Transit Propensity

Transit Vision Plan for the Charlottesville Area

Background and Purpose

The *Regional Transit Vision Plan for the Charlottesville Area* is a study effort that seeks to develop a single, unified vision for the future of transit service in the Charlottesville area. The Thomas Jefferson Planning District Commission (TJPDC) initiated this effort to provide a basis for increased cooperation and collective action among the region's transit providers. The Vision Plan is a next step for the Regional Transit Partnership (RTP), which the TJPDC formed "to provide recommendations to decision-makers on transit-related matters."

One of the critical first steps in this planning and visioning effort is completing a Transit Propensity analysis of the study area which informs two different types of considerations in transit planning:

- Where are the strongest markets for transit, with potential for high ridership and low operating costs?
- Where are there moderate or severe needs for transit, where coverage services may be important even if they do not attract high ridership?

A "strong transit market" is mostly defined by where people are, and how many of them are there, rather than by who people are. We learn about transit needs mostly by examining who people are and what life situation they are in.

The analysis presented in this memo help measure potential transit markets and needs:

- Residential density
- Job density (including low-wage jobs and retail jobs)
- Activity density (combined residential and jobs)
- Walkability
- Zero-Vehicle households
- Poverty density map
- Density of Residents under age 18 (Youth)
- Density of senior residents (65+)

No one measure tell us that a place has high ridership potential or high needs. Rather, we must consider them in combination.

Designing for Ridership

If you asked a transit planner to draw you a very high-ridership bus route, that planner would look mostly at densities of all residents and jobs; at the walkability of streets and neighborhoods; and at the cost of

running a bus route long enough to reach them. Only secondarily would that planner look into the income or age of those residents or workers.

Designing for Coverage

If you asked a transit planner to draw you a route that helped as many people with severe needs as possible, they would look at where low-income people, seniors, youth and households with zero vehicles live and where they need to go. The densities at which these people live matters, because at higher densities a single bus stop can be useful to more people in need. However, the transit planner might also try to get the route close to small numbers of people. In fact, the more distant and scattered people are, the more isolated they can be and the more badly they might need access to transit.

Civil Rights and Equity

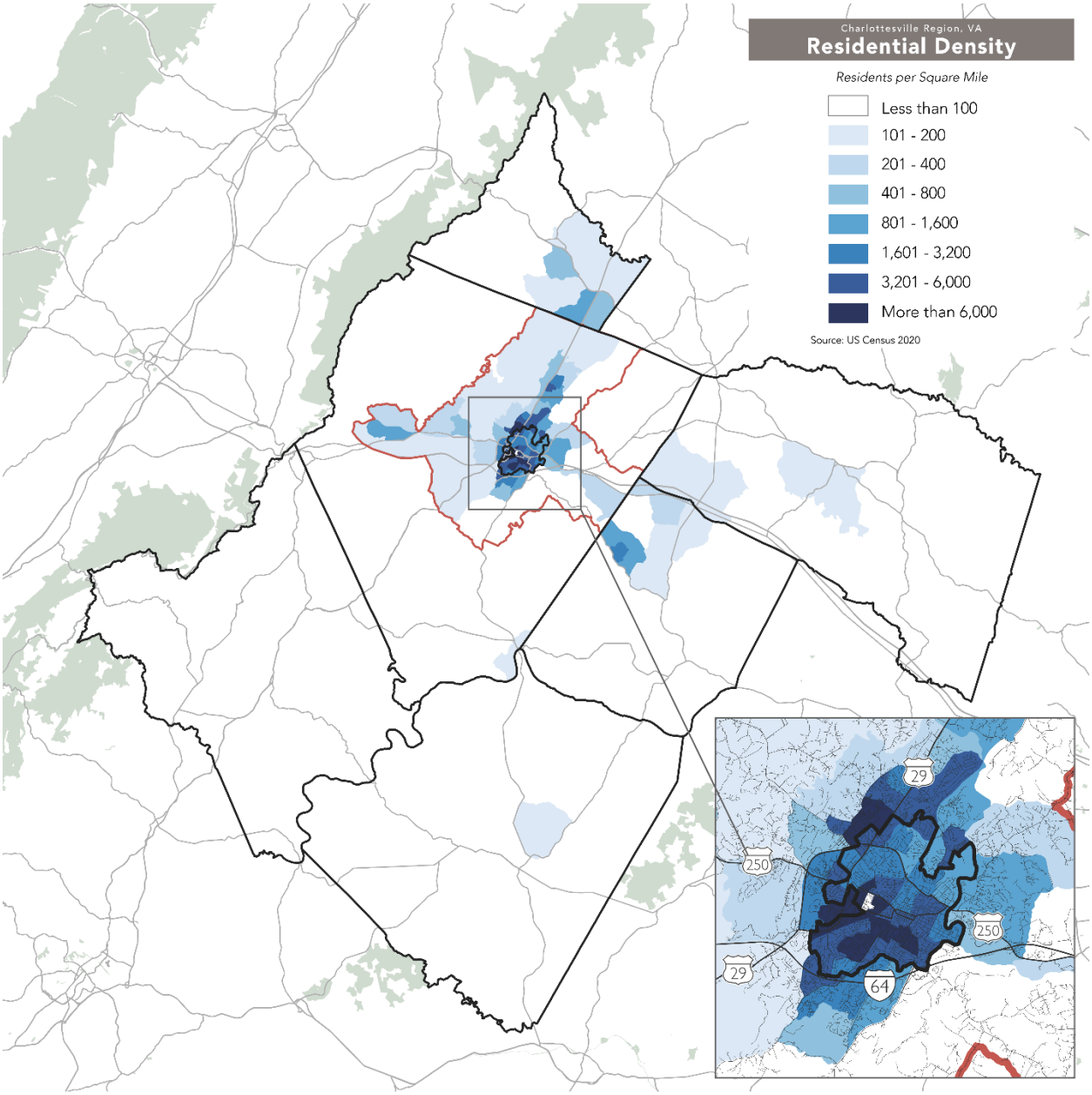
Another important set of maps in this report is not strictly related to need but rather to civil rights. These maps show where residents of color live. By resident of color, we mean a person who identifies themselves in Census surveys as non-white or of Hispanic or Latino origin. Unequal treatment on the basis of race or ethnicity is prohibited by Civil Rights Act of 1964. (Unequal treatment on the basis of other characteristics, including income and age, is also prohibited by law.)

A person's race or ethnicity does not tell us if they need transit, or if they have a propensity to use transit. However, we know that race and ethnicity are correlated with income. Providing equitable and supportive levels of service to people of color, even in areas that are costly to serve or that do not generate much transit ridership, can be one of the important coverage goals for transit.

Indicators of Demand: Residential Density

Residential density is a key metric in assessing the strength of transit markets because most people's daily travel behavior begins and ends at home. **Figure 1** shows that residential density is centered around Charlottesville, extending into surrounding Albemarle County, north into Greene County and southeast along I-64 into Fluvanna County. Outside these area, residential density is very low. Research suggests that residential densities above 3,200 residents per square mile are reasonably supportive of fixed route bus service at productivity levels that are politically acceptable. Areas with lower densities could be supportive of on-demand or other more flexible transit tools. This map only represents one side of the travel market. The other half is where people go when they leave their home, such as offices, schools, retail, and other places.

Figure 1 | Residential Density



Indicators of Demand: Job Density

Figure 2 shows the density of jobs in the study area. Employment density can tell us not just about where people might be going to work, but also about important destinations people travel to. Particularly in the retail and service sectors, high employment density also indicates places that are likely to have a high density of customers. The largest concentration of job density is around Charlottesville and north along US-29. Hospitals, government offices, shopping centers and the UVA campus are sites of significant employment in and around Charlottesville. Research suggests that job density levels above 2,500 jobs per square mile are reasonably supportive of fixed route bus service at productivity levels that are politically acceptable. Such density levels are only found in the core of the region in Charlottesville.

Figure 3 shows the density of low-wage jobs in the study area and **Figure 4** shows the density of retail jobs, which are typically low-wage jobs. Low-wage jobs are more widely distributed across the study area. There is a high concentration of low-wage jobs near UVA, most of which is retail serving the campus. There is also a large low-wage jobs concentration near the Sentara Martha Jefferson Hospital and surrounding the Seminole Square Shopping Center and west along Hydraulic Road. A Walmart Supercenter and distribution facility are a concentration of low-wage jobs in western Louisa County at the Zion Crossroads interchange off I-64. The map of retail jobs (**Figure 4**) shows that retail jobs and low-wage jobs follow similar patterns.

