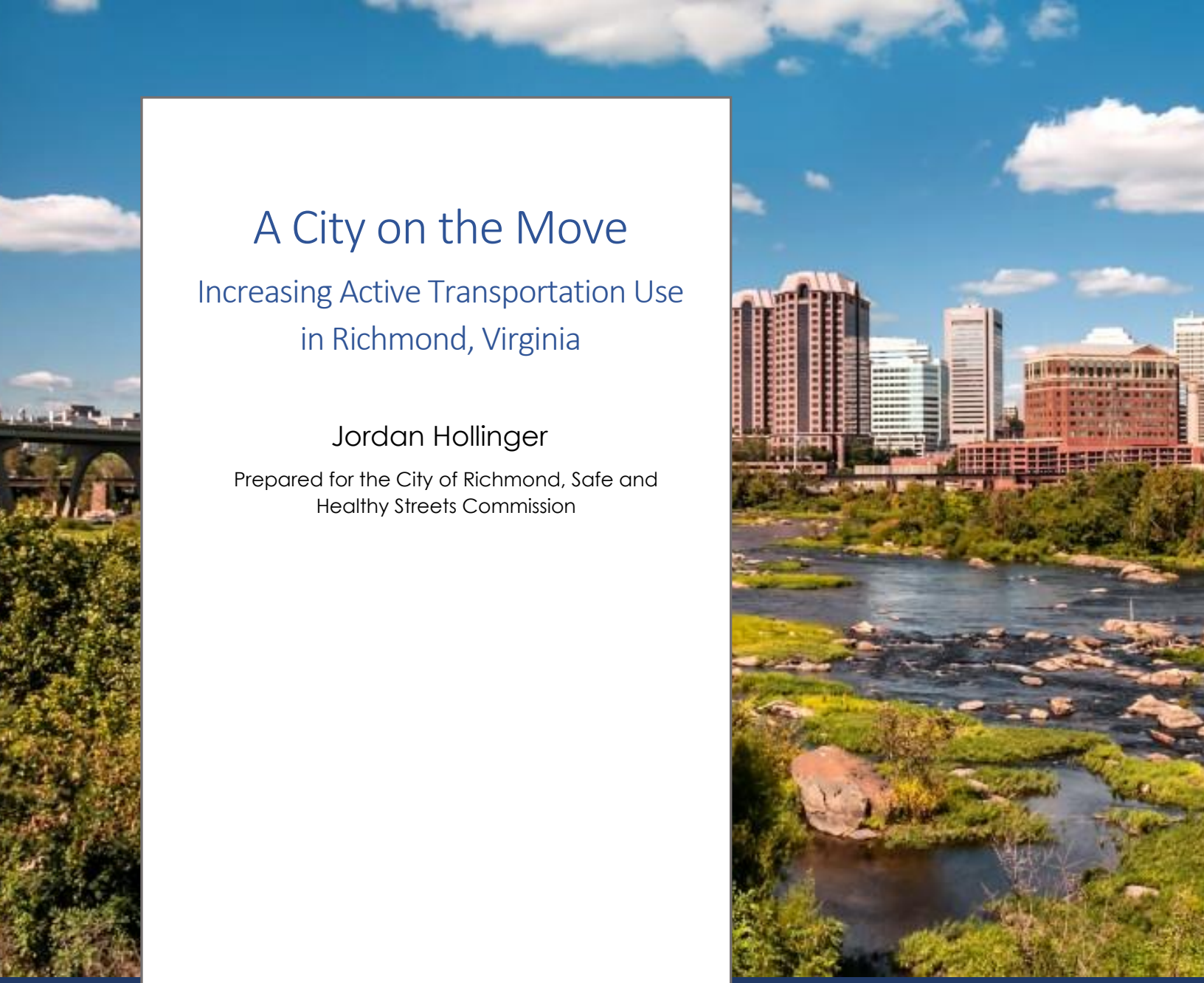

A City on the Move

Increasing Active Transportation Use in Richmond, Virginia

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Prepared for the City of Richmond, Safe and Healthy Streets Commission

Frank Batten School of Leadership and Public Policy
University of Virginia
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DISCLAIMER

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, or by any other agency.

HONOR PLEDGE

On my honor as a student, I have neither given nor received unauthorized aid on this assignment.

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GLOSSARY OF TERMS

Active Transportation – Biking, walking, or both in combination with public transit.

Passive Transportation – Driving or carpooling.

Complete Streets - Transportation policy and design approach that requires streets to be planned, designed, operated, and maintained to enable safe, convenient and comfortable travel and access for users of all ages and abilities regardless of their mode of transportation.

Zoning - Process of dividing land in a municipality into zones (e.g. residential, industrial) in which certain land uses are permitted or prohibited.

Up-Zoning/Re-Zoning – The process of changing the designated use zone of a parcel of land. Up-zoning refers to a change from more-restrictive zones to less restrictive.

Master/Comprehensive Plan - Process that determines community goals and aspirations in terms of community development.

Long-Range Transportation Plan - Process used to guide a region's transportation planning for a 20-year horizon.

Population Density - Number of people per unit of area, usually quoted per square kilometer or square mile.

Mixed-use - A type of urban development that blends multiple uses into one space (residential, commercial, cultural, institutional, or entertainment). The functions of each use are, to some degree, physically and functionally integrated, and generally provide pedestrian connections.

Traffic Calming – The process of reducing automobile speed through built environment design.

Walkability - Several commercially developed metrics, incorporating walking infrastructure, connectivity, distance to various amenities, and the quality of infrastructure. These metrics attempt to quantify on a 100-point scale how walkable a city is – with 100 indicating a “walking paradise,” and 0 indicating “Fully Car Dependent.”

ACRONYMS

CDC – Centers for Disease Control

HHS – US Department of Health and Human Services

DOT – US Department of Transportation

SHSC – Safe and Healthy Streets Commission

CPC - City Planning Commission

DPR - Department of Planning and Development Review (PDR)

EXECUTIVE SUMMARY

Research increasingly demonstrates that passive transportation contributes to high levels of inactivity and poor health. Within the city of Richmond, Virginia, 80% of the population uses passive forms of transportation as a primary mode. This translates to a resident population where only 44.1% of adults meet the HHS and CDC guidelines for aerobic activity, and only 13.1% meet both the aerobic and strength activity guidelines. Overall health in the city ranks 63rd among the nation's largest 100 cities.

Research indicates that switching from passive transportation to active transportation can counteract the negative health impacts of inactivity and lead to substantially improved health outcomes. Encouraging higher levels of physically active transportation use within Richmond, therefore, presents a profound opportunity to increase levels of physical activity and health outcomes within the city.

The decision to bike or walk is impacted by safety, convenience, competitiveness, and behavioral biases. Factors affecting each of these components include active transport infrastructure (bike lanes and sidewalks), traffic calming (speed limits), population density, land-use mix, connectivity, roadway design, parking management, and behavior change and incentive programs.

In order for the city of Richmond to increase the percentage of people utilizing physically active modes of transportation, it could implement the following alternatives:

1. Let Present Activities Continue: Implement the Remaining Bike Master Infrastructure and Adopt Richmond 300.
2. Conduct a Health Impact Assessment of Proposed Bike Infrastructure and Richmond 300 land-use changes.
3. Pilot a Parking Cash Out Ordinance.
4. Implement an In-Lieu Parking Fee into the City's Zoning Ordinance.
5. Implement a 20-Minute Neighborhood Vision in Richmond 300

Each of these alternatives is evaluated based on their effectiveness to increase active transportation rates, costs to the City of Richmond, equity, and administrative and political feasibility.

After a thorough analysis, **it is recommended that Richmond implement a 20-Minute Neighborhood Vision in the Richmond 300 Master Plan update.** This alternative is the timeliest and sets the legal basis for future zoning changes, which are essential in addressing the land-use factors that impact active transportation rates. While the impact of this alternative is uncertain due to a multitude of factors, it is the most comprehensive in terms of factors that affect active transportation.

1. PHYSICAL ACTIVITY AND HEALTH

INACTIVITY LEADS TO POOR HEALTH OUTCOMES

From work to play, American's increasingly live sedentary lifestyles. Inactivity is one of the driving forces behind high rates of obesity, heart disease, diabetes, stress, and other preventable diseases and mental health problems in the US (APHA, 2019, CDC, 2019). It is estimated to be a major risk factor in over 5 million, or 9%, of premature deaths worldwide (Lee et al., 2012). However, given society's current battle against the novel coronavirus pandemic, many of these risk factors will likely be contributing factors in a higher percentage of premature deaths. Obesity, heart disease and diabetes, in particular, are related to higher rates of COVID-19 fatality. In economic terms, the estimated burden from lack of physical activity is $117 billion or 9–11% of total health care costs in the US (Carlson et al., 2015; RCHD, 2017). Compared to inactive adults, the most active adults have approximately a 30% lower risk of premature death from all causes (Carlson et al., 2018).

Regular participation in physical activity lowers the risk of developing high blood pressure, high levels of "bad" cholesterol, heart disease, stress, obesity, dementia, and depression (AHA, 2019; HHS, 2017; National Library of Medicine, 2019; Johns Hopkins Medicine, 2019)The US Department of Health and Human Services (HHS) recommends that adults perform at least 150 minutes per week of moderate physical activity and muscle-strengthening activities two or more days per week (HHS, 2018). However, in the agency's most recent health statistics report, only 22.9% of U.S. adults aged 18–64 met the guidelines for both aerobic and muscle-strengthening activities - 32.4% met one, and 44.7% met neither.

Among wealthy nations, the US currently underperforms on measures of physical activity and health (APHA, 2019). According to the American Public Health Association and the CDC (2019), when compared to other countries,

- US life expectancy has historically grown at a slower rate than European countries, and has now declined since 2014.
- The US death rate from heart disease is the second-highest among wealthy countries – 1 in every 4 deaths in the US is related to heart disease.
- US Adults over age 50 are more likely to develop and die from cardiovascular disease - nearly half of U.S. adults deal with some form of cardiovascular disease.
- The US has the highest obesity rate across all age groups – 2/3 of adults are overweight.
- American adults have one of the highest rates of diabetes at 9.4% of the population.

INACTIVITY AND HEALTH IN RICHMOND, VIRGINIA

Like the US as a whole, residents of Richmond, Virginia, mostly fail to meet the HHS and CDC recommendations for physical activity. In the American College of Sports Medicine's (2019) most recent fitness index ranking, 44.1% of Richmond adults met the HHS and CDC guidelines for aerobic activity, and 13.1% met both the aerobic and strength activity guidelines. According to data provided by the Virginia Department of Health, 22.9% of Richmond adults over 20 years of age did not participate in any physical activity within the past month (BeHealthyRVA, 2019). Overall health in the city ranks 63rd among the nation's largest 100 cities (ACSM, 2019). The following is a table of additional health indicators for the city of Richmond:

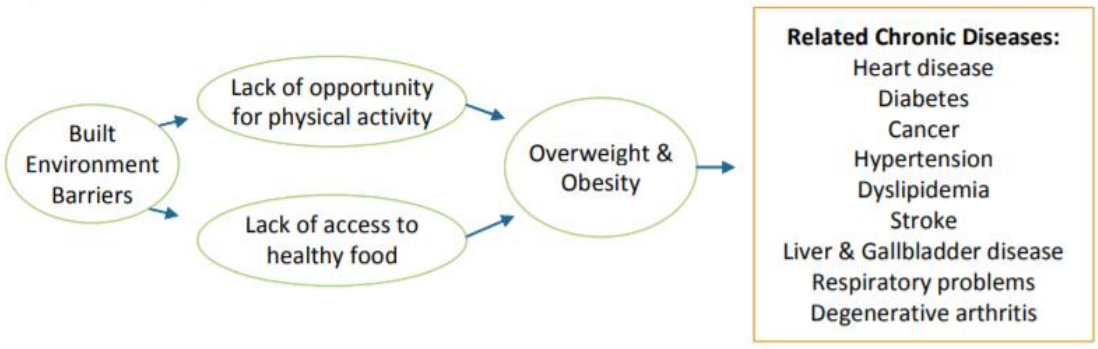
TABLE 1 RICHMOND HEALTH STATISTICS 2012 - 2017

Indicator	2012/13 Value	2016/17 Value
Reported poor mental health in the past 14 days**	12.6%*	14.8%*
Obese or Overweight	56%	66.20%
High blood pressure	35.80%	33%*
Angina or coronary heart disease	5.7%*	5.6%*
Diabetes	10.30%	12.70%

Source: Richmond City Health District (2019)
* Denotes 2013 or 2017 value.
** 48.9% reported poor mental health in the past 30 days

Although these indicators are influenced by a variety of factors, nutrition and physical activity are two of the most important (CDC, 2020) (see Fig 1). The Richmond City Health District, as part of their most recent community health assessment, identified physical activity as one of the primary areas to focus on to improve health within the City. One of the most sustainable ways to achieve recommended levels of physical activity is to utilize active modes of transportation – biking and walking. As such, this report examines how physical activity and health is directly tied to transportation behavior, identifies built environment and policy factors that influence transportation mode choice, and provides recommendations to the city of Richmond for ways they can increase the number of people that utilize physically active modes of transportation.

FIGURE 1 HEALTH IMPACT FLOW CHART FOR PHYSICAL ACTIVITY



SOURCE: (CDC, 2019)

2. THE PROBLEM: PASSIVE TRANSPORTATION & HEALTH

PROBLEM STATEMENT

Research increasingly demonstrates that passive transportation contributes to high levels of inactivity and poor health. Within the city of Richmond, Virginia, 80% of the population uses passive forms of transportation as a primary mode. This translates to a resident population where only 44.1% of adults meet the HHS and CDC guidelines for aerobic activity, and only 13.1% meet both the aerobic and strength activity guidelines. Overall health in the city ranks 63rd among the nation's largest 100 cities. Encouraging higher levels of active transportation use within Richmond is a profound opportunity to increase levels of physical activity and improve health outcomes within the city.

PASSIVE TRANSPORTATION IS A DRIVING FORCE OF INACTIVITY RELATED HEALTH ISSUES

America is one of the most car-dependent nations on earth (Tomer, 2017; Buehler, 2014). According to the latest (2017) US National Household Travel Survey, 83% of all trips are made by personal automobile, while only 11% are taken by foot, 3% by bicycle, and 2% by public transport. Rates for the most common trip types, such as commuting to work, are even lower, with only 3% of the population choosing to walk and less than 1% bike.

A growing body of research indicates that passive transportation – driving a car - is a primary contributor to high levels of inactivity and poor health in the United States (Bauman et al., 2014; Barlow et al., 2012; Chatterjee et al., 2017; Douglas et al., 2011; Kahneman & Krueger, 2006; Künn-Nelen, 2016). Passive commuting behavior negatively affects blood sugar, cholesterol, blood pressure, cardiovascular disease, anxiety, depression, stress, obesity, and overall self-reported life happiness.

Several studies have shown that lengthy car commuting perpetuates and increases the likelihood of experiencing mental health problems (Chatterjee et al., 2017; Kageyama et al. 1998; Rasmussen et al. 2000; Bauman et al., 2014; Künn-Nelen, 2016). Chatterjee at al. (2017) evaluated passive commuters and found that each minute spent commuting was associated with a reduction in self-reported mental health. Similarly, a study by MERCER and RAND (2017) demonstrated that longer-commuting workers are 33% more likely to suffer from depression, 12% more likely to report work-related stress, 46% more likely to get less than the recommended seven hours of sleep each night, and 21% more likely to be obese.

