

The Bike Problem:  
Examining Bicycle Route Access in Arlington County, Virginia

Katherine Little  
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Professor Jennifer Hurley  
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In 2019, the local government of Arlington, Virginia adopted a Community Energy Plan (CEP) that declared a county-wide goal of net zero greenhouse gas emissions by the year 2050, a plan which identified the county's car-dependent transportation sector as the target for the largest emissions cuts<sup>1</sup>. Regulators of the sector, which has been reflective of a county landscape rapidly shifting from mostly suburban to more uniformly urban, have sought to balance pressure from the area's rising population with the need for emissions reductions and a parallel movement away from personal internal combustion vehicles in the county's newest Master Transportation Plan (MTP)<sup>2</sup>. The most recently developed aspect of this plan has as of this paper's writing been its Bicycle Element, which governs plans for education about and access to bicycling in the county, in particular access to the different types of bike lanes and paths that largely determine whether residents decide to travel via bicycle or not<sup>3</sup>. In this paper, I will be focusing in on a particular aspect of access: the need of underserved communities for bicycling as a form of transportation. In short, which areas of Arlington without bike lanes stand to socioeconomically benefit the most from their installation? By identifying these communities, county survey data on bicycle route demand can be supplemented and more information can be used to determine the construction priority of different routes.

Arlington County has historically concentrated its urban development on three urban corridors: the Rosslyn-Ballston and Richmond Highway Metro Corridors, which arose around metro lines going into and out of Washington, D.C., and the Columbia Pike Corridor, which is

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<sup>1</sup> Arlington County, "New Community Energy Plan (CEP) Roadmap for Arlington County," n.d., <https://www.arlingtonva.us/files/sharedassets/public/v1/environment/documents/clean-cep-roadmap-07-26-2022-with-cover.pdf>, 17.

<sup>2</sup> Arlington County, "Master Transportation Plan (MTP): Goals and Policies Summary," February 2017, <https://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/31/2017/03/Overall-plan-updated-February-25-2017.pdf>, 2-4.

<sup>3</sup> Arlington County, "Master Transportation Plan (MTP): Bicycle Element," April 23, 2019. [https://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/31/2019/05/MTP\\_Bicycle\\_Element\\_2019\\_adopted.pdf](https://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/31/2019/05/MTP_Bicycle_Element_2019_adopted.pdf).

situated around a principal arterial road (see Fig. A1). However, facing a rise in both population and housing prices over the past several decades<sup>4</sup>, the local government recently pivoted toward a development plan that encourages increased density throughout the county, upzoning areas that were previously dominated by single-detached housing<sup>5</sup>.

As a result of rising density, pressure continues to build on a county transportation system built for and dominated by cars, which in turn shape the direction of development in favor of further car use (the system described by Urry as ‘automobility’, utilized by the automobile with car access). This system cannot co-exist with the county’s Community Energy Plan for carbon neutrality, and the CEP as a result has articulated a ‘post-car’ vision through the ultimate goal described in its transportation sub-plan, the Master Transportation Plan<sup>6</sup>: a county in which residents can comfortably move about their daily lives through a multimodal system of walking, driving personal electric vehicles, and/or using public transportation or micromobility vehicles like scooters and bicycles.

The bicycle element of the MTP was adopted most recently out of the plan’s six sub-elements in April 2019<sup>7</sup>, identifying bicycling within the MTP’s envisioned multimodal system as a mode for travel over “short- and medium-range distances” that “connect[s] many origins and destinations to transit services, conveniently providing “the first mile, last mile” access that allows a broader geographic reach for fixed transit routes”<sup>8</sup>. Resident surveys found

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<sup>4</sup> United States Census Bureau, “QuickFacts: Arlington County, Virginia,” n.d., <https://www.census.gov/quickfacts/arlingtoncountvirginia>; Redfin, “Arlington, VA Housing Market,” n.d. <https://www.redfin.com/city/21282/VA/Arlington/housing-market>.

<sup>5</sup> Arlington County, “General Land Use Plan (GLUP) Booklet,” June 2023, [https://www.arlingtonva.us/files/sharedassets/public/v2/projects/documents/glup/booklet\\_june\\_2023.pdf](https://www.arlingtonva.us/files/sharedassets/public/v2/projects/documents/glup/booklet_june_2023.pdf), 4-6.

<sup>6</sup> John Urry, “The ‘System’ of Automobility,” *Theory, Culture & Society* 21, no. 4–5 (October 2004): 36, <https://doi.org/10.1177/0263276404046059>.

<sup>7</sup> Arlington County. “Master Transportation Plan (MTP),” n.d., <https://www.arlingtonva.us/Government/Projects/Plans-Studies/Transportation-Plans-Studies/Master-Transportation-Plan>.

<sup>8</sup> Arlington, “Bicycle Element”, 4.

that access to a bike in general was not among the most significant barriers to entry, but instead access to safe bicycle paths: forty-five percent of those surveyed expressed that the “primary reason why they do not bicycle more often” was “their concerns about the safety of bicycling on Arlington streets”<sup>9</sup>. These responses align with what we already know about bicycle safety: the vast majority of bicycle crashes are on mixed bike-car roads. As a result, the primary focus of the plan is the installation of new lanes and upgrading of old ones to enhance separation from traffic and create an effective network of car-free bicycle routes through a combination of existing options: protected bike lanes, unprotected bike lanes, and off-street trails (see Fig. A2)<sup>10</sup>.

As pointed out by Sheller, expansion of sustainable multimodal transport generally follows and even intensifies existing patterns of racial and economic inequality in an area<sup>11</sup>. The county has made projects that enhance underserved communities’ access to the proposed multimodal system a priority<sup>12</sup>; with the understanding that access to paths safe for bicycle travel is a concern that frequently turns potential bicycle users away from a sustainable mode of traveling that is more affordable than even traveling by bus or metro in the D.C. area<sup>13</sup>, the goal of this paper is to analyze the demographic characteristics of areas within the county in the context of the presence of bike lanes in order to identify areas that are both socioeconomically marginalized and underserved by the county bike lane network. By doing so, more data can be provided to supplement the primary sources of data on demand—community surveys and street sensors—that county documents reported utilizing in order to make decisions about county

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<sup>9</sup> Arlington, “Bicycle Element”, 10.

<sup>10</sup> Arlington, “Bicycle Element”, 4-12.

<sup>11</sup> Mimi Sheller, “Racialized Mobility Transitions in Philadelphia: Connecting Urban Sustainability and Transport Justice,” *City & Society* 27, no. 1 (April 2015): 85-87, <https://doi.org/10.1111/ciso.12049>.

<sup>12</sup> Arlington, “MTP: Goals and Policies”, 3-4.

<sup>13</sup> Washington Metropolitan Area Transit Authority (WMATA), “Cost to Ride,” n.d., <https://www.wmata.com/fares/basic.cfm>; Miriam Quick, “Cycling v Public Transport: How Do Cities Compare?,” December 11, 2016, <https://www.bbc.com/worklife/article/20161209-cycling-v-public-transport-how-do-cities-compare>.

bicycling needs<sup>14</sup>. Community surveys oftentimes underreport on marginalized communities due to, among others, income-, education-, or language-based barriers to understanding survey content or being reached by surveys at all<sup>15</sup>; this may well have been true for the several block groups that exist in Arlington County in which almost one third of the population over 5 speaks English “not well” or “not at all”, one tenth of occupied housing units do not belong to occupants with telephone service, and/or more than one quarter of the population lives in a household without a computer (see Figs. B1-3)<sup>16</sup>. Street sensors, meanwhile, can only collect data on existing use and offer no information on unmet need, providing a more complete picture of potential demand in the county for policymakers to take into account when deciding the priority of certain bicycle lanes or planning entirely new ones. The census data examined, while being a type of survey in and of itself, can nonetheless be helpful in pointing out potential blind spots in existing county government perceptions of which areas need more extensive bicycle route access and providing more context on the economic situations of residents. This is due to its block group-specific information (as opposed to the county community surveys, which were not based on any kind of neighborhood or sub-area<sup>17</sup>) and specific focus on the demographic data that may fundamentally influence need or demand.

To create a baseline for analysis of what areas counted as “having access to a car-free bicycle route”, a buffer with a radius of a city block was created around each type of bike lane (see Figs. C1 and 2. Though I chose to avoid comparing county data with that of other cities or

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<sup>14</sup> Arlington, “Bicycle Element”, 7.

<sup>15</sup> Abdolreza Shaghaghi, Raj S Bhopal, and Aziz Sheikh, “Approaches to Recruiting ‘Hard-to-Reach’ Populations into Research: A Review of the Literature,” *Health Promotion Perspectives* 1, no. 2 (2011): 87-88, <https://doi.org/10.5681/HPP.2011.009>.

<sup>16</sup> United States Census Bureau, “American Community Survey 5-Year Estimates: Arlington County, Virginia,” 2022.

<sup>17</sup> Mobility Lab, “Arlington County’s Oversample and Special Analysis of the 2017/2018 MWCOG Regional Travel Survey,” April 2021, [https://www.arlingtonva.us/files/sharedassets/public/v1/commissions/documents/transportation/2021\\_tc/household-travel-survey-report-2021-final.pdf](https://www.arlingtonva.us/files/sharedassets/public/v1/commissions/documents/transportation/2021_tc/household-travel-survey-report-2021-final.pdf).

towns in order to focus on where there is room for improvement within Arlington County specifically, I did use the length of a Manhattan east-west block as a “standard” city block length due to the general lack of standardization among city block lengths. This block-sized radius was chosen to act as the equivalent of someone walking a bicycle from their home to the street over. When analyzing the total area of the county within this radius, I found that 34% of the county is not within a street block distance of a car-free bicycle route (see Fig. C3). All demographic data analyzed or used in maps was taken from the American Community Survey<sup>18</sup>.