Figure 2 | Job Density

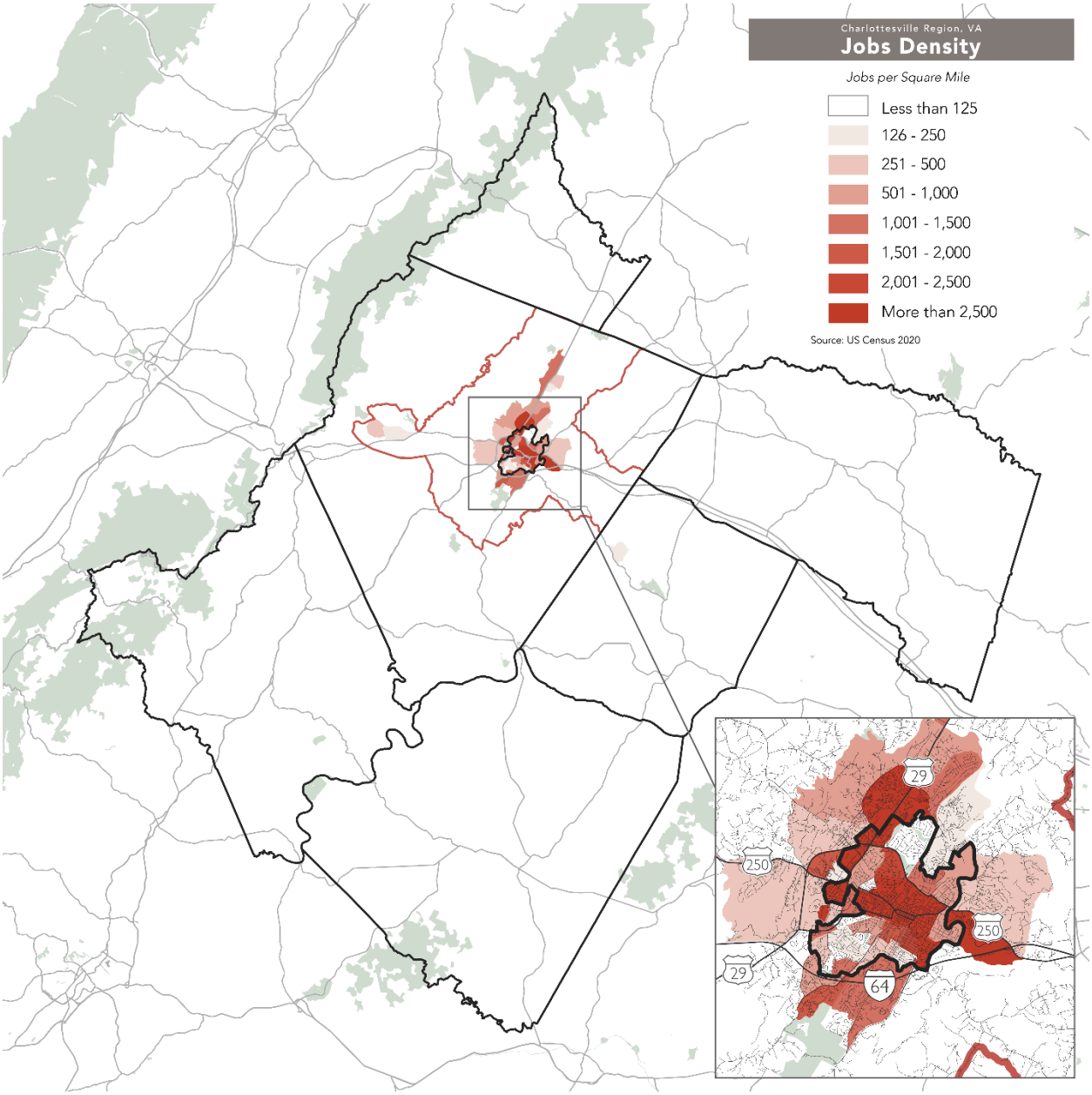


Figure 3 | Low-Wage Job Density

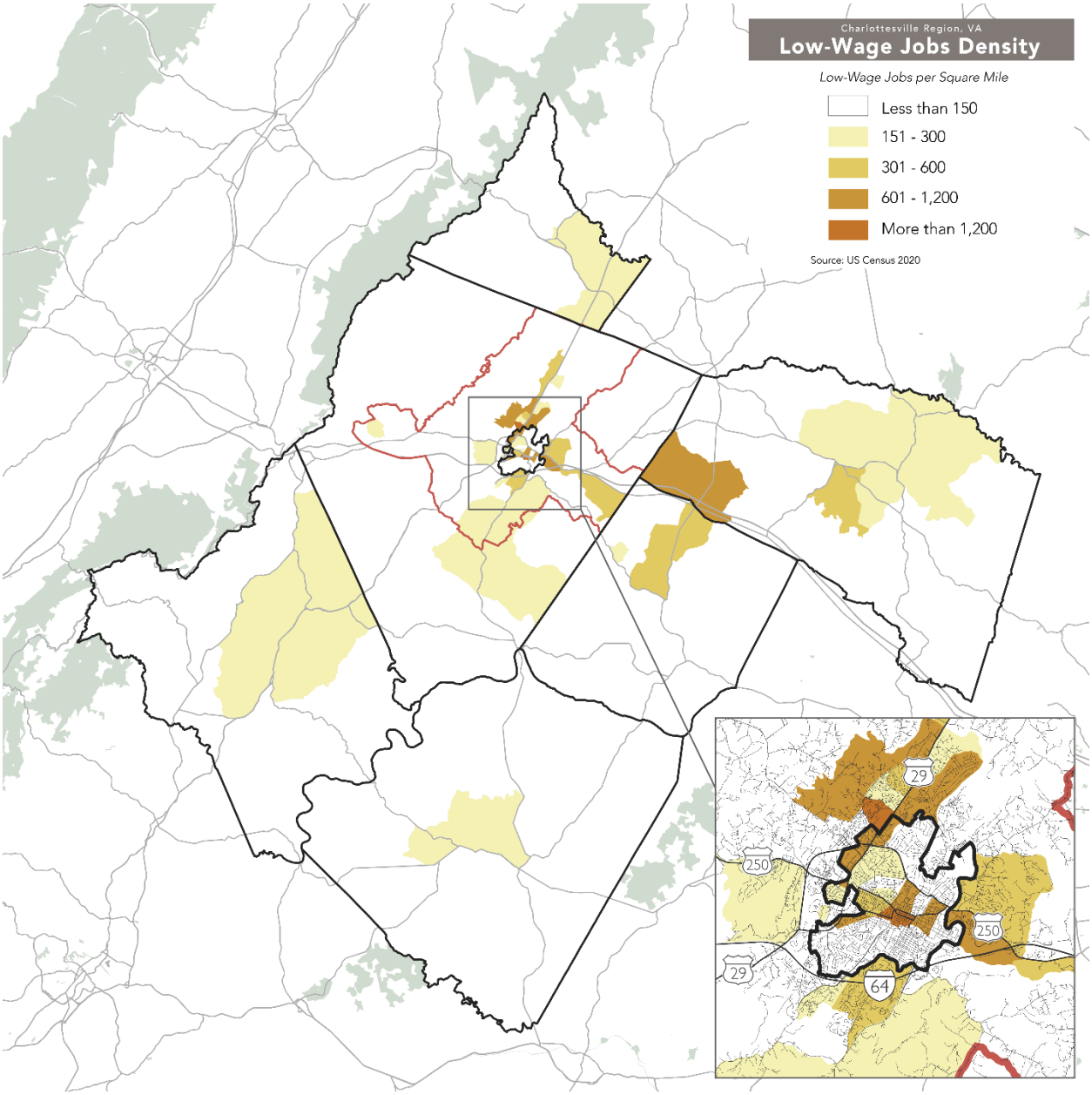
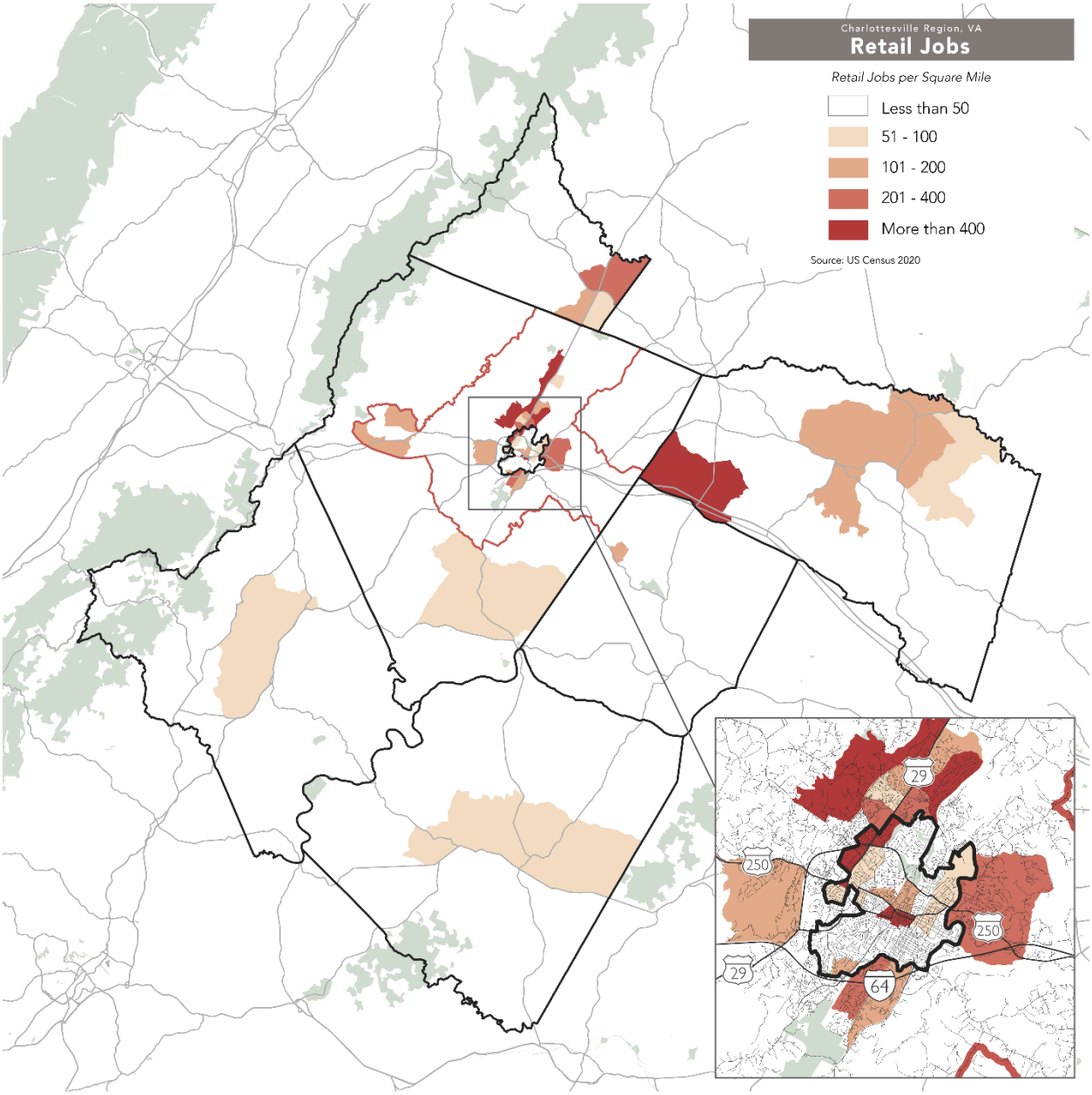


