Quantifying Accessibility and Equity in Washington, D.C.’s Bicycle Facilities

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ABSTRACT

Robust bicycle infrastructure not only improves the safety of cyclists, but also improves the mobility of the populace and improves their access to urban amenities. With a small land area, numerous shared bicycle services, and mild topography, Washington, D.C. should be simple to traverse by bicycle. Unfortunately, the bicycle facilities of Washington, D.C. are inequitably concentrated in the central business district, and poor and non-white populations have reduced access to the bicycle facilities network. Through complete analysis and evaluation of Washington, D.C.’s bicycle infrastructure using GIS mapping, the deficiencies of Washington, D.C.’s current network are laid bare. As is, Washington, D.C.’s bicycle infrastructure fails to fill the most important role of bicycle infrastructure in a multimodal transportation system: failing to connect riders to needed destinations and links to high capacity transit. By understanding the deficiencies of the current systems and potential solutions, Washington, D.C. can become a world leader in bicycle infrastructure while better integrating all residents into a complete multimodal transportation network.

KEYWORDS
Bicycle Infrastructure, Transportation Equity, Equitable Access, Sustainability, Urban Design, Washington DC

RESEARCH QUESTIONS

1. What is the current state of bicycle infrastructure in Washington, D.C. with regards to sufficient coverage, connectivity, accessibility, and equity?

2. How does Washington, D.C.’s bicycle infrastructure compare to other major metropolitan areas either in the United States or internationally?

3. Can Washington D.C.’s bicycle infrastructure be improved to better increase mobility, access to needed destinations, and access to high capacity transit, especially for underserved communities?
TABLE OF CONTENTS

Abstract, Keywords and Research Questions ................................................................. 1
Table of Contents ................................................................................................................ 2
List of Figures ....................................................................................................................... 3
Introduction .......................................................................................................................... 4
Literature Review ............................................................................................................... 7
Research Methodology ...................................................................................................... 15
Part 3: Highlighting Land Use and Accessibility on M Street NE ............................... 72
Conclusion ......................................................................................................................... 74
Bibliography ..................................................................................................................... 75
LIST OF MAPS

Map 1: Bicycle Lanes in Washington, D.C. ................................................................. 20
Map 2: Grocery Stores in Washington, D.C. ................................................................. 23
Map 3: 100-yard Grocery Store Buffer in Washington, D.C. ........................................ 24
Map 4: Grocery Stores within 100-yards of a Bike Lane in Washington, D.C. ............... 25
Map 5: Metro Station Entrances within 20-Yards of a Bike Lane ................................ 26
Map 6: Bank Locations in Washington, D.C. ............................................................... 28
Map 7: Bank Locations in Washington, D.C. (Ward 2 Detail) ....................................... 28
Map 8: Banks within 100-yards of a Bike Lane in Washington, D.C. ......................... 29
Map 9: Banks within 100-yards of a Bike Lane in Washington, D.C. (Ward 2 Detail) ..... 30
Map 11: Density Distribution of Bike Lanes in Washington, D.C. ................................. 32
Map 13: Mean Center and 1 Standard Deviation Distribution of Bicycle Lanes ............ 34
Map 14: Mean Center and 1 Std. Dev. Distribution of Bike Accessible Grocery Stores ... 34
Map 15: Mean Center and 1 Std. Dev. Distribution of Bike Accessible Banks ............. 35
Map 16: Mean Center and 1 Std. Dev. Distribution of Bike Accessible Metro Entrances ... 35
Map 17: Mean Center and One Std. Dev. Distribution of Relative Population Density ... 36
Map 18: Washington D.C. Wards by White Population ............................................. 38
Map 19: Washington, D.C. Wards by Black Population ........................................... 39
Map 20: Census Tracts by Median Income in Washington, D.C. .................................. 40
Map 21: Median Household Income: White Households in Washington, D.C. ............... 41
Map 22: Median Household Income: Black Households in Washington, D.C. ............... 41
Map 23: Mean Center and One Std. Dev. Distribution of White Population ................. 43
Map 24: Mean Center and One Std. Dev. Distribution of Black Population .................. 43
Map 25: Mean Center and One Std Dev. Distribution of White Population, against Mean Center and One Std. Dev. Distribution of Bikeable Amenities in Washington, D.C. ................................................................. 44
Map 26: Mean Center and One Std. Dev. Distribution of Black Population, against Mean Center and One Std Dev. Distribution of Bikeable Amenities in Washington, D.C. ......................................................................................... 45
Map 27: Bicycle Lanes by "Tier" in Washington, D.C. ................................................... 50
Map 28: Location of amenities in Washington, D.C. ..................................................... 51
Map 29: Mean Center and 1 std. dev. Distribution of Amenities .................................. 52
Map 30: Half-mile Buffer of Bicycle Lanes in Washington, D.C. ................................. 56
Map 31: Proposed Bicycle Facilities in 2005 Master Plan ........................................... 57
Map 32: Calgary, Alberta Bicycle Facilities Map ......................................................... 64
Map 33: Bicycle Superhighways in Copenhagen ......................................................... 67
Map 34: Proposed Projects in Seattle Master Plan ....................................................... 68
Map 35: Bicycle Infrastructure in Amsterdam ............................................................ 69
Map 36: The Only Tier 1 Bicycle Lane in Washington, D.C. That Does Not Cross a Ward Boundary ................................................................. 72
**Introduction**

In many ways, Washington, D.C. is quite bike friendly. Between its small geographic size, relatively mild topography, profusion of shared bicycle services, slow surface traffic, and a willing populace, Washington, D.C. could be a simple city to traverse by bicycle. Between the many national park spaces, the numerous bicycle trails, and even off-road mountain biking opportunities, Washington, D.C. also provides numerous recreational biking options. On the other hand, Washington’s bicycle infrastructure—like many cities—is in need of significant revision and additions. Significant portions of the city lack bike lanes or cycle paths. Worse, in areas with bike lanes, the lanes are often fragmented, narrow, and uninviting for use. As an awarded national leader in sustainability and green development, Washington, D.C. is ripe for in-depth analysis of its bicycle infrastructure and targeted improvements to help reduce congestion and greenhouse gas emissions, and encourage increased use of bicycles for day-to-day transportation.

To accurately make targeted recommendations for capital investment in Washington’s bicycle infrastructure, the bicycle facilities of Washington, D.C. are documented and analyzed in this study. For the purposes of this report, both ArcGIS and in-person documentation were used to compile a complete understanding of the extent of Washington’s bicycle infrastructure. Thereafter, video equipment was used to compile extensive documentation of the state of Washington’s bike lanes and bike routes. This documentation process allows GIS analysis to be cross-referenced against existing maps of bicycle facilities. The documentation process was invaluable for identifying and correcting gaps or errors in bicycle facility maps maintained by the city’s GIS database.
Currently, the vast majority of Washington’s bicycle infrastructure consists of non-grade separated, painted bike lanes. These lanes are primarily placed between lanes of travel and parked cars, placing cyclists close to passing motor vehicles, and also exposing them to the hazards of being “doored” (when a parked car opens a door in front of a cyclist, causing a dangerous collision), right-crossed (when a car turns through the bike lane without checking for cyclists), and dangers from double parked cars and delivery vehicles. In addition, there are numerous areas where bicycle lanes disappear from streets or change positions in confusing ways. These issues create a significant barrier to entry for new cyclists and also create serious problems for cyclists hoping to connect to needed destinations using bicycle facilities only, and reduces the utility of bicycle lanes that do exist but may not connect to necessary destinations.

Upon completion of cataloguing Washington’s bicycle infrastructure, extensive GIS analysis is used to examine the facilities for equity, accessibility, and connectivity. Using this GIS analysis and reviews of relevant planning documents, Washington can be effectively compared to world leaders in bicycle infrastructure connectivity and equity. Many global cities incorporate bicycles more fully into their urban landscape than Washington, D.C., or have planning approaches that more fully contemplate the ability of bicycle to connect people to needed destinations in an equitable way. In looking at global best practices in combination with a critical review of Washington’s infrastructure for accessibility and equity, targeted recommendations can be developed that will enable informed investment and maximize equity and access across demographics.

To date, despite extensive efforts to build out a more complete, connected bicycle facility network, Washington, D.C. has not built a bicycle infrastructure network that increases mobility and access for citizens in the city. The approach the city has taken has emphasized development
of bicycle infrastructure that serves the central business district, fundamentally discriminating against poor and primarily African American communities that could benefit from more options for mobility and access. A bicycle facility network that focuses on mobility within the central business district is inherently discriminatory and does not meaningfully advance the stated bicycle planning objectives of Washington, D.C. Building a more equitable, accessible bicycle facilities network that serves all of Washington, D.C. would enable the city to achieve the equity goals of the new comprehensive plan, while also embracing the benefits of the secondary effects increased bicycle usage among the populace, including better health outcomes, better economic outcomes, lower emissions, and less congestion.
Literature Review

For the purposes of this study, past analyses of connectivity, usage, and equity—both in Washington, D.C. and other cities—are relevant for identifying potential gaps in research. Washington, D.C. itself has been the focus of a study on the impact of bicycle ridership on congestion.¹ Capitol Bikeshare, Washington, D.C.’s first bikeshare program, began operation in September 2010,² and has remained in steady operation since then. Hamilton and Wachman considered to what extent Capitol Bikeshare helped reduce congestion in Washington, D.C. after its rollout and found a 4% reduction in congestion in areas where a bikeshare station was present³ and higher reductions in higher congestion areas.⁴ That reduction in congestion, using the model designed by Hamilton and Wachman, resulted in estimated private benefits of $24-million and public benefits of $850,000 due to less time spent in traffic.⁵ Similarly, they found total cost reduction for commuters of $182-million.⁶ Moreover, this monetized benefit was found to be larger than that associated with transit.⁷ In addition to the economic benefit, Hamilton and Wachman’s study shows a basic but important concept that was a minor focus of the research: people in Washington, D.C. were willing to quickly adopt usage of Capital Bikeshare as a part of their day-to-day lives and commutes.⁸ Hamilton and Wachman did not consider from what mode bikeshare users switched, and the possibility remains that bikeshare users were previously primarily users of public transit. Thus, some questions remain: to what extent do bikeshare users

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² Ibid. at 73
³ Ibid. at 90
⁴ Ibid.
⁵ Ibid. at 73
⁶ Ibid. at 90
⁷ Ibid.
⁸ Ibid. at 74
use bikeshare to link to other modes of transit? To what extent are bikeshare users even able to link to with other modes of transit via currently built bicycle infrastructure?