Examining the distribution of race, ethnicity, and immigration in the county, I found that the county is majority white, with significant Black, Hispanic or Latino, and Asian minorities. Most block groups with high concentrations of white residents were located in North Arlington and fringes of the southernmost parts of the county (see Fig. D1). Block groups with high concentrations of Black residents were located in South Arlington (see Fig. D2). The Hispanic or Latino population is broadly distributed in South Arlington, with a concentration of block groups with a high share of Hispanic or Latino residents located in the southwest part of the county in particular (see Fig. D3). Because the county is so white, there were still significant shares of white residents in areas with higher concentrations of Black and Hispanic or Latino residents, but generally only single-digit shares of Black and Hispanic or Latino residents in areas with higher concentrations of white residents. Asian residents tended to be evenly distributed throughout the county, with no particular block groups containing starkly different concentrations. Block groups with high shares of foreign-born residents tended to be located in South Arlington and along metro corridors, overlapping heavily with block groups containing high shares of Hispanic and Latino residents, meaning that either most foreign-born residents in these areas are also Hispanic or Latino or that foreign-born residents tend to also live in these areas (see Fig. D4). Analysis of

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<sup>18</sup> Census Bureau, “American Community Survey”.

indicators of underprivileged communities existing within county block groups showed that poverty and participation in the food stamps/SNAP program was concentrated in South Arlington, specifically Southwest Arlington, and in the metro corridors (see Figs. E1-2). Block groups with higher shares of populations with these indicators compared to the rest of the county also tended to be the block groups with the lowest concentrations of white residents. There were no noticeable patterns of car-free bicycle route access that appeared in relation to the distribution of residents based on race, immigration, or economic underprivilege; however, areas with high concentrations of marginalized and underprivileged groups did tend to overlap with the areas noted in Figures B1-3, potentially indicating that residents in these areas may generally be harder to adequately reach with surveys compared to the rest of the county.

Car-free bicycle route access tended to overlap well with block groups that had high-rates of car-less households, while most areas that weren't within that weren't within a block of a car-free bicycle route had high shares of households with at least one car (see Figs. F1-2). Block groups with high shares of the population reporting living alone did overlap with block groups that had high shares of ownership of only one car, potentially indicating that most households without access to a car-free bicycle route in the county do not contain multiple people who share a single vehicle and may need alternative modes of transportation when one person is using the household car (see Fig. F3).

It was noticeable that off-street trails tended to be the only form of car-free bicycle route in South Arlington outside of the bike lanes in the Richmond Highway Metro Corridor. When these trails were removed from the map, a lot of block groups with high rates of indicators of underprivilege and/or high shares of non-white populations compared to other parts of the county lost access to a car-free bicycle route, while the whiter, less impoverished parts of the county

located in North Arlington retained most of their car-free bicycle routes (which, in North Arlington, are mostly composed of on-street bike lanes). Almost all of these off-street trails are part of the Arlington Loop (see Fig. G), a trail built in the 1990s to connect park space around Four-Mile Run in South Arlington and the Potomac River. On the other hand, when taking a stricter definition of safety into account when discussing car-free bicycle routes by acknowledging the fact that unprotected bike lanes are generally more dangerous than protected bike lanes or off-street trails, safer forms of bicycling access in North Arlington and metro corridors virtually disappear due to the reliance of car-free bicycle infrastructure in those areas.

The demographic data also shows that of the block groups in the county, those containing high shares of residents from marginalized and/or underprivileged communities (mostly located in South Arlington, which has historically been home to larger shares of nonwhite and/or poor residents due a combination of the effects of racial covenants and a concentration of wealth in North Arlington<sup>19</sup>, or the metro corridors) were more or less served at the same rates by car-free bicycle routes as the whiter, less impoverished parts of the county. However, this says very little about the adequacy of the bicycle *network*: its internal connection is very poor, and most people can only bike along a single route to get anywhere if they want to stay on a route with a bike lane or an off-street trail. Block groups with high concentrations underprivileged and/or marginalized residents in particular were served primarily by the Arlington Loop, which doesn't go directly to metro corridors, but instead forces a user to travel around the county in order to bike to a metro stop on a car-free route.

Areas that would benefit most from *any* kind of access to the network, however, were the ones with high concentrations of underprivileged and/or marginalized populations just outside of

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<sup>19</sup> G. Stephen Thurston, "Are There Two Arlingtons?," April 27, 2015, <https://www.arlingtonmagazine.com/are-there-two-arlingtons/>.

the car-free bicycle route network's radius in South Arlington: these areas tended to either be parts of block groups that the network did run through to some extent, but were outside of the one-block radius (meaning a bicycle user would have to walk or bike several blocks on a sidewalk to get to a route if they didn't want to bike alongside cars), or were part of the sprawl of underprivileged and/or marginalized communities living adjacent to the block groups with higher concentrations.

Though opportunities for analysis by planning authorities are dependent on county budget constraints, there is room for further research on obstacles to bicycling. County documents have noted a variety of different potential obstacles to bicycling beyond the access to safe bike paths, including education about bicycle use and maintenance, bicycle facility quality, and the price of bike shares<sup>20</sup>. However, significant further obstacles to bicycling exist that have not been intensively explored. To start, in light of the glaring reliance of South Arlington car-free bicycle route infrastructure on off-street trails, their quality and ease should be compared to that of protected and unprotected on-street lanes. Furthermore, seeing the gaps between the network car-free bike lanes and efficient access to the metro, the network's intersection with the county bus network also has potential for exploration. Additionally, although bicycle route difficulty has been mapped in terms of comfort with the presence of cars, no such difficulty analysis has been undertaken in terms of the physical geography of the county; as an Arlington resident, I have noted that bicyclists are infrequent in the hilly northern parts of the county due to the difficulty of the terrain, even on roads where there are separated bike lanes. In order to prioritize the installation of new bike lanes or upgrading of existing ones on routes people are most likely to use frequently, future analysis could identify routes in the county that feature gentle or flat terrain. Future exploration of bicycling access in the county may benefit from a comprehensive

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<sup>20</sup> Arlington, "Bicycle Element", 20-24.

analysis including, but not limited to, all of the above, something which could not be undertaken in this paper due to time constraints and my own GIS skills.

In order to supplement existing data informing plans for the expansion of bicycling, as an essential and affordable part of the non-automobile, multimodal transportation system proposed by Arlington County's Master Transportation Plan, I analyzed demographic data from the county by block group. Looking at the distribution of race, ethnicity, and immigration as well indicators of socioeconomic hardship and automobility across the county, I found that car-free bicycle routes (which overcome the main barrier of safety that discourages residents from biking), specifically the vastly safer protected bike routes or off-street trails, should receive two forms of attention from the county in order to expand resident access to it across the county: *expansion of existing reach* (particularly into the underserved parts of South Arlington, where block groups with large shares of residents from underprivileged and/or marginalized communities are primarily concentrated) and *increase of network connectivity* (in order to decrease travel distance and more effectively establish biking as an intermediary mode of transportation that gets users to and from pick-up and drop-off locations). Additional research into topics like the efficacy of off-street trails as opposed to on-street lanes, connection to other transportation networks, and route ease of use based on terrain can further inform future decisions on how and where to install or upgrade car-free bicycle routes. By investing in further expansion of bicycle access beyond metro corridors and areas with the resources to more intensively pursue less affordable modes of transportation like driving a car, decisionmakers in Arlington would be able to more effectively support the freedom of movement of the county's more vulnerable communities in the process of pursuing a more sustainable future.