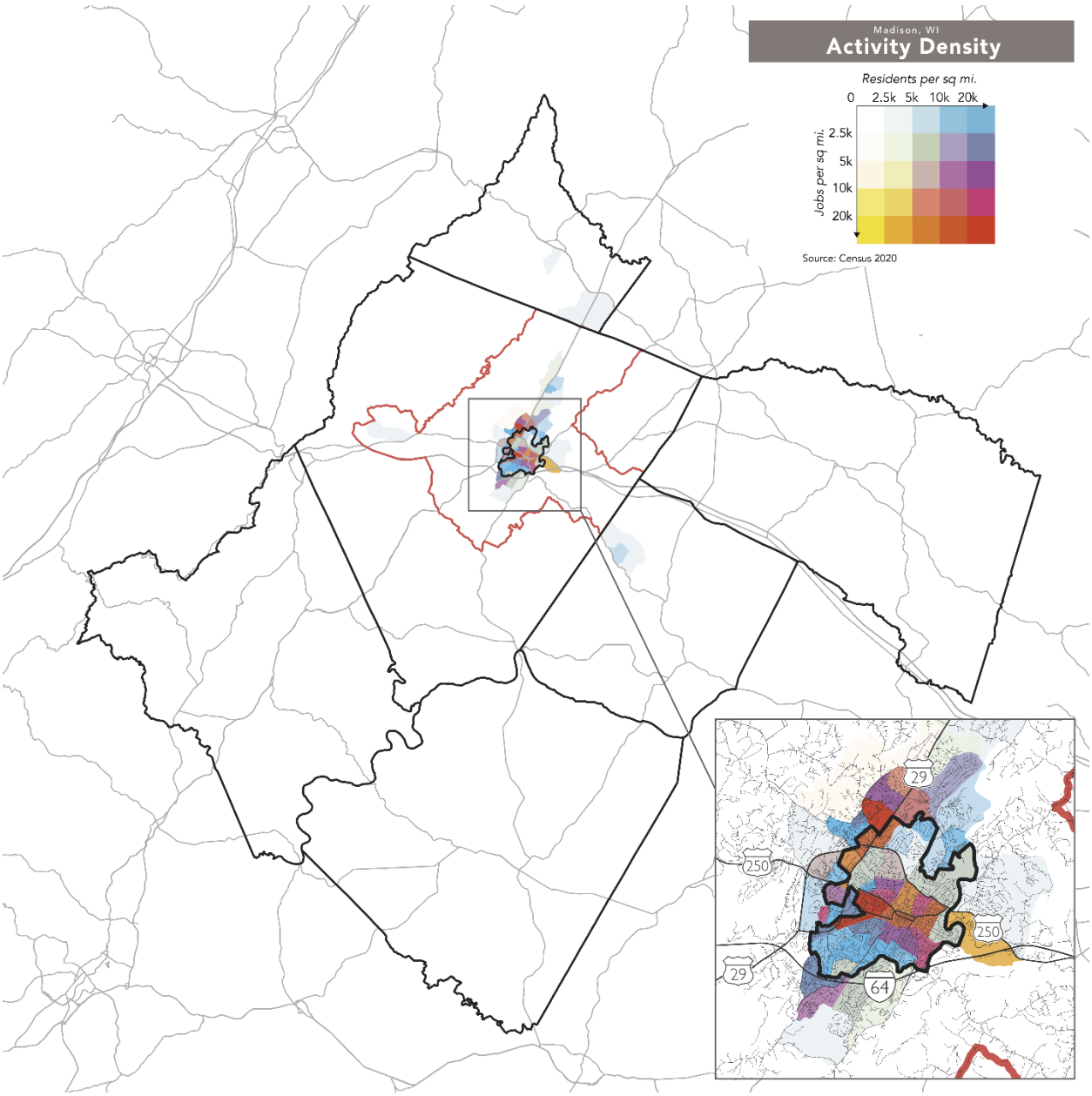
Figure 4 | Retail Job Density



Indicators of Demand: Activity Density

The map below shows many different types of activity: homes, workplaces, shopping, industry, entertainment and more. It uses a three-color scale: residential density is shown in shades of blue, job density is shown in shades of yellow, and places where residents and jobs are both present are shown in shades of red. The darker the color, the greater the number of jobs or residents in the area. This map allows us to see not only high density, but also the mix of activities in an area, which contributes to ridership potential. Transit routes serving purely residential neighborhoods tend to be used mostly in only one direction each morning and evening rush hour. In contrast, where residential, commercial, and other uses are mixed, people are traveling in both directions so buses can be full in both directions. Corridors which run between purely residential and purely employment areas see some of the benefits of mixed land-uses. In the study area, the highest activity density is in the City of Charlottesville and immediately outside the city. Research suggests that a combined density level of 5,000 people or jobs in an area is reasonably supportive of fixed route transit. Therefore, any area with color on this Activity Density map is a moderately good candidate for at least 30 or 60 minute bus service. Other areas in the region might be more effectively served with on-demand, flexible routes, or peak-only commuter services depending on the nature of the demand or need.