In addition to the work done by Hamilton and Wachman; Zahabi, Chang, Manuel-Miranda, and Patterson explored the link between neighborhood typologies, commuting by cycling, and greenhouse gas emissions. Importantly, Zahabi et al found a strong connection between increases and improvements to bicycle infrastructure and bicycle usage.9 Similarly, Zahabi et al found a direct link between increased bicycle ridership and reduced greenhouse gas emissions and automobile usage.10 However, Zahabi et al also found that bicycle usage was closely linked to neighborhood typology mattered for usage, but were not able to control for how cycling usage was impacted by access to other modes of transportation nor for self-selection in living near bicycle infrastructure.12 While the study was not designed to do so, it also identified the potential that attitudinal changes had an impact on cycling usage as well.13 Thus, Zahabi et al were able to show that while bicycle usage resulted in less usage of automobiles, and that proximity to infrastructure and neighborhood typology influenced usage if bicycle infrastructure, they were not able to link those results to transit connectivity or availability of other mode choices.

Like many cities, Washington, D.C. has strong geographic splits between wealthy and poor populations. Braun, Rodriguez, and Gordon-Larson looked at the extent to which poor

10 Ibid. at 95
11 Ibid. at 101
12 Ibid.
13 Ibid.
neighborhoods are linked to bicycle networks in 22 large United States’ cities.\textsuperscript{14} Washington, D.C. was included in the cities they studied.\textsuperscript{15} In the 22 cities, Braun et al. found that minority and low-income populations had disproportionately low access to bicycle infrastructure.\textsuperscript{16} Braun et al. attributed this to the demographic make-up of policy makers,\textsuperscript{17} existing cyclists,\textsuperscript{18} and the apportionment of social capital by residents of low-income and minority neighborhoods in advocating for neighborhood investment (i.e., low-income neighborhoods are more likely to take-up different causes instead of advocating for bicycle infrastructure).\textsuperscript{19} Taken in concert with other studies previously discussed, Braun et al.’s findings could suggest that any documented low usage of bicycle infrastructure in low-income and minority communities could be primarily linked to lack of investment, as opposed to attitudinal choices.

In the United States, attitudes towards cycling may be impacted by the fact that biking and walking are disproportionately dangerous. The United States has a dearth of information about the safety of bicycle infrastructure.\textsuperscript{20} Research into bicycle safety in the United States has remains largely incomplete and lacking in rigor.\textsuperscript{21} A review of numerous studies in safety revealed that many studies had sample sizes that were too small to be conclusive, or methodologies that were insufficiently rigorous to return conclusive results.\textsuperscript{22} One major issues


\textsuperscript{15} Ibid. at 3

\textsuperscript{16} Ibid. at 7

\textsuperscript{17} Ibid at 2

\textsuperscript{18} Ibid.

\textsuperscript{19} Ibid.


\textsuperscript{21} Ibid at 106

\textsuperscript{22} Ibid at 113
is the serial underreporting of accident data.\textsuperscript{23} As a result, improvements that lead to changes in ridership can be misleading if there are more minor accidents reported.\textsuperscript{24} Effectively, safer bicycle facilities could, in some studies, look more unsafe, even if the severity of accidents is reduced. On the other hand, some of the more reliable studies have found a “safety in numbers’ effect.\textsuperscript{25} Essentially, the strongest indicator of safety in examined studies was increased ridership and visibility of cyclists.

Amsterdam and Copenhagen are excellent examples of cities that have made cycling a primary form of transportation, rather than a secondary form of transportation.\textsuperscript{26} Both of these cities show that there is a possible future where reliance on automobiles is greatly reduced, and there is already evidence that transportation planners overestimate care usage and the desire of people to drive.\textsuperscript{27} Copenhagen and Amsterdam were early to realize that the appeal of cycling isn’t the act of cycling itself, but rather the positive impacts that cycling has on cities and residents.\textsuperscript{28} Essentially, residents of cities are recalibrating their views of what city life should be like, with a focus on livability.\textsuperscript{29} Importantly, the choice to cycle is often most profoundly impacted by the bicycle infrastructure that people can use to make short and medium length trips.\textsuperscript{30} Studies have shown that 60\% of people are “interested but concerned” with regards to cycling due to a lack of available infrastructure.\textsuperscript{31} Thus, to increase bicycle ridership and realize the associated benefits to the city and populace, the focus for most cities should be on developing

\begin{itemize}
\item \textsuperscript{23} Ibid at 116
\item \textsuperscript{24} Ibid.
\item \textsuperscript{25} Ibid.
\item \textsuperscript{27} Ibid at 1
\item \textsuperscript{28} Ibid at 2
\item \textsuperscript{29} Ibid.
\item \textsuperscript{30} Ibid.
\item \textsuperscript{31} Ibid.
\end{itemize}
new bicycle facilities and capturing the “interested but concerned” segment.\textsuperscript{32} Without dedicated. Physically separated bicycle facilities, cycling loses efficiency as cyclists choose to divert from direct routes because of safety concerns.\textsuperscript{33} Some issues that stand in the way of bicycle facility and network research is a dearth of research on mature systems like Copenhagen and Amsterdam, as well as a lack of longitudinal research into the impact of different bicycle facilities on ridership.\textsuperscript{34} In places with incomplete bicycle facility networks, there is a notable gender gap between male and female ridership, indicating that there is a higher safety threshold to attract females riders.\textsuperscript{35} However, once that threshold is achieved, there is evidence that women will be more eager to ride than men.\textsuperscript{36} As ridership increases, there is also evidence that, on a collective level, the health benefits associated with cycling and increased physical activity outstrip the impact of increased accidents or crashes.\textsuperscript{37} While research on the bicycle facilities of Amsterdam has been surprisingly sparse,\textsuperscript{38} the research that has been done has found that the answer to building more robust bicycle facilities and increasing ridership may be simpler than they appear: adopting experimental measures, using innovative bicycle infrastructure, and reducing the attractiveness of car travel in urban space.\textsuperscript{39} In simple terms, taking road space away from cars and giving it bicycles has the effect of encouraging people to cycle and bringing the associated social benefits along with increased ridership.\textsuperscript{40}

\textsuperscript{32} Ibid.
\textsuperscript{33} Ibid at 3
\textsuperscript{34} Ibid.
\textsuperscript{35} Ibid.
\textsuperscript{36} Ibid.
\textsuperscript{37} Ibid.
\textsuperscript{38} Ibid.
\textsuperscript{39} Ibid at 6
\textsuperscript{40} Ibid.
In analyzing bicycle ridership and the associated societal benefits in the United States, equity is often unfortunately overlooked.\textsuperscript{41} This has held true even as interest in, and funding for, bicycle facilities has increased.\textsuperscript{42} In the United States, the populations that have been the most marginalized are poor minority groups;\textsuperscript{43} similarly, these are the groups that would most benefit from the health benefits of active transportation options.\textsuperscript{44} Moreover, these populations are often among those with the lowest access to cars and are more reliant on other transportation options.\textsuperscript{45} Minority populations are also more likely to suffer from accidents as a result of deficient infrastructure.\textsuperscript{46} One of the major issues holding back research advances in active transportation equity is lack of information about available facilities,\textsuperscript{47} understanding of bicycle facilities and equitable access is particularly lacking in transportation equity research.\textsuperscript{48} This lack of focus on equity is reflected in bicycle facility planning, as cities in the United States frequently do not consider equity in their bicycle master plans.\textsuperscript{49} Unfortunately, some cities that claim to incorporate equity as a planning objective frequently fail to actually implement equitable projects, and focus instead on cost-benefit analyses that favor projects without equity considerations.\textsuperscript{50} Seattle has emerged as a leader in equity in active transportation planning, focusing on spatial equity as well as social equity in the deployment of new projects.\textsuperscript{51} In sum, understanding of spatial equity remains lacking in the United States, and a better understanding

\textsuperscript{42} Ibid at 212
\textsuperscript{43} Ibid.
\textsuperscript{44} Ibid.
\textsuperscript{45} Ibid.
\textsuperscript{46} Ibid at 213
\textsuperscript{47} Ibid at 216
\textsuperscript{48} Ibid at 217
\textsuperscript{49} Ibid.
\textsuperscript{50} Ibid at 218
\textsuperscript{51} Ibid.
of the geographic distribution of bicycle facilities is needed. Ultimately, while the limited existing research shows that bicycle facilities can help bridge the gap of transportation inequality, in practice, the consideration of equity in research and planning of bicycle facilities remains lacking.

Outside the United States, there has been research in Sao Paulo, Brazil about the ability of bicycle facilities to provide links to needed destinations for jobs and high capacity transit. While bicycle facility improvements alone were not enough to level the ability to access jobs, bicycles were able to play an important role in providing access to high capacity transit and enabling more of the populous to have increased mobility and accessibility. While bicycles were not the complete answer in Sao Paulo, they could be an important part of the picture, even though Sao Paulo, unlike some places that have high levels of bicycle ridership and connectivity, has extremely hilly topography, potentially limiting the ability of people to ride bicycles efficiently.

Ultimately, there is a need for more research into the equity of bicycle facilities in urban spaces, and a better understanding of how that equity can be measured and corrected. Washington, D.C. is ripe for examination and could potentially benefit from an equity, accessibility, and connectivity focused analysis of its existing bicycle facilities. Moreover, an analysis of this type could open the door for further research into how equity in bicycle facility planning can be addressed and implemented. The research questions as related to Washington, D.C. are thus apparent: what is the current state of bicycle infrastructure in Washington, D.C.

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52 Ibid at 220
53 Ibid at 222
55 Ibid at 386
56 Ibid.
57 Ibid at 390
with regards to sufficient coverage, accessibility, and equity? How does Washington, D.C.’s bicycle infrastructure compare to other major metropolitan areas in the United States and with international leaders? And how can Washington D.C.’s bicycle infrastructure be improved to better increase mobility and access to needed destinations and high capacity transit for underserved communities?

Since the 2005 Bicycle Master Plan, complete analysis of Washington’s bicycle infrastructure has been limited, focusing on select corridors. A holistic, city wide view of the current accessibility and equity of Washington, D.C.’s bicycle facilities has, until now, not been completed. After extensive in-person observation of Washington, D.C.’s existing bicycle facilities are used to rectify inaccuracies in the existing, city-maintained maps of bicycle lanes and tracks, GIS analysis can be more accurately used to evaluate the connectivity provided by existing bicycle facilities, as well as the equity of their distribution. The way bicycle infrastructure interacts with high capacity transit options and connects to needed amenities impacts the value of bicycle infrastructure based on the mobility and access that bicycle infrastructure actually provides. Such linkages to high capacity transit are one of the key components of the Metropolitan Washington Council of Governments’ “Visualize 2045” plan. To enable bicycles to be used safely as a form of transportation for the majority of the populace, bicycle infrastructure needs to actually connect to destinations that people would need to access, another goal of COG’s Visualize 2045 plan.