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## Index

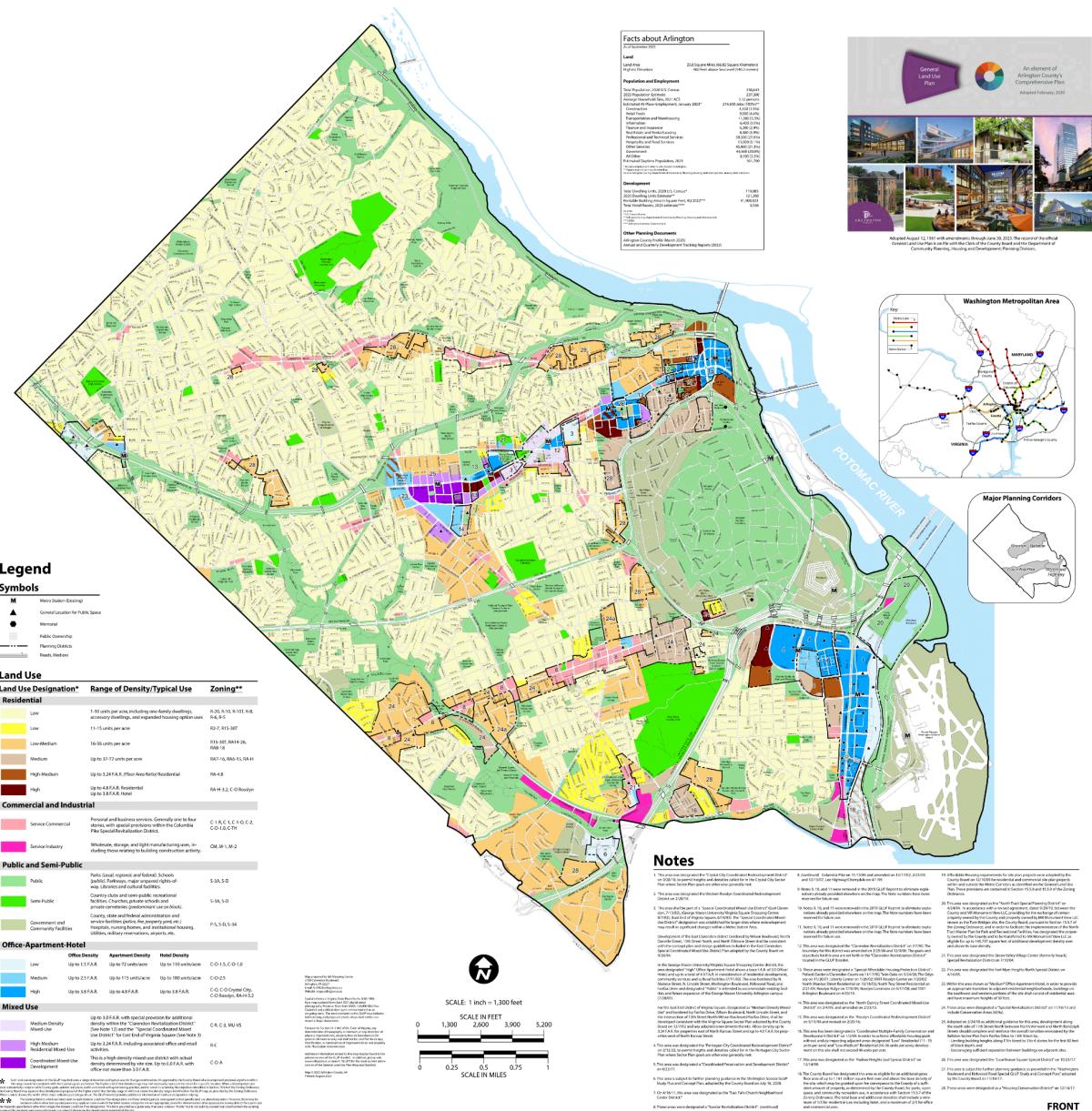


Figure A1: Best viewed at 200% zoom: front page of the Arlington County General Land Use Plan (GLUP) map. The Rosslyn-Ballston Metro Corridor is the northernmost area in blue, while the Richmond Highway Metro Corridor is the area in blue to the southeast. The Columbia Pike Corridor is the black-outlined area to the west of the Richmond Highway Metro Corridor. Areas marked for low-density residential use are in pale yellow.

Source (containing higher-resolution PDF of the figure): Arlington County. “GLUP Map: Front.”

June

2023.

[https://www.arlingtonva.us/files/sharedassets/public/v2/projects/documents/glup/glup\\_map\\_june\\_2023\\_part1.pdf](https://www.arlingtonva.us/files/sharedassets/public/v2/projects/documents/glup/glup_map_june_2023_part1.pdf).



Figure A2: From left to right: an unprotected bike lane, a protected bike lane, and an off-street trail. Sources: *Photograph of an Unprotected Bike Lane in Arlington*. n.d.

<https://www.bikearlington.com/explore/>; *Photograph of an Protected Bike Lane in Arlington*.

n.d. <https://www.bikearlington.com/explore/>; *Photograph of an Off-Street Trail in Arlington*. n.d.

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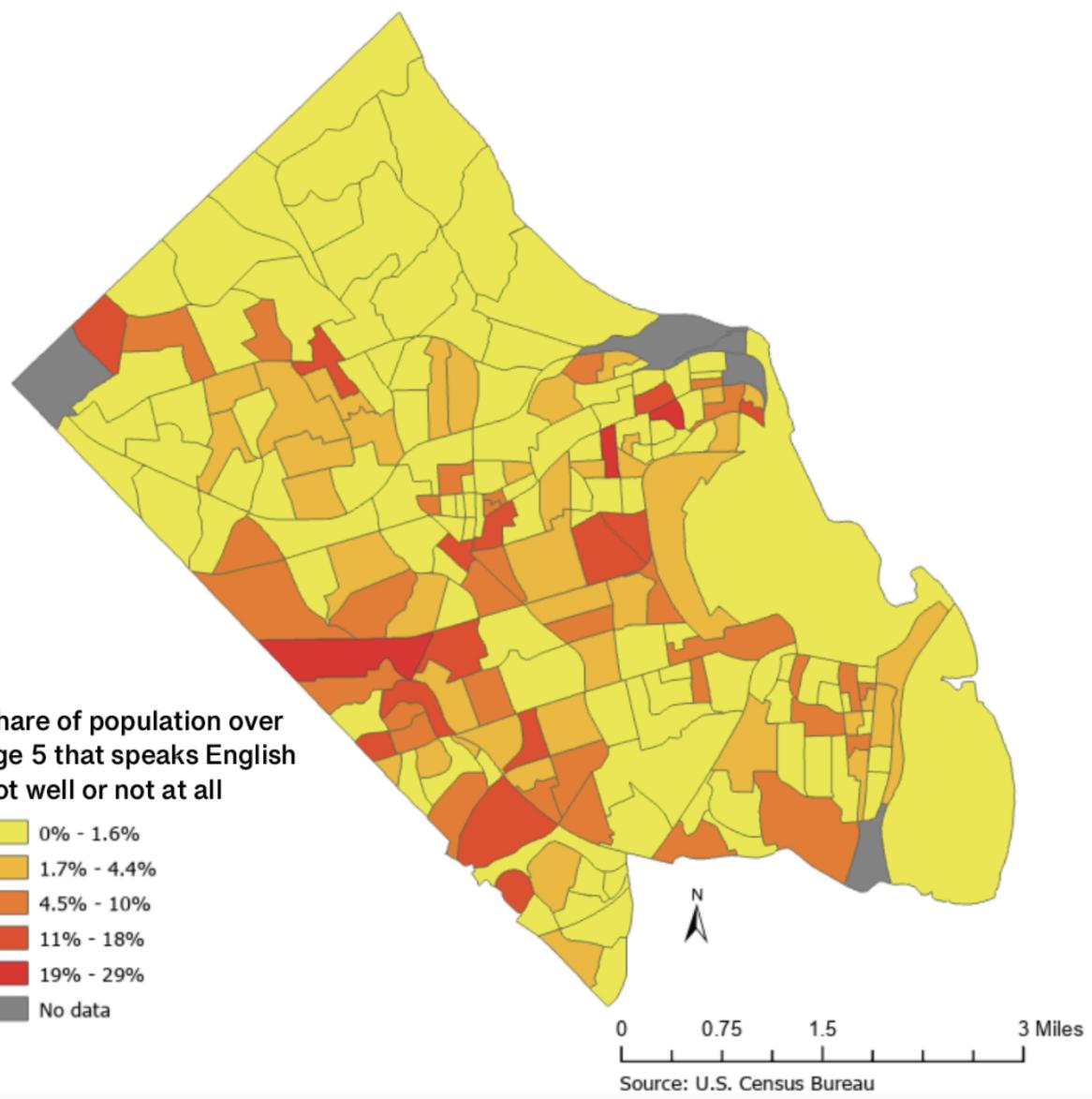


Figure B1: Map of the share of the population of Arlington County over age 5 that speaks English not well or not at all, by block group.

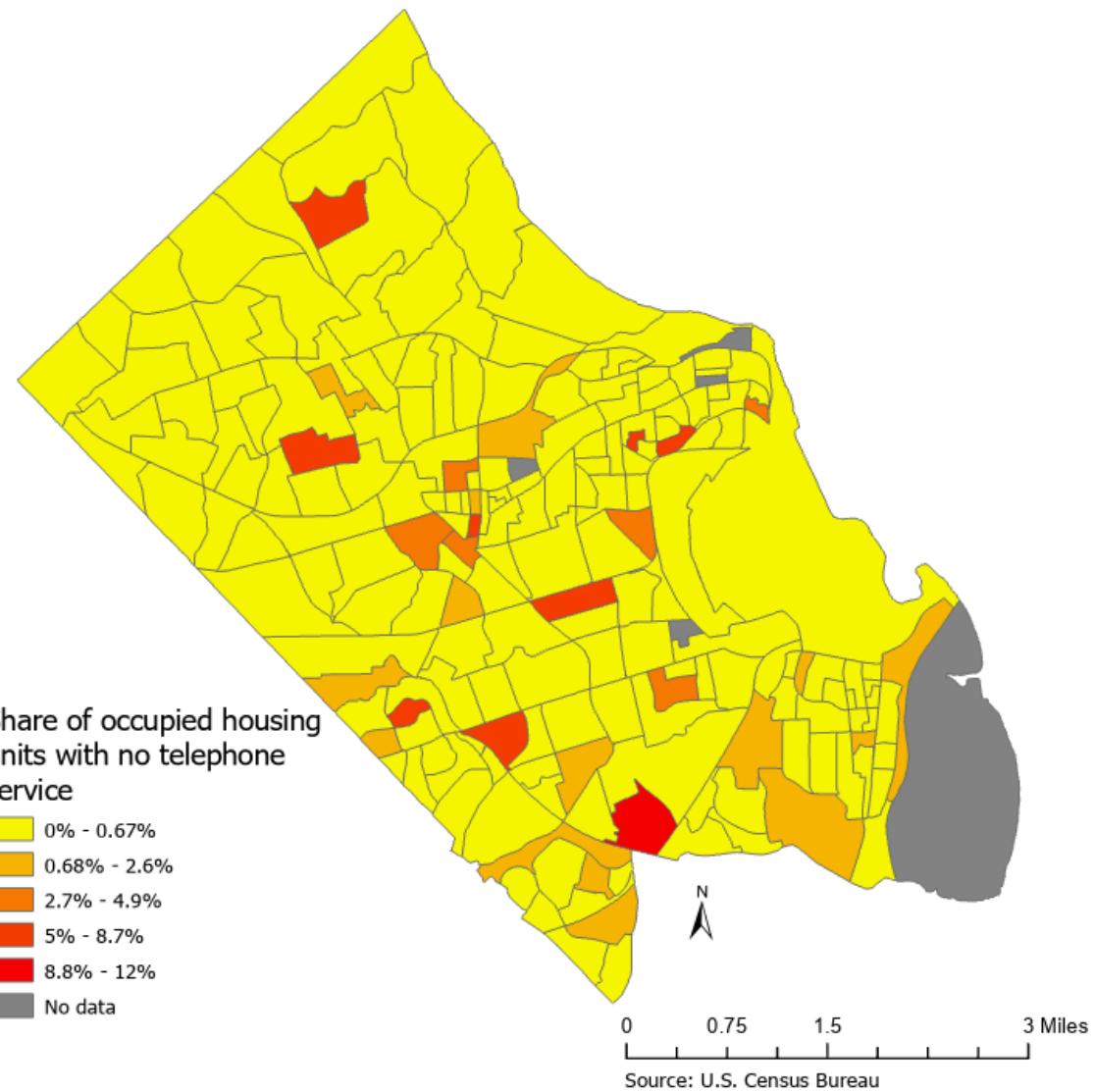


Figure B2: Map of the share of occupied housing units in Arlington County with no telephone service, by block group.