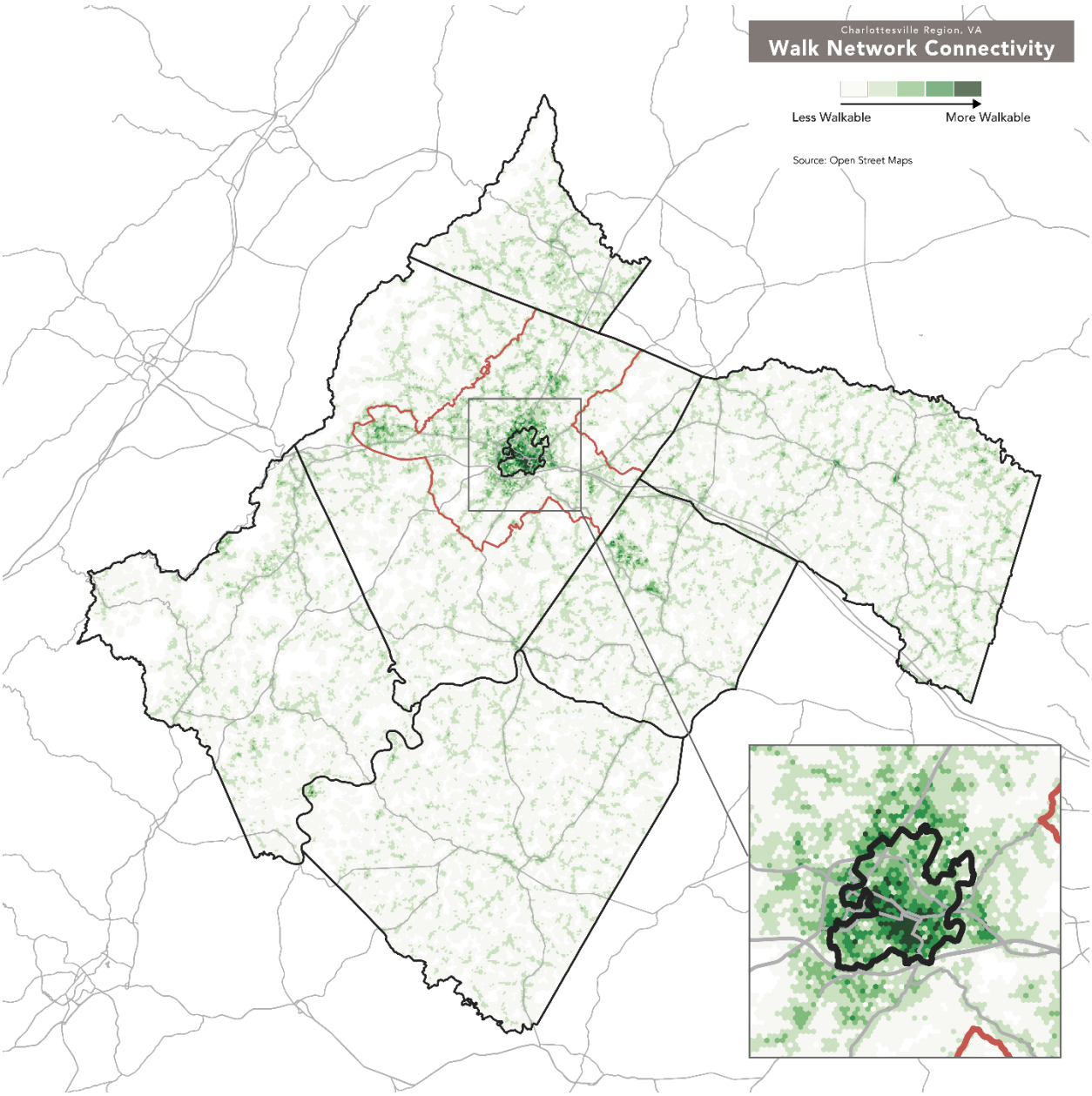
Figure 5 | Activity Density



Indicators of Demand: Walkability

The map below shows an estimate of how walkable different parts of the study area are, based on the percentage of the land area within a half-mile of any given point that can actually be reached by walking a half-mile, using available streets and pedestrian paths. This map clearly shows the more walkable urbanized areas, which feature a denser grid of streets with many intersections makes it easier to walk to bus stops. However, most of the study area is rural and appears in light shades because it has few streets and no sidewalks. Newer suburban developments can have high street connectivity, even without a traditional grid of streets but many newer developments are designed to minimize car traffic with intentionally poor street connectivity. This means that in most cul-de-sac developments, walking routes are long and circuitous, making it hard for people to reach transit since bus routes need to remain on major roads to be direct, efficient, and useful to many people.

Figure 6 | Walk Network Connectivity



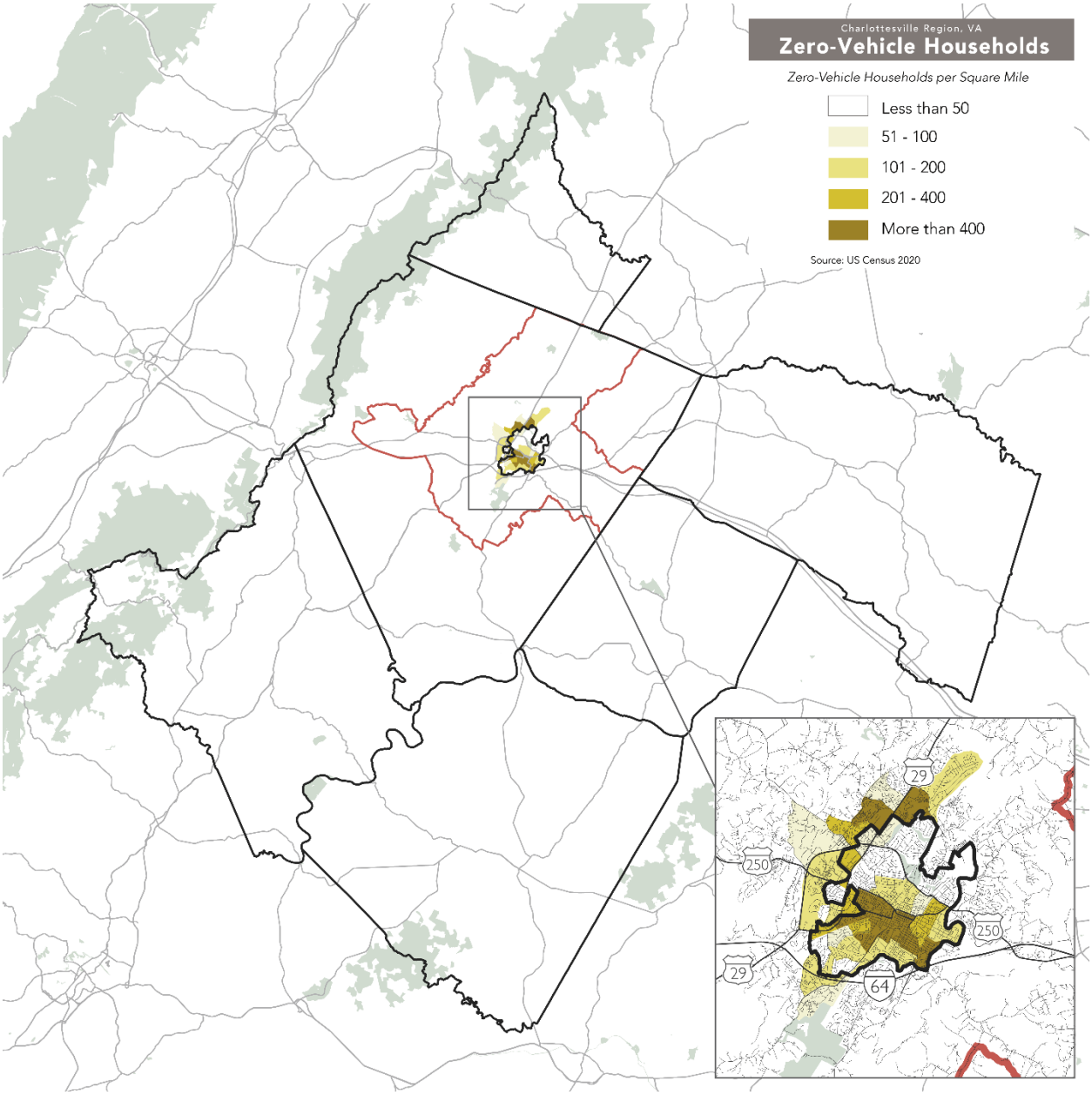
Indicators of Demand: Zero-Vehicle Households

Another factor affecting transit's competitiveness in an area is the availability of personal cars. The map below shows the density of households with zero vehicles.

While people who don't own cars don't use transit by default, they have fewer options than those people who do have access to personal automobiles. As a result, if transit is a useful method (fast, reliable, available when they need to travel) of reaching the places they need to go, it can be a compelling option. If transit does not present a realistic travel option, then people without cars will find other ways of reaching the places they need to go, by getting rides from friends or family members, cycling, walking, or using taxis or ridesharing services.

In the study area, the absolute highest density of zero-vehicle households is found in downtown Charlottesville, and around the UVA campus. This is a common pattern in cities with major universities, since students, particularly those living in on-campus residences, are much less likely to own cars than the general population. Outside of the central city, the density of zero-vehicle households largely corresponds to the density of low-income households. However, there are some exceptions. The areas near Glenwood Station and Raintree north of the City as well as in Sherwood Manor, both have high rates of car ownership despite having a density of people in poverty. This suggests that transit does not meet the travel needs of many people there, despite high levels of need.

