estimated. The *Let's Move Nashville Technical Analysis* estimates trips that would be diverted from personal vehicles to LRT as a result of transit improvements. With the TIP's implementation coming to completion in 2032, 2033 is the first year that health benefits from increased active transportation due to the TIP would begin to be fully realized.

Research has found that individuals who commute using public transit walk an average of 0.75 miles per day more than those who don't use transit.<sup>11</sup> Assuming a health benefit of \$3.36 per mile walked,<sup>12</sup> it is estimated that the increase in physical activity by those individuals who would switch to transit would generate annual benefits for Davidson County residents, amounting to \$15,084,656 million in health benefits in 2033. These results expected to be conservative because this estimate only considers projections of trips diverted from personal vehicles to LRT and does not include those individuals diverting from personal vehicles to other modes of transit within the TIP's proposed network.

The TIP has the potential to increase physical activity levels for system riders and individuals living near transit corridors. It is expected that Davidson County residents

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<sup>8</sup> Freeland, A L, Banerjee, S N, Dannenberg A L, and Wendel, A M, (2013) Walking Associated With Public Transit: Moving Toward Increased Physical Activity in the United States. *American Journal of Public Health*.

<sup>9</sup> Sparks, J P, and Schmidt, S (2012) A Demographic Analysis of Metro/nonmetro Differences in Adult Normal Weight, Overweight, and Obesity. *Journal of Rural Social Sciences*. 27(3), 46-73.

<sup>10</sup> Brown, B B, and Werner, C M (2009) "Before and After a New Light Rail Stop," *Journal of American Planning Association*. 75(1), 5-12.

<sup>11</sup> New Zealand Transport Agency (2013) Improving the Cost-Benefit Analysis of Integrated PT, Walking and Cycling. Research Report 537.

<sup>12</sup> Litman, T (2017) Evaluating Active Transport Benefits and Costs. Victoria Transport Policy Institute.

would experience increased overall health and lower risk for some medical issues, particularly those related to obesity.

## Safety

In addition to health benefits, public safety would improve following the TIP's implementation. Research shows that public transit is associated with fewer automobile crashes, heightened safety for pedestrians and cyclists, and decreased crime.

### Avoided Vehicle Crash Injuries

Infrastructure improvements such as the TIP have been shown to avoid a number of vehicular crashes resulting in fatality, injury, or property damage by reducing the overall number and severity of crashes on roadways when people choose to take transit rather than driving a single-occupancy vehicle.<sup>13</sup> The fatality rate for public transit passengers is approximately 90 percent less than for automobile occupants.<sup>14</sup> By providing more transportation options, automobiles would be diverted from the road and fewer vehicle miles would be traveled daily. Small increases in transit ridership can result in large benefits to society. Studies have found that a one percentage-point increase in transit mode share is associated with a several-percent reduction in total crashes.<sup>15</sup> Reducing vehicle crashes and associated injuries is expected result in cost savings to Metro residents.

To estimate traffic crash injuries avoided because of the reduction in vehicle miles traveled (VMT), three data sources were used. Davidson County traffic crash data was obtained from the Tennessee Department of Safety and Homeland Security for 2014, categorizing traffic crash injuries by varying levels of severity and aggregating vehicle crash injuries involving other vehicles as well as pedestrians and cyclists in Davidson County. In addition, data on total VMT estimations from the MPO's MOVES model from 2014 was used in conjunction with Davidson County traffic crash injury data to estimate the rate of injuries per 100 million VMT in Davidson County. Through this, it was

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<sup>13</sup> U.S. Department of Transportation (2017) Benefit-Cost Analysis Guidance for Discretionary Grant Programs.

<sup>14</sup> American Public Transportation Association, 2016.

<sup>15</sup> American Public Transportation Association, 2016.

determined that there are nearly 700 traffic crash injuries per 100 million VMT in Davidson County.<sup>16</sup>

In order to finally evaluate the number of avoided crash injuries associated with the TIP’s VMT reduction, the third source of data used was output from the STOPS model providing daily projections of VMT diverted to LRT, given by the program’s technical analysis. Using this, the average value in the forecasted range of VMT reductions was used to estimate annual VMT diverted from personal vehicles. Safety benefits were calculated by converting vehicle crash data to the KABCO scale, created by the National Safety Council (NSC), which quantifies the monetized values for avoided injuries, noted in **Table 1**.<sup>17 18</sup> Using this scale, it was estimated that implementation of the TIP could result in \$14,953,139 in safety benefits in 2033 as a result of the avoided vehicle crashes, shown in **Table 2**.<sup>19</sup> This estimate is conservative since it only considers individuals diverting to LRT.

**Table 1. KABCO Scale**

<b>KABCO Scale</b>	<b>Monetized Value</b>
O – No injury	\$3,200
C – Possible Injury	\$63,900
B – Non-incapacitating	\$125,000
A – Incapacitating	\$459,100
K – Killed	\$9,600,000
U – Injured (Severity Unknown)	\$174,000

Source: U.S. DOT (2017)

<sup>16</sup> Tennessee Department of Safety and Homeland Security (2018) Tennessee Traffic Crashes by Year, Type and County.