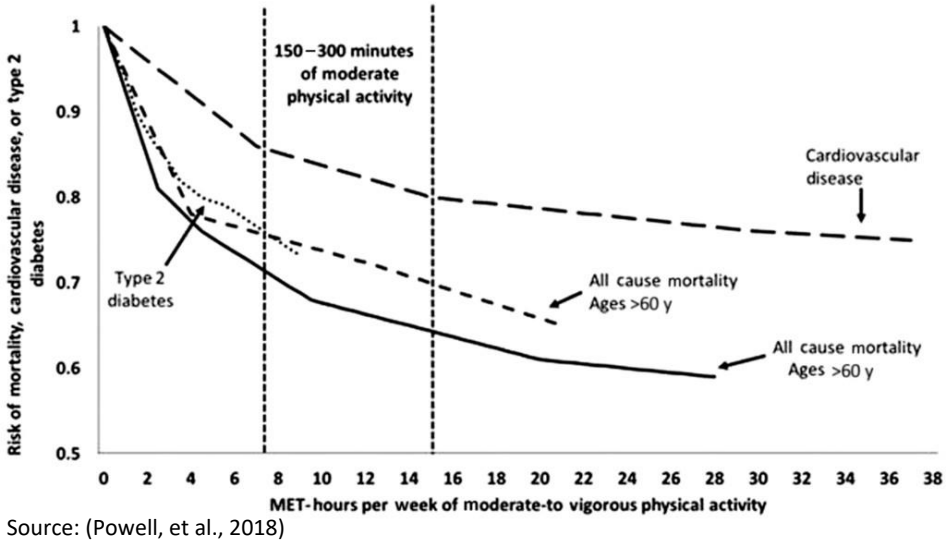
Other studies show that commuting times are inversely related to overall physical activity and physical health measures (Künn-Nelen, 2016; Barlow et al., 2012). In one study, Frank et al. (2004) found that each hour in the car was associated with a 6% increase in the odds of obesity. Similarly, Barlow et al. (2012) found that people who drove longer distances to work reported less frequent participation in moderate to vigorous physical activity and decreased cardiorespiratory fitness (CRF) and had a higher body mass index (BMI), waist circumference, and blood pressure. The study demonstrated that people who commuted 15 miles or more to work were less likely to meet CDC recommendations for physical activity and had a higher

likelihood of obesity. Commuting distances of just 10 miles were associated with high blood pressure. In a similar study, Bauman et al. (2014) found that more than 120 minutes of driving per day significantly increased the probability of experiencing insufficient physical activity, short sleep, obesity, and worse physical and mental health.

ACTIVE TRANSPORTATION IMPROVES HEALTH

Active commuters are generally defined as those who either walk or ride a bicycle. It is well established that increases in physical activity are causally related to improvements in health. Figure 2 demonstrates the relationship between physical activity and diabetes, cardiovascular disease, and all-cause mortality.

FIGURE 2. RESPONSE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND HEALTH



Source: (Powell, et al., 2018)

Active transportation is an underutilized method for promoting public health and for addressing health issues related to inactivity (USDOT, 2019; APHA, 2018; CDC, 2018). In response to the body of literature on the adverse health effects of passive transportation, researchers find that active transportation and commuting behavior can increase the proportion of people meeting recommended physical activity guidelines and have positive health effects (Berger, Qian, & Pereira, 2018; Merom et al., 2010; Zwald, Fakhouri, Fryar, Whitfield, & Akinbami, 2018; Kaczynskietal., 2012; Schauder & Foley, 2015; Dill, 2009; Scheepers et al., 2014; Omura et al., 2019). In fact, a 15-minute walk or bike ride to work or school for a total of 30 minutes a day would be sufficient to meet the CDC's recommended physical activity guidelines.

In a study examining the effect of varying levels of active transportation on cardiovascular risk factors among U.S. adults, Furie and Desai (2012) found risk reductions in all active transportation groups when compared with passive transportation groups. The odds of hypertension were 24% to 31% lower among individuals with low and high levels of active transportation, respectively. High active transportation was associated with 31% lower odds of diabetes. Akinbami et al. (2018) conducted a similar study evaluating active transportation and cardiovascular risk. They found that high levels of active transportation were associated with

decreased odds of hypertension, hypercholesterolemia, low HDL cholesterol, diabetes, and obesity. Low levels of active transportation were associated with reduced odds of hypertension and diabetes only.

In a meta-analysis of active commuting studies, Dinu et al. (2018) found that people who engaged in active commuting experienced an 8% reduction in mortality risk, a 9% reduction in cardiovascular disease risk, and a 30% reduction in the risk of diabetes. Cycling commuters experienced a decline in all-cause mortality (− 24%) and cancer mortality (− 25%).

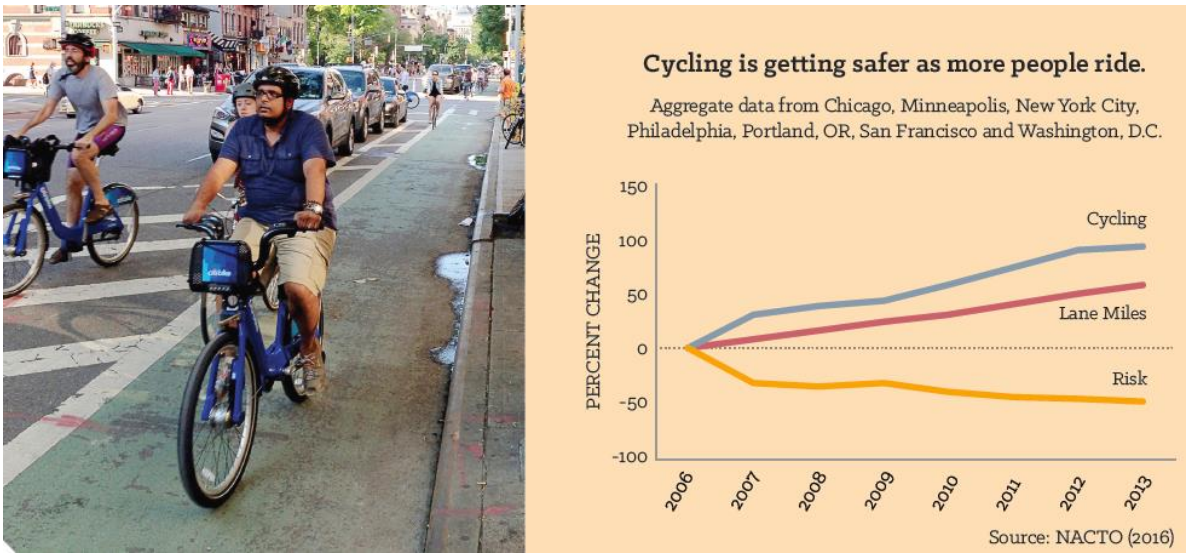
Other research has demonstrated that active transportation, particularly biking and walking, is associated with positive mental health outcomes. Scheepers et al. (2014) found that commuters who biked or walked to work felt more relaxed than non-active commuters. Morris (2015) similarly found that active transportation is associated with higher life satisfaction.

ACTIVE TRANSPORTATION BENEFITS OUTWEIGH THE RISKS

There are two potential negative health implications of active transportation – 1) higher exposure to pollutants in heavily congested cities; 2) Increased risk of accidents (de Hartog, 2010). All studies reviewed for this report indicate that when the benefits and abovementioned risks of active transportation are compared directly, the estimated health benefits of cycling and walking are substantially larger than the health risks. One such study showed that if 500,000 people in the Netherlands swapped their car for a bicycle for short trips on a daily basis, 3-14 months of life would be gained as a result of increased physical activity levels, compared to the smaller harmful effects of inhaled air pollution (0.8-40 days lost), and increase in traffic accidents (5-9 days lost).

Several studies have also noted that the risk of bike and pedestrian accidents gets substantially lower the more people that bike and walk (Jacobsen, 2003; NACTO, 2016). Jacobsen (2003) found that the likelihood that a given person walking or bicycling will be struck by a motorist varies inversely with the amount of walking or bicycling present in the city. This pattern is consistent across communities of varying sizes, from specific intersections to cities and countries. His analysis and data support the notion that as the salience of biking and walking increases, motorists adjust their behavior to be more aware of and careful around cyclists and pedestrians. Figure 3 below demonstrates this relationship through an analysis conducted by the National Association of City Transportation Officials (NACTO).

FIGURE 3. ANALYSIS DEMONSTRATING THE REINFORCED SAFETY EFFECTS OF HIGHER BIKE RIDERSHIP



BICYCLING AND WALKING LEAD TO HEALTHY COMMUNITIES

According to the CDC, “A healthy community is one in which local groups from all parts of the community work together to prevent disease and make healthy living options accessible.” (CDC, 2015). Creating bikeable and walkable communities is a crucial way to promote health because bicycling and walking are everyday activities accessible to most people, and under the right conditions, offer the most equitable and convenient ways to get around. As stated in “Step it Up!” The Surgeon General’s Call to Action to Promote Active Communities, “Walking and biking are excellent ways for most people to increase their physical activity because they are easy ways to start and maintain a physically active lifestyle,” (CDC, 2019). They serve many purposes, from leisure to commuting, and they have ancillary benefits such as safety, social cohesion, economic productivity, and reducing air pollution.

3. RICHMOND'S COMMITMENT TO ACTIVE TRANSPORTATION

RICHMOND GOALS – A MULTIMODAL CITY

Richmond is a traditionally sprawling city with a built-environment that is generally non-conducive to active transportation. This dynamic is best demonstrated by the fact that 71.7% of Richmond residents drive alone to work (ACS, 2018). However, over the past 10 years, Richmond has shifted its political commitment to becoming multimodal. In 2011, the city hired its first bicycle, pedestrian and trails coordinator, while in 2012, Bike Walk RVA - a non-profit advocacy group dedicated to advocating for the growth of biking and walking in the region - was established. In 2013, the city published a Richmond Strategic Multimodal Transportation Plan, which outlined nine general need areas for improving multi-modal transportation conditions. Then, in 2014, the city adopted a Complete Streets Policy. Finally, in early 2015, the Department of Public Works finalized the city's first Bike Master Plan, which proposed an extensive network of bike trails and roadway interventions throughout the city.

These efforts have impacted the development city's most essential and impactful planning documents--the citywide Master Plan, and the Region's Long-Range Transportation Plan (LRTP). The LRTP, called RVAConnects2045, began the update process in December of 2019. Although early in the process, the plan website makes clear that transportation investments and infrastructure will focus holistically on transforming the region's transportation infrastructure to facilitate greater use of biking, walking, and public transit. Additionally, the plan aims to connect the region's transportation vision with the region's locality's land-use decisions and Master Plans.

Richmond is also currently updating its Master Plan.[1] The plan is called Richmond300: *A Guide for Growth,* and lays out a vision for the city as it relates to land-use and the built environment. The plan currently outlines five topics with designated goals, objectives, and strategies (see fig 4). One of these topics is Equitable Transportation (highlighted in fig 4). The Plan's Equitable Transportation vision statement seeks to prioritize non-personal automobile forms of transportation, reading:

FIGURE 4. RICHMOND 300: TOPICS AND GOALS

[1] To understand more about the Master Planning process, see Appendix A

"Richmond prioritizes the movement of people over the movement of vehicles through a safe, reliable, equitable, and sustainable transportation network.

Walking, biking, and transit options should be the most convenient and used forms of transportation in Richmond; thereby improving the natural environment and our health. Richmond's multi-modal transportation system should be easy for all people to use and seamlessly connect Richmond neighborhoods and attractions to each other, the region, and the nation."

The update of these two crucial planning documents presents the city with a timely opportunity to consider additional planning and policy changes that could enhance and catalyze active transportation use in the city. The policies and programs presented in this report take this opportunity into account, and partially consist of land-use and zoning changes that could be leveraged through this process.

THE STATE OF ACTIVE TRANSPORTATION IN RICHMOND

Like the US as a whole, residents of Richmond largely drive alone as their primary transportation mode. According to the most recent (2018) American Community Survey, roughly 4.4% of Richmond workers over 16 years of age walk to work, 3.2% bike, 6.4% take public transit, while 80.3% drive or carpool (ACS, 2018).

Although current rates of active transportation are relatively low, they have been steadily growing as the city has increasingly prioritized bike and pedestrian infrastructure. Table 2 demonstrates the change in commuting mode from 2000 to 2018.

TABLE 2 RICHMOND COMMUTING MODE SHARE 2000 - 2018

	2000 Census (Percent)	2018 1-Year ACS (Percent)	% Change
Drove Alone	72.2%	71.7%	-0.7%
Carpooled	12.8%	8.6%	-33%
Public Transit	8.5%	6.4%	-25%
Bicycle	1.1%	3.2%	191%
Walk	4.5%	4.4%	-2%
Other	0.8%	1.1%	38%

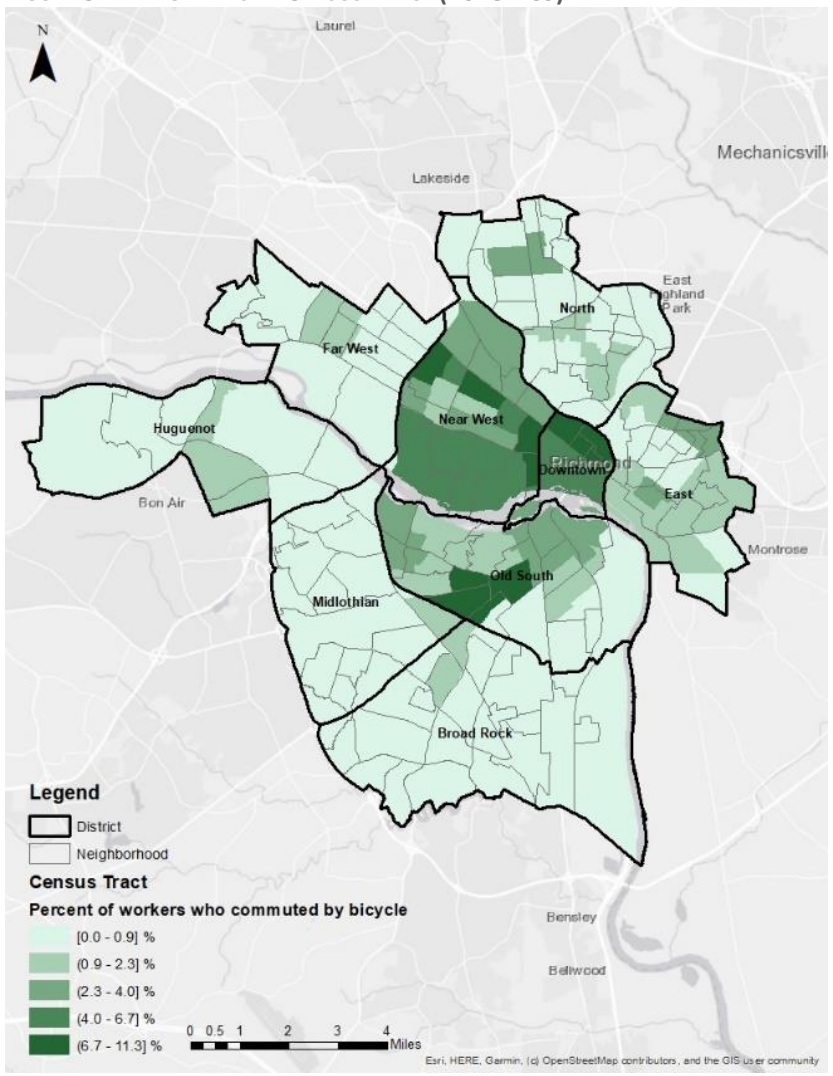
SOURCE: (CENSUS, 2000; ACS, 2018)

Table 2 shows that walking has remained relatively stable over the time period, from 4.5% in 2000 to 4.4% in 2018. However, bicycling rates have drastically risen by over 190 percent, from 1.1% in 2000 to over 3% in 2018. This is the product of efforts to increase biking infrastructure throughout the city.