Figure 8 | Zero-Vehicle Households

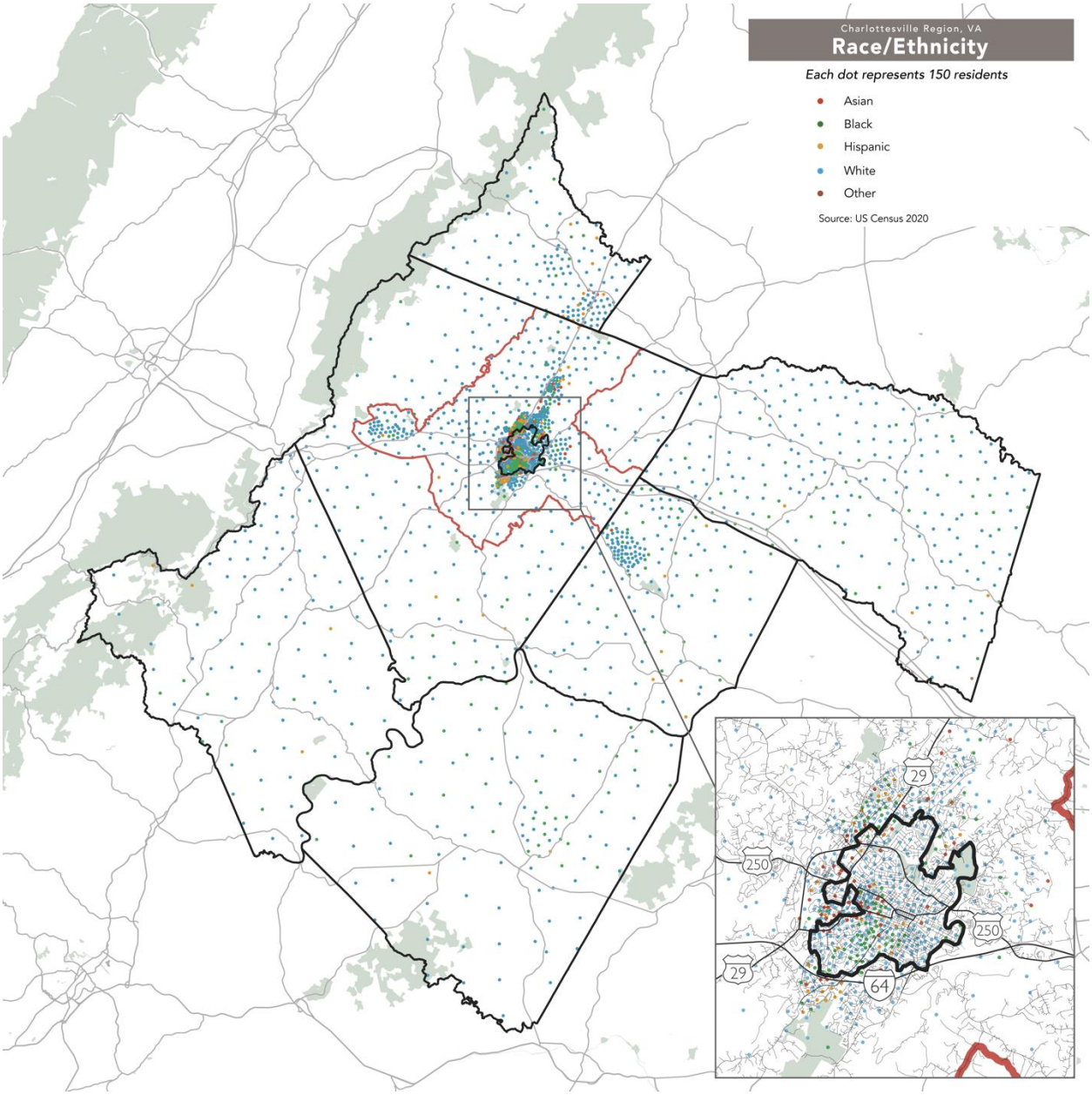


Indicators of Demand and Need: Low Income Households

A frequently-cited goal for transit service is to provide affordable transportation for lower-income people, who are less likely to own cars or have difficulty with the cost of owning and maintain a car. Understanding where low-income populations are located is also a key civil rights requirement. Comparing the maps in **Figure 9** and **Figure 10**, there is in fact some correlation between areas of higher poverty and lower vehicle ownership. Transit can be an attractive option for low-income people due to its low price. In medium to high density areas with walkable street networks, this can produce high ridership. However, if transit doesn't actually allow people to make the trips they need in a reasonable amount of time, even lower-income people will not use it. They will seek other options, such as buying a used car or getting a ride from a friend, even if causes financial or social stress. In the study area, the absolute highest density of households in poverty is found downtown, around the UVA campus, north of the City in Knollwood, Oak Terrace, Glenwood Station and Raintree as well as in Sherwood Manor south of the City.

In Downtown and the UVA campus, the high-density of households in poverty corresponds largely to the student population. Outside of downtown, the density of households in poverty correlates with areas of higher concentrations of residents of color.

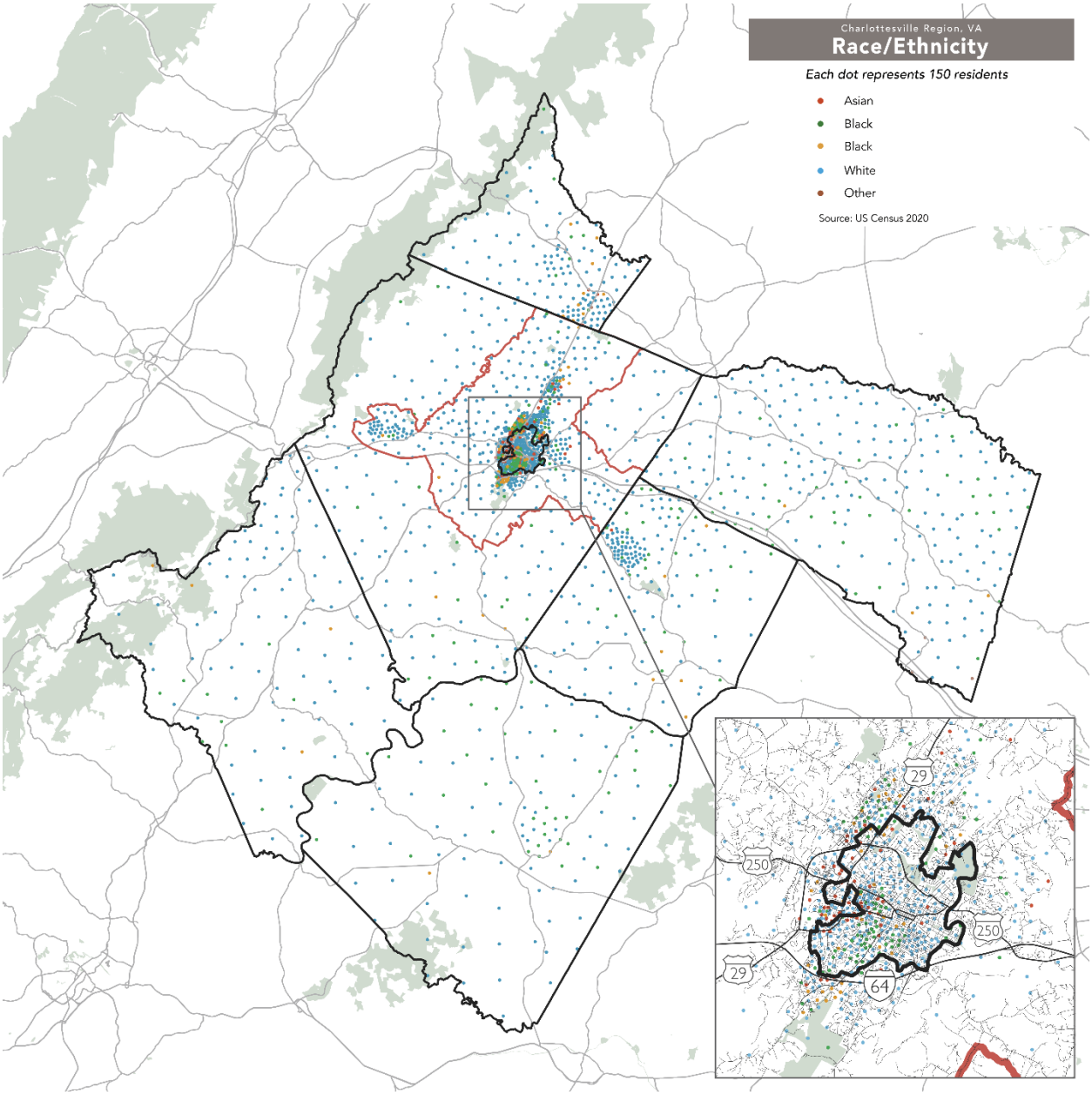
Figure 9 | Race/Ethnicity



Civil Rights: Race and Ethnicity

The map below shows where people of different races and ethnicities live in the study area. Each dot represents 150 residents. Where many dots are very close together, the overall density of residents is higher. Where dots of a single color predominate, people of a particular race or ethnicity make up most of that area's residents. While information about people's income tells us something about their potential interest in or need for transit, information about ethnicity or race do not. However, avoiding placing disproportionate burdens on people of color, through transportation decisions, is essential to an equitable transit-planning process. Outside Charlottesville and the urbanized areas of Albemarle County, most residents are white.