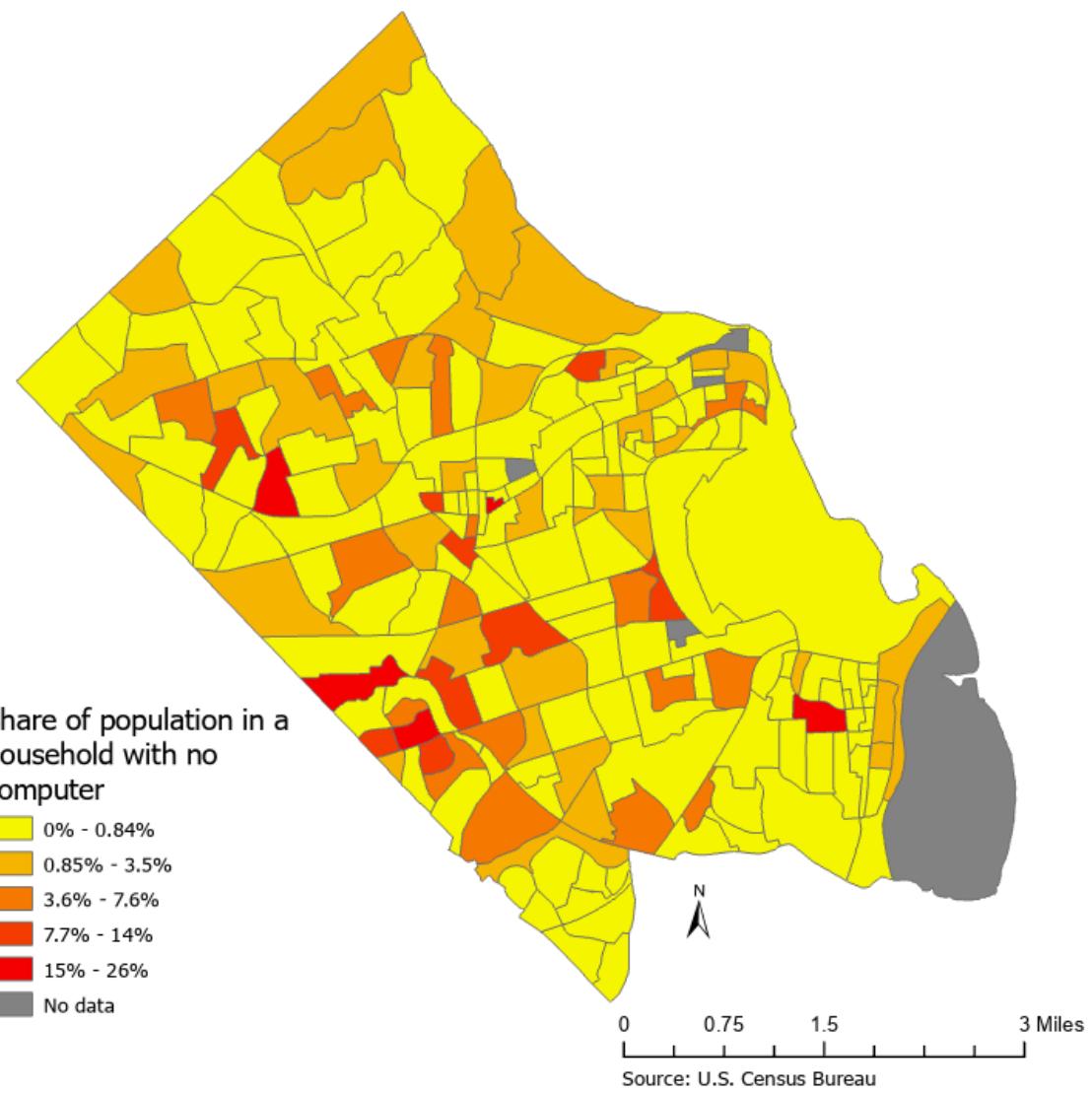


Figure B3: Map of the share of the population in a household in Arlington County with no computer, by block group.



Figure C1: Map of all protected and unprotected bike lanes, off-street trails (which are limited to pedestrians and micromobility vehicles like bicycles), and roads in Arlington County.

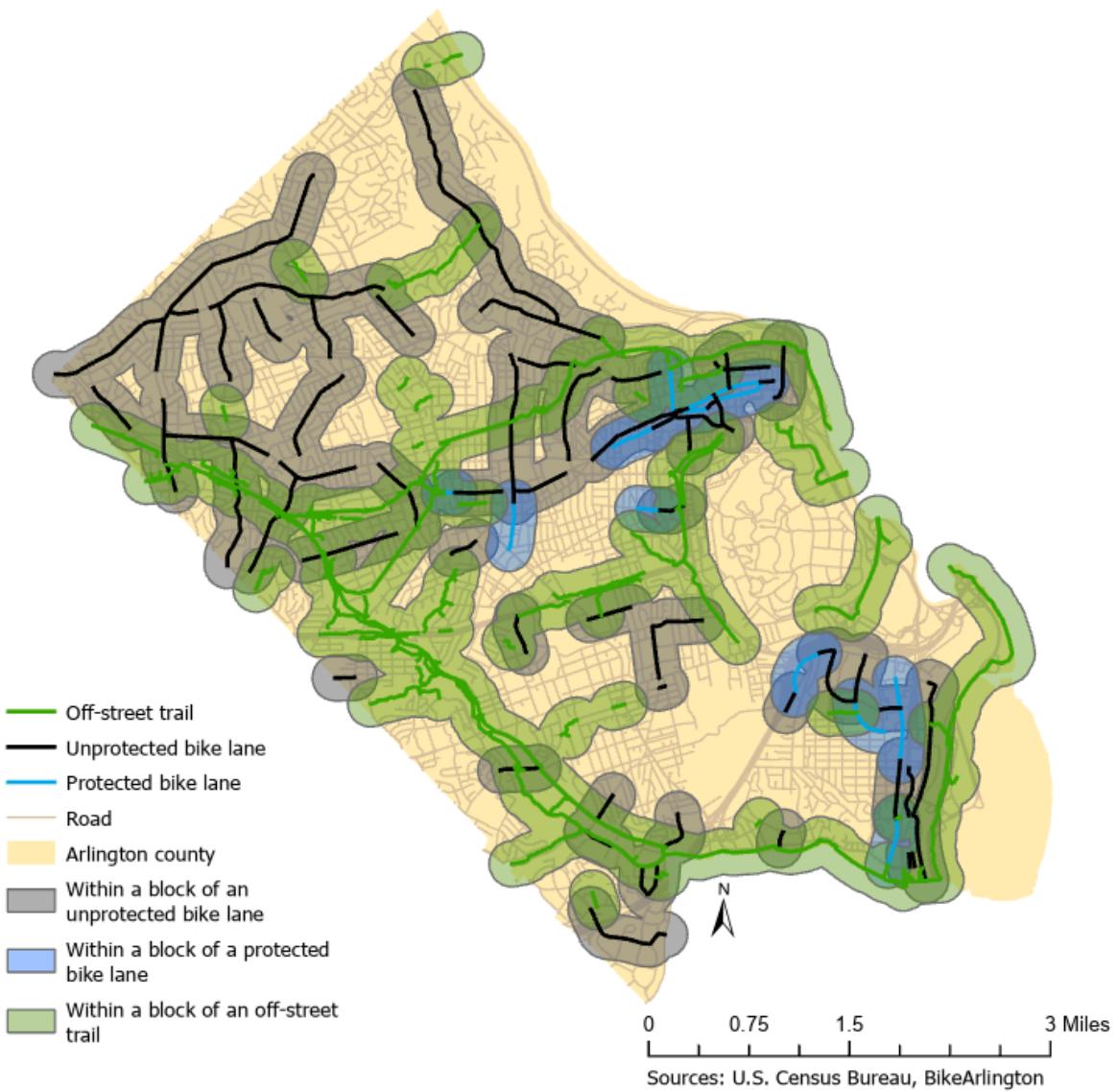


Figure C2: Map of all areas in Arlington County within a Manhattan east-west block of a protected bike lane, unprotected bike lane, and off-street trail (which are limited to pedestrians and micromobility vehicles like bicycles) by type, as well as roads within the county.