58 District Department of Transportation. “NoMa / Mount Vernon Triangle Bicycle Network Study.” Planning document, Washington, D.C., April 2018
60 Ibid.
**Research Methodology**

By evaluating the equity of access to the bicycle facilities of Washington, D.C., and scoring them for connectivity, comparisons of Washington, D.C.’s bicycle facilities can be made against national and global leaders in bicycle infrastructure. For this study, four such cities were chosen and highlighted for unique and exceptional characteristics: Calgary, Seattle, Copenhagen, and Amsterdam. In addition to comparisons of built infrastructure, comparisons of legal policies and planning policies can be used to target recommendations for Washington, D.C.

Bicycle infrastructure needs to be accessible for people throughout the city, and allow people coming from different areas to complete trips via bicycle, either by reaching needed destinations or linking with high capacity transit that will then allow them to complete a trip in a different portion of the city. If a bicycle facility network is incapable of providing a reasonable level of mobility and access to the populace, its value as a mode of transport is, obviously, reduced. To make “accessibility” an actionable item, rather than a mere concept, it needs to be quantified. Other systems have attempted to do so in various ways, such as using parcel level data to generate point of origins and simulating trips to identified destinations.61 Michael Lowry and Tracy Hadden Loh developed a connectivity assessment tool for the Rails to Trails conservancy that rates possible routes from origin points to destinations within a certain radius based on the stress level a cyclist may be under based on whether the hypothetical cyclist is able to ride on cycle tracks, in painted bicycle lanes, or in open traffic without bicycle lanes.62 Thus, the connectivity rating developed by Lowry and Loh does not rate the connectivity of bicycle

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62 Ibid.
facilities, but rather the ability of the populace to get to needed destinations based on their average confidence level riding under different circumstances.63

For the purposes of this study, the approach to quantifying accessibility and connectivity is based around rating the ability of existing bicycle facilities to provide access to needed destinations using only bicycle facilities. This rating system developed for this study seeks to answer the question “where can you go without having to leave a bicycle lane in Washington, D.C.?” This system does not, like the system developed by Loh and Lowry, use parcel level data to predict origins, nor does it account for the ability to access destinations by bicycle if the hypothetical rider uses non-bicycle facilities for any portion of their trip. Thus, the rating system developed for this study is not a measure of a various types of hypothetical rider’s ability to access different areas based on their comfort level of riding a bicycle in various conditions.

Quantifying accessibility as a function of different riders’ comfort levels does not paint a complete picture of what is accessible by bicycle facility only, nor does it effectively rate the accessibility or connectivity provided by those facilities. Quantifying accessibility the way Lowry and Loh have done is not a rating of bicycle facilities at all, but rather a rating of the degree to which different people can access destinations by bicycle under variable conditions. The system created to rate accessibility and connectivity in this study uses similar facilities as Loh and Lowry,64 banks and grocery stores, as proxies for commercial and residential areas, respectively, and adds metro station entrances as a way to quantify the ability to use bicycle facilities to link to high capacity transit. Thus, without having to consider where a trip originates, bicycle facilities can be scored based on their ability to link to commercial areas, residential areas, high capacity transit, or other bicycle facilities that link to those destinations.

63 Ibid.
64 Ibid at S135
Bicycle facilities were scored on a 4.0 scale, rounded to the nearest hundredth, with 4.0 being the best, and 0.0 being the worst. “Tier 1 Bicycle Lanes” are bicycle lanes that connect to all three identified amenities (banks, grocery stores, and metro entrances) or connect to two types of amenity and also cross a ward boundary. Tier 1 Bicycle Lanes are scored 4.0. “Tier 2 Bicycle Lanes” are bicycle lanes that connect to a Tier 1 bicycle lane; cross a ward boundary and connect to one amenity; connect to a bicycle lane that crosses a ward boundary and one amenity; or connect to two amenities without crossing a ward boundary or ward connecting bicycle lane. Tier 2 Bicycle lanes are scored 3.0. “Tier 3 Bicycle Lanes” are bicycle lanes that only connect to a Tier 2 bicycle lane; only cross a ward boundary; only connect to a bicycle lane that crosses a ward boundary; or only connect to one of the three identified amenities. Tier 3 Bicycle Lanes are scored 2.0. “Tier 4 Bicycle Lanes” are bicycle lanes that do not connect to ward connectors; do not cross a ward boundary themselves; and do not connect to any identified amenities, but that may connect to Tier 3 bicycle lanes. Tier 4 Bicycle Lanes are scored 1.0. “Tier 5 Bicycle Lanes” are bicycle lanes that do not connect to anything other than Tier 4 Bicycle Lanes. Tier 5 Bicycle Lanes are scored 0.0.

The rating system developed for this study was designed exclusively to rate the accessibility and connectivity of bicycle lanes, and not their physical form, or design. While additional research on the physical structure of Washington’s bicycle facilities would be important to overhauling Washington’s bicycle facility network, connectivity and accessibility scoring will highlight target areas for immediate improvement. Additionally, direct policy recommendations can be made using applied scores, and comparisons can be made to identified global and national leaders in bicycle network connectivity. The mobility provided by bicycle lanes is valuable, but without meaningful access to other urban amenities, that mobility can mean
very little. Thus, evaluating accessibility and connectivity was prioritized in evaluating Washington, D.C.’s bicycle facilities and when making policy recommendations.

In addition to scoring the accessibility and mobility provided by bicycle lanes, bicycle lanes were also mapped against financial and racial demographics to evaluate the level of equitable access provided by Washington, D.C.’s bicycle facilities. Unlike the scoring system that describes accessibility by tiering bicycle lanes, bicycle lanes were not given an equity rating. Instead, the city was examined at a high level, with the physical location of various demographics compared against the location of available bicycle facilities, and specifically bicycle facilities that provide direct access to the same amenities identified in the accessibility scoring metric. After mapping the relevant demographic factors in Washington, D.C.—i.e. race and median income—Arc GIS is used to find the mean center of the white population of Washington, D.C. and the mean center of the black population in Washington, D.C. That is, GIS was used to map the distribution of ethnic and socioeconomic groups in Washington, D.C., and the center of that distribution identified.

Washington, D.C. has a strong demographic split wherein there is a strong correlation between wealth and race, and the white and black populations were used for the purposes of evaluating equitable access both for economic and racial demographics. Finding the mean center allows us to build a one standard deviation distribution of the location of those same data points—in this case the location of households that match the specified demographics—which shows the directional tendency of the spatial distribution and contains approximately 68% of all data points in a set. Thus, the mean center and one standard deviation distribution for each demographic; for each physical bicycle facility feature; and for each identified amenity, shows us the geographic center of those identified datapoints and the distribution within which the
majority of those data points fall. Effectively, the mean center and one standard deviation distribution let us make fair, calculated conclusions about the spatial relationships between different features on a map, and the ability of the identified populations to access the bicycle facilities and bicycle accessible amenities in Washington, D.C. This approach takes information and creates a visual representation that is easy to understand and can be displayed simultaneously with other visualizations to examine spatial relationships.
Part 1: Geospatial Analysis of Bicycle Facilities in Washington, D.C.


In addition to information gathered through direct observation and field research, Washington, D.C. maintains an extensive array of GIS data available for public use. While the data sets can be large and difficult to manipulate, they provide invaluable insight into how the city’s existing bicycle infrastructure serves the populace.

To begin, a basemap with Washington, D.C. Ward boundaries and existing bike lane locations was created

Map 1: Bicycle Lanes in Washington, D.C. Map developed by Thomas G. Renkes, Data provided by DCGISopendata

As can be seen in Map 1, Washington, D.C. has an existing system of bicycle lanes and cycle tracks that is primarily concentrated in wards 1, 2, and 6. Overall, Washington, D.C. has a total
of about 90 miles of bicycle lanes\textsuperscript{65} against roughly 1500 miles of surface roads. While the proportion of bicycle lane mileage to surface road mileage is extremely small, that ratio does not, on its own, mean that the bicycle lanes in Washington, D.C. are presenting poor service as a transportation network in the city. For example, if bike lanes and cycle tracks effectively connect residential areas to commercial zones, transit stops (in this case Metro), and needed amenities, then the effectiveness of bicycles as a transportation option will be significantly greater than the raw ratio of bike lanes to surface streets.

In the context of this study, the ability of bike lanes to connect residents to their destinations is considered to be of the utmost importance. For bicycles to be an effective form of transportation they must meet the same standards that other modes of transportation are capable of meeting. Bicycles need to be able to \textit{safely} provide accessibility and mobility to people using them to commute or otherwise travel in Washington, D.C. To evaluate the extent to which bicycles are able to provide sufficient mobility and accessibility (including to other transportation networks), a system of evaluating the connectedness of the bicycle network was essential. Because individual surveys were not a part of this study, GIS was used to examine the spatial relationship between bike lanes and various proxies that were selected to represent the kinds of amenities people would want to access and that are generally in different locations across the city of Washington, D.C. Past studies have used such proxies to evaluate bicycling connectivity in the context of stress in urban areas.\textsuperscript{66} Lowry and Loh developed a proprietary GIS tool that, using a series of inputs, allowed different bicycle routes to be given a connectivity score. As identified by the developers of the tool, there is potential for even places with extensive


\textsuperscript{66} Lowry and Loh
bicycle networks to have limited connectivity because the bike infrastructure creates “islands” that do not connect to one another. To understand Washington D.C.’s bicycle infrastructure, a similar analysis must be performed. Because the tool developed by Lowry and Loh is proprietary, and the Rails to Trails conservancy collaborates exclusively with state and local agencies in allowing access to the tool, a parallel rating system was developed using similar parameters to evaluate accessibility across Washington, D.C. without programmed concern for starting and ending points. Whereas the Rails to Trails tool uses parcel level information to analyze start points and end points, the scoring system developed for this study analyzes the system wide availability of destinations accessible by existing bike lanes or cycle tracks without leaving a bicycle facility.

Similar to the Rails to Trails tool, a number of proxies for important destinations were selected to represent various destinations. For the purposes of this study, the locations of banks, grocery stores, and Metro entrances were chosen to evaluate the ability of available bicycle infrastructure to connect people to residential locations (for which grocery stores served as a proxy), commercial centers (for which banks were a proxy), and the ability to connect to high-capacity transit (for which Metro entrances were a proxy). To begin building a scoring system, first the locations of grocery stores, banks, and metro entrances had to be mapped.