Figure 10 | Race/Ethnicity Dot Density



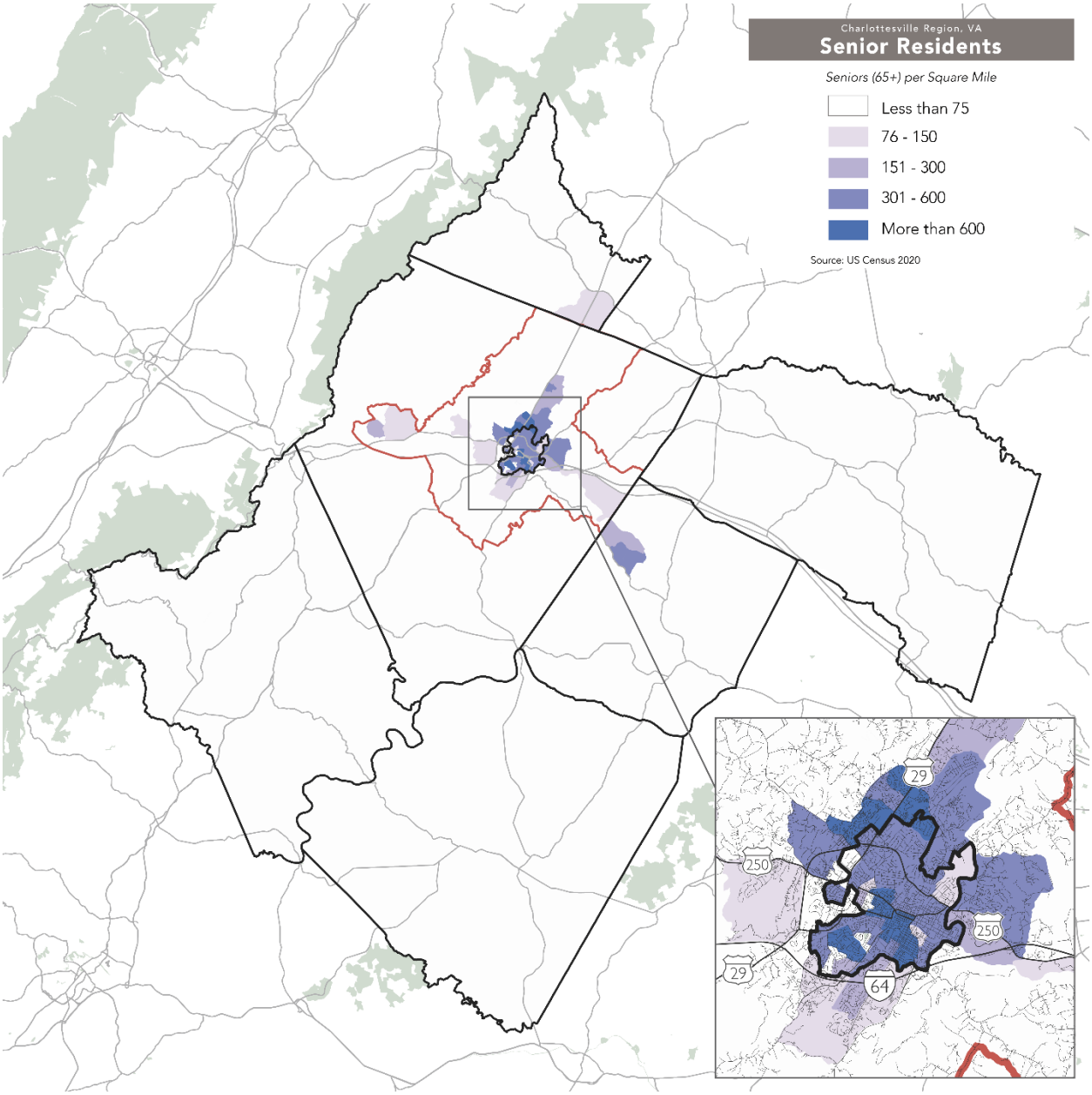
Indicators of Need: Senior Residents

As a group, senior-headed households are less likely to own cars than the general population, an advantage for transit in places where other characteristics for high rider- ship (such as density, walkability) are present. Seniors' needs and preferences are, on average, different from those of younger people. Seniors tend to be more sensitive to walking distance, because more seniors have limits on their physical ability than the average resident.

On average, seniors also tend to be less sensitive to long waits for transit, because many are retired and have a relatively flexible schedule. For the same reason, seniors are, on average, less likely to be discouraged by slow or indirect routes that take them out of their way. Because of these factors, transit service designed primarily to meet the needs of seniors rarely attracts high overall ridership. Most riders who are employed, in school or caring for kids in school will find service with long waits to be intolerable. Thus, the amount of focus that transit agencies place on meeting the needs of seniors should be carefully balanced with the needs and desires of the community.

Figure 11 shows the density of senior residents in the study area. Seniors are distributed throughout the City of Charlottesville more evenly than the general population but concentrate in Charlottesville compared to the surrounding counties.

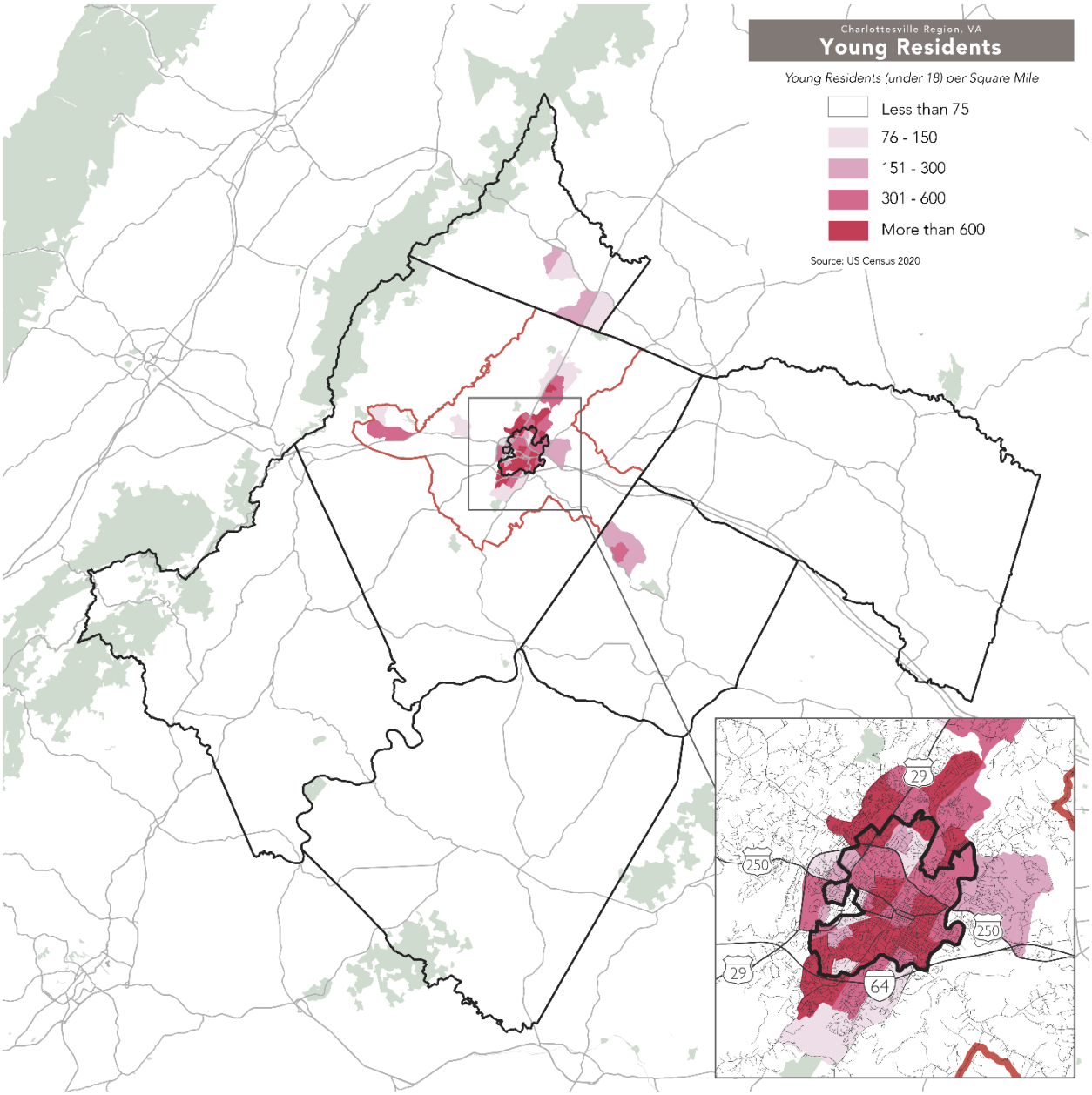
Figure 11 | Residents Aged 65+



Indicators of Need: Residents under 18

Just as transit coverage can meet the needs of seniors who cannot or choose not to drive, transit coverage can also meet the needs of children and teenagers who are too young to drive. The map below shows the density of residents under the age of 18 in each Census block group in the study area. The pattern of youth density is similar to the pattern of overall residential density in the study area.