Another important aspect of these figures is that they are not equally distributed throughout the city. Some areas of Richmond experience much higher rates of biking and walking than others. Figures 5 and 6 show biking and walking rates within the city of Richmond by census

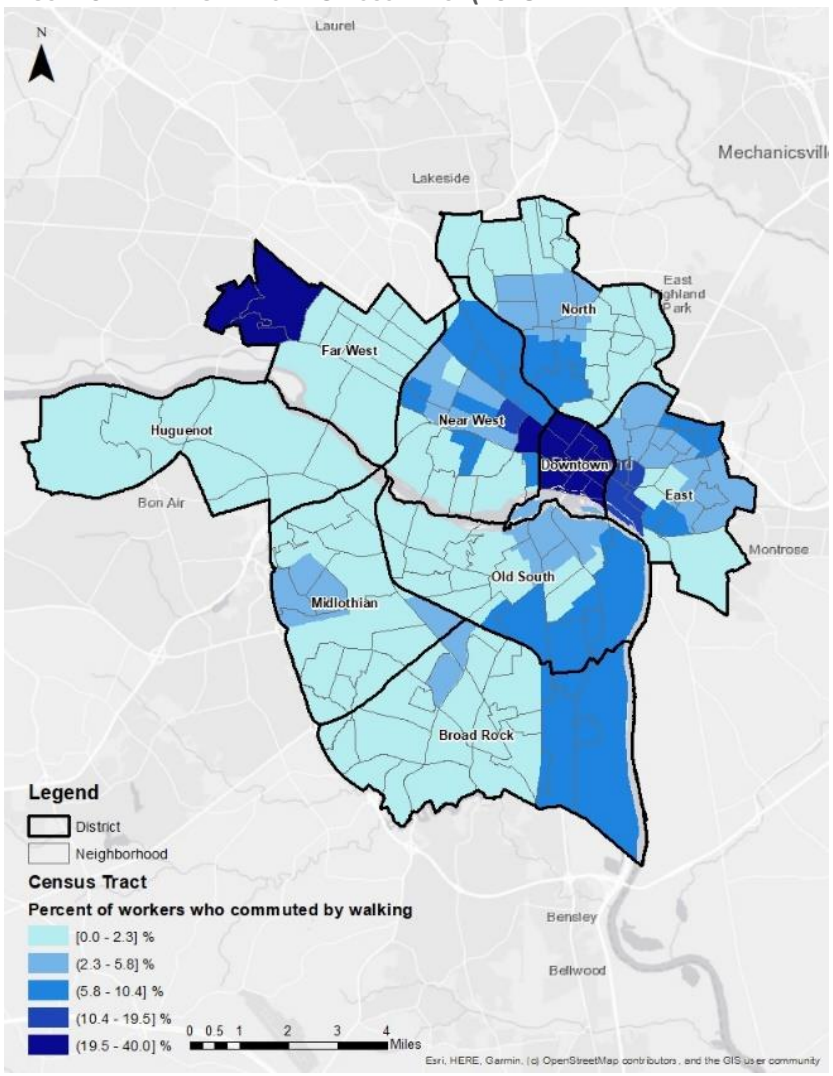
tract. Notably, for both modes, bike and walk rates are higher in the higher density areas of the city such as Downtown, the Fan District (Near West End on the maps), and some census tracts in the Old South District. These areas have biking and walking rates upwards of 11 to 40 percent. As will be outlined in section 4, these areas of the city have built environments that are far more conducive to active transportation than those in predominantly low-density residential areas.

FIGURE 5. BIKING RATES BY CENSUS TRACT (2018 ACS)



SOURCE: CREATED IN ARCGIS USING ACS (2018) DATA

FIGURE 6. WALKING RATES BY CENSUS TRACT (2018



SOURCE: CREATED IN ARCGIS USING ACS (2018) DATA

THE OPPORTUNITY MOVING FORWARD

A review of Richmond's planning and policy documents makes clear that the city government and planning agencies understand the many benefits of a multimodal city. Additionally, the city has demonstrated through bike and pedestrian improvements and a complete streets policy that commuting mode change is feasible and even likely. As the city continues to implement the infrastructure outlined in the bike master plan, and roadway enhancements and new development follow the complete streets policy, the city will continue to become more bike-friendly.

Richmond is also experiencing substantial growth (Weldon Cooper Center, 2020). Estimates indicate that this growth is likely to accelerate within the region over the next 20 years. This is, therefore, a critical time for the Richmond city officials to decide how the city should develop over time. Maintaining existing land-use policies and growth patterns will likely result in increasing pressure on the city's surrounding counties, and it will continue sprawl outward. This type of growth is considered anathema to active transportation. As cities sprawl outward, people and the places they want to go move farther apart, making biking and walking as transportation modes less feasible.

The city now has an opportunity to make policy and program changes to enhance active transportation in the city. Current efforts are working, but there are additional opportunities as well. Any efforts undertaken today will continue to yield additional health, social, and economic benefits as the city continues to grow.

4. FACTORS THAT AFFECT ACTIVE TRANSPORTATION USE

For the city of Richmond to make informed policy and program decisions, it is imperative to understand the many factors that influence people's decision to bike or walk. This report examines a number of these factors, including safety, convenience and competitiveness, and individual behavior bias. Corresponding to each of these factors, this section evaluates active transport infrastructure (bike lanes and sidewalks), traffic calming (speed limits), population density, land-use mix, connectivity, roadway design, parking management, and behavior change and incentive programs. Each section of this literature review first outlines the relevant factor and structural element and then presents evidence for how it impacts travel behavior. This is followed by a discussion of current conditions in Richmond.

SAFETY

Safety refers to the conditions that cyclists and walkers experience when they engage in physical activity. Conditions and infrastructure that increase both protection and the sense of safety work to increase the number of people utilizing active transport modes.

PEDESTRIAN INFRASTRUCTURE

Designated sidewalks increase safety for pedestrians. Research to date demonstrates that the number of sidewalks within a community is positively associated with rates of walking (Stappers et al., 2018; Active Living, 2016; McCormack et al., 2012). For example, McCormack et al., (2012) examined the relationship between sidewalk availability and participation in walking for transportation. They found that after controlling for neighborhood-based selection bias, sidewalk length is positively associated with the probability of walking for transportation. For each 10 km increase in sidewalk length, they also found that walking for transportation increased by 5.38 min/walk, and overall walking increased by 5.26 min/walk.

BLOCK SIZE AND WALKABILITY

Well-connected sidewalk networks enhance the safety effect. In a study that used cross-sectional data to examine built environment impacts on walking, Kamruzzaman et al. (2016) found that individuals are significantly more likely to be walkers if they live within a well-connected street network. This means, shorter blocks with more opportunities to cross roadways encourage more walking than poorly connected networks. In fact, according to a thorough study by Reid, Ewing, and Cervero (`2012), no other measure is more predictive of walkability than block size. Speck (2018) suggests that to realize the benefits of small block sizes, cities should aim for a 1,000-foot maximum perimeter.

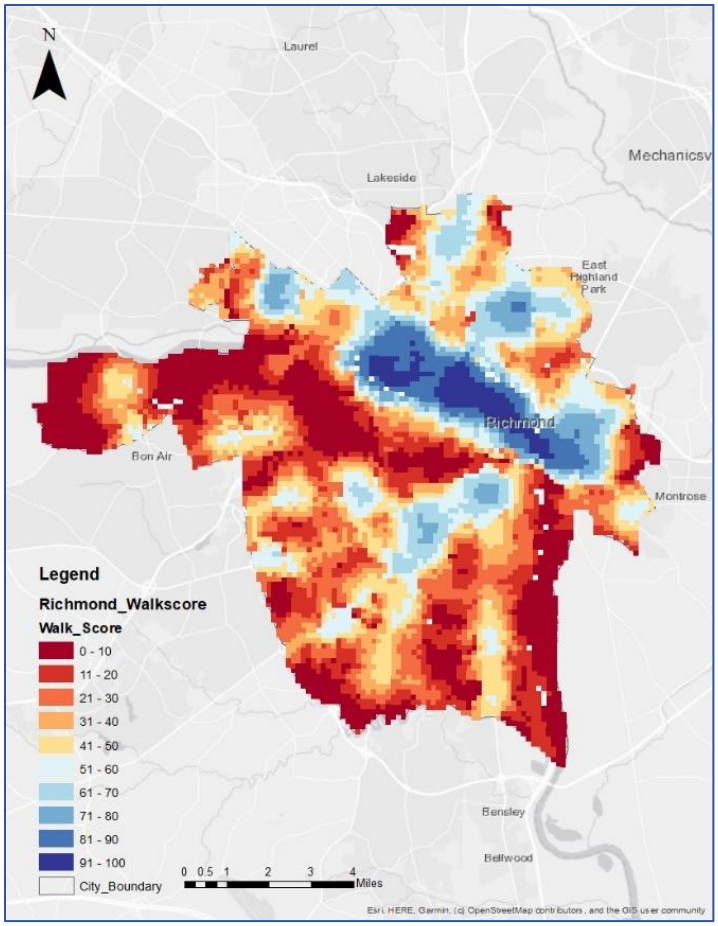
Numerous studies also evaluate the relationship between walking rates and "walkability" – which includes several commercially developed metrics, incorporating walking infrastructure, connectivity, distance to various amenities, and the quality of infrastructure. In a systematic review, Wang and Wen (2017) found that of 18 studies relating walkability scores to active transportation rates, 15 indicated a strong positive relationship between measures of walkability and rates of walking for transportation. Although these studies generally don't specify the isolated effect of increasing walking infrastructure or connectivity, they

demonstrate a holistic methodology for making the built environment more attractive to pedestrians.

RICHMOND WALKABILITY

Figure 7 shows the results of a walkability analysis for the city of Richmond. The analysis utilizes the walkability analysis tool Walkscore®, which is a mapping tool that assigns values between 0 and 100 to measure the walkability of any address. The city-wide average is 51. The most walkable Areas of the city are downtown, Carytown, and Virginia Commonwealth University. Comparing this map to figure 10, the least walkable areas throughout the city tend to be those that are less dense, single-use, and have less sidewalk infrastructure per square mile. The city's most recent capital improvement plan allocates $9,000,000 to the general sidewalk project program; however, it is unclear where and how those funds will be used.

FIGURE 7 RICHMOND WALKABILITY SCORE



SOURCE: RECREATED USING DATA FROM RICHMOND300

BIKE INFRASTRUCTURE

Research to date demonstrates that the number of bike lanes within a community is positively associated with rates of biking (Le Huyen et al., 2019; Zhao, P. 2014; Ma & Dill, 2015; Zahabi et al., 2016). In a recent study examining cycling demand in 20 US metro-regions, Le Huyen et al. (2019) found that bike-specific infrastructure was related to higher bicycle volumes. Specifically, they found that locations with off-road facilities (i.e., bike trails, shared-use paths) are correlated with higher bicycle volumes (25–31%) as compared with locations without such facilities. On-street facilities (i.e., bike lanes, sharrows, and other shared roadway markings) also had a positive effect, although significantly smaller at 10-15% increase relative to no infrastructure.

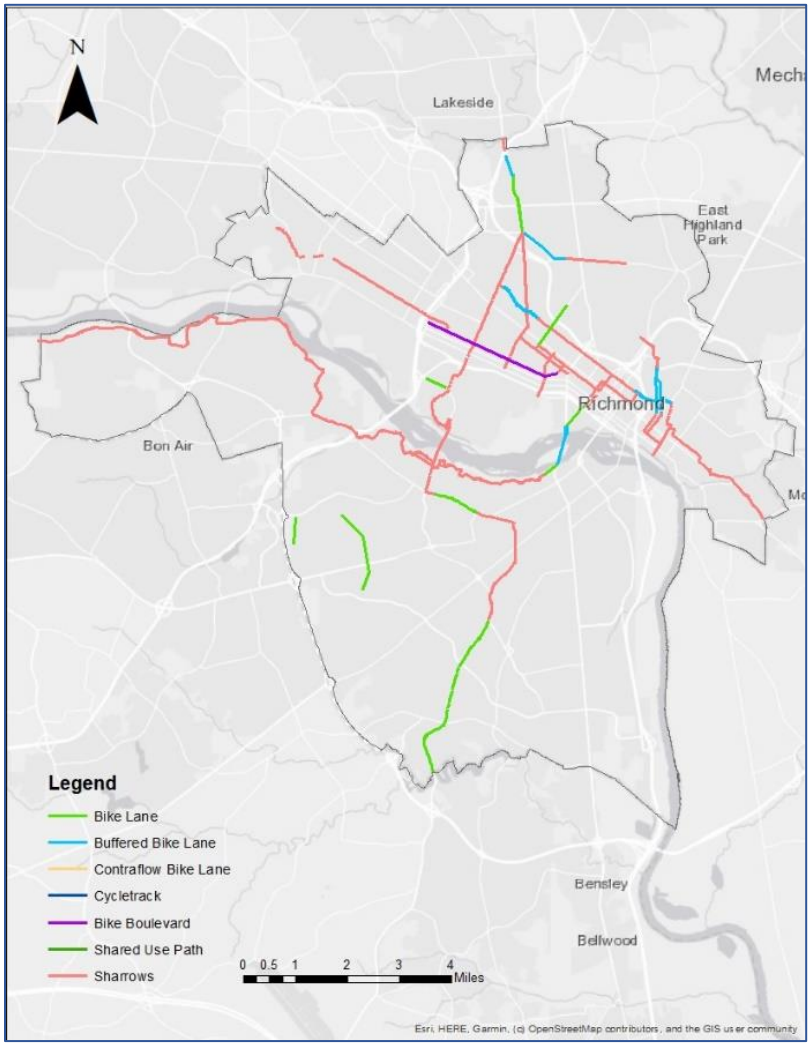
The literature indicates that pedestrian and bike infrastructure increase comfort, convenience, and safety for pedestrians and bikers (Winters et al., 2017). For both walking and cycling, most studies suggest a positive relationship between access to sidewalks and bike lanes and the connectivity and coverage of the resulting networks. A shorter distance from homes to bike routes, provision of off-road paths, and cycle tracks are all related to increases in cycling. In particular, separated paths or lanes are preferred by cyclists over lanes and sharrows that are on the roadway. Off-road bike lanes are perceived as being safer, which many researchers suggest is essential to encouraging less confident cyclists to decide to ride a bicycle.

Data from 167 European cities suggests that the length of cycling infrastructure is associated with a cycling mode share up to a rate of 24.7%, in which 1 in every 4 citizens would choose the bicycle for their daily commuting. Beyond 24.7%, the availability of bicycle facilities loses their relationship with the percentage of people riding bikes.