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67 Ibid at S134
68 Ibid.
Currently, there are 68 grocery stores in Washington, D.C. (excluding the 30 that are located in Prince George’s and Montgomery counties that are indicated in Map 2). It is important to note that the symbology of Map 2 is not to scale relative to the size of the grocery store or the size of its parcel relative to the street grid and bicycle lanes, though the actual location data used to generate the map is parcel level data. For the purposes of this study, that means that while some of these locations appear to intersect with bicycle lanes, that may not actually be true. Thus, to identify the grocery stores that have parcels accessible by bicycle, a buffer radius of 100-yards was chosen to account for sidewalks, parking lots, or other buffers between the grocery store entrance and any potential nearby bike lanes. To control for the relative quality and service level of grocery stores in this analysis, the dataset used includes only grocery stores defined as “large”
or “national” grocery stores that have been determined to be “Healthy Food Options” by the Washington, D.C. Office of Planning.69

Map 3: 100-yard Grocery Store Buffer in Washington, D.C. Map developed by Thomas G. Renkes, Data provided by WDCEP

After generating this buffer, an analysis was performed to identify locations where the grocery store buffer intersected with bicycle facilities in Washington, D.C.

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Map 4: Grocery Stores within 100-yards of a Bike Lane in Washington, D.C. Map developed by Thomas G. Renkes, Data provided by WDCEP

Map 4 indicates 30 grocery stores in Washington, D.C. are within 100-yards of bicycle lanes.

Because of the way the buffer was generated, these existing locations also indicate places where bicycle lanes may exist on adjacent streets within 100-yards, this was chosen as an acceptable distance over which a cyclist may walk from a parked bicycle to their destination. This is true, for example, of the Whole Foods Market located at 610 H Street NE and the Giant located at 300 H Street NE. H Street NE does not have bicycle lanes and, given the presence of light rail tracks and high speed, high density traffic, is particularly hostile to cyclists. However, I street NE and G street NE have contraflow bike lanes that are within the buffer distance of the Whole Foods Market.
After performing this analysis of the locations of grocery stores, an almost identical process was followed to produce similar location data for banks, and Metro entrances. The only difference being that that the buffer for metro entrances is reduced to 20-yards, to account for the lack of parking lots around Metro entrances within the Washington, D.C. city limits, and to highlight the benefit of being able to ride a bicycle directly to a Metro station and lock one’s bicycle at that station while using Metro, or taking one’s bicycle on Metro to be ridden to a different destination at the other end of the rail trip.

Map 5: Metro Station Entrances within 20-Yards of a Bike Lane. Map Developed by Thomas G. Renkes, Data Provided by DCGISopendata

Of the 113 Metro station entrances in Washington, D.C., there are only 16 station entrances within 20-yards of a bike lane, and those 16 entrances are spread amongst only 10 stations: Metro Center, Gallery Place/Chinatown, Archives/Navy Memorial/Penn Quarter, Farragut North,
Dupont Circle, Union Station, Waterfront, Stadium Armory, NOMA/Gallaudet University/New York Avenue, and Columbia Heights. 11 of the station entrances within 20-yards of a bicycle lane are located in Ward 2; three are in Ward 6; two lay on the border of Wards 6 and 7; and one is in Ward 1. Of the ten stations that have entrances within 20-yards of a bicycle lane, five are in Ward two, three are in Ward 6, one lays on the border of Wards 6 and 7, and one is in Ward 1. Overall, the ability to access Metro via bicycle without having to make use of pedestrian facilities (which is illegal in some parts of the city) or potentially dangerous motor vehicle facilities is scant.

Finally, using banks as a proxy for commercial areas, and a 100-yard buffer to account for parking a bicycle, parking lots, or other setbacks, the same analysis was performed as for Metro entrances and grocery stores. At greater scales, banks are clustered densely enough in Ward 2 as to make the map difficult to read, as can be seen in Map 6. A detail of bank locations in Ward 2 is provided in Map 7.
(Above) Map 6: Bank Locations in Washington, D.C. Map Developed by Thomas G. Renkes, Data Provided by WDCEP

Map 7: Bank Locations in Washington, D.C. (Ward 2 Detail), Map Developed by Thomas G. Renkes, Data Provided by WDCEP
After bank locations are mapped, and a 100-yard buffer generated, intersections of bike lanes and the buffer are generated to identify banks that were within 100-yards of a bike lane. Similar to the maps developed to identify locations of grocery stores plotted against bike lanes, the symbology of the map is not to scale regarding the parcel shapes and size, but the data provided is parcel level location data. Thus, while some bank icons may appear to overlap with bike lanes on the map, in actuality they may not.

Map 8: Banks within 100-yards of a Bike Lane in Washington, D.C. Map Developed by Thomas G. Renkes, Data Provided by WDCEP

As with Maps 6 and 7, there is a significant cluster of banks in Ward 2, home to Washington, D.C.’s central business district.
Of the 234 commercial banks in Washington, D.C., 111 of them lay within 100-yards of a bike lane. Those 111 banks are primarily concentrated in Ward 2, and the dense cluster of bike lanes therein. Compared to grocery stores and Metro entrances in Washington, D.C., banks are generally more accessible by bike lane, but 73 of them are located in Ward 2, meaning that while a significant proportion of Washington, D.C.’s commercial banks are accessible via bike, they may not service everyone in Washington, D.C. because of their seemingly clustered location.

After mapping the locations of bike lanes, and their proximity relative to grocery stores, Metro entrances, and banks, more analysis is necessary to evaluate the extent to which Washington, D.C.’s bicycle infrastructure provides mobility and accessibility to the populace. The raw proportion of grocery stores, Metro entrances, and banks is only 37%, and that access is
seemingly tightly consolidated in Ward 2 and the central business district therein. To examine the distribution of these amenities in Washington, D.C., a series of analyses were performed.

**Evaluating Location of Residents Relative to Amenities and Equity of Access**

First, a density map was created to examine the general location of bike lanes in Washington, D.C. as compared to the distribution of the population. A census block level raw population map was plotted. To match the symbology of a bicycle lane density map, these census block populations were converted into point data and then replotted as a relative population density map.

![Map 10: Raw Population Density in Washington, D.C., Map Developed by Thomas G. Renkes, Data Provided by American Community Survey](image_url)

Map 10 reflects raw population density; that is, the number of people per square mile in each census block.
Map 11 (Above): Density Distribution of Bike Lanes in Washington, D.C., Map Developed by Thomas G. Renkes

Maps 11 and 12 reflect gradient density, where areas of increased density are darker purple, and areas of lower density are lighter purple (or translucent). Facially, Maps 11 and 12 appear relatively similar, with the densest population and densest collection of bike lanes relatively near the central business district. The center of bicycle lane density is further south than the center of
population density. Additionally, bicycle lane density is relatively higher in Ward 6 than population density, indicating a higher number of bicycle lanes per person than in other areas, especially as compared to Ward 5, the highest population density area in Washington, D.C., but that has relatively lower bicycle lane density as compared to Wards 2 and 6, the apparent epicenters of bicycle facilities in Washington, D.C. While the relative density of bike lanes and population do track with one another, it is important not to draw an incorrect conclusion from these maps. These maps do no indicate that there is an appropriate level of service across the city just because the centers of relative density of bike lanes and population are in relatively similar positions. What the maps indicate is that bicycle facilities in Washington, D.C. are more focused on higher density areas; however, in a city wherein wards are divided to have roughly equal populations, a relative bike lane density map for a city with bicycle facilities spread out throughout the city would not have a strong, obvious center as indicated by Map 11. Maps 11 and 12, taken in concert, tend to indicate that people living outside Wards 2 and 6 have relatively lower access to bicycle lanes than people living in those wards. To further analyze the distribution of bicycle lanes in Washington, D.C., a series of analyses were completed to examine how the distribution of bicycle lanes and bike accessible amenities tracked with the distribution of the population across Washington, D.C.

For each feature examined—bicycle lanes and bike lane accessible grocery stores, Metro entrances, and banks—a distribution analysis was performed to locate the mean center of their distribution across the city, as well as the area within one standard deviation from the mean center of each distribution.
Map 13 (Above): Mean Center and 1 Standard Deviation Distribution of Bicycle Lanes in Washington, D.C. Map Developed by Thomas G. Renkes

Map 14: Mean Center and 1 Standard Deviation Distribution of Bike Accessible Grocery Stores in Washington, D.C. Map Developed by Thomas G. Renkes
Map 15 (Above): Mean Center and 1 Standard Deviation Distribution of Bike Accessible Banks in Washington, D.C. Map Developed by Thomas G. Renkes

Map 16: Mean Center and 1 Standard Deviation Distribution of Bike Accessible Metro Entrances in Washington, D.C. Map Developed by Thomas G. Renkes
As evidenced by Maps 12 through 15, Washington, D.C.’s bicycle infrastructure and bicycle accessible amenities is tightly focused in Wards, 2, 5, and 6. While the mean center of bicycle lanes is relatively near the center of Washington, D.C. itself, the one standard deviation distribution makes it clear that outside the dense clusters of bike lanes in Wards 2 and 6, there is little development of bicycle infrastructure across the rest of the city. Similarly, the distribution of bicycle accessible amenities is even more tightly focused, with the one standard deviation distribution of bicycle accessible grocery stores, metro entrances, and banks more tightly concentrated in or near the central business district than the bicycle lanes themselves. This distribution shows that the development of bicycle facilities—and thus the amount of bicycle accessible amenities—is heavily focused on the central business district, and the areas of highest population density, but not evenly distributed across relative density in Washington, D.C.

Map 17: Mean Center and One Standard Deviation Distribution of Relative Population Density in Washington, D.C. Map Developed by Thomas G. Renkes
As evidenced by Map 16, the mean center of relative population density is further to the southeast than the mean center of bicycle lanes, and the one standard deviation distribution is significantly larger, especially extending further into Ward 3, 4, 7, and 8 than the distribution of bicycle lanes, and much further than the distribution of bicycle accessible amenities. Essentially, the distribution of bicycle facilities and bicycle accessible amenities tracks closely with the center of density in Washington, D.C., and more specifically, closely with the location of the densest population in Washington, D.C. Facially, this makes sense, but upon further scrutiny it is clear that focusing bicycle facilities on the most densely populated areas does not advance the goals of accessibility and mobility throughout Washington, D.C. Because the Wards are approximately evenly populated, focusing bicycle infrastructure development on the most densely populated areas and the central business district significantly restricts access to bicycle facilities by people outside of those areas. If access to bicycle facilities was well distributed across the city, the one standard deviation bicycle distribution would track more closely with the one standard deviation distribution of relatively density. Ideally, the one standard deviation distribution of bicycle lanes would encompass the majority of the District of Columbia, indicating that people across the city have relatively similar access to bicycle facilities, if not bicycle accessible amenities.