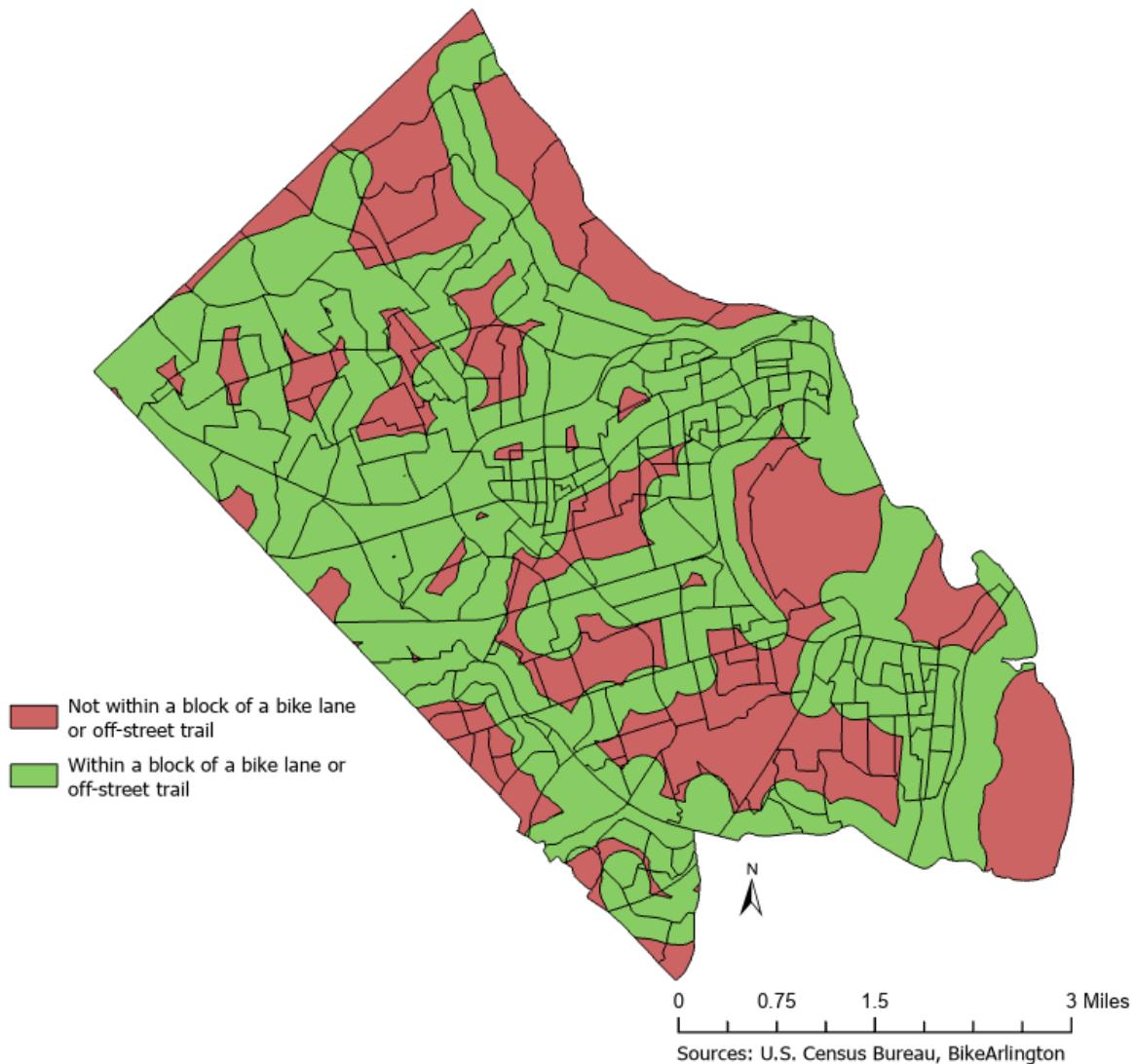


Figure C3: Map of all areas in Arlington County within and not within a Manhattan east-west block of a protected bike lane, unprotected bike lane, and off-street trail (which are limited to pedestrians and micromobility vehicles like bicycles).

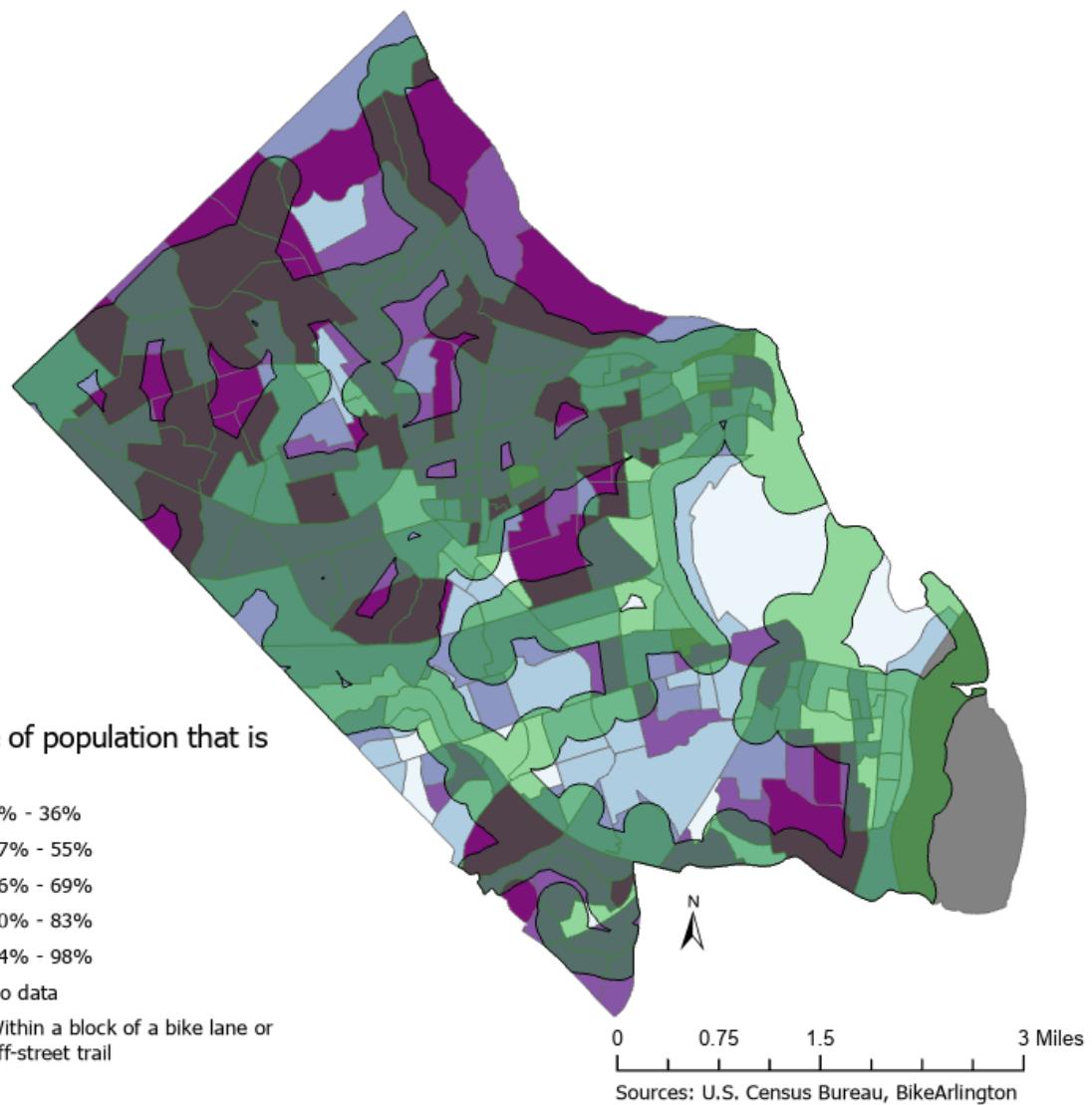


Figure D1: Map of the share of the population in Arlington County that is white by block group, overlaid with all areas in Arlington County within a Manhattan east-west block of a protected bike lane, unprotected bike lane, and off-street trail (which are limited to pedestrians and micromobility vehicles like bicycles).