RICHMOND BIKE INFRASTRUCTURE

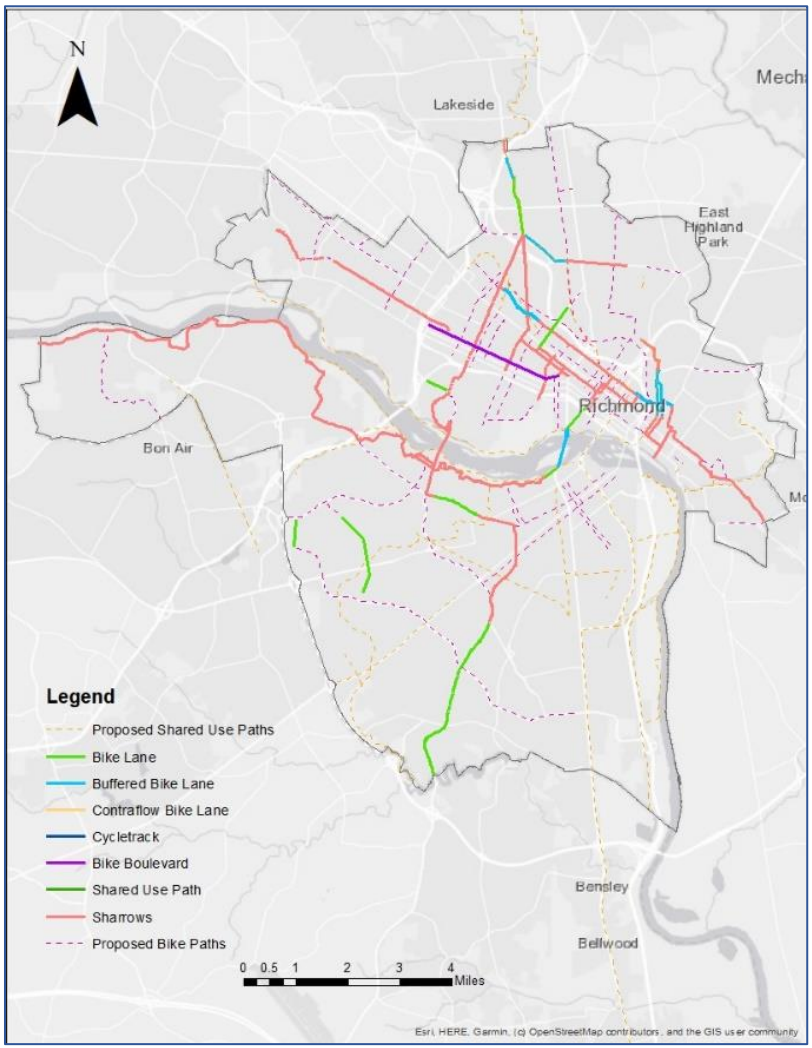
Figure 8 shows the existing bike infrastructure in Richmond. The existing network consists of roughly 32 miles of various types of bike lanes, from sharrows to bike boulevards. The network in figure 9 was designed as part of the city's bike master plan. It consists of an additional 85 miles of bike lanes and shared-use paths. Currently, the city has designed and is awaiting stripping on 25 of those miles, leaving 60 miles that have no plan in place to be implemented. As Richmond looks for ways to increase rates of active transportation, the City should continue to designate funds for its bike network.

FIGURE 8 RICHMOND EXISTING BIKE INFRASTRUCTURE



SOURCE: RECREATED USING DATA FROM RICHMOND300

FIGURE 9 EXISTING AND PROPOSED INFRASTRUCTURE



SOURCE: RECREATED USING DATA FROM RICHMOND300

TRAFFIC CALMING

Traffic calming refers to a combination of measures that reduce the negative effects of motor vehicle use, alter driver behavior, and improve safety conditions for non-motorized street users (USDOT, 2020). Traffic calming consists of physical design and other measures put in place on existing roads to reduce vehicle speeds and improve safety for pedestrians and cyclists. For example, vertical deflections (speed humps, speed tables, and raised intersections), horizontal shifts (crosswalk extensions), and roadway narrowing are intended to reduce speed and enhance the street environment for non-motorists. Reducing the speed limit is one of the most common methods of traffic calming.

A meta-analysis of studies on traffic calming showed that they effectively reduce injury accidents by around 25% (Elvik, 2001). Research suggests that as these types of traffic calming measures are introduced into a city and increase both safety and the perception of safety, participation in active transportation increases (Tranter, 2018).

RICHMOND TRAFFIC CALMING

As part of the city's "vision zero" efforts to reduce traffic fatalities, it has implemented multiple traffic calming measures. A recent effort by Mayor Levar Stoney resulted in the department of public works reducing the speed limit to 25mph on numerous city streets (Tynes, 2019). Additional initiatives include increasing visibility of pedestrians at intersections through curb extensions and crosswalks, and "road diets" on several city streets (Bryan, 2017). City Council has already approved funding for the road diets, but department staff are still working to identify key locations that would be best served by the funds.

CONVENIENCE & COMPETITIVENESS – LAND-USE

Although research makes clear that that the perception and reality of safety are prominent factors that limit and, when addressed through infrastructure and traffic calming measures, increase rates of active transportation, commuters also make decisions on the relative convenience and competitiveness of transportation modes. Because the United States as a whole has prioritized investment in auto-centric infrastructure such as highways and parking structures while encouraging cities to sprawl outward through low-density, single-use development, the relative competitiveness of driving has increased. As cities invest in walking and biking infrastructure, it is also crucial to influence the development patterns of cities so that walking and biking become more convenient and competitive.

MIXED LAND-USE AND DENSITY

Many studies have demonstrated the impact that various built environment factors have on active transportation rates. Generally, these studies find that higher residential density, increases in mixed-use areas, street connectivity, and pedestrian and bike infrastructure are all associated with higher levels of active transportation (Winters et al., 2017; Wang & Wen, 2017; Active Living, 2016; Scheepers et al., 2014; Stappers et al., 2018). In particular, urban design and land-use policies that locate more stores, jobs, and schools within walking or biking distance of where people live promote active movement. Such policies may include zoning regulations and

building codes, encouraging transit-oriented development, addressing street layouts and increasing residential density (Heath et al., 2006; Winters et al., 2017)

Traditionally, American zoning laws and ordinances have favored sprawl and low residential density (Buehler, 2014). They have done so through minimum lot sizes, parking requirements, and separated land-uses. This means that many American cities, including Richmond, grew outward, increasing the distance between resident's homes and potential destination points, such as work, school, and grocery stores. Numerous studies demonstrate that transitioning to higher density and mixed land uses increase the likelihood that residents will choose to bike or walk (Forsyth et al., 2007; Bentley et al. 2018; Fishman, Böcker, & Helbich, 2015; Le Huyen et al., 2019).

In one such study examining multiple built-environment factors, Bentley et al. (2018), found that the odds of any walking for transport (vs. none) was positively associated with residential density. Increases in residential density were also positively associated with minutes of walking for transport. The study also demonstrated a positive relationship between walking and higher land-use mixes. In a review of biking and walking in the Netherlands, Fishman et al. (2015) also found that urban density is positively associated with rates of biking and walking.

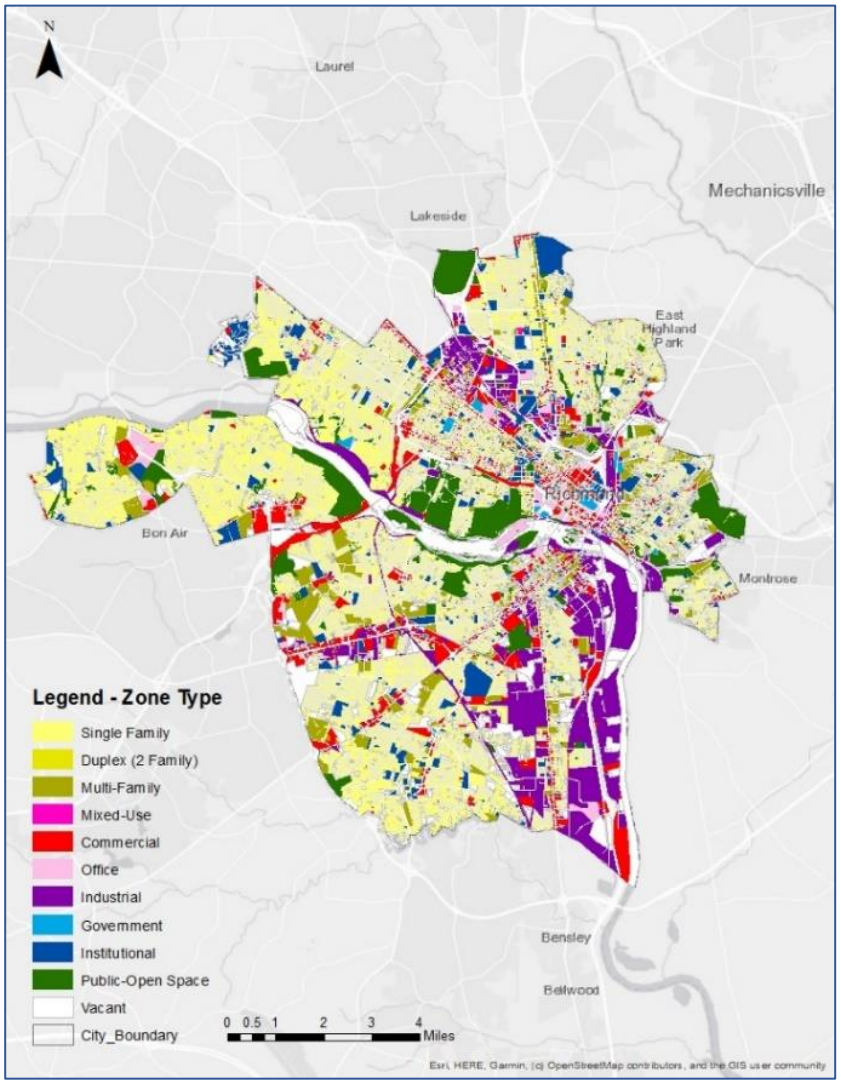
In a meta-review of 51 active transportation studies, Wang and Wen (2017), confirmed that high density and mixed-use development encourages walking and biking. Across 35 walking studies, they found a strong, positive relationship between walking for transport and residential density, land use mix, street connectivity, and retail land-use. Many of these studies indicate that mixed-use development ensures that people live conveniently close to potential destinations, while density increases the number of people that can choose to live in that environment. Higher density that is not tied to either existing or future mixed-use development will likely have a substantially smaller impact on active transportation rates.

RICHMOND EXISTING AND PLANNED FUTURE LAND USE

Figure 10 shows Richmond's existing land-use map – the land use patterns that result from the city's zoning regulations.[2] Figure 11 shows the proposed future land-use map that the City developed as part of the master plan update. There are very few use changes in the map, and the Richmond insights report suggests that the city currently has no plans to change land-use patterns in the city substantially.

[2] See Appendix A for Richmond's zoning map.

FIGURE 10 EXISTING LAND USE MAP



SOURCE: RECREATED USING DATA FROM RICHMOND300

FIGURE 11 PROPOSED FUTURE LAND USE MAP

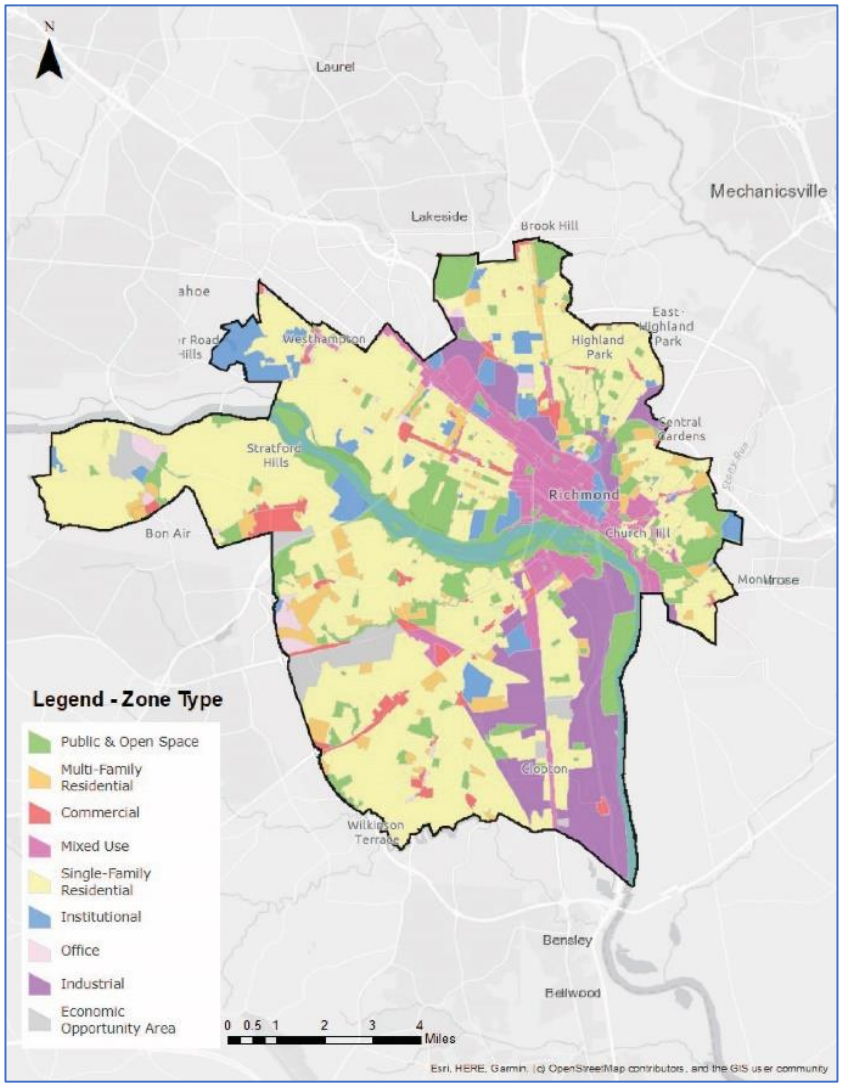
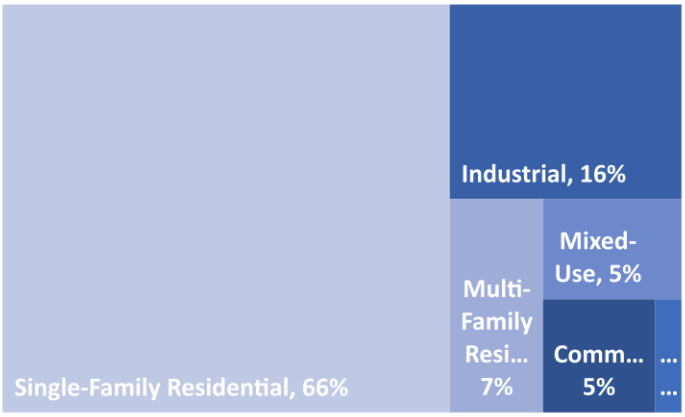


Figure 12 shows the breakdown of use zones throughout the city. The vast majority of zoned land in Richmond is single-family residential - the lowest density and most restrictive use type. Mixed-use land accounts for 5% of zoned land. Although this is a substantial proportion when compared to many other cities, it is highly concentrated in the Downtown and Fan districts. If this land-use is realized, most of the area to the south of the James river will have few high-quality mixed-use areas.

FIGURE 12 PERCENT OF TOTAL ZONED LAND BY USE TYPE



SOURCE: CREATED USING RICHMOND ZONING MAP GIS FILE

RICHMOND DENSITY CONDITIONS

Richmond is much less dense than comparable cities, such as Norfolk, Minneapolis, Pittsburgh, and Washington, D.C. Each of these cities, like Richmond, have vibrant downtown districts and also maintain lower-density residential neighborhoods. Figure 13 demonstrates how Richmond's density has changed over time. The areas of highest population density are The Fan and Museum District neighborhoods (historic urban typology). The lowest density areas generally align with the post-war suburbs, industrial neighborhoods, and estate neighborhoods – those designated in Fig 10/11 as single-family residential. Additionally, table 3 shows the active transportation rate for several cities, demonstrating that rates of walking and biking correlate positively to population density.