The bicycle network that Washington, D.C. has built is not an infrastructure network that reaches the entire city. Washington, D.C. has made a clear decision—either in planning or implementation—to have a bicycle infrastructure network that fundamentally does not serve vast portions of the city. To be sure, everyone in Washington, D.C. has access to the bicycle infrastructure—if they can get to it. The questions then are: how would someone get to the bicycle network? Who has easier access to the bicycle network? Who is excluded? Bicycles can
be an important part of the urban transportation landscape if people have access to infrastructure that enables them to safely use their bicycles as transportation.

Washington, D.C. has a divided population, with significant divisions between where white and black residents live within the city.

As evidence by Maps 17 and 18, there is a stark difference between the demographics of northwest Washington, D.C. and northeast and southeast Washington, D.C. In addition to a significant racial divide, there is a wide gap in median income in different areas of Washington, D.C.
As evidenced by Map 19, the median income of different areas of Washington, D.C. track closely with the racial make-up of an area. Areas that are predominantly black are significantly poorer than areas that are predominantly white. Further sorting by race and median income together reveals that there are significant portions of Washington, D.C. in which there are either no black households or no white households, and that those areas are keeping in line with the divisions evidenced in Maps 17 through 19. The darkest green section of Wards 2 and 6 in Map 19 is the National Mall and the Capitol, neither of which have any residents, and thus record $0.00 income.

In addition to the vast economic disparity between black and white households evidenced by Maps 20 and 21, they also show that there are significant portions of Wards 2 and 3 without any black households, and significant portions of Wards 7 and 8 without any white households. These maps paint an important picture for planners in Washington, D.C.: there are vastly different groups living in different areas of the city, and plans and projects can very easily favor one group over another if they are not carefully implemented.

With a clearer picture of who lives where—and with what means—in Washington, D.C., the location of the city’s bicycle infrastructure can be mapped relative to demographic groups. As shown in Maps 17 through 21, there is a significant geographic split in where white residents and black residents live in Washington, D.C. A far greater proportion of white residents live in the northwestern quadrant—and the central business district—of Washington, D.C. than the eastern quadrants. On the other hand, a far greater proportion of black residents live in the eastern quadrants of the city. Corresponding with this split by race is a split by median income, with people earning higher incomes living in higher proportions in the western quadrants of the city, and people earning lower incomes living in the eastern part of the city. In sum, that means that Washington has a distinct demographic and geographic split between white and black residents: white residents are, generally, wealthier and live further west, and black residents are poorer and live further east. Given this demonstrated split, it is important to evaluate the location of Washington’s bicycle infrastructure and bicycle accessible amenities in comparison to the locations of the people that live in the city.
Map 23 (above): Mean Center and One Standard Deviation Distribution of White Population in Washington, D.C. Map Developed by Thomas G. Renkes

Map 24: Mean Center and One Standard Deviation Distribution of Black Population in Washington, D.C. Map Developed by Thomas G Renkes
Maps 22 and 23 help visualize the demographic and geographic split more clearly. The white population is more densely clustered in the northwest quadrant of the city, relatively near the central business district. The black population, on the other hand, is more spread out across the eastern half of the city, with the majority of the population actually living on the eastern side of the Anacostia river (as shown in Map 18). How then, are these different populations served by the bicycle accessible amenities within the city?

Map 25: Mean Center and One Standard Deviation Distribution of White Population, against Mean Center and One Standard Deviation Distribution of Bikeable Amenities in Washington, D.C. Map Developed by Thomas G. Renkes

As shown in Map 24, the distributions of all bike accessible amenities in Washington, D.C. are almost completely contained within the one standard deviation distribution of the white population in Washington, D.C. Moreover, a majority of the one standard deviation distribution
of the white population falls within an area that has bikeable access to amenities, and the mean center of the white population falls within the one standard distribution of two out of the three bikeable amenities.

Map 26: Mean Center and One Standard Deviation Distribution of Black Population, against Mean Center and One Standard Deviation Distribution of Bikeable Amenities in Washington, D.C. Map Developed by Thomas G. Renkes

As shown in Map 25, the black population of Washington, D.C. generally has less access to Washington’s bike accessible amenities due to more people living a greater distance away. Significant portions of the one standard deviations distribution of amenities fall outside of the one standard deviation distribution of the black population, and none of the distributions of amenities falls completely within the distribution of the black population. Moreover, the distance from the mean center of the black population is further away from every mean center for a bike
accessible amenity indicating a greater overall distance from those amenities than the white population endures.

A question these maps do not answer is why there are fewer bike accessible amenities closer to black populations in Washington, D.C. While these maps indicate a clear bias in favor of wealthier, whiter residents, the genesis of that phenomenon could be multifaceted. Further research can, and should be targeted towards this gap. It could be explained by any number of possible reasons, including but not limited to: imbalances in social capital; a lack of amenities in black neighborhoods generally; less desire for bicycle facilities in black neighborhoods; a lack of policy advocates on behalf of underserved neighborhoods; a lack of adequate outreach to underserved neighborhoods; or myriad other potential problems. Any of these possibilities (or a combination thereof) could be the answer. Ultimately, the simple fact is that relatively poorer populations and black populations are underserved by the bicycle infrastructure of Washington, D.C. and are granted less mobility and access via that infrastructure, and steps should be taken to ensure a more equitable ability to access Washington, D.C.’s bicycle facility network.

**Grading Washington, D.C.’s bicycle infrastructure for accessibility**

To better evaluate the bicycle infrastructure of Washington, D.C., and how it can be used to access identified amenities, a rating system was developed to examine the ability of residents to access different wards, different bike lanes, and different amenities by bike lane. This analysis was inspired by a proprietary tool developed by the Rails to Trails Conservancy.\(^70\) The Rails to Trails tool uses parcel level data and traffic data to determine the stress level of riders in reaching specified destinations and using that stress level to assign an accessibility score.\(^71\) The Rails to Trails tools developed identified that different types of riders are more or less willing to ride

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\(^70\) Lowry and Loh

\(^71\) Ibid.
based on the kinds of conditions they may come across. That is, some riders are comfortable riding in areas with no bicycle lanes and heavy traffic, while other riders may only want to ride in areas with protected bike lanes and sparse traffic. In contrast to the Rails to Trails rating tool, the rating system designed for this study does not consider the comfort level of the rider when addressing bicycle accessibility. For a sufficiently comfortable rider, any part of Washington, D.C. would be rated accessible so long as bicycles were not expressly banned on any portion of the route. Instead, the rating system herein looks at the ability of riders to connect to destinations using only bicycle facilities, and assigns each individual lane a score from 0.0-4.0 with 0.0 being the worst and 4.0 being the best. Scores are rounded to the nearest hundredth of a point.

To begin developing this rating system, adjustments had to be made to two important map layers: the ward boundaries of Washington, D.C. and the bicycle lanes of Washington, D.C. While both datasets are freely and publicly available through Washington, D.C.’s open GIS data source, they are constructed in such a way as to make certain types of analysis extremely difficult, if not impossible. The ward boundary layer maintained by the City of Washington is a polygon layer, meaning that analysis could not be performed to identify line layers (like bicycle lanes) that crossed ward boundaries. This is because the wards in the publicly available data source are stored as polygons, and any line layer that touches said polygon (including laying completely within the polygon) is considered to “intersect” with that polygon. Luckily, converting the mapped ward boundaries into line data is a simple process using ArcGIS Pro. Thereafter, however, additional work had to be done to adapt the bicycle lane information provided by Washington, D.C. into a usable form.

The City of Washington maps all of the bicycle facilities in the city in “segments.” Generally, these segments are approximately one city block long, though some are longer or
shorter depending on their location. The granularity of these divisions is such that thousands of bicycle lane segments exist for what amounts to approximately 90 miles of bicycle lanes. In addition to these divisions, Washington’s GIS database gives every bicycle lane segment a “Segment ID;” in total, there are 1,370 segment IDs. Each segment ID is a unique numerical identifier. Unfortunately, these segment IDs are non-consecutive, and have proprietary nomenclature. This means that two segments of the same bicycle lane can have IDs completely unrelated to one another. Because Washington, D.C. fractures the bicycle lane layer into segment IDs in this way, it prevents some forms of analysis from being performed, like finding bicycle lanes that intersect bicycle lanes that then connect to additional wards or amenities. Additionally, the bicycle lane maps provided by Washington’s open GIS data source are not constantly updated, and so some bicycle lanes that currently exist are not accounted for in the city’s layer. To alleviate these problems, a new bicycle lane data layer was created. In addition to redrawing every bicycle lane contained in the city’s data layer, additional bicycle lanes were added that were identified over the course of approximately 60-miles of bicycle lane examination conducted over a one-week period in February 2020. A major example of one such bicycle lane added to Washington’s city-maintained map was the new bicycle tracks on Florida Avenue Northeast. Every bicycle lane that was newly mapped or re-mapped was drawn as a standalone line within the same layer, allowing more complex analyses to be performed, including every intersection each bicycle lane had with identified amenities, other bicycle lanes, and ward boundary lines.

To grade accessibility, the same previously identified amenities were used: grocery stores, banks, and Metro station entrances. The ability to access these amenities by bicycle provides insight into the ability of a person on any bicycle lane in the city to access residential areas, business areas, and to link with high capacity transit. Additionally, to add a proxy measure
for mobility, the ability to cross ward boundaries or directly connect to bicycle lanes that cross ward boundaries was considered as part of the rating system. For the purposes of this analysis, a perfect bicycle lane would either cross a ward boundary itself and connect to all three identified amenity types, or connect to a bicycle lane that crosses a ward boundary and is itself able to connect to all three amenity types.