<sup>17</sup> U.S. Department of Transportation (2017) Benefit-Cost Analysis Guidance for Discretionary Grant Programs.

<sup>18</sup> U.S. Department of Transportation Federal Highway Administration (2011) Highway Safety Improvement Program Manual 4.0 Planning: Project Prioritization.

<sup>19</sup> The U.S. DOT estimates the benefit of preventing an injury or fatality using the Value of a Statistical Life, defined as “the additional cost that individuals would be willing to bear for improvements in safety, that in the aggregate, reduce the expected number of fatalities by one”. Agencies use estimates of values of risk reductions when conducting a benefit-cost analysis of a new policy or regulation that may affect public health and safety.



**Table 2. Safety Benefits from Traffic Crash Reduction**

Motorized Vehicle Accident Outcome	Total	Injuries per 100 Million VMT	Injuries Avoided	Annual Safety Benefits (2017 USD)
No injury	45,301	549.20	314.86	\$1,028,576
Possible Injury	6,546	79.36	45.50	\$2,967,942
Non-Incapacitating	1,995	24.19	13.87	\$1,769,422
Incapacitating	456	5.53	3.17	\$1,485,101
Killed	61	0.74	0.42	\$4,155,082
Unknown	2,873	34.83	19.97	\$3,547,018
<b>Total</b>	<b>57,232</b>	<b>693.84</b>	<b>397.78</b>	<b>\$14,953,140</b>

## Bicycle and Pedestrian Safety Improvement

In addition to safety provided directly from public transit use, TOD influences safety by encouraging compact development and lower traffic speeds.<sup>20</sup> There are one-fifth fewer casualties in transit-oriented communities as compared to automobile-oriented communities.<sup>21</sup> In 2017, 405 accidents involving pedestrians and 89 accidents involving cyclists were reported by the Tennessee Department of Safety and Homeland Security.<sup>22</sup> Because the TIP would provide a greater variety of travel options to residents and encourage mode-sharing and active transport, it is expected that infrastructure improvements from the TIP would increase active transportation to and from transit stations. Research indicates that where there are more walkers and cyclists, the likelihood of motorist-caused injury is lower.<sup>23</sup> Another study found that doubling the number of cyclists on the road in mixed traffic decreases the risk of injury by 34%.<sup>24</sup>

<sup>20</sup> American Public Transportation Association, 2016. Transit-Oriented Development

<sup>21</sup> Litman, T (2014) A New Transit Safety Narrative. Journal of Public Transportation. 17(4), 118-135.

<sup>22</sup> TN Department of Safety and Homeland Security. 2014 Davidson County Crash.

<sup>23</sup> Jacobsen, P L (2003) Safety in numbers: more walkers and bicyclists, safer walking and bicycling. Injury Prevention. 9, 205-209.

<sup>24</sup> Robinson, D L (2005) Safety in numbers in Australia: more walkers and bicyclists, safer walking and bicycling. Health Promotion Journal of Australia, 16(1), 47-51.

Ultimately, more pedestrian traffic and cycling related to TIP improvements would likely lower the risk of traffic accidents.

With more pedestrian activity due to expanded and convenient transit options, improved transit facilities, better lighting and connectivity to stations, people would be expected to be and feel safer. The concept of “eyes on the street” suggests that crime risk declines as more responsible people live, work, and walk around areas.<sup>25</sup> Although there is no industry-accepted approach for monetizing this value, it is still a valuable component of TOD.<sup>26</sup> Ultimately, the activity generated from TOD and the infrastructure improvements are expected to create safer, more walkable communities in Davidson County.

## Conclusion

The TIP presents transportation infrastructure improvements that are likely to yield significant health and safety benefits for residents. Health and safety benefits are expected to stream over time as a result of the TIP and this analysis provides a snapshot of the undiscounted benefits anticipated in 2033, the first year of full service. TIP-related benefits would help those who use transit as well as those that live near the network. Greater physical activity levels, as existing drivers choose to take transit and walk to and from the transit station, may reduce costs associated with obesity-related issues.<sup>27</sup> This analysis indicates that health benefits associated with increased physical activity are expected to accrue annually and amount to \$15.1 million upon the full implementation of the TIP.

Beyond the health benefits generated by transit, the TIP investments are expected to support avoided traffic crash injuries due to fewer automobiles on roads, valued at an estimated \$15 million in 2033. The TIP is expected to have additional safety improvements for pedestrians and cyclists with lower traffic speeds, improved pedestrian infrastructure, and more compact development associated with TOD. Finally, the TIP improvements are also expected to result in less crime along the corridors as transit stations are built, and lighting, connectivity and other amenities are added or improved.

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<sup>25</sup> Jacobs, J (1961) *The Death and Life of Great American Cities*. Vintage Books. New York.

<sup>26</sup> Billings, S B, Leland, S, and Swindell, D (2011) Effects of the Announcement and Opening of Light Rail Transit Stations. *Journal of Urban Affairs*. 3(5), 549-565.

<sup>27</sup> Sener, I (2016) Potential Health Implications and Health Cost Reductions of Transit-Induced Physical Activity. *Journal of Transport and Health* 3(2):133-140.