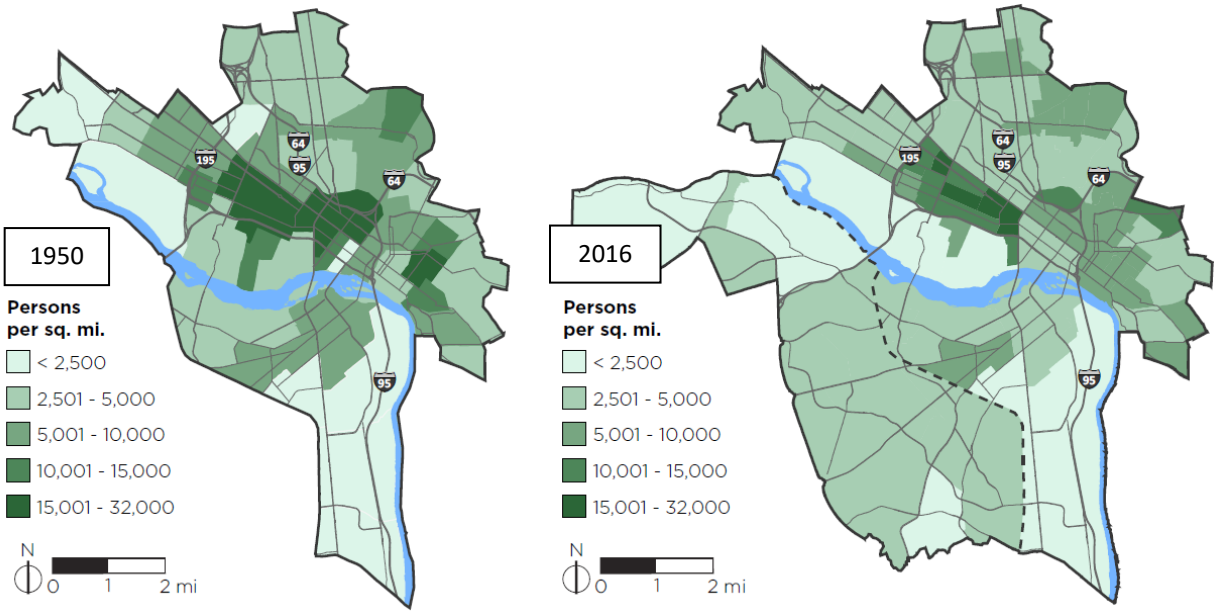
TABLE 3 POPULATION DENSITY COMPARISON

City	Population	Size (mi^2)	Density (ppl/ mi^2)	Active Transportation rate (ACS 2018)
Washington, D.C.	681,170	61.0	11,167	17.6%
Minneapolis	413,645	54.0	7,660	11%
Pittsburgh	303,624	55.4	5,481	11.9%
Norfolk	245,115	54.1	4,531	9.6%
Richmond	**223,170**	**62.5**	**3,571**	**7.6%**

SOURCE: (RICHMOND300 INSIGHTS REPORT, 2018; ACS, 2018)

Note: These cities were chosen as comparative cities because they are a similar geographic size as ot have the ability to annex land.

FIGURE 13 CHANGE IN POPULATION DENSITY 1950 - 2016



SOURCE: (RICHMOND300 INSIGHTS REPORT, 2018; ACS, 2016)

OPPORTUNITIES FOR ENHANCED LAND-USE DENSITY AND DIVERSITY

Across the US, cities with higher portions of their land designated as mixed-use development, experience higher rates of walking, biking, and public transit use. Unfortunately, there is no quick policy or program that can increase density and levels of mixed-use development in Richmond. In order to realize these effects, the city must go through the existing land-use regulation system – master planning and zoning.[3]

There are two broad zoning changes that cities can utilize to enhance land-use diversity and density (Speck, 2018; Elliot, 2008; Talen, 2012). The first is to begin eliminating restrictive zoning requirements such as minimum lot sizes, density maximums, and parking maximums that drive low-density development. The second is through the process of up-zoning - changing areas of the city from more restrictive use zones (such as single-family residential) to less restrictive zones (such as medium density mixed-use).

There are an increasing number of American cities that recognize the power of land-use regulations to promote healthier lifestyles. Minneapolis, MN, recently eliminated their single-family zone citywide, while cities such as Seattle, Washington, DC and Portland, OR have been successful in encouraging local mixed-use areas throughout the city through up-zoning efforts (Bliss, 2019; Britschgi, 2019; Capps & Kriston, 2019; PBS, 2019).

[3] See appendix A for a description of this process.

CONVENIENCE & COMPETITIVENESS - PARKING

One of the primary differences between urban development in the US and other wealthy nations with higher rates of active transportation is how American cities accommodate the automobile (Buehler, 2014). In particular, many American cities have historically incorporated parking requirements into zoning codes and subsidized city parking lots. Minimum parking requirements, a ubiquitous part of zoning law, require a fixed number of parking spaces depending on the building type - usually, these are provided for free to users. Shoup (2011), suggests that mandated minimum car parking requirements for homes and businesses have resulted in excess parking spaces - upwards of 3-8 parking spaces for every car (Shoup, 2011; Kimmelman, 2012).

This glut of parking makes driving comparatively convenient. Buehler (2012; 2014) identified that within Washington DC, access to free parking is associated with 70% smaller odds for active commuting. Parking requirements have undoubtedly contributed to higher rates of driving in the US. To truly address low levels of active transportation, cities need to reduce parking supply to levels that make driving and parking less convenient and comparatively less competitive to biking and walking.

Evidence suggests that decreasing the number of available parking spaces and increasing the financial and time-cost of parking in urban areas decreases the convenience of using cars and increases the likelihood that commuters will use alternate modes (Shoup, 2011; Pucher, Dill & Handy, 2010). Indeed, many European countries with high rates of walking and biking have, inversely to the US, implemented maximum parking limits to restrict car use in urban areas (Buehler, 2014).

Additionally, by requiring high numbers of parking spaces, zoning codes have ensured that development is less dense. Aerial imagery of many cities will reveal downtown and residential areas littered with grey parking lots. The two images next to Figure 14 show how parking requirements can result in different built forms (parking highlighted in orange). The top image shows a section of downtown Richmond, where no parking requirements currently exist. The bottom image shows the Old Town Manchester neighborhood, which does have minimum parking requirements. It demonstrates how regulations force development to sprawl, decreasing walkability.

RICHMOND'S EXISTING PARKING REQUIREMENTS

Richmond still requires minimum parking spaces as part of new development in most of the city. Figure 14 shows the only areas of Richmond for which the city's zoning code does not designate minimum parking requirements. These areas are also some of the most walkable. As described above, the two images to the right of Figure 14 show how areas with different parking requirements result in different levels of building density.

Moving forward, the city has room to address the induced demand and density implications of minimum parking requirements. Reducing or limiting the supply of parking in the city will result in driving becoming less convenient and competitive as compared to biking and walking. However, this effect is likely to only be seen over a long time as developers infill on underutilized parking structures.

OPTIONS TO REDUCE PARKING EFFECTS

There are three approaches to limiting or reducing the sprawl effect of parking requirements. One approach is to simply eliminate minimum parking requirements and allow markets to determine the optimal amount of parking that should be attached to a particular development. This approach is widely utilized in Europe, but has been difficult for planners and policymakers to adopt in the US. The first city to do so was Buffalo, NY, which ended its minimum parking requirements in 2017 (Poon, 2017). However, even as some progressive cities move to eliminate these restrictions, it remains an extremely contentious and politically unpopular approach.

Another approach is to utilize an in-lieu payment option for minimum parking. This system keeps in place existing requirements but allows developers to pay a fee instead of building the required parking. The city can then use this money to either implement demand management programs that seek to reduce congestion or build centralized public parking that is more efficient than small, surface lots. Although the developers must pay the fee, it is often lower than the incremental economic benefit to the development project (Un, 2010).

The final approach is a parking cap, which several dense European cities, such as Zurich, Hamburg, and Amsterdam, use to discourage driving. Parking maximums restrict the amount of parking that developers or individuals can build as part of a development project (Kodransky & Hermann, 2011). Additionally, some cities use stricter, citywide parking supply restrictions that simply restrict the total number of parking spaces that can be maintained in the city. This type of approach has only been utilized by New York City in the US and is seen as largely politically infeasible in most other cities where land is less scarce.

FIGURE 14 AREAS OF RICHMOND WITH NO MINIMUM PARKING REQUIREMENT

BEHAVIOR CHANGE AND INDIVIDUAL-ORIENTED INTERVENTIONS

Another approach to increase active transportation rates is to influence commuting and travel behavior through targeted programming directly. These types of interventions include informational and educational policies and programs, workplace travel plans, financial incentives, and nudges (behavior change programs). However, the evidence is mixed for behavioral programs (Forberger et al., 2019). Several reviews have demonstrated that there is little evidence to suggest that, by themselves, non-financial incentive programs – particularly nudges - result in sustainable, population-level increases in active travel (Macmillan et al., 2013; Martin, Suhrcke, Ogilvie, 2012; Ogilvie, 2004). Others have demonstrated that individual-level programs, in combination with infrastructure investments and land-use changes, have additive impacts on active travel behavior (Forberger et al., 2019; Daekin, 2019).

In a recent meta-analysis of physical activity studies, Forberger et al. (2019) concluded that nudging and behavioral interventions are, in principle, effective approaches to promote physical activity within the general population. However, they caution that there are large gaps in research and that many more opportunities are available to evaluate the intervention type's effectiveness. Daekin (2019) indicates that although transportation decisions are often made rationally in response to convenience and cost, a growing body of recent works suggest that social norms, attitudes, and perceptions can have significant effects on travel preferences and choices.

One specific behavioral program that has demonstrated high levels of success is Parking Cash-Out (Shoup, 2002). This program requires certain employers who provide subsidized parking for their employees to offer a cash allowance instead of a parking space. The program intends to reduce vehicle commute trips and emissions by offering employees the option of "cashing out" their subsidized parking space and taking transit, biking, walking or carpooling to work. Shoup (2002) analyzed a sample of California firms after the state implemented a Parking Cash-Out Law and found that bicycling and walking rose by 33% - from 3% of employees to 4%.

KNOWLEDGE – ALIGNING FACTORS WITH HEALTH NEEDS

The evidence relating the aforementioned built environment and behavioral factors to active transportation is strong. Increasing bike and pedestrian infrastructure will result in higher ridership. Rezoning to increase density and mixed land-use areas will bring people closer to where they need to go, making walking and biking more viable. Eliminating parking requirements will slowly alter the parking supply and reduce induced demand, allowing markets and developers to determine optimal parking supply and make decisions based on the opportunity value of land. These are just a few of the many possible ways that the presented evidence can lead to change within the city of Richmond.

However, often, these changes are implemented in cities without extensive thought as to how they align with a city's health needs. In other words, if the city committed to building bike lanes, how do proposed lanes align with the city's population that have higher rates of heart disease or obesity? The primary problem is that priority is often given to projects with

immediate returns. Within planning and analysis documents, such as Richmond's Bicycle Master Plan, new routes and lanes are proposed using propensity analysis (Bike Master Plan, 2014). Existing conditions are analyzed to identify areas with high biking or walking potential. These are areas that are more conducive to biking already and would yield immediate returns. Although, in theory, this is a sound analysis for prioritizing limited bike transportation funds, it does not take into account the health needs of a city or equitable distribution of health impacts.

Numerous cities across the US are beginning to amend the bike and pedestrian planning process to align with health needs through the use of Health Impact Assessments (HIA's) (Pew, 2019). The HIA is a process that helps evaluate the potential health effects of a plan, project, or policy before it is built or implemented. An HIA provides practical recommendations to increase positive health effects, improve the equitable distribution of health effects, and minimize negative health effects. As Richmond moves forward with infrastructure and land-use changes to improve active transportation, HIA's could be a valuable analytical tool. The result of such a process could include additional infrastructure, localized re-zoning recommendations, or zoning changes to benefit health in particular areas.

IMPLICATIONS OF RESEARCH FOR RICHMOND

American cities are, holistically, behind the curve in terms of enhancing and encouraging active transportation. Most cities have developed outward with car-centric sprawl and infrastructure. Fortunately, many cities, like Richmond, are actively trying to reverse this trend and encourage more people to walk and bike. Around the US, this strategy has primarily involved enhancing funding for active transportation infrastructure such as bike lanes, sidewalks, and other bike-ped safety features. This is a good starting point, and many cities, including Richmond, have seen steady increases in biking rates as a result of this investment. However, the past 50 to 100 years of zoning and planning practices have been anathema to active transportation. To reach high levels of physical activity, Richmond needs comprehensive policy and planning efforts that steer development toward dense, mixed-use, and multi-modal development over the next 50 years while continuing to invest in designated active transportation infrastructure.

5. CRITERIA FOR EVALUATION

The criteria specified in this section serve as the basis for evaluating alternative interventions that are proposed in section 6. The ultimate goal of each alternative is to increase levels of active transportation and improve health outcomes within the city of Richmond. As such, the alternatives presented in this report are evaluated based on their effectiveness, costs, equity, feasibility.

EFFECTIVENESS

Effectiveness in this evaluation is defined as the ability of the policy or program to increase the percent or number of people utilizing active transportation.[4] In cases where uncertainty is high, a low and high estimate will be given to each alternative based on the best available information. In order to ensure that the effectiveness estimate is contextualized, it will include a timeframe estimate of 0-5 years, 5-10 years, and 10+ years.

COST

The cost criterion will compare all anticipated costs between alternatives. These costs will include direct fixed and variable costs of program/policy development and implementation, such as capital, labor hours, materials, and training. All cost estimates from all sources are adjusted to 2020 dollars. The cost estimates are derived from sources such as: Precedent studies – what did another city spend implementing the same or similar policy; Cost quotes from consultant groups and construction contractors; and BLS average hourly wage.

EQUITY

The equity criterion asks the questions “who pays?” and “who benefits?” Within the city of Richmond, there are grave disparities in socioeconomic and health outcomes, and this criterion evaluates whether impacts are likely to be equitably distributed or whether they are experienced disproportionately by some groups over others.

FEASIBILITY

Administrative Feasibility will evaluate whether the city of Richmond has the requisite knowledge and staff to implement the respective alternative, or whether external hiring or help is needed.

Political Feasibility will evaluate whether the proposed alternative is likely to receive support from the relevant stakeholders needed for implementation. As the alternatives presented here are largely part of the planning process, which involves extensive public participation, it will evaluate whether there is likely to be public support, public opposition, or public indifference toward the alternatives. The level of public support will inform whether the Richmond City Council will be likely to approve and implement the proposed alternative.

[4] In academic literature, growth in active transportation is often estimated based on research models that utilize the American Community Survey (ACS), Census, or National Household Travel Survey (NHTS).

6. ALTERNATIVES AND EVALUATION

The following section introduces five alternative interventions that Richmond could undertake to enhance active transportation, and provides an evaluation of each alternative on the aforementioned criteria.

ALTERNATIVE 1 – LET PRESENT ACTIVITIES CONTINUE

Continue with Implementation of Bicycle Master Plan and the City-Wide Master Plan

Alternative one proposes that the city continue to implement the Bicycle Master Plan, and Richmond300 (the city's Master Plan update). The Bike Master Plan lays out progressively more accommodating bike infrastructure, safety improvements, and design standards. The bike improvements are broken down into four sections, short term (2-4 years), midterm (4-7 years), long-term (7-10+ years), and future (no timeline). Most of the initial short-term and mid-term infrastructure has been installed by the City's Public Works Department (DPW), but the long-term projects are still underway. According to the Public Works section of the city's website, an additional 25 miles of buffered bike lanes are designed and awaiting striping. This leaves an additional 60 miles of bike infrastructure that is outlined in the Bike master plan that has no timeline. In addition to bike infrastructure, the city has allocated additional funds in the capital improvement plan for sidewalks and other pedestrian infrastructure.