Using the ability of bicycle lanes to connect to amenities, other wards, and other bicycle lanes as the criteria, a scoring system was developed that can be applied on a lane-to-lane basis, a ward-wide basis, and a city-wide basis. “Tier 1 Bicycle Lanes” are bicycle lanes that connect to all three identified amenities (banks, grocery stores, and metro entrances) or connect to two types of amenity and also cross a ward boundary. Tier 1 Bicycle Lanes are scored 4.0. “Tier 2 Bicycle Lanes” are bicycle lanes that connect to a Tier 1 bicycle lane; cross a ward boundary and connect to one amenity; connect to a bicycle lane that crosses a ward boundary and one amenity; or connect to two amenities without crossing a ward boundary or ward connecting bicycle lane. Tier 2 Bicycle lanes are scored 3.0. “Tier 3 Bicycle Lanes” are bicycle lanes that only connect to a Tier 2 bicycle lane; only cross a ward boundary; only connect to a bicycle lane that crosses a ward boundary; or only connect to one of the three identified amenities. Tier 3 Bicycle Lanes are scored 2.0. “Tier 4 Bicycle Lanes” are bicycle lanes that do not connect to ward connectors; do not cross a ward boundary themselves; and do not connect to any identified amenities, but that may connect to Tier 3 bicycle lanes. Tier 4 Bicycle Lanes are scored 1.0. “Tier 5 Bicycle Lanes” are bicycle lanes that do not connect to anything other than Tier 4 Bicycle Lanes. Tier 5 Bicycle Lanes are scored 0.0.

In total, there are 155 contiguous bicycle lanes in Washington, D.C. Of those 155 bicycle lanes, nine are Tier 1 bicycle lanes, 52 are Tier 2, 38 are Tier 3, 17 are Tier 4, and 39 are Tier 5.
As a result, the total score on the 4.0 scale is 1.83 for the City of Washington, D.C. This score was calculated using the following equation: 

\[
\frac{(\text{total number of Tier 1 lanes})(4.0)+ (\text{total number of Tier 2 lanes})(3.0)+ (\text{total number of Tier 3 lanes})(2.0)+ (\text{total number of Tier 4 lanes})(1.0)+ (\text{total number of Tier 5 lanes})(0.0))}{\text{(Total number of bicycle lanes)}}
\]

In practice, this equation was:

\[
\frac{(9)(4.0) + (52)(3.0) + (38)(2.0) + (17)(1.0) + (39)(0.0))}{155} = 1.83.
\]

This rating system was designed to mirror the common 4.0 grading scale in academic institutions in the United States for easy understanding. A score of 1.83 translates to a C- letter grade.

Map 27: Bicycle Lanes by "Tier" in Washington, D.C. Map Developed by Thomas G. Renkes

Ultimately, in mapping the locations of each tier of bicycle lanes in Washington, D.C., it becomes apparent that the more highly ranked bicycle lanes are clustered in the central business district. Facialy, this clustering may not appear to answer the question of why higher tiered lanes
offering greater accessibility are clustered in the central business district; after all, could not the answer simply be that the central business district has more development, and thus more destination amenities, and thus bicycle lanes in that area have a higher accessibility score? To an extent, this appears to be true, as evidenced by Maps 27, and 28.

Map 28 (above): Location of amenities in Washington, D.C., Map Developed by Thomas G. Renkes, Data Provided by DCGISopendata and WDCEP
Maps 27 and 28 indicate that amenities are clustered in the central business district, which, to an extent, is to be expected. What is problematic, and indicative of an inability to link to amenities by bicycle infrastructure, however, is the dearth of Tier 2 and Tier 3 bicycle lanes outside Wards 1, 2, and 6. Outside of those wards, there are a total of five bicycle lanes on which a bicycle trip can be completed to the cluster of Tier 1 and 2 lanes in Wards 1, 2, and 6. Moreover, while amenities are clustered in the central business district, they are not completely absent from outlying wards, but bicycle lanes that connect to amenities are absent. Every ward has every identified amenity, often in close proximity to one another, but the ability to connect to those locations outside the central business district is limited. Whether it was planned or not, land use decisions are a driver of the ability of the current bicycle facilities to provide meaningful access to people throughout the city. With amenities clustered in the central business district, there is
more incentive for the city to provide access to those areas, placing strain on the ability of bicycle facilities to extend into outlying areas and provide access to the central business district.

In looking at the location of bicycle infrastructure in Washington, D.C., the location of amenities in Washington, D.C., and the extent to which different populations are served by the bicycle infrastructure in Washington, D.C., it is clear that the city has made a decision to primarily develop the bicycle infrastructure in and around the central business district. Wards 2 and 6 have extensive bicycle infrastructure that is well connected to amenities and other bicycle lanes, but that ability to connect to destinations near the central business district rapidly drops off closer to the edges of the city. This drop-off in accessibility is especially noticeable in the areas of the city more heavily populated by persons of color. The questions then are what process led to the current state of Washington’s bicycle infrastructure? Was the plan specifically to develop the central business district before developing other areas of the city? Was the plan to build to new bicycle facilities all around the city but the plan has only been implemented in the areas near the central business district? Washington’s most recent bicycle master plan is dated, but has some answers.

Reviewing Washington, D.C.’s Bicycle Plan

Washington, D.C. completed its most recent bicycle master plan in 2005. At the time, Washington, D.C. had only 17-miles of bicycle lanes, but had the fifth highest share of bicycle commuters amongst cities in the United States. Some areas had bicycle commute shares as high as 8.5% despite the lack of bicycle facilities. In looking at the map of bicycle commuting shares from 2005, it appears the areas with the highest shares of bicycle commuting were clustered in Wards 2 and 6—the same areas that now have the highest number of well-connected bicycle lanes. As shown in Map 29, the highest percentage of bicycle commuters are found near the central business district in Wards 1 and 2, as well as in upper northwest, and in Ward 6. Compared to the maps developed in this study, there appears to be a close correlation to where bicycle facilities have subsequently been built. Of

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73 Ibid at 5
74 Ibid at 9
75 Ibid at 7
note, in Wards 7 and 8, in the southeast of the city, there were two pockets with high rates of bicycle commuting along East Capitol Street and Pennsylvania Avenue. These areas have not received bicycle facilities improvements of the same significance that has been seen in other areas of the city with higher proportions of wealthy, white residents. In reviewing the goals set forth in the 2005 Bicycle Master Plan, there is nothing to indicate that the goals were to be targeted in the way they have been in the subsequent 15-years. The plan does express the principle that there should be “bicycle arterials” and that the bicycle network should be able to connect people to the central business district from anywhere in the city.\footnote{76} However, the plan also frames this connectivity principle as satisfied if everyone in the city lives within a half-mile of a bicycle lane in the bicycle network.\footnote{77} This planning principle that is a clear weakness in the 2005 plan. Additionally, according to the 2005 Bicycle Master Plan, bicycle facility installation would be implemented \textit{only} when roads were repaved or reconstructed, another glaring weakness in the plan.

First and foremost, the goal of having every person living with a half mile of a bicycle lane does little to advance any of the planning objectives listed in the 2005 Bicycle Master Plan, such as improving bicycle access to public transportation,\footnote{78} maintaining the continuity of bike routes,\footnote{79} improve bicycle access,\footnote{80} or improve and expand the bike route system.\footnote{81} While it may appear as if the state goal addresses those planning objectives, simply mapping Washington’s current populace relative to the locations of bicycle lanes, it is obvious that Washington, D.C. has largely accomplished the goal of having the majority of the populace living within a half-

\footnotesize{\begin{itemize}
\item \footnote{76} Ibid at 10
\item \footnote{77} Ibid at 16
\item \footnote{78} Ibid.
\item \footnote{79} Ibid at 32
\item \footnote{80} Ibid at 15
\item \footnote{81} Ibid.
\end{itemize}}
mile of a bicycle lane without significantly improving the access to amenities for a similarly significant portion of the populace.

Map 30: Half-mile Buffer of Bicycle Lanes in Washington, D.C. Map Developed by Thomas G. Renkes, Data Provided by DCGISopendata

As evidenced in map 29, the City of Washington has nearly accomplished the goal of having every person be within a half-mile of a bicycle lane. What Washington has failed to do, however, is provide meaningful access to amenities and the ability to link throughout the city via bicycle lanes despite the generally close proximity of the populace to their nearest bicycle lane. There are significant portions of northwest, northeast, and southeast that have bicycle lanes that meet the goal of having people live within a half-mile of a bicycle lane, but fail to meet the planning objectives of linking those people to destinations nearby, throughout the city, or to high capacity transit. Effectively, the half-mile goal is a hollow, toothless achievement that can be easily
completed without significantly advancing the planning objectives of improving mobility and access via bicycle facility. In a vacuum, the achievement of the half-mile goal is not, in itself, problematic so long as it doesn’t cause other areas of plan implementation to stagnate. Unfortunately, it’s difficult to look at the 2005 Bicycle Master Plan and not see just such a phenomenon in action. The 2005 Bicycle Master Plan included a number of proposed bicycle lanes throughout the city. However, the city, while achieving the “half-mile goal” has only developed dense bicycle lanes in and around the central business district in Ward 2. Outlying areas, like upper northwest and Wards 7 and 8 have seen limited bicycle lane development; seemingly just enough to meet the half-mile goal. It’s possible that this is related to
another problematic proposal in the 2005 Master Plan: only installing new bicycle facilities when roads are resurfaced or reconstructed.

With the stated planning objectives of improving access to bicycle routes, public transport, and improving bicycle access and expanding the bicycle network, the plan to only install bicycle facilities when replacing or repairing roadways makes little sense. Given the plain reading of the text providing these scenarios as the only time roadways would be installed, it’s possible that bicycle lane installation in Washington, D.C. has stalled in some areas alongside roads that were replaced or resurfaced before the planning objectives and policies from the 2005 Bicycle Master Plan took effect. According to the National Asphalt Paving Association, typical asphalt surfaces last 15-20 years, requiring only surface reconditioning, and can last 35-years or more without need for reconstruction. For the purposes of the 2005 Bicycle Master Plan, it’s possible that roadways that have not had bicycle lanes added have not been resurfaced or reconstructed in that time period. Moreover, while the District of Columbia does not make all past projects public, ongoing paving projects are available through an online portal. Cross referencing this portal with field observations and the City’s own bicycle lane maps reveals that there are areas that have been resurfaced within the past two years that have not received bicycle lanes. There are areas that have been repaved without the installation of bicycle lanes, and other areas have received significant bicycle facility improvements without corresponding

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82 Ibid at 19. The plan, when discussing expanding the bicycle lane system, says: “[b]icycle facilities will be improved and maintained whenever streets are repaved or reconstructed” and does not indicate any other plans to install bicycle lanes. Taken in context, this reading appears to say that the only time bicycle lanes will be installed is during other roadway projects.
86 As of April 8, 2020, the online projects portal contains projects from the 2018 budget year that have been completed, but those roads have not received new bicycle lane construction, including portions of Massachusetts Avenue Southeast.
resurfacing. Thus, it appears that the city has abandoned the plan to install bicycle lanes during repaving projects. In reviewing Map 30 against the current map of existing bicycle lanes (such as that in Map 26), it is clear that the city has intentionally developed a dense bicycle facility network in and around the central business district but has failed to meet their planning goal of extending arterial access to that bicycle facility network to populations throughout the city.