Figure 12 | Residents Under 18



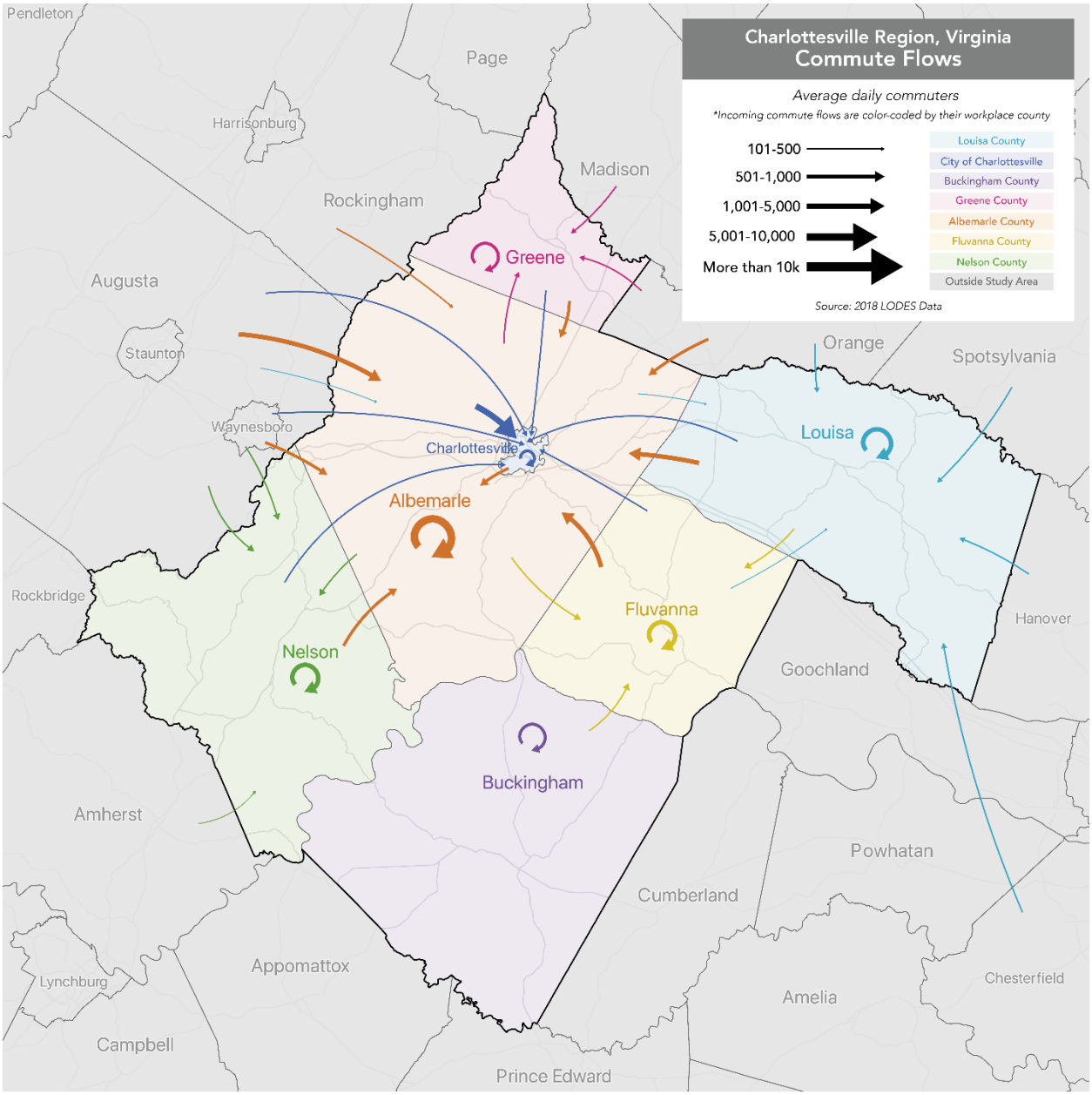
Commute Flows

Only a quarter (28 percent) of the region's commuters live and work in the same jurisdiction. The remaining commuters cross a jurisdictional boundary to reach their workplace. This generates extensive inter-jurisdictional movements to jobs. The largest inter-county commuting movements are from Albemarle into Charlottesville (7,800 commuters) and into Albemarle from Fluvanna (2,000), Greene (1,800), Louisa (1,200) and Augusta (1,000). Louisa County has the largest influx of commuters from other jurisdictions (73 percent of its workforce) and Buckingham County has the smallest influx (54 percent of its workforce). **Note:** These commute flow patterns are from the most recent data, 2018, which was before the Covid-19 pandemic, which significantly affected commute patterns.

The map and data above tell us only about travel patterns related to commuting to work. As of the 2010 Census, 29% of U.S. workers did not work a traditional weekday, daytime schedule, so not all of these trips are happening at the typical rush hour times. Add to this population the large proportion of people who work a second job, are studying, are retired, or are not working, and we can imagine the proportion of the region's residents whose essential travel needs go far beyond the morning and evening weekday rush hours. Also, we know from survey data that only about one-third of trips are for the purpose of commuting to work. Therefore, we should not put too much emphasis on commute patterns as a guide to transit need or markets.

Yet work trips tend to be longer, more consistently timed, and more likely to be trips that a person might take by transit, if transit were useful. This might lead some to suggest peak-only routes to serve commute trips. All people, regardless of their income, value flexibility and spontaneity. If a transit service does not support a midday trip home to pick up a sick child, or a late night at the office finishing a report, more affluent people can easily respond by using a private car. Even very low-income people who need to travel at uncertain times will find another option (such as a ride from a family member, or a very inexpensive car) if the transit network does not offer them flexibility. Only a few people are willing to build their lives and their commutes around a peak-only route. Also, peak-only routes come with relatively higher costs than all-day services because the limited hours of service require generally less efficient use of scarce and expensive labor. So peak-only services tend to be less justifiable from a ridership-maximizing perspective than all-day services, when serving markets with similar levels of demand.

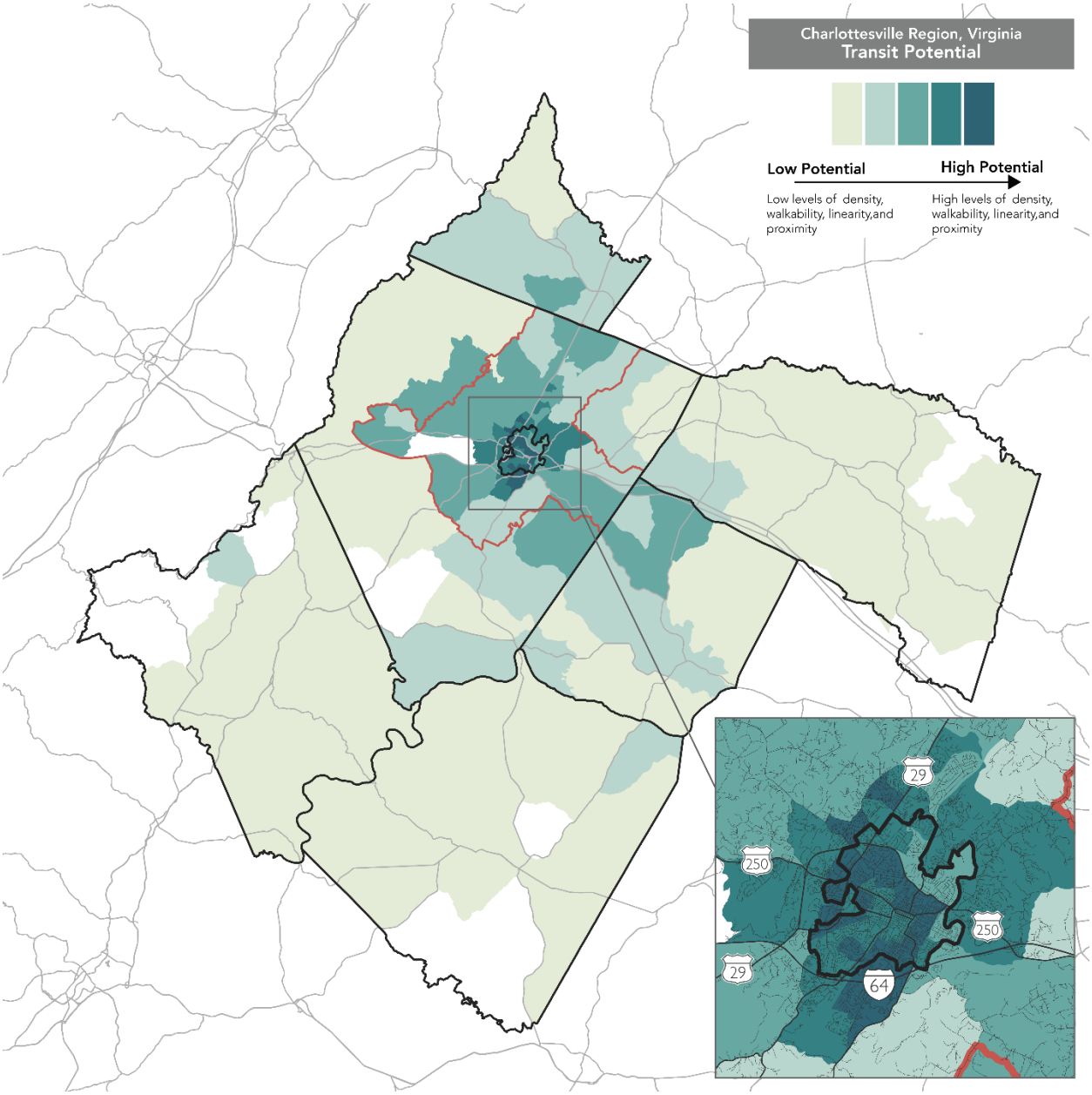
Figure 13 | Regional Commute Flow



Transit Potential: Composite

Areas with good levels of density, walkability, and proximity are the best places to run frequent transit if the goal is high ridership. After quantifying each of these factors to the degree possible, we can estimate the ridership potential of each Census Block Group in the region and the result is shown in the map below. Areas shaded with a dark greens illustrate areas that score higher on the four ingredients of the "ridership recipe". Areas with lighter shades have those characteristics to a much lesser extent. How these four indicators vary spatially is shown on maps in **Figure 14, Figure 15, Figure 16, and Figure 17**.