Richmond 300 is slated to be adopted by the city council in mid to late 2020. The implication of the plan is that it will enable the city to accommodate more people over the next 20 years, allowing for higher levels of density.

EFFECTIVENESS

Based on estimates of population growth, infrastructure installation, and the relationship between infrastructure and active transportation, this alternative is estimated to **increase active transportation rates in the city of Richmond by 16.27% to 33.32%, equating to a total active commute mode share of between 8% and 10%.**[5]

COST

The cost to the city of Richmond under this alternative includes the infrastructure costs for both bike and pedestrian infrastructure, the labor costs for installation, and the maintenance of that infrastructure. The total cost for both bike and pedestrian infrastructure over 10 years is estimated to be **$7,272,102** to **$14,823,726.**[6]

EQUITY

The equity of this alternative is **Medium**. Throughout the current Master Plan update documents, the term equity is woven through many of the city's strategic goals, particularly housing, the economy, and transportation (Richmond300, 2020). Although it is likely that Richmond's Master Plan will instill some positive change in terms of housing, transportation, and economic equity, these impacts are uncertain.

[5] See Appendix B for calculations

[6] See Appendix C for cost calculations

As low-cost mobility options, bike lanes, and pedestrian infrastructure enable lower-income residents to access more of the city conveniently and safely. Recent estimates suggest that low-income Americans walk and bike to work at higher rates than wealthy Americans (Snyder, 2014). Investing in this infrastructure, then, has profound equity implications and indicates that the city's investment in active transportation infrastructure will improve equity in the city.

FEASIBILITY

Administrative: The administrative feasibility of this alternative is **High**. Implementing the Bike Master Plan, and finalizing the updated Richmond300 Master Plan involves hiring no new staff, little to no further training, and no work that falls outside of existing staff purview.

Political: The political feasibility of this alternative is also **High.** The city has and continues to go through an extensive public engagement process as part of the Master Plan update. Any public concerns will mostly be resolved before final adoption (Elliot, 2008).

ALTERNATIVE 2 – CONDUCT A HEALTH IMPACT ASSESSMENT

Alternative 2 recommends that the City of Richmond develop a program for conducting Health Impact Assessments as part of their transportation planning and decision making. This would include an evaluation of how the remaining infrastructure proposed in the Bike Master Plan aligns with health and socioeconomic outcomes in the city, as well as an evaluation of how land-use changes (or lack thereof) from the Richmond300 Master Plan align with physical activity levels and health outcomes around the city.

This process is a relatively innovative approach to conducting HIA's. It is derived from an HIA conducted by Clark County, WA, government but is expanded to include further evaluation of land-use changes. The ultimate purpose of this alternative is to understand where there are gaps in current transportation planning efforts as they relate to both direct health indicators as well as social determinants of health indicators.[7]

Example – Clark County, WA

Clark County in the State of Washington conducted both a rapid and comprehensive HIA of their bike and pedestrian master plan. The HIA used a variety of analytical techniques to understand the city's baseline health and socioeconomic conditions and how proposed active transportation infrastructure aligned with those conditions. The final report included 11 recommendations that the county could undertake to enhance health in the region. Notably, some of these recommendations simply affirmed the implementation of the region's bike master plan, as the HIA concluded that the plan distributed benefits equally across multiple areas of need.

EFFECTIVENESS

The effectiveness of this alternative is contingent upon the assessment's findings and how the findings translate into decision making. If the HIA finds gaps in how proposed bike infrastructure aligns with the city's economic conditions and health needs, it could result in a recommendation for additional bike and pedestrian infrastructure. If the HIA finds few gaps, it may present few recommendations. As far as can be identified, no research exists that evaluates the 'effect' of conducting HIAs on physical activity and active transportation rates. However, several evaluations that have examined HIA effectiveness have found that in the near-term they can illuminate the potential health effects of policy and program choices on communities, influence decision-making, demonstrate the connection between health and a range of sectors, and raise the profile of health impacts among decision-makers (Pew, 2019).

COST

The cost of this alternative is estimated to be between **$12,000** and **$240,000.**[8]

EQUITY

The equity implications of this alternative are **High**. Inherent in an HIA is the evaluation of programs and projects relative to equity considerations such as health and economic outcomes. Within this context, the city of Richmond would be able to prioritize pertinent equity indicators as part of an HIA of the city's active transportation decisions. HIAs are generally seen to,

[7] Conducting a HIA would follow the process and steps outlined in Appendix D

[8] See Appendix C for cost calculations

- Build trust and strengthen relationships between decision-makers and community residents.
- Contribute to more equitable access to health-promoting resources such as healthy foods, safe places for physical activity, transit, and health care.
- Protect vulnerable communities from disproportionate exposure to environmental hazards

These findings highlight how HIAs can influence decision-making and call attention to the importance of HIAs in illuminating inequitable allocation of resources.

FEASIBILITY

Administrative: The administrative feasibility of this alternative is **Medium**. Many HIA's utilize state or regional departments of health, academic institutions, research centers, or consultants (Pew, 2020). The city of Richmond would either have to ensure that HIA expertise exists within the Richmond Health District office, or hire outside consultants to help conduct the HIA.

Political: The political feasibility of this alternative is **High**. There is no evidence that conducting an HIA is politically contentious. In fact, due to the inherent positive equity implications of HIA's on future decision making, it is likely that public support for them will be high. It is also likely that City Council Members would find such a report useful in their decision making and would, therefore, support the use of resources to conduct an HIA.

ALTERNATIVE 3 – PILOT A PARKING CASH OUT ORDINANCE

Alternative 3 proposes that the city of Richmond design and implement a local Parking Cash-Out Ordinance. Designed by Professor Donald Shoup at UCLA, Parking cash out is a commuter benefit in which an employer offers employees the option to accept taxable cash income instead of a free or subsidized parking space at work. The idea behind parking cash out is simple: given a choice of cash or a parking space, many people would prefer to receive cash. Most employers in the US provide free or subsidized parking to their employees (EPA, 2005). This practice encourages employees to drive to work alone, regardless of how far away they live, thereby increasing traffic congestion, air pollution, and harming personal health. Given the option to take cash instead of the parking space, many employees will take the cash and choose to carpool, take transit, or walk or bike to work. The benefits of this program are substantial - employees receive broader and more equitable commuter benefits while reducing traffic and emissions, and improving personal health. Shoup (2002) also suggests that many employers will benefit from the program as they reduce parking costs over time. Under this program, employees could either keep their tax-free parking subsidy or accept additional income. Employees who elect to accept the cash income pay taxes on it, but can use the money as they choose.

EFFECTIVENESS

The effectiveness of a parking cash-out ordinance is contingent upon the percent of employees that receive subsidized parking, and the resulting percent that uses the new program. Parking Cash Out is estimated to increase active transportation rates in the city of Richmond by **10.2% to 28.6%**.[9]

COST

The cost of this alternative to the City of Richmond includes the labor costs of developing and maintaining the ordinance. For a similar, updated transportation benefits program, the Washington DC government estimated that the cost of development and implementation over five years would be **$523,000** (Government of DC, 2020). This cost included the hiring of one new staff person**.**

EQUITY

The equity of this alternative is **Medium**. Shoup (2002) demonstrates that employees affected by the ordinance feel overwhelmingly positive about it. Additionally, by equalizing benefits, companies provide a more equitable compensation package for all employees. The effect of this ordinance, however, is only applicable to employees that receive subsidized parking. This means that there are significant portions of the Richmond workforce that would not benefit from the program. These employees may be lower-wage workers, whose incremental benefit of additional cash is far higher than the average affected employee.

FEASIBILITY

Administrative: The administrative feasibility of this alternative is **Medium**. If assuming a similar program to Washington DC's proposed ordinance, the City of Richmond would likely have to hire one new staff person to oversee the program. Additionally, current city employees and

[9] See Appendix B for calculations

lawyers would likely need to spend a moderate amount of time supporting the new employee in their role.

Political: The political feasibility of this alternative is **Low**. Although analyses of parking cash-out ordinances demonstrate that the actual administrative and financial burden to employers is relatively low, recent experience in Washington DC demonstrates that employers are likely to oppose a parking cash-out program (Di Caro, 2017; Coalition for Smarter Growth, 2020). It is likely that Richmond would face similar opposition from business groups and that the city council would respond accordingly.

ALTERNATIVE 4 – IMPLEMENT AN IN-LIEU PARKING FEE

As previously discussed, parking requirements in most American cities have impacted car use through two factors. First, off-street parking requirements and parking minimums have ensured that auto-use is competitive and convenient, ensuring that ample parking is available in most locations. Through extensive research, Shoup (2005) has demonstrated that excessive parking has an induced-demand effect as it makes driving exceedingly convenient even at short commuting distances. Second, parking minimums are a primary contributor to sprawl, resulting in urban forms that are challenging or inconvenient for residents to bike or walk. Addressing parking management is, therefore, an opportunity to reverse these long-standing trends in Richmond.

Alternative four proposes that the City of Richmond amend the city's zoning ordinance to include an in-lieu parking fee scheme. This program would allow developers in Richmond to pay an In-lieu fee toward a citywide active transportation and travel demand management fund instead of building the required minimum parking spaces as currently outlined in the city's zoning ordinance. The city could use the active transportation fund to complete implementation of the Bike Master Plan or in conjunction with capital improvement funds for pedestrian improvements.

EFFECTIVENESS

Well-developed theory by Shoup (2005) suggests that by reducing parking availability, people will shift to other modes. However, to date, no research exists that evaluates the impact of an In-lieu fee program on biking and walking rates specifically. In fact, consultant In-lieu fee reports for the City of Santa Monica emphasize that there is not enough research to determine the mode shift from driving to active transportation (AECOM, and Nelson Nygaard, 2012). The reason for this is that in-lieu fees are inherently tied to future development, which involves long-term, unpredictable changes. However, the Sustainable Development Code (2020) and Shoup (2005) suggest that the force of reducing parking over time contributes to positive pedestrian mobility systems by incentivizing people to walk, and when paired with active transportation funding has the potential to enhance the relative competitiveness of walking and biking.

COST

The cost of this program is estimated to be between **$50,000 and $90,000**.[10]

EQUITY

The equity of this alternative is **Medium**. The primary purpose of this program is to incentivize developers to build less parking, which inherently increases the walkability of neighborhoods. This has positive equity implications as lower-income residents often walk and bike at higher rates than wealthy residents (Snyder, 2014). Additionally, forgoing parking construction allows developers to increase the usable floor area of purchased land for more valuable uses such as housing. The time-frame over which these changes may occur is generally long-term and highly

[10] See Appendix C for cost calculations

variable. Therefore, the positive equity implications of this alternative are not guaranteed and may only be realized over a long time period.

FEASIBILITY

Administrative: The administrative feasibility of this alternative is **Medium**. To develop an In-lieu parking scheme, the City of Richmond will likely have to hire consultants or conduct a moderate amount of training for existing employees on how to construct and implement an in-lieu zoning code change.

Political: The political feasibility for this alternative is **High**. In-lieu fees are generally seen as favorable by developers, who are likely to support city councilors in making this decision. As part of the Richmond300 Master Plan update, the city conducted a parking study, which included public outreach, and found that there was wide support for in-lieu parking fees (City of Richmond, 2020).

ALTERNATIVE 5 – IMPLEMENT A 20-MINUTE NEIGHBORHOOD VISION IN RICHMOND'S MASTER PLAN UPDATE

Alternative 5 recognizes the profound connection between the built environment and active transportation, and calls for the city to implement a 20-minute neighborhood vision into the current Master Plan Update – also called a 'Complete Neighborhood.' The 20-minute neighborhood is a visionary idea about living locally, giving people the ability to meet most of their everyday needs within a 20-minute walk or cycle. As has been outlined throughout this report, Richmond, like most US cities, has historically utilized land-use regulations that pushed development outward. The result of this development pattern is an ever-increasing reliance on passive transportation. The intent of the 20-minute neighborhood is to break out of this "mobility trap"—the vicious cycle of driving ever longer distances to get to the same things—and to begin developing places around walking and biking.

KEY INGREDIENTS OF 20-MINUTE NEIGHBORHOODS

To accomplish 20-minute neighborhoods throughout Richmond, the city will have to wrestle with its current and historic land-use regulations.

Density: First, local development densities need to be increased. This means ensuring minimum density levels of around 25-30 dwellings per hectare, which will better support local activity and services provision. In order to achieve this, the city of Richmond will need to either up-zone areas within the city to less restrictive use types, or begin to loosen requirements such as minimum lot sizes.

High Quality and Walkable Mixed-Use Nodes or Corridors: The other essential component of 20-minute neighborhoods is to enable the development of a wider variety of uses in more localized locations. This will include small grocery, retail, multi-family, and potentially other commercial uses that don't conflict with residential character. These mixed-use nodes or corridors should prioritize pedestrian and cyclist access. Again, in order to accomplish this, the city will have to go through a process of up-zoning to allow "by right" uses in what are now single-family and multifamily residential zones.

The reason that this alternative begins with the non-binding Master Planning Process, is that it provides cities with a legal basis for making future zoning changes (primarily up-zoning). Within Richmond, this vision should focus primarily on low-density, underserved residential areas of the city – areas with low walkability and little walkable access to quality goods and services.

EFFECTIVENESS

Because this alternative is inherently visionary, it is challenging to assess the relative effectiveness. How this vision extends to real zoning and policy changes is dependent on future development pressures, political will, and public support or opposition. Portland, Oregon, provides the most compelling example of how a 20-Minute vision can increase levels of active transportation.[11] Portland expects to reach a total of 32.5% active commute mode share by 2035 through the comprehensive 20-Minute Neighborhood approach (BikePortland, 2019).

[11] Other cities that have incorporated 20-minute neighborhoods into their master plan include, Detroit, MI., Madison, WI.

Case Study – Portland, OR

In 2012, the city of Portland adopted the 'Portland Plan,' which called for vibrant neighborhood centers throughout the city to increase the number of people living within a 20-minute walk of essential goods and services. The goal of the plan was to ensure that 90% of Portland residents could meet their basic needs within a 20-minute walk by 2030. Although the city has not reached this goal yet, the progress made is reflected in the city's high bike and walk rates to work - 6.3% and 5.7%, respectively. Utilizing the 20-Minute Neighborhood as a backing for active transportation policy and infrastructure investment, the city anticipates reaching a total of 32.5% active commute mode share by 2035.

It is important to note that although commute mode share in Portland remains relatively low when compared with European examples, the 20-minute neighborhood is more focused on trips for all purposes – not just work. The city emphasizes that the 20-minute neighborhood has had a much greater impact on non-work-related trips, where commute mode share may be as high as 40%.

COST

The initial cost associated with this alternative includes minimal labor hours needed to conduct a 20-minute neighborhood GIS analysis and create a few accompanying Master Plan pages. The labor needed for this is relatively low, and as such, this cost is estimated to be between **$1,466 and $2,932**.[12] Although this upfront cost is relatively low, in the future, greater development resulting from up-zoning may induce costs such as utility lines and infrastructure that push the total cost estimate significantly higher.