Effectively, while Washington, D.C. has created a high level of access in the central business district, the implementation of the 2005 Bicycle Master Plan has failed to give that same access to people who live outside the immediate area. If a resident or visitor can get to the central business district, they will be able to use bicycle facilities to get to many destinations, but the issue then is enabling people to use those bicycle facilities by riding their bicycle to where those facilities are. Currently, the inability to connect to the downtown bicycle facility network using bicycle facilities is the great failing of Washington, D.C.’s bicycle network.

Before the 2005 Bicycle Master Plan and in the time since, Washington, D.C. has proven to be willing and able to codify special protections for bicycle facilities, as well as cyclists. As early as 1984, Washington, D.C.’s city council was taking steps to protect cyclists and to lay the groundwork for future bicycle infrastructure.\(^{87}\) Subsequently, Washington, D.C. passed laws regarding the amount of bicycle parking that residential developments must provide,\(^ {88}\) as well as the amount of bicycle parking that retail and other commercial developments a must provide.\(^ {89}\) Finally, in 2016 Washington, D.C. changed the statutory structure of tort liability for cyclists involved in accidents with motor vehicles.\(^ {90}\) Prior to the enactment of the law, Washington, D.C.


\(^{89}\) Ibid.

did not allow cyclists to recover for injuries suffered in an accident with a motor vehicle if it could be shown that a cyclist had been negligent in any amount, even if the ultimate but for cause and greater level of negligence lay with the driver of the motor vehicle. Under the new comparative negligence regime, cyclists involved in accidents with motor vehicles can still recover damages even if the cyclist was negligent in their actions leading up to the accident, but any awarded damages will be reduced by an amount proportionate to the level of responsibility borne by the cyclist. While monetary damages are not a salve for all injuries, the ability of cyclists to have a means to recover in the event of an accident even if they themselves were partially responsible provides a level of protection that was not previously enjoyed by residents of and visitors to Washington, D.C.

**Global Leaders in Bicycle Connectivity in Comparison to Washington, D.C.**

People for Bicycles is a North American non-profit that uses a proprietary system to rate the overall bicycle networks of North American cities based on five criteria: ridership, safety, network connectivity (i.e., accessibility), reach (i.e., mobility), and “acceleration” (i.e., the rate at which the rated city is improving its bicycle infrastructure and ridership). According to People for Bicycles, Washington, D.C. rates at 2.2 for network connectivity, and a 3.5 overall. The 2.2 Washington, D.C. received for network connectivity is, assuming similar absolute scales, lower than the score awarded by the connectivity scoring metric developed for this study. In looking for comparables for Washington, D.C., it’s important to ensure that cities of similar population size are considered. The planning and implementation of a bicycle network for a large city like Washington, D.C. is inherently different than the planning for a city with a significantly

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92 Ibid.
93 Ibid.
lower population. Thus, while cities like Boulder, Colorado are highly rated using People for Bicycles’ metric, the vast difference in size reduces the feasibility of comparing the bicycle network with Washington, D.C.

In examining best practices—from both a planning and implementation perspective—it is important to compare Washington, D.C. to global leaders that excel specifically in connectivity and accessibility, as those are the areas of study currently at issue. Using People for Bicycles’ ratings, there are only two cities in North America that achieve at least a 3.0 rating in network connectivity: Seattle, Washington and Calgary, Alberta. Globally, Copenhagen, Denmark, and Amsterdam, Netherlands were chosen as leaders in bicycle infrastructure development. In Amsterdam, for example, the bicycle has been the number one mode of transportation for school and work trips since 2005. Similarly, in Copenhagen, bicycle trips make up 35% of all trips to work and school. In Washington, D.C., at the time of the last bicycle master plan, the highest bicycle ridership areas had ridership lower than 8%, city-wide, the bicycle ridership rate for Washington was only 1.16% at the time the 2005 Bicycle Master Plan was being completed.

One of the major differences between the Washington, D.C. 2005 Bicycle Master Plan and similar plans from Copenhagen and Amsterdam, is the fundamental belief that bicycles can be the primary form of transportation for the populace. The Washington plan acknowledges the potential for bicycles to provide highly valuable mobility and accessibility for people throughout the city, especially the significant portion of residents that do not own cars. Similarly, the Washington plan acknowledges the great potential for Washington, D.C. as an extremely

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95 2005 DC Bicycle Master Plan page 7
96 Ibid.
97 Ibid at 6
bikeable city,\textsuperscript{98} highlighting the potential for congestion relief,\textsuperscript{99} economic benefits,\textsuperscript{100} health benefits,\textsuperscript{101} and environmental benefits.\textsuperscript{102} Despite these strong endorsements for cycling as a primary mode of transportation, the plan never pushes a planning objective of reducing the number of cars on the street by shifting mode choice to cycling over motor vehicle. This is despite many proposed planning objectives designed to increase ridership, safety and visibility. Moreover, the plan does recommend making cycling the primary mode of transportation in one area of the city: the National Mall.\textsuperscript{103} Thus, it is apparent that the planners involved with the 2005 Bicycle Master Plan made a conscious decision not to make a push for cycling as a primary mode of transportation, but rather as an accessory to other forms of transportation. The question, then, is what can Washington, D.C. learn from other cities about how to plan for cycling as a mode of transportation, and enabling people to access needed amenities, jobs, and recreation by bicycle?

Each of the identified plans—Calgary, Seattle, Copenhagen, and Amsterdam—has unique characteristics that can help inform how Washington, D.C. can continue to promote cycling as an effective mode of transportation, and how the city can further develop its bicycle infrastructure to ensure that bicycling can actually function as a safe and effective mode of transportation for any type of trip. In analyzing Washington’s bicycle infrastructure using GIS, in-person observation, and review of available planning documents the primary weaknesses of Washington, D.C.’s bicycle facilities are apparent: first, the city lacks adequate connectivity (and thus accessibility) outside of the central business district; second, the city lacks sufficient bicycle

\textsuperscript{98} Ibid at 11
\textsuperscript{99} Ibid.
\textsuperscript{100} Ibid.
\textsuperscript{101} Ibid.
\textsuperscript{102} Ibid.
\textsuperscript{103} Ibid.
facilities in areas outside of the central business district (reducing overall bicycle mobility); third, the city lacks ridership; fourth, the bicycle facilities network does not adequately connect to other modes of transportation; and finally, the bicycle facilities network does not provide equitable access to different economic and racial demographics within the city. Each selected plan can help provide insight to one or more of these problems.

Calgary, Alberta is a much larger city than Washington, D.C. by both land area and population. Even accounting for that size discrepancy, however, the density of off-street bicycle paths Calgary has created is remarkable, and an excellent example for Washington, D.C. to follow to improve access for all residents in the city, as well as improving connectivity to the central business district and needed amenities. As of the most recently produced planning document, Calgary has built 442 miles\textsuperscript{104} of off-street multi-use paths that enable cyclists to connect to destinations throughout the city while reducing the number of interactions any cyclist would need to have with a motor vehicle. Additionally, the city of Calgary has prioritized building new bicycle facilities at an extremely high rate, adding 193 miles of multi-use paths between 1999 and 2010.\textsuperscript{105} The rate at which Calgary has added bicycle facilities far outstrips Washington, despite Calgary and Washington having similar bicycle mode shares (between 1 and 2\%).\textsuperscript{106} Calgary has specifically identified a goal of moving citizens away from motor vehicles and onto bicycles as a primary planning objective.\textsuperscript{107} Finally, with the extensive build out of bicycle facilities throughout the city, Calgary has built a network of bicycle facilities similar to that envisioned by the Washington, D.C. 2005 Bicycle Master Plan: a densified bicycle network in the central business district with arterial connections to outlying areas. Overall,

\textsuperscript{104} City of Calgary. “Cycling Strategy Report.” Planning document, Calgary, Alberta, Canada 2011 (Converted from kilometers)
\textsuperscript{105} Ibid at 22
\textsuperscript{106} Ibid at 16
\textsuperscript{107} Ibid at 2
Calgary’s bicycling plan is an excellent example of translating a plan into a success through implementation of that plan. When Calgary’s applicable planning departments set planning objectives, they followed through in implementing those objectives in a way that Washington, D.C. has failed to do, and Calgary has done it across the city, rather than focusing on one area, as Washington has done.

Map 32: Calgary, Alberta Bicycle Facilities Map. Reproduced from: https://maps.calgary.ca/Pathways andBikeways/
It is not difficult to envision a similar extensive facility network in Washington, D.C., with the arterial bicycle connectors originally envisioned in the 2005 Bicycle Master Plan.

Copenhagen has developed a positive reputation as a world leader in bicycle and pedestrian infrastructure to the extent that “Copenhagenization” is a defined term cited by the Calgary bicycle plan. 108 Copenhagen stands in contrast to Washington, D.C. and Calgary in that the bicycle is the most popular mode share, accounting for 36% of all commute trips to work and school.109 Unlike Washington, D.C., Copenhagen has made a dedicated choice to make the bicycle the primary mode of transportation in the city. 110 Similarly, where Washington, D.C. views the bicycle solely as a means of transportation, Copenhagen has adopted the bicycle as a political tool, used to address various urban issues 111 and to help the city achieve a carbon neutrality by 2025.112 Beyond the goal of having the bicycle as the primary mode of transportation, Copenhagen’s reasoning behind its planning objectives are all issues identified by the Washington, D.C. 2005 Bicycle Master Plan. Similar to Washington, D.C., Copenhagen has identified the bicycle as a means to reduce congestion, provide more recreation space, improve air quality and individual health, and to provide economically accessible transportation for as many people as possible. 113 Copenhagen has also found that investment in bicycle infrastructure and increased bicycle mode share has broader budget savings by reducing wear and tear on roads as residents choose cycling over the automobile for transportation.114 Copenhagen has also taken action to address some of the smaller peccadillos associated with cycling as transportation by