Figure 14 | Transit Propensity: Composite

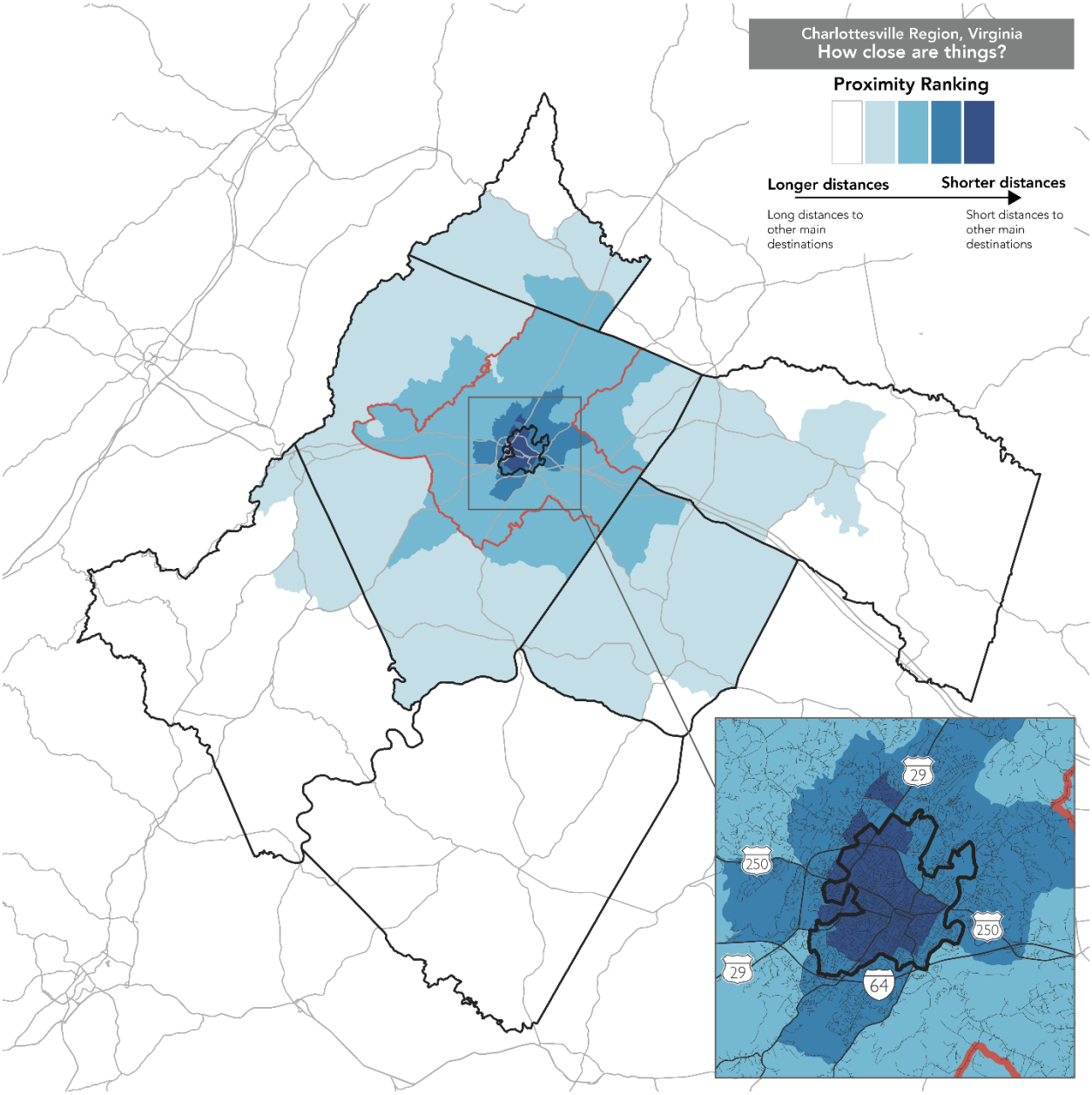


Transit Potential Estimation: Proximity

Short distances between many destinations and activities are faster and cheaper to serve. Buses running short distances in busy corridors also tend to have better frequency since it doesn't cost that much to run compared to a corridor where buses have to traverse long gaps. This map shows areas with a lot of activities, that are also close to areas with a lot of activities. Census Blocks near areas with high activity density are shaded darker and Census Blocks that are close to areas with low activity density are shaded lighter.

In this analysis we estimated a ratio of activity to Euclidean distance (activity/mile) for all Census Block centroids. Then we normalized these values by the total number of jobs and people in the region. Values closer to one illustrate areas that are very close to other Census Blocks that have a high concentration of activity.

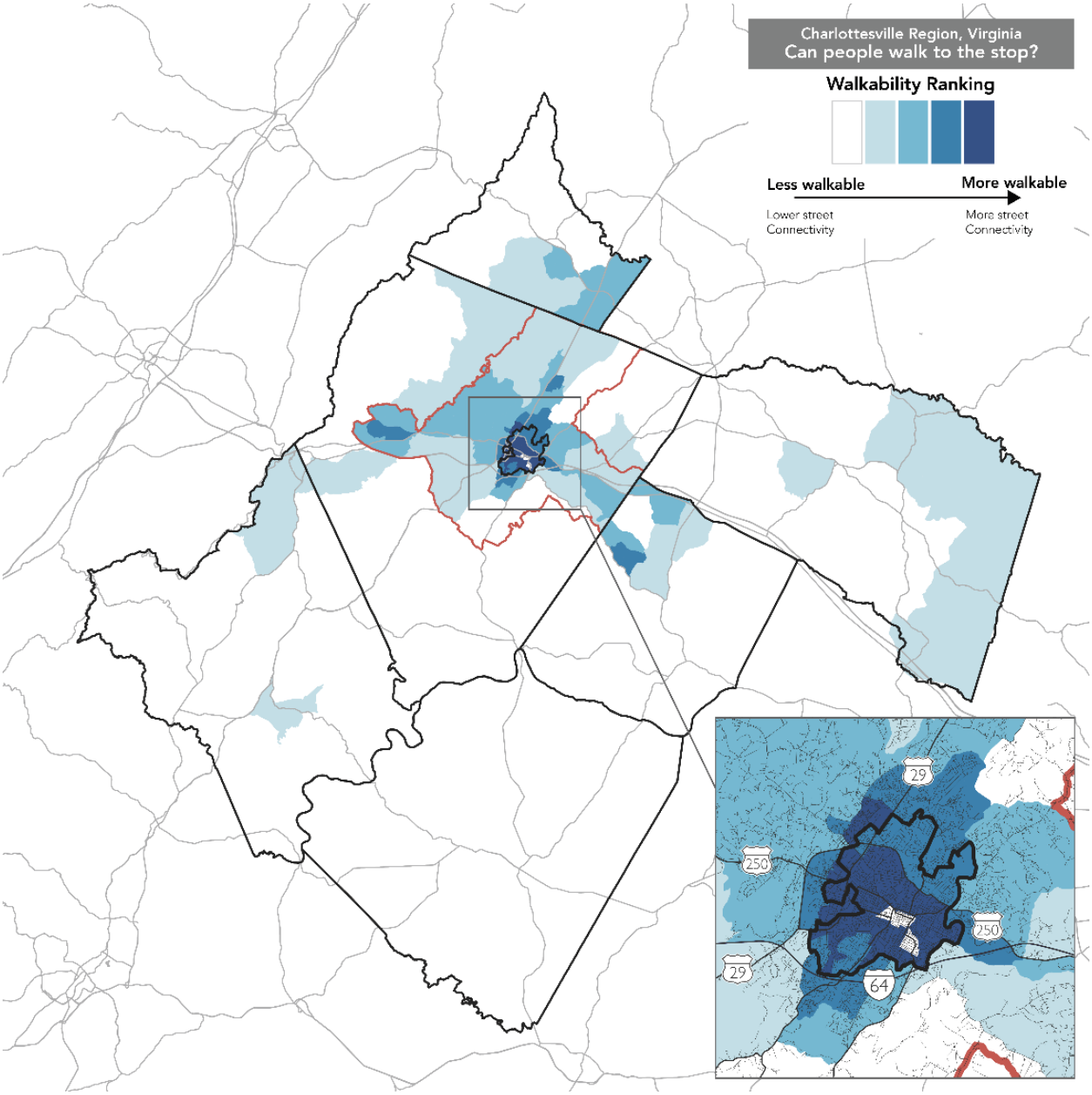
Figure 15 | Transit Propensity: Proximity



Transit Potential Estimation: Walkability

The local street network, and the design of the street that transit runs on, determine whether it's possible to get to the service. People who can't get to the service aren't going to be riders, so this impacts ridership directly. Areas shaded darker show the blocks where the streets are well connected, so you can take less time walking to a bus stop. Based on the walkability analysis (shown in Figure 7), we aggregated the walkability indicator by Census Block.

Figure 16 | Transit Propensity: Walkability



Transit Potential Estimation: Density

Transit that runs on dense corridors are more useful for people and less expensive to operate. Since many more people and jobs are within walking distance of transit, it is justifiable to have better frequencies, thus better access for these areas. This map shows Census Blocks with high activity density (Jobs + People/area) in darker shades and the least dense Blocks in lighter shades.

Figure 17 | Transit Propensity: Density