EQUITY

The equity of this alternative is **High**. Although it is non-binding in the short term, laying out a vision for walkable access to all basic needs is a truly equitable vision. As aforementioned, lower-income commuters' bike and walk at higher rates to work out of necessity. By designing and structuring development around the necessitated behaviors of lower-income residents, cities can ensure that access to essential daily needs is enhanced for most people.

FEASIBILITY

Administrative: The administrative feasibility of this alternative is **High**. No new staff and little training would be required to implement this alternative.

Political: The immediate product of this alternative – an additional Master Plan section – is **Medium-High** on political feasibility. It is highly likely that residents of low-density residential neighborhoods may object to proposed land-use changes that bring mixed-use development to their community. But, beyond localized land-use change opposition, the majority of city residents are likely to support the vision for 20-minute neighborhoods. Looking to the future, up-zoning, especially in low density, wealthy, residential areas may remain politically contentious, but, so long as the changes are captured in the city's master plan, legally easy to implement (Elliott, 2008).

[12] See Appendix C for cost calculations

OUTCOMES MATRIX

This outcomes matrix summarizes the evaluation results for all alternatives.

	Effectiveness (Percent increase in active transportation mode share)	*Time Frame For Effectivenes*	Cost (2020 Dollars over specified time frame)	Equity	Administrative Feasibility	Political Feasibility
Alternative 1 - Let Present Activities Continue	16.27% to 33.32%	10-20 years	$7,272,102 to $14,823,726 *(10-20 Years)*	Medium	High	High
Alternative 2 – Health Impact Assessment	Not sufficient data (Evidence for improved decision making)	<1 year	$12,000 to $240,000 *(1 year)*	High	Medium	High
Alternative 3 – Parking Cash Out Ordinance	10.2% to 28.6%	0-5 years	523000 *(5 years)*	Medium	Medium	Low
Alternative 4 – In-lieu Parking Fee	Not sufficient data (Theory supports significant active transportation benefits)	10-20 years	$50,000 to $90,000 *(1 year)**	Medium	Medium	High
Alternative 5 – 20-minute neighborhood	Too many uncertainties (Sets up legal basis for binding land-use changes)	10-20 years	$1,466 to $2,932 *(1 year)***	High	High	Medium-High

*** 1 year to draft ordinance with help of consultants. Additional costs may accrue after implementation.**

**** Less than 1 year to develop GIS analysis and master plan pages. Additional costs will be incurred over the 10-20 year period.**

7. RECOMMENDATION

The above analysis attempts to evaluate each alternative on a set of comparable metrics. However, it is important to note that none of the alternatives are mutually exclusive, and are, in fact, complementary of one another. Each one addresses a critical factor that impacts the decision to bike or walk. If possible, the City of Richmond should proceed with all options. However, given the limited time and bandwidth of the city government, this is likely infeasible. To account for this, this section presents a single recommendation – Alternative 5: Implement a 20 Minute Neighborhood Vision in the Richmond Master Plan.[13]

IMPLEMENT A 20-MINUTE VISION IN RICHMOND'S MASTER PLAN

Out of the five alternatives presented in this report, the 20-minute vision is the most structurally comprehensive in terms of impact, and also the timeliest.

Historic patterns of land-use regulation have largely made walking and biking in Richmond less convenient and competitive than driving. Reversing this trend and increasing opportunities for high-quality, human-scale development in residential areas will provide Richmond residents walkable options for grocery shopping, entertainment, work, and retail.

As the City is currently going through its master planning process, there is a tremendous opportunity to address the land-use factors that substantially impact the decision to bike or walk; namely, density and mixed-use development. Within the current Richmond Master Plan, the future land-use map shows few changes. This means that if the plan is adopted, the city will face tremendous challenges if it attempts to up-zone areas that are not in keeping with the Master Plan goals and objectives or land-use map. Therefore, if this alternative is not implemented during the current master planning process, up-zoning will remain infeasible until the plan and future land-use map are revised. Under Virginia code, cities are required to review their master plan every 5 years. It is likely that major changes, however, such as a 20-minute vision would not receive attention during incremental updates.

[13] To account for other potential city priorities Appendix D presents reasons for why the city might choose one of the other alternatives.

8. IMPLEMENTATION CONSIDERATIONS

Implementing a 20-minute vision in the Richmond 300 Master plan requires that the city progress through the legally mandated comprehensive planning process. The following section outlines key steps needed to implement a 20-minute vision, and places where implementation may fail.

STEP 1. GET BUY-IN FROM KEY STAKEHOLDERS

The first critical step in the implementation process is to get buy-in from the City Planning Commission (CPC), City Council, and Department OF Planning and Development Review (PDR).[14] These three bodies are the primary drivers, along with citizen input, of the master plan contents. The Safe and Healthy Streets Commission (SHSC) should, therefore, be prepared with persuasive memos or reports to initially present to each of these stakeholders.

To take these efforts further, the SHSC could also prepare draft master plan materials. By creating draft documents, the SHSC would reduce work for the key government stakeholders and make implementation and adoption more likely.

Finally, mobilizing support from other government agencies and citizen organizations can be an effective way to put additional pressure on the Planning Commission, Planning Department, and City Council to take the implementation of this process seriously. The SHSC should work to mobilize the Richmond Health District, which has shown prior interest in active transportation, and the organization BikeWalkRVA. Both of these bodies are influential voices within the city when it comes to physical activity and city health.

STEP 2. CONDUCT PUBLIC MEETINGS EARLY

As mandated by law, the final master plan document must be presented to the public for comments and an in-person hearing (VA Code). However, most master plans (including Richmond300) involve much more extensive public participation, with ongoing meetings between citizens, active citizen groups, consultants, developers, and key government decision-makers. This process is a negotiation between city councilors, who are beholden to their constituents, planning commissioners, who are beholden to the city council, and the public. Early public outreach during this process will likely face some “Not in My Backyard” (NIMBY) reaction.

Richmond residents living in low-density residential neighborhoods will likely be concerned that after future up-zoning, their neighborhoods will be overrun by large apartment buildings, businesses, and increased noise and traffic. It is the job of the Richmond CPC and PDR to listen to the public during this process but to also present the 20-minute vision in a way that helps residents understand the holistic benefits. Adding density and mixed-use development to neighborhoods can look many different ways, and often residents envision a “worst case” scenario (Elliott, 2008). Conducting early public outreach and listening is an essential step in addressing NIMBY opposition.

[14] Appendix A provides additional information about the key stakeholders in this process.

STEP 3. FINALIZE MATERIALS AND AMEND THE MASTER PLAN

After citizen input, the CPC and PDR should amend the 20-minute materials to align with the goals and items negotiated during the community engagement process. The key item here is the future land-use map, which should be updated in accordance with residential areas in Richmond that were receptive to the proposal. The final section of the master plan should detail specific areas throughout the city that have been identified through analysis and community input that could be up-zoned in the future to achieve 20-minute neighborhoods.

Prior to any Master Plan being adopted in the state of Virginia, it must be presented to the public for final review and comments (VA code). Again, the issues that may arise during this process primarily revolve around citizen opposition (NIMBYism). The concerns that are likely to arise are, again, related to how the plan sets up future land use and zoning changes. Some citizens, when presented with a final map, may realize that their home is closer to the proposed changes than they first imagined, and address their concerns to the city council and planning commission accordingly.

STEP 4. RE-ZONE IN ACCORDANCE WITH THE MASTER PLAN

This is the most likely place that a 20-minute vision will fail. Although a well-constructed and sound Master Plan and future land-use map provide the legal basis for city officials to up-zone in accordance with the plan, officials often don't end up doing so if they face strong public opposition, or other policy areas take priority. The legal act of up-zoning remains politically unpopular in low-density residential areas, where concerns about neighborhood character and gentrification often arise (Elliott, 2008).

Within Richmond, there have been relatively few efforts to systematically up-zone large sections of the city, but recent localized efforts, such as the Monroe Ward rezoning has been supported by the City Council with little opposition (Rojas, 2019). However, this effort largely focused on infill of underutilized parking lots and was therefore unlikely to garner the same opposition that rezoning in residential areas would.

In any future effort to up-zone, the city council, CPC, and PDR should work to educate the public on how up-zoning can beneficially impact the community. This can include much-needed housing, new businesses and economic development, and the health benefits of walking for most daily needs. Additionally, the city should build coalitions with outside stakeholders that can also work to promote the policy.

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APPENDIX A – RICHMOND MASTER PLANNING PROCESS

ENABLING LEGISLATION FOR VIRGINIA MASTER PLANNING[15]

Code of Virginia § 15.2-2223: "The local planning commission shall prepare and recommend a comprehensive plan for the physical development of the territory within its jurisdiction and every governing body shall adopt a comprehensive plan for the territory under its jurisdiction." The plan shall "be made with the purpose of guiding and accomplishing a coordinated, adjusted and harmonious development of the territory." The comprehensive plan shall include a transportation plan. The comprehensive plan, "with the accompanying maps, plats, charts, and descriptive matter, shall show the locality's long-range recommendations for the general development of the territory covered by the plan. It may include, but need not be limited to:"

Designation of areas for public and private development (different kinds of residential, industrial, business, agricultural, conservation, recreation, public services, flood plain and drainage, and other areas);

- Designation of a system of community service facilities;
- Designation of historical areas;
- Designation of areas for the implementation of ground water protection measures;
- A capital improvements program;
- Location for recycling centers, military installations, and electric transmission lines; and
- Designation of areas for the construction, rehabilitation, and maintenance of affordable housing.

“At least once every five years the comprehensive plan shall be reviewed by the local planning commission to determine whether it is advisable to amend the plan.”

Richmond City Charter, Chapter 17: The City Council and the City Planning Commission shall have the power to adopt by ordinance a master plan for the physical development of City, which shall include the items required by the Code of Virginia, and may include, but shall not be limited to:

- Location, character, and extent of roads, walkways, playgrounds, recreational facilities, parks, squares, stadiums, swimming pools, arenas, waterways, and other public places or ways;
- Location, character, and extent of all public buildings and public property;
- Location, character, and extent of slum clearance, and housing and neighborhood rehabilitation projects; and
- A general plan for railways, streetcars, buses, and all other vehicular traffic.

[15] Summary of enabling legislation as presented in Richmond 300

RICHMOND 300: A GUIDE FOR GROWTH

Richmond 300 is the City of Richmond new Master Plan. The purpose of the plan is to determine how Richmond should look, feel, and grow over the next 20 years. Richmond 300 will articulate this vision and outline recommendations to get there. One of the most important aspects of Richmond 300 is the master plan future land-use map.

The City's effort follows the statutory framework imposed by the General Assembly (outlined above), which affects all local government jurisdictions in Virginia. Specifically, since 1980, each locality has been required to prepare a Master Plan, which the courts have defined as a "guideline for future development and systematic change, reached after consultation with experts and the public" for the territory within the locality's jurisdiction. As a land-use document that makes recommendations concerning long-term future land use, the master plan, its future land-use maps, goals, and strategies, is both general and visionary in nature. This stands in contrast to the zoning ordinance and zoning maps of Richmond, which directly concern the legal rights of underlying parcels and their respective owners.

Despite being an advisory document, the master plan has an important legal bearing on land-use decisions by the governing body for the jurisdiction. The document typically is the key source that guides land use decisions by the governing body, such as rezoning and special use permits. A city council that acts in conflict with the recommendations of the comprehensive plan invites judicial scrutiny in connection with an appeal, potentially offering evidence that the decision was arbitrary or capricious.

FUTURE LAND-USE MAP

The Future land-use designations outlined in Figure 11 are visionary and indicate how the area should look and feel in the future, but does not specify what an owner can or cannot legally do with their property. Zoning designations, on the other hand, stipulate what a landowner can legally build on their land today and include permitted uses, setback requirements, and building height and bulk limits, and sometimes include form-based requirements, such as regulations on window and entrance location. Future land-use is an important tool in helping communities envision the future of a place without getting into the implementation of how, specifically, the buildings will be designed and built. Once a future land use map is adopted, the City begins the process of implementing various tools (zoning, streetscape projects, park and open space projects, transportation improvements, and economic development programs) to achieve its vision.

RICHMOND ZONING MAP

Zoning is the process of dividing land in a municipality into zones (e.g. residential, industrial, commercial) in which certain land uses are permitted or prohibited. Zoning often also regulates the sizes, bulk, and placement of buildings. Within a zoning ordinance, the type of zone determines whether planning permission for a given development is granted "by-right" or whether the development needs special permission from the city planning office. Zoning may

specify a variety of outright and conditional uses of land. It may also indicate the size and dimensions of land area as well as the form and scale of buildings. In the US, zoning ordinances also often regulate things that must be a part of development, like parking and storm water management. These guidelines are set in order to guide urban growth and development. Figure 15 shows the current zoning map in Richmond.

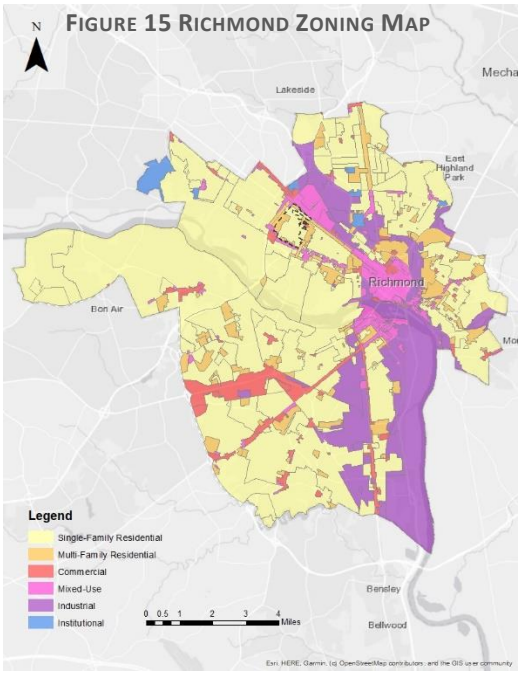

FIGURE 15 RICHMOND ZONING MAP

PRIMARY STAKEHOLDERS IN THE MASTER PLANNING PROCESS

City Planning Commission: Per the City Charter and Virginia Law, the city planning commission (CPC) must make and adopt a Master Plan that guides coordinated and harmonious development of the city. The CPC will adopt Richmond 300 and send it to City Council for final approval. The CPC is instrumental in guiding the scope and vision of the master plan. It consists of: Five citizen members appointed by City Council; One citizen member appointed by the Mayor; One member of City Council; One member of the Board of Zoning Appeals; The Chief Administrative Officer or appointees.

Governing Body: The City of Richmond Council is responsible for adopting the final Master Plan. As mentioned above, they are also responsible for appointing the majority of planning commissioners. Upon adopting the Richmond 300 Master Plan, the council is responsible for approving updates and amendments to the Master Plan, adopting rezoning regulations that are consistent with the plan's land use designations.

Administrative Staff and Consultants: The lead administrative body in the development of Richmond 300 is the city's Department of Planning and Development Review (PDR). The PDR is responsible for most of the drafting and analytical work, and has some say in the direction of the plan.

Citizens and Other Stakeholders: Other stakeholders include concerned citizens, who elect members of the City Council, members of the local community that may be impacted by land use plans, and community organizations that are invested in public health, such as BikeWalkRVA. These stakeholders are likely to contribute by participating in public hearings and meetings, acting as advocates or opponents for the plan, and Serving on ad hoc committees to advise planning commission or study issues in depth.