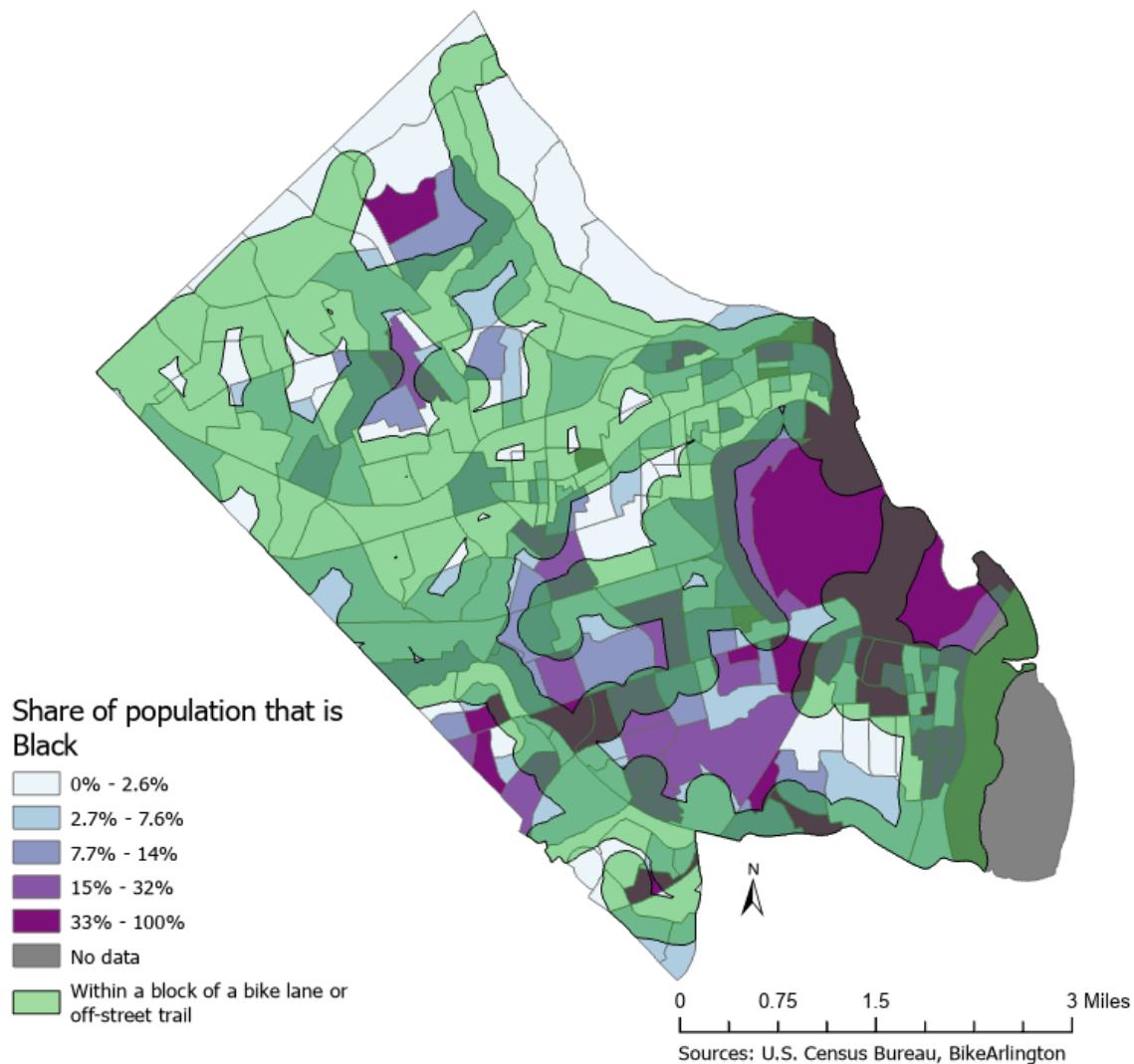


Figure D2: Map of the share of the population in Arlington County that is Black by block group, overlaid with all areas in Arlington County within a Manhattan east-west block of a protected bike lane, unprotected bike lane, and off-street trail (which are limited to pedestrians and micromobility vehicles like bicycles).

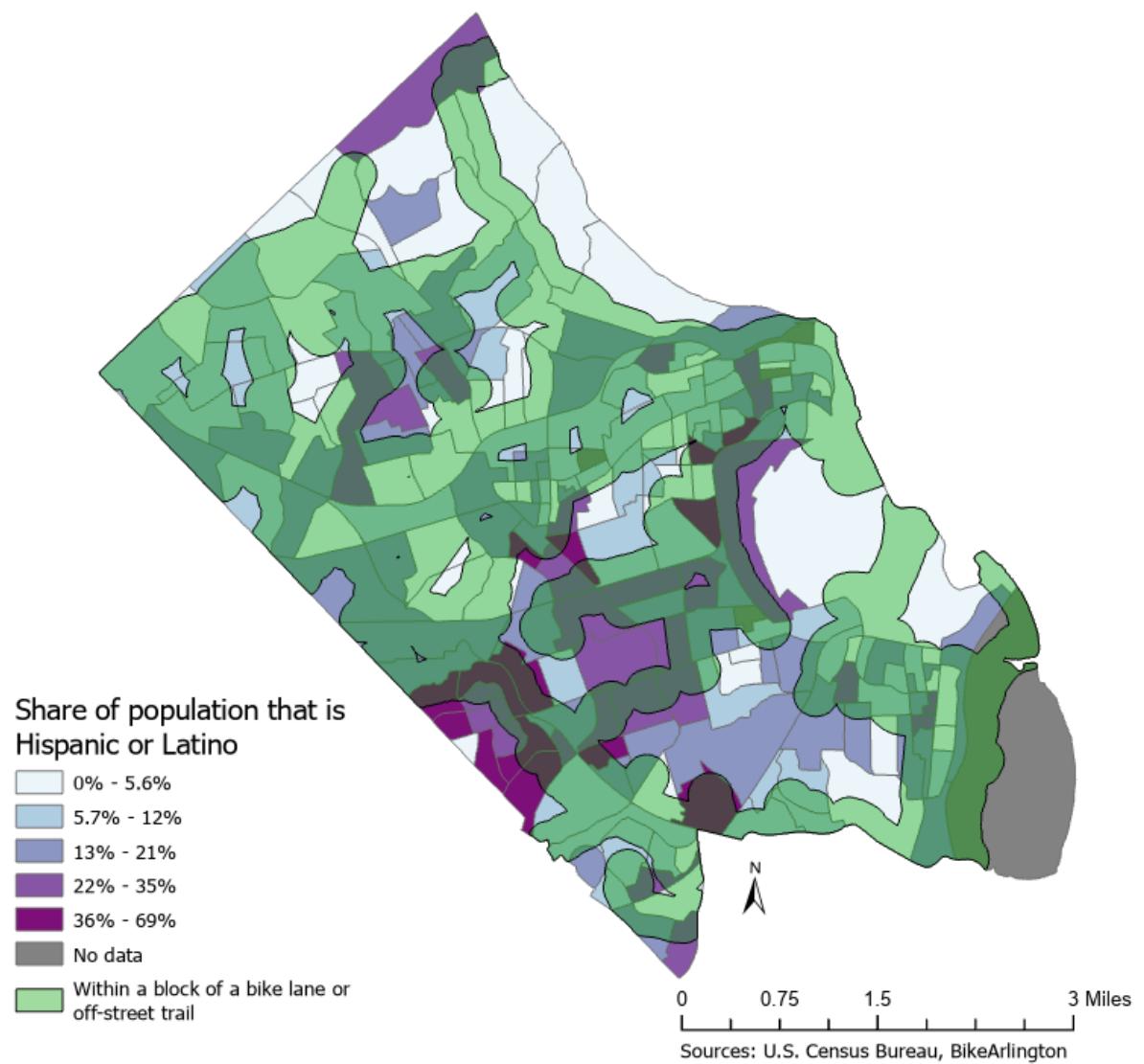


Figure D3: Map of the share of the population in Arlington County that is Hispanic or Latino by block group, overlaid with all areas in Arlington County within a Manhattan east-west block of a protected bike lane, unprotected bike lane, and off-street trail (which are limited to pedestrians and micromobility vehicles like bicycles).

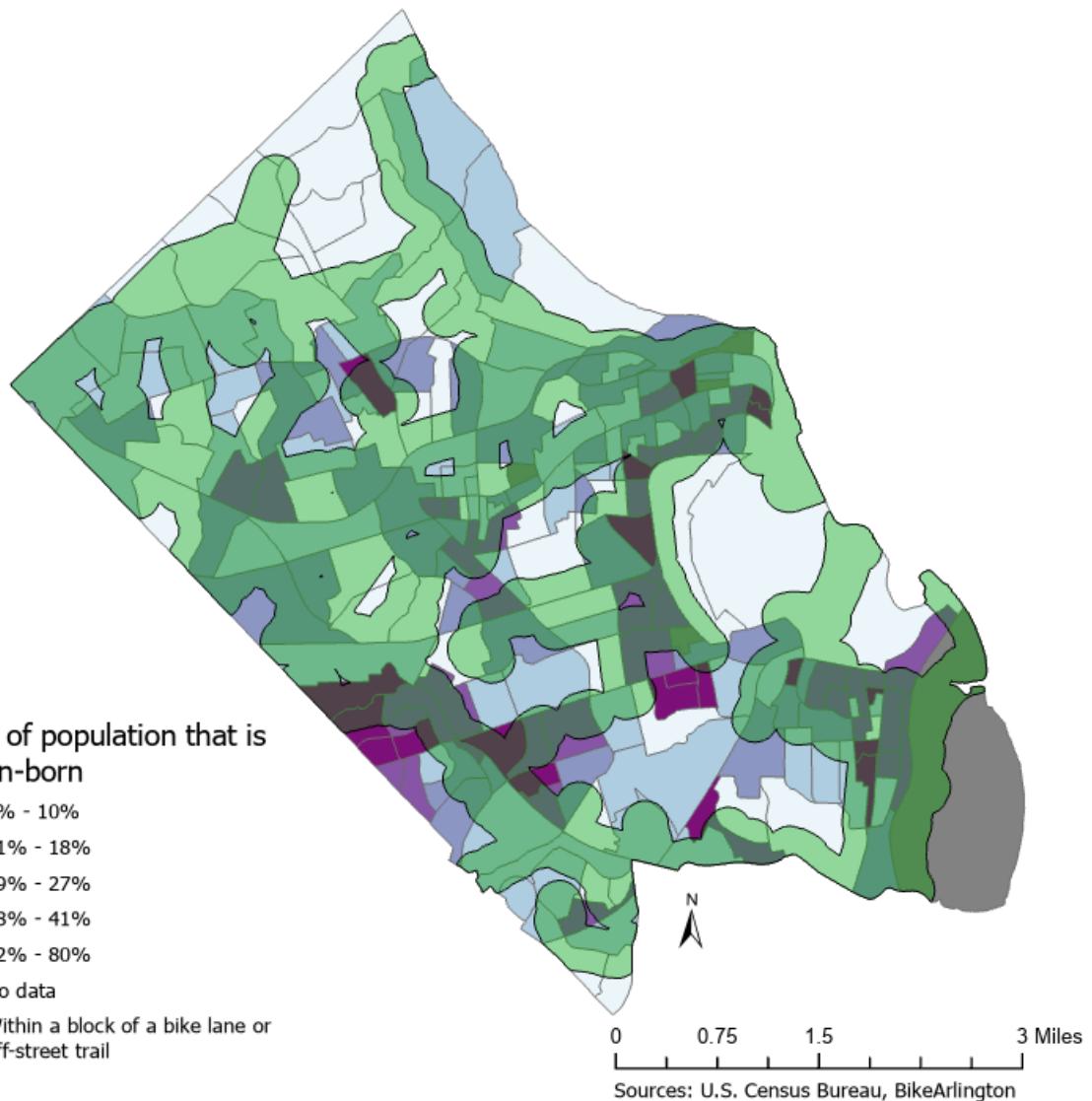


Figure D4: Map of the share of the population in Arlington County that is foreign-born by block group, overlaid with all areas in Arlington County within a Manhattan east-west block of a protected bike lane, unprotected bike lane, and off-street trail (which are limited to pedestrians and micromobility vehicles like bicycles).