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108 Ibid at 29
110 Ibid at 4
111 Ibid.
112 Ibid at 5
113 Ibid.
114 Ibid.
adding footrests at intersections to allow cyclists to remain seated while waiting for a light and deploying community air pumps throughout the city.\textsuperscript{115} Copenhagen has also embraced land use as an implicit driver of bicycle facility use by partnering with vendors and developers to ensure that development continues to favor the bicycle by creating hubs of activity that are easy accessible by bicycle.\textsuperscript{116} Copenhagen has found that bicycle ridership is highest for trips less than 10 kilometers (approximately six-miles) long, a distance that for Washington, D.C.’s purposes would encompass nearly the entire city regardless of starting point. Copenhagen is also prioritizing the elimination of what they call “missing links;”\textsuperscript{117} that is, areas where bicycle routes terminate and prevent cyclists from continuing on to their destination without having to use non-bicycle infrastructure. In contrast, Washington, D.C. has many bicycle lanes that don’t connect anywhere, and many areas that cannot seamlessly link to other parts of the city via bicycle facility alone. Copenhagen also, like Calgary, is not afraid to build infrastructure

\textsuperscript{115} Ibid at 19
\textsuperscript{116} Ibid at 7
\textsuperscript{117} Ibid at 9
exclusively for bicycles, especially those that help facilitate better, safer, quicker bicycle travel and in building their bicycle facilities has built bicycle arterials that allow people from even distant reaches of the city to access destinations throughout the area. Copenhagen calls these arterials “cycle superhighways” and they are targeted at the small proportion of bicycle trips that are longer than five kilometers (approximately three miles) in length. To date, 128-miles out of a planned 290-miles have been completed, creating direct, arterial routes for bicycles to connect to dense, multipurpose destinations. Moreover, in addition to bicycle lanes and routes, Copenhagen also aggressively prioritizes more intense bicycle-only infrastructure projects like bridges to enable cyclists to take shorter, faster, routes that further incentivize bicycle use. Copenhagen has decided not just to provide cycling as an alternate, they have decided that cycling should be the primary way people move throughout the city, and they have made that choice largely because

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118 Ibid at 29
120 Ibid. (converted from kilometers)
121 Ibid.
adopting the bicycle as the primary means of transportation will allow the city to achieve other important policy goals that might be more difficult to achieve otherwise.\textsuperscript{122}

In contrast to Washington, D.C., Seattle, Washington views equity considerations as an important factor in designing and deploying bicycle facilities. Washington, D.C. currently has a bicycle system that favors whiter, wealthier areas of the city, despite the 2005 Bicycle Master Plan showing plans for bicycle lanes throughout the city. Seattle rates all proposed bicycle facility plans in five categories that are each given different weights. Behind safety and connectivity, Seattle weights equity as the third most important factor in evaluating bicycle infrastructure projects.\textsuperscript{123} On the other hand, the 2005 Bicycle Master Plan for Washington, D.C. contains no reference or acknowledgement of racial or socioeconomic equity in the entire document. Fundamentally, any and all planning projects should account for equity considerations—especially in a city as starkly divided on

\textsuperscript{122} Copenhagen Bicycle Plan at 5
\textsuperscript{123} City of Seattle, Department of Transportation. “Seattle Bicycle Master Plan, 2019-2024 Proposed Implementation Plan.” Planning document, Seattle, Washington, United States, 2019 at 11
racial and socioeconomic lines as Washington, D.C. In addition to doing a complete job tracking and documenting projects across the city, Seattle, by taking equity into account, has spread bicycle facility development evenly throughout the city, rather than concentrating on densifying the downtown core. This approach not only ensures more equitable access to bicycle lanes, but could also influence land use policy by encouraging development in areas that are served by bicycle lanes. Focusing on connectivity and accessibility over mobility can drive diverse, multiuse development throughout an urban area. Bringing development to bicycle lanes rather than bicycle lanes to development can shorten the needed length of bicycle lanes to provide the same level of access.

Amsterdam has taken perhaps the most aggressive approach to bicycle facilities out of any of the selected cities. Where Calgary, Copenhagen, and Seattle have all focused on bicycle networks that maximize accessibility with targeted development, Amsterdam has taken an even more inclusive approach. In Amsterdam, if there is a

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124 Ibid at 7-10
125 Ibid at 20-21
route through the city, there is an accompanying cycle route, generally completely physically separated from the routes designed for motor vehicles. Moreover, Amsterdam provides more routes for cyclists than for motor vehicles within the city. Amsterdam has effectively eliminated the consideration of how to build bicycle accessible areas by making *all* areas accessible by bicycle. This extensive buildout of bicycle lanes would be difficult to match in a short period of time, but shows, definitively, that such profound coverage is possible for a large city. Even in Washington, D.C.’s 2005 Bicycle master Plan, there is an acceptance that some parts of the city will not—and should not—have bicycle infrastructure installed.\textsuperscript{126} Accepting that some areas will not have bicycle infrastructure, however, effectively undermines the goal of building out complete bicycle facilities. Instead of focusing on build out, the planning discussion can instead revolve around why certain areas don’t need bicycle facilities, a focus on negatives rather than positives, and ultimate reluctance to continue building bicycle facilities. Amsterdam has proven that it is a feasible goal to buildout bicycle facilities to complete grid coverage. There is little to lose by setting an aspirational goal of having complete coverage by bicycle facilities; a lesson Washington, D.C. would be wise to learn.

The extent to which Washington, D.C. has built out its bicycle infrastructure since the adoption of the 2005 Bicycle Master Plan is impressive. In 15-years, Washington, D.C. has quadrupled the total length of bicycle lanes, adopted an enormously successful bicycle share service, increased total ridership, and improved the legal and statutory protections for cyclists and cycling infrastructure in the city. Despite these leaps and bounds of improvement, Washington, D.C. has not created a truly city-wide, inclusive, equitable, accessible bicycle network. While the bicycle lanes Washington, D.C. built in and around the central business district provide excellent access to amenities within that area, the city has failed to provide

\textsuperscript{126} 2005 DC Bicycle Master Plan at 13
meaningful access to that dense downtown network to people who live outside the immediate area.

The 2005 Bicycle Master Plan made plans to have arterial connectors for cyclists to connect to a dense downtown network, but after 15 years, those arterial connectors have failed to materialize. Future plans to complete the system have similarly remained elusive. Moreover, land use decisions in other parts of the City of Washington have limited the ability of bicycle lanes in those areas to link with amenities such as banks, grocery stores, and metro stations, as those amenities exist at lower rates in outlying parts of the city. In effect, Washington, D.C. has built a bicycle network that, if a person can access it, provides meaningful connections within its reach. At the same time, however, Washington, D.C. has built a bicycle network that favors wealthier, whiter portions of the city with regards to accessibility and connectivity, and does not provide enough connections to high-capacity transit nor arterial bicycle corridors to allow residents who live further away from the central business district to appreciate the full benefits of Washington’s bicycle infrastructure network. The 2005 Bicycle Master Plan failed to set planning goals that would tend to lead to greater accessibility for all people throughout the city.

Washington, D.C. has much to learn from various world leaders in bicycle infrastructure. Calgary and Copenhagen provide an excellent example of how bicycle arterials can expedite access to an urban core of dense bicycle infrastructure; Seattle highlights the impact equity analysis can have on expanding bicycle networks throughout a city; and Amsterdam proves that complete coverage of a bicycle network throughout an urban space is an achievable goal even for a major city. Robust bicycle networks can provide a path towards healthier, more equitable places by expanding access, reducing emissions, reducing the need to bear the financial burden of a car or transit pass, and provide improved efficiency by reducing hours lost to congestion.
Part 3: Highlighting Land Use and Accessibility on M Street NE

In analyzing Washington, D.C.’s bicycle infrastructure through GIS, there is one particular bicycle lane that stands out as unique in the type of access it provides. This particular bicycle lane is the only bicycle lane in Washington, D.C. to provide access to a bank, grocery store, and Metro station entrance without crossing a ward boundary. Thus, it is the only Tier 1 bicycle lane wholly contained within a single ward in the entire City of Washington. The bicycle lane in question extends less than two city blocks in the northeast neighborhood now known as “NOMA”

Beginning in 2007, Washington, D.C. has been redeveloping an area north of Union Station under the moniker “NOMA,” an acronym (and abbreviation) for North of Massachusetts Avenue. Development of NOMA has focused on dense, multiuse urban space, including federal office buildings, housing, dining, and commercial businesses. NOMA is an excellent example of how land use decisions can significantly alter the ability of bicycle lanes to provide meaningful access. Despite being less than two city blocks long, the bicycle lane that runs along M Street NE between First Street NE and Third Street NE connects to a bank, a grocery store, and a metro entrance, an achievement matched by no other bicycle lane in Washington, D.C. that doesn’t cross a ward boundary. While the span of this bicycle lane is not long, it highlights the impact that land use decisions can have on providing meaningful access to amenities via bicycle. While the bicycle arterials proposed by the 2005 Bicycle Master Plan would provide increased accessibility to people living in outlying areas of the city, changes in land use policy can also allow bicycle lanes to provide better access by bringing the amenities to the bicycle lane, rather than bringing bicycle lanes to the amenities. The development of NOMA can provide a blueprint for how small-area planning around transit as well as pedestrian and cyclist accessibility can provide significant benefits for accessibility.

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128 Ibid.
Conclusion

To fully realize the goals of the 2005 Bicycle Master Plan, the equity goals of the new comprehensive plan, and to continue to build a greener, more equitable city, Washington, D.C. must go to greater lengths to adopt the bicycle as a primary mode of transportation. The city must end the practice of relegating the bicycle to an accessory mode of transportation due to inequitable, poorly connected bicycle infrastructure. Either by building arterial bicycle connectors, or by diversifying land use decisions built around existing bicycle lanes, Washington, D.C. can, and should, extend the benefit of accessibility and connectivity via bicycle across the entirety of the city. Washington, D.C. has the opportunity to embrace the bicycle as the future of local transportation and to appreciate all the associated benefits of doing so. Until Washington makes that choice, however, the existing bicycle infrastructure will remain a near success, hollowed out by a lack of equity and a lack of meaningful accessibility for every resident of the city.

Moving forward, there remains significant work to be done to evaluate the actual physical state of all of Washington, D.C.’s bicycle facilities and determine the level of service provided by that physical infrastructure—an important step for which the methodology of this study could not account. A complete understanding of the physical form, safety, and service level of Washington’s bicycle facilities, combined with accessibility and equity evaluations could provide a clear blueprint towards a future where the bicycle is a primary mode of transportation for people of all races and socioeconomic backgrounds in the city. Until the government of Washington, D.C.—supported by the bicycle advocacy community—makes the decision to prioritize bicycle facility development equitably across the city, however, the bicycle will remain, at best, a secondary mode of transportation within the city.
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