APPENDIX B – EFFECTIVENESS CALCULATIONS

ASSUMPTIONS FOR ALL CALCULATIONS

- The current bike commute mode share in Richmond is 3.2% (ACS, 2018)
- The current walk commute mode share in Richmond in 4.4% (ACS, 2018)
- 2020 Population estimate = 232,533 (Weldon Cooper Center, 2020)
- 2030 Population estimate = 245,483 (Weldon Cooper Center, 2020)
- 2040 Population estimate = 255,094 (Weldon Cooper Center, 2020)
- All costs have been adjusted from their recorded year to 2020 dollars

ALTERNATIVE 1 – LET PRESENT ACTIVITIES CONTINUE

EFFECT FROM BIKE INFRASTRUCTURE

Although many studies utilize different measures of biking, such as leisure time physical activity, or commute mode share, consistently, studies indicate a positive and statistically significant relationship between miles or density of bike lanes and biking physical activity. For the purposes of this analysis, findings from Dill and Carr (2003) are used to estimate future changes to bike ridership. They developed a model that examined the effect of bikeway-miles on bicycle commuting and found that each additional bikeway-mile per 100,000 residents increases bicycle commuting 0.075%, all else being equal.

The low estimate in this analysis assumes an additional 25 miles of bike lanes are installed over the next ten years, whereas the high estimate assumes that the remaining 60 miles of planned infrastructure is also installed. Table 1 summarizes the results.

The low estimate is calculated by taking the Dill and Carr (2003) model value – 0.075% increase per 100,000 people – and is adjusted to represent the percent change for the 2030 estimated population of Richmond, which is 245,483 (Weldon Cooper Center, 2020). This adjustment yields a value of 0.184%, predicting that each additional installed bike lane mile increases commute mode share by 0.184%.

Low Estimate Calculation:

- Percent Increase = Model Value x Miles of Bike Lane
- Percent increase = 0.184% x 25 = **4.6%**
- Resulting bike mode share = 1+percent increase x existing mode share
- Resulting bike mode share = 104.6% x 3.2% = **3.45%**

High Estimate Calculation

- Percent increase = 0.184% x 85 = **15.65%**
- Resulting bike mode share = 115.65% x 3.2% = **3.7%**

EFFECT FROM PEDESTRIAN INFRASTRUCTURE

Increasing the mileage of sidewalks in a city is associated with higher walking rates. However, unlike bike infrastructure, Richmond currently has no specific plan outlining priority sidewalks and other pedestrian infrastructure. The process for improving pedestrian infrastructure largely goes through the Richmond's RVA311 service request system (Richmond.gov., 2020). This program is run by the department of Public Works and is funded by the city's Capital Improvement Program. The most recently adopted 2020 Capital Improvement plan allocates $9,000,000 to the general sidewalk project program (pg. 103) from 2020 through 2024. The majority of these funds have historically gone to repairing and replacing existing sidewalks instead of building new ones. It is certain that some of these funds will be used to build new sidewalks over the next 5 to 10 years. Therefore, this analysis uses a rough high and low estimate for sidewalk installation over the next 10 years. The low estimate is based on 20% of funds being used for new infrastructure and the high estimate is based on 40% of the funds being used for new infrastructure.

McCormack et al. (2012) estimate that each 10-km increase in sidewalk length is associated with a 2.97 percentage point increase in the probability of participating in neighborhood-based walking for transportation. Adjusting this to miles equals a 2.97 percentage point increase per 6.2 miles. However, this estimate does not account for the frequency of participation and could be as low as once a week. Therefore, for this analysis, it is assumed that 4.4% - the current walk mode share in Richmond - of people participated as their primary transportation mode. This equates to a 0.13068 percentage point increase in mode share per 6.2mile increase.

To align effect time frames with the planned bike infrastructure previously analyzed, it is assumed the capital funding will remain stable from 2025 through 2030, resulting in an additional $9,000,000 (2020 $'s) in sidewalk project funding. These figures, combined with sidewalk installation average costs and proportion assumed for new sidewalk miles are the basis for the calculations. Table 2 summarizes the results of the analysis.

Assumptions:

- Cost per mile of sidewalk = $295,762 (Walkbikecny.org, 2014)
- Total Funding for sidewalks from 2020 – 2030 = $18,000,000
- Proportion used for new sidewalk:
    - Low = 20% - Total miles of new sidewalk = (18,000,000 x 0.2)/$250,000 = **12.17 miles**
    - High = 40% - Total miles of new sidewalk = (18,000,000 x 0.4)/$250,000 = **24.34 miles**

Low Estimate Calculations

- Walk mode share change = (New miles / 6.2 miles) x Percentage point increase per 6.2 miles
- Walk mode share change = 12.75/6.2 x 0.13 = **0.27 percentage points**
- Percent Increase = (Current mode share + increase) / current mode share – 1
- Percent increase = (4.4% + 0.268%) / 4.4% - 1 = **6%**

High Estimate Calculations

- Walk mode share change = (New miles / 6.2 miles) x Percentage point increase per 6.2 miles

- Walk mode share change = 24.34/6.2 x 0.13 = **0.5** percentage points
- Percent Increase = (Current mode share + increase) / current mode share – 1
- Percent increase = (4.4% + 0.5%) / 4.4% - 1 = **12%**

EFFECT FROM GROWTH AND HIGHER DENSITY

The city is predicted to grow by 22561 residents by 2040 (Weldon Cooper center, 2020). Given that the city cannot annex land, this growth will increase population density in the city. Numerous studies have indicated that as cities become denser, the proportion of residents utilizing active transportation increases. For example, Manville and Shoup (2005) found that a 1% population density increase is associated with a 0.58% reduction in vehicle miles traveled (VMT). To extend this to active transportation rates, Kenworthy and Laube (2000) demonstrate that there is a strong linear relationship between VMT and non-motorized commute trips indicating that as VMT decreases by 1% Active miles traveled increases proportionately. Using these estimate the projected increase in active transportation is calculated and presented in table 3. There is no high and low estimate.

Assumptions:

- City area = 62.57 square miles
- Current population density = 3,716 people per sq. mile

Calculation:

- Percent increase in population density = (4076-3716)/3716 x 100 = 9.7%
- Reduction in VMT = 5.67% (Proxy for increase in active commute mode share)
- New Mode share = 7.6% (Bike and walk mode share) x 105.67% = 8%
- Mode share change = 8% - 7.6% = 0.4 percentage point increase

TABLE 1 EFFECTIVENESS OF BIKE, PED AND DENSITY ON COMMUTE MODE SHARE

	Low Estimate (%Increase)	Low Mode Share change	High Estimate (%Increase)	High Mode Share Change	Time Frame Estimate
Bike Infrastructure	4.6%	+0.146 % points (3.45% bike share)	15.65%	+0.5 % points (3.7% share)	5-10 years
Pedestrian Infrastructure	6%	+0.27 % points (4.67% walk share)	12%	+0.5 % points (4.9% share)	5-10 years
Density	5.67%	+0.4 % point (8% Active share)	5.67%	+0.4 % point (8%% share)	10-20 years
Total	**16.27%**	**0.456 % points (8.056% Active commute share)**	**33.32%**	**+1.4% point (9% Active commute mode share)**	**10-20 years**

ALTERNATIVE 3 – PARKING CASH OUT

The effectiveness of a parking cash-out ordinance is contingent upon the percent of employees that receive subsidized parking, and the resulting percent that uses the new program. No estimates were found for the number or percent of Richmond employees that benefit from subsidized parking; therefore, for this evaluation, estimates from other cities are used.

Estimates on the percent of employees that receive subsidized parking across a number of large US cities indicates a range of 4.3% in New York City to 86.8% in San Diego (Greenberg et al., 2017). Given the relatively unique nature of New York – having a relatively low car commute mode share – to calculate the low estimate of this alternative, the next lowest city's - Washington DC - value of 31% is used. San Diego's value is used to calculate a high estimate. Shoup (2002) analyzed eight California firms after the state implemented a Parking Cash-Out Law and found that bicycling and walking rose by 33% - from 3% of employees to 4%.

Assumptions:

- Number of employees = 109,362
- Current active commute mode share = 7.6%
- Existing number of active commuters = 109,362 x 7.6% = 8312
- Percent of affected employees that switch modes = 33%
- Low percent with subsidized parking = 31%
- High percent with subsidized parking = 86.8%
- Low number of affected employees = 31% x 109,362 = 33,902
- High number of affected employees = 86.8% x 109,362 = 94,926

Low Estimate Calculations:

- Low increase in active transportation (# of people) = 33% x (7.6% x 33,902) = 850 people
- Low percent increase = (850 / 8312) x 100 = **10.2%**
- Low city-wide active commute mode share = 7.6% x 110.2% = **7.93%**

High Estimate Calculations:

- High increase in active transportation (# of people) = 33% x (7.6% x 94,926) = 2380 people
- High percent increase = (2380 / 8312) x 100 = **28.6%**
- High city-wide active commute mode share = 7.6% x 128.6% = **9.26%**

TABLE 2 EFFECTIVENESS OF PARKING CASH-OUT ORDINANCE

	Low Estimate (%Increase)	Low Mode Share change	High Estimate (%Increase)	High Mode Share Change	Time Frame Estimate
Parking Cash-Out	10.2%	+0.33 % points (7.93% share)	28.6%	+1.66 % points (9.26% share)	0-5 years

APPENDIX C – COST CALCULATIONS

ALTERNATIVE 1

As part of the Bike Master Plan, the consultants that developed the report estimated the cost for each section of bike lane. The total for the low estimate of 25 miles is **$2,665,865.79,** and the total for the high estimate is **$3,762,605.95** (Bike Master Plan, 2014).

The city of Minneapolis (2011), estimates that their annual maintenance cost is roughly $4373 per mile, while the City of San Gabriel (2014), estimates a per-mile cost of $5448. Using an average of the two with the low and high bike lane estimates yields a total maintenance cost range of $122,762 to $417,392. This equates to a cost of **$1,227,620** to **$4,173,920** over 10 years.

For sidewalk infrastructure, the estimated cost per mile installed is $295,762 (BikeWalkNY, 2014). Multiplying this by the low and high estimates for new sidewalk mileage yields a total range of **$3,599,423** to **$7,198,847.**

BIKE INFRASTRUCTURE

Total installation costs = **$2,445,059** to **$3,450,959**

Maintenance costs:

- Cost per mile = $4371 (City of Minneapolis)
- Cost per mile = $5448 (City of San Gabriel)
    - Average = $4910
- Annual cost Low = $4910 x 25 (miles) = $122762
- Annual cost High = $4910 x 86 (miles) = $417392
- Total 10-year cost Low = $122762 x 10 = **$1,227,620**
- Total 10-year cost High = $417392 x 10 = **$4,173,920**

PEDESTRIAN INFRASTRUCTURE

- Sidewalk cost per mile (2020 $'s) = $295,762
- Total low cost = $295,762 x 12.17 (miles) = **$3,599,423**
- Total high cost = $295,762 x 24.34 (miles) = **$7,198,847**

Total Cost Over 10 Years

Total cost = **$7,272,102** to **$14,823,726**

ALTERNATIVE 2

The Pew Charitable Trusts (2010) Health Impact Project, which both carries out and maintains information on HIAs conducted around the country, estimates that the cost of conducting an HIA is between **$12,000 and $240,000**. Some of the variables that determine cost include,

- Whether the analysis is done in-house or contracted with a consultant
- Whether the analysis is a rapid or comprehensive HIA,
- The complexity of the subject matter being analyzed

ALTERNATIVE 3

For a similar, updated transportation benefits program, the Washington DC government estimated that the cost of development and implementation over five years would be **$523,000** (Government of DC, 2020).

ALTERNATIVE 4 – IN-LIEU PARKING

The cost of this program is estimated to be between **$50,000 and $90,000.** To design and implement this alternative, the city will likely higher consultants to determine the areas that should be impacted and the relative fee structure. After a review of numerous In-lieu fee programs summarized by Sustainable Development Code (2020), all reviewed cities utilized consultant services to design the program. The above estimates are based on consultant fees for a similar study (City of Santa Monica, 2010).

ALTERNATIVE 5 – 20-MINUTE NEIGHBORHOOD

This alternative assumes that one person could conduct a 20-minute neighborhood analysis and master plan materials in 40 to 80 hours of work. The following calculates the cost of creating these materials using mean wage for urban planners from the Bureau of Labor Statistics.

BLS Mean Wage = $36.65
Total Cost 40 hours = $1,466
Total Cost 80 hours = $2,932

APPENDIX D – HEALTH IMPACT ASSESSMENT PROCESS

The Pew Charitable Trusts, Health Impact Project maintains information for professionals about conducting HIA's. The suggest that HIAs involve six steps (presented below). Engagement with the communities and individuals that may be affected, policymakers, and other stakeholders occurs throughout the steps.

Step 1: Screening. The HIA team and stakeholders determine whether an HIA is needed, can be accomplished in a timely manner, and would add value to the decision-making process.

Step 2: Scoping. The HIA team and stakeholders identify the potential health effects that will be considered and develop a plan for completing the assessment, including specifying their respective roles and responsibilities.

Step 3: Assessment. The HIA team evaluates the proposed project, program, policy, or plan and identifies its most likely health effects using a range of data sources, analytic methods, and stakeholder input to answer the research questions developed during scoping.

Step 4: Recommendations. The team and stakeholders develop practical solutions that can be implemented within the political, economic, or technical limitations of the project or policy to minimize identified health risks and to maximize potential health benefits.

Step 5: Reporting. The team disseminates information including the HIA's purpose, process, findings, and recommendations to a wide range of stakeholders.

Step 6: Monitoring and evaluation. The team and stakeholders evaluate the HIA according to accepted standards of practice. They also propose a plan for monitoring and measuring the HIA's impact on decision-making and the effects of the implemented decision on health.

APPENDIX E – RECOMMENDATION CONSIDERATIONS

ALTERNATIVE 2

Priority: Align Transportation Decision Making with Health-Related Indicators

If the city currently wants to prioritize aligning transportation decision-making with health outcomes, it should implement Alternative 2. The city is currently moving forward with a number of plans, infrastructure improvements, and policy changes that could impact the health of residents well into the future. A health impact assessment provides an unutilized way to evaluate how these efforts align with health outcomes and other social determinants of health. Through this process, the city may find that effects from ongoing projects are disproportionately distributed and look to adjust or amend them to enhance health equity. The insights gained through this process would be extremely pertinent in particular to the ongoing bike and pedestrian infrastructure improvements and the city's Master Plan Update.

ALTERNATIVE 3

Priority: Shift Transportation Mode Choices as Quickly as Possible

Alternative 3 is the only option that seeks to shift transportation behavior in the near term. If near term shifts are a priority, the city should start with a pilot cash-out program that is evaluated every few years for effectiveness. As presented in a brief evaluation, the expected impact of this program is that 10-29% of workers in Richmond will shift from driving to active commuting. However, this is a crude estimate with the potential for significant variation. Even so, the cost of this option is low relative to the estimated impact, and therefore offers a short-term, cost-effective intervention to increase active transportation usage.

ALTERNATIVE 4 & 5

Priority 3: Alter the Built Environment Over Time to Systematically Shift Transportation Mode Choice

Both alternatives 4 (In-lieu parking fee) and 5 (20-Minute Neighborhood) result in changes to the built environment over time. However, alternative 5 presents a more comprehensive approach and utilizes the time-sensitive nature of the Master Planning process to setup zoning and land-use changes into the future. For this reason, Alternative 5 is the preferred long-term option. The in-lieu parking fee program could be implemented by the city at any point in the future, while significant visionary changes that provide a legal basis for future zoning changes are most effective when implemented in a Master Plan. Because the city of Richmond is currently going through a complete Master Plan update, it is imperative that this sort of language and analysis is implemented to set up future changes. Implementing this vision now presents the city with an opportunity to achieve active transportation rates on par with the US' best cities for biking and walking.