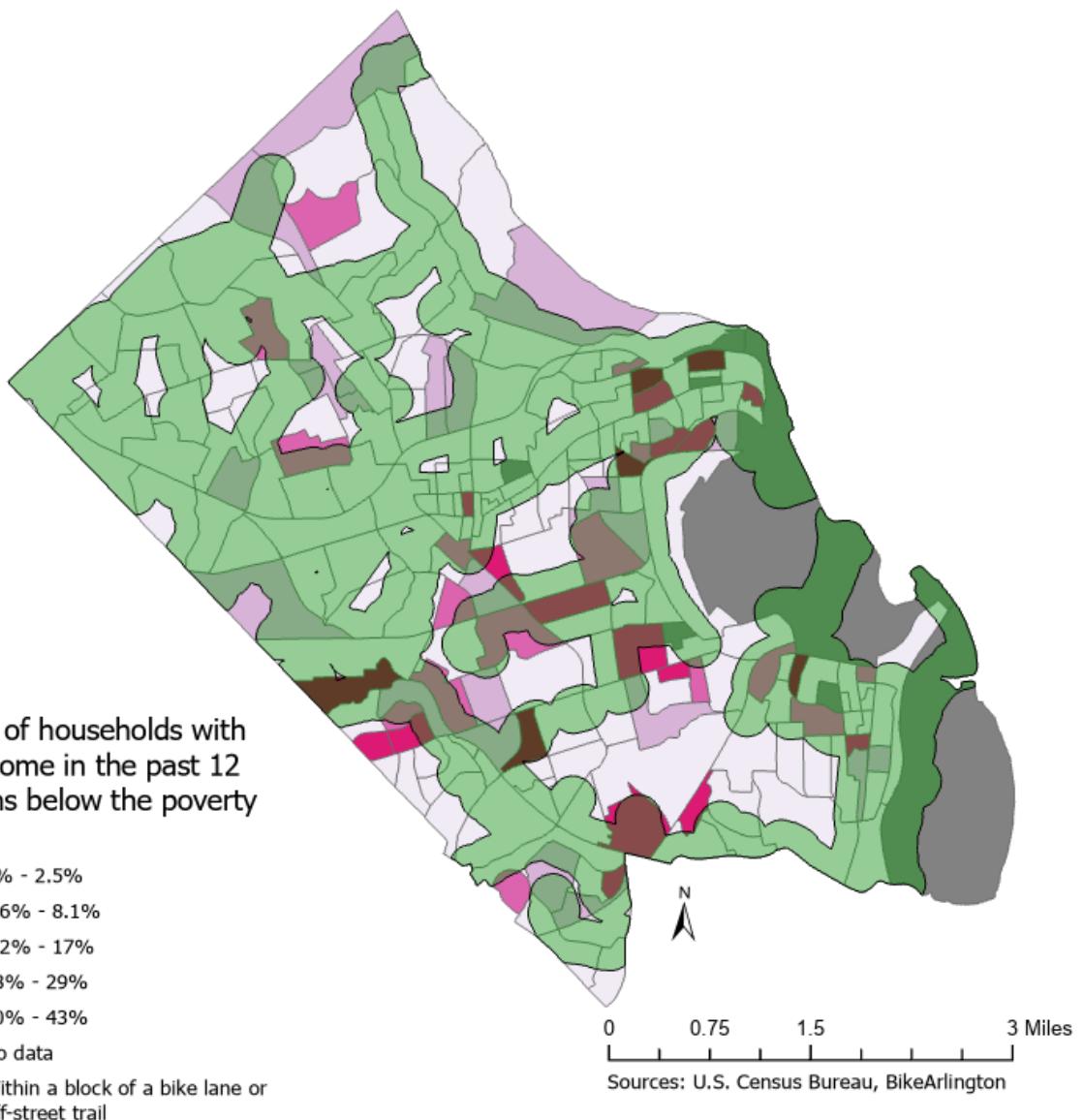


Figure E1: Map of the share of households in Arlington County with an income that was below the poverty level in the last 12 months, by block group, overlaid with all areas in Arlington County within a Manhattan east-west block of a protected bike lane, unprotected bike lane, and off-street trail (which are limited to pedestrians and micromobility vehicles like bicycles).

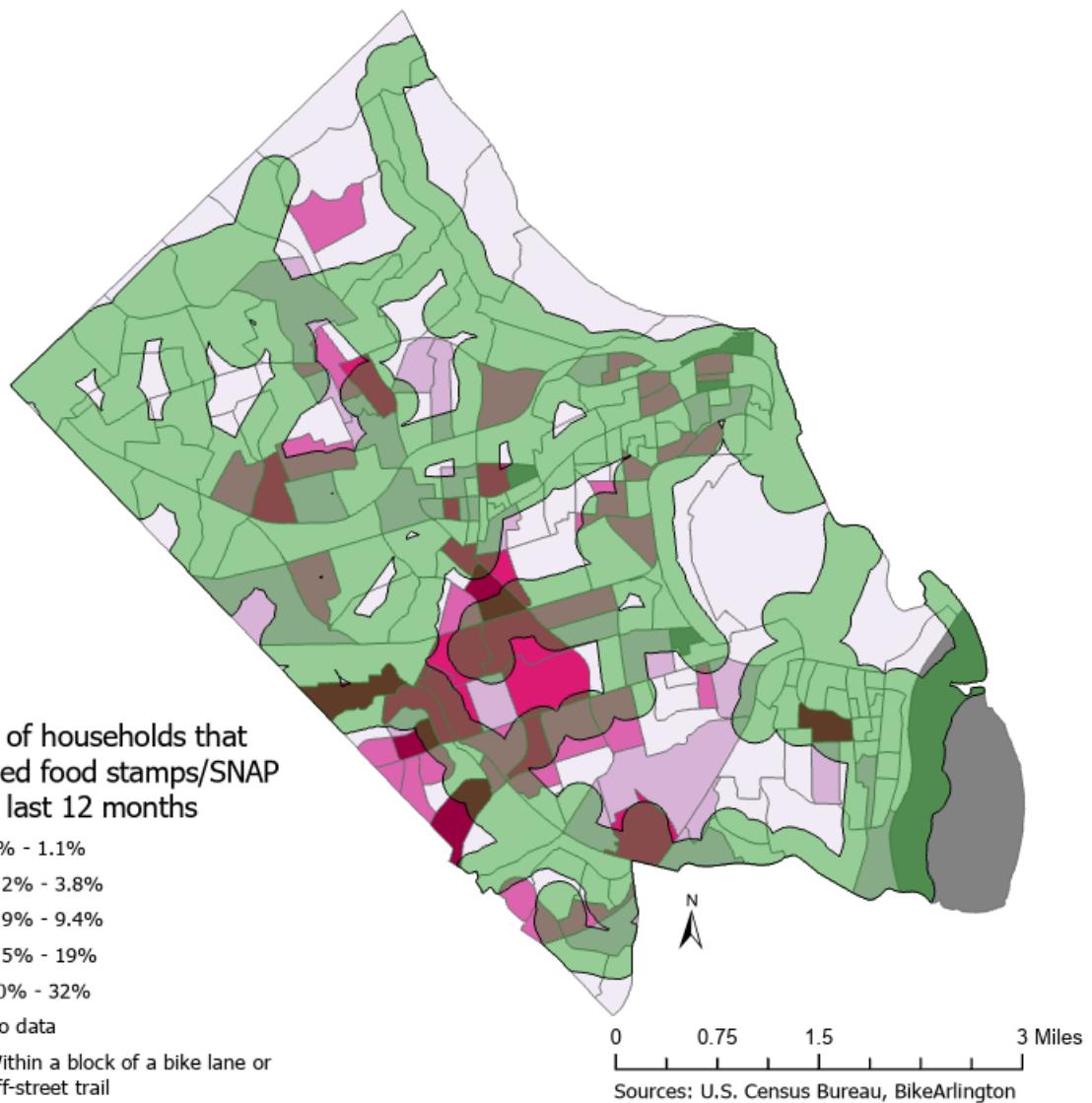


Figure E2: Map of the share of households in Arlington County that received food stamps/SNAP in the last 12 months, by block group, overlaid with all areas in Arlington County within a Manhattan east-west block of a protected bike lane, unprotected bike lane, and off-street trail (which are limited to pedestrians and micromobility vehicles like bicycles).

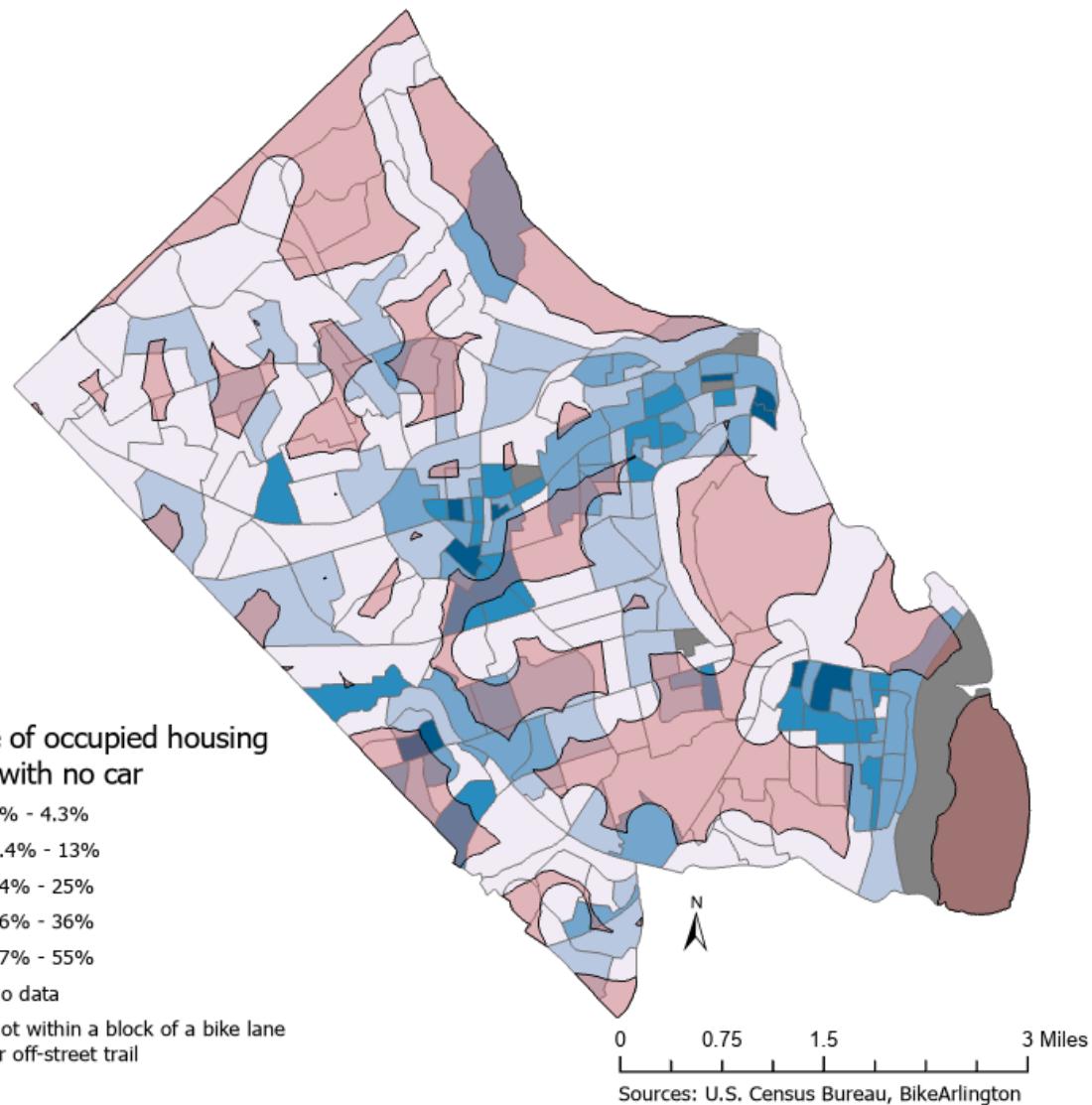


Figure F1: Map of the share of occupied housing units in Arlington County with no car by block group, overlaid with all areas in Arlington County not within a Manhattan east-west block of a protected bike lane, unprotected bike lane, and off-street trail (which are limited to pedestrians and micromobility vehicles like bicycles).

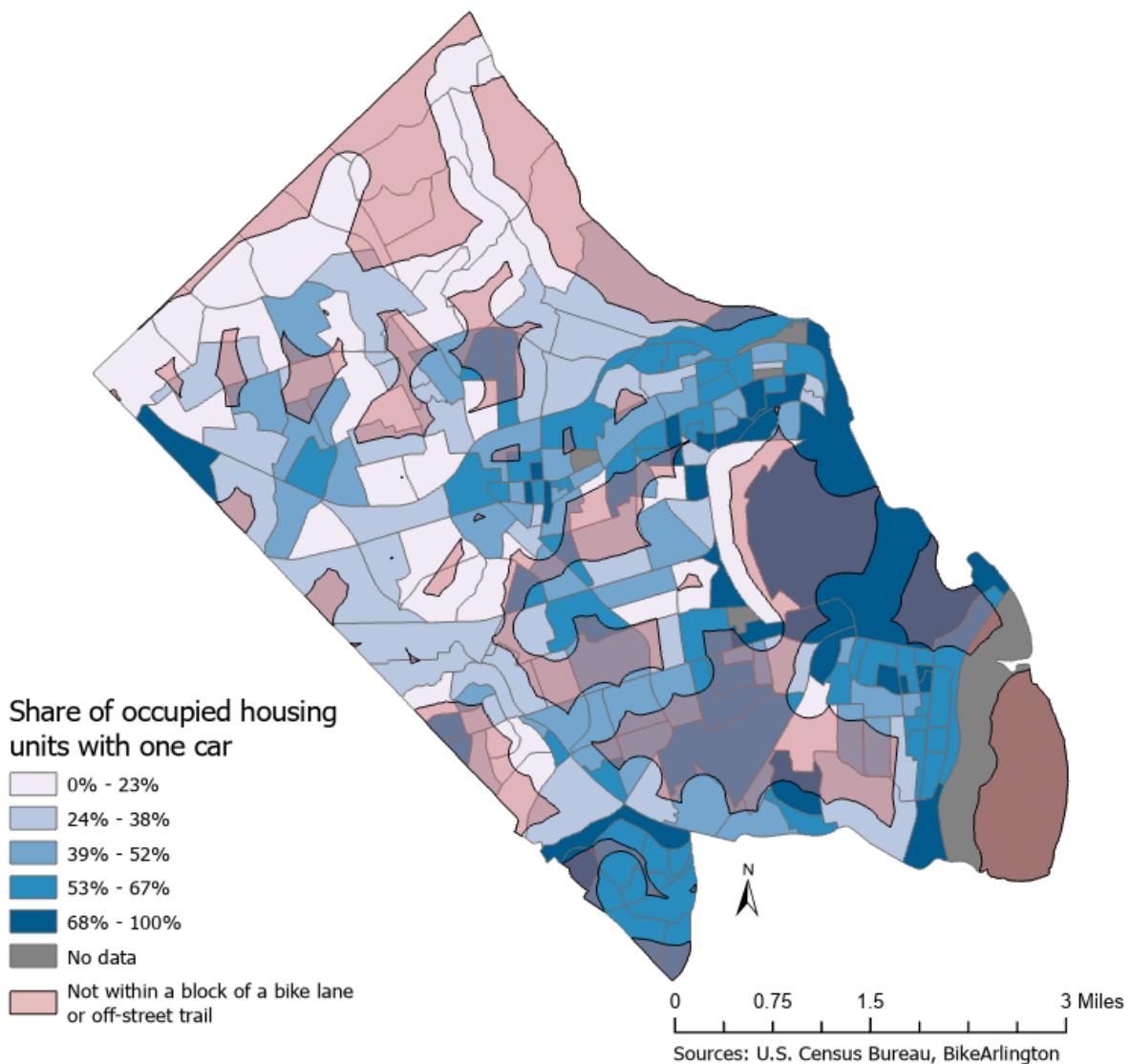


Figure F2: Map of the share of occupied housing units in Arlington County with one car by block group, overlaid with all areas in Arlington County not within a Manhattan east-west block of a protected bike lane, unprotected bike lane, and off-street trail (which are limited to pedestrians and micromobility vehicles like bicycles).

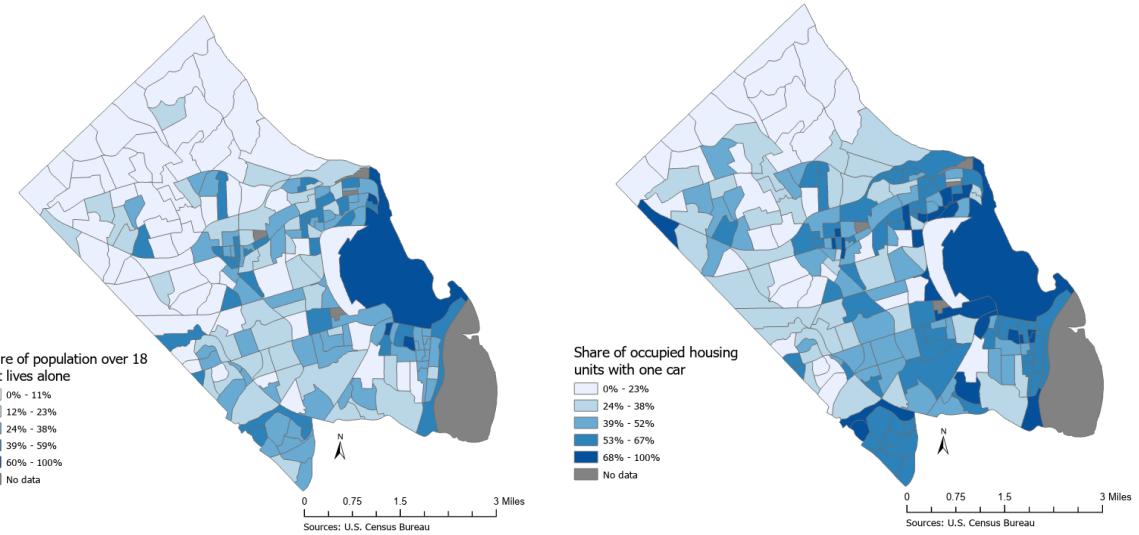


Figure F3: Map of the share of the population in Arlington County that lives alone (left), and a map of the occupied housing units in Arlington County with one car by block group.



Figure G: Map of the Arlington Loop trail.