White Paper: Equity in Arlington County Open Public Spaces

Summary

Parks are one of the few common assets that allow neighbors to gather as a community in a healthy environment to enjoy all the benefits nature can bestow, irrespective of age, race, physical ability, or socioeconomic status. Park, natural and casual recreational spaces provide an equal opportunity for us to build stronger, healthier and more enjoyable communities. These important benefits should extend to all Arlingtonians, equitably.

In the fall of 2020, the Arlington County Civic Federation's (ACCF) Parks and Recreation Committee (P&R) used publicly available data sources to examine equitable proximity for County residents with respect to open public spaces (OPS).

> **OPS is defined** for this analysis as county parkland spaces where there are no "buildings, parking lots, and recreational facilities within the parks' boundaries," defined generally as natural "treed" areas as well as green "open" spaces that are open and available to the public without reservation or restriction (see page 3 for calculations).
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> **WALKING DISTANCE or PROXIMITY to OPS is defined** for this analysis as "total OPS approximate[d] at 10- to 15-minute walk zone for each resident or student" (see page 3 for further analysis).

Although equitable proximity or the walking distance to OPS can be analyzed with many metrics, P&R had a narrow scope of:

1. *Neighborhood Median Income*
   - Finding: Residents living in areas with median incomes below $125,000 typically have significantly less OPS within walking distance or proximity than residents living in areas with median incomes above $125,000.
2. *Residence Type*
   - Finding: Residents of townhomes live in areas with significantly fewer trees than residents of single-family detached homes (SFHs). Furthermore, residents of elevator apartments live in areas with significantly fewer trees, typically have fewer number of parks in close proximity, and have less OPS within walking distance per capita compared to residents of SFHs, townhomes, or garden apartments.
3. *Arlington Public Schools (APS) Elementary Students by Race*
   - Finding: White APS elementary students have greater proximity to tree canopy than do Black, Hispanic, or Asian APS elementary students.
4. *Racial Groups*
   - Finding: Asian residents with below-average proximity to OPS (concentrated predominantly in the Columbia Heights neighborhood) live a greater distance from OPS assets than do Black and white residents.

Suggestions for improving OPS equity in Arlington:

While necessary to continue park acquisition to provide more OPS within walking distance, on average, across the county, the 2019 Public Spaces Master Plan (PSMP) identified future land acquisition and park development that generally targeted higher income areas and away from high-density residential sites. This plan will not address the inequities in walking distance to OPS, as shown in this analysis. Arlington leadership must reevaluate its planning processes to provide additional OPS within walking distance, especially in high-density areas.

It is important to note that whereas previous ACCF resolutions may not have addressed equity issues, this report reflects the subsequent cultural shift and equity focus that our community now seeks and the County Board has highlighted as a priority. ACCF P&R is using its newly expanding access to county data to highlight equity issues in proximity to and the quality of natural assets and recreational space within a walking distance.

Background on importance of equity in proximity to OPS

> *Arlington's public spaces, which include parks, plazas, trails, streets, and recreation facilities, bestow unique and irreplaceable benefits on residents, workers and visitors in the County and the region. Our public spaces make us happier, healthier and more prosperous…. Understanding the range of benefits associated with public space investments informs public policy. A well-managed public space system supports environmental infrastructure, economic development, social health and recreation and leisure activities. April 25, 2019, Public Spaces Master Plan*

After a four-year planning process in 2019, Arlington updated its Public Spaces Master Plan (PSMP) Park Spaces Master Plan to prioritize "[ensuring] access to spaces that are intentionally designed to support casual, impromptu use and connection with nature." This connection with nature conveys important health, community, environmental, and economic benefits to residents.

According to the PSMP, in 2017 Arlington joined the campaign lead by the Trust for Public Land (TPL), the Urban Land Institute, and the National Recreation and Park Association to ensure parks within walking distance for all residents in all neighborhoods. Furthermore, Arlington County joined the Biophilic Cities Network in 2020 citing several goals including "equitable access to green spaces, parks and other natural elements."

Arlington's participation was supported by County research as well as a large number of external studies that that document benefits of OPS for residents' health and well-being, education and child development, economics and business, and social activity and community participation. Collado and Staats (2016) thoroughly document the health benefits of nature. They survey a number of studies that find benefits to children including lower probabilities of being overweight, increased ability to focus, better moods, and many more. Sturm and Cohen (2014) document mental health benefits for residents living close to parks. According to Woolley (2003), parks and open space can help focus and build the neighboring community. The TPL emphasizes the development of parks within a 10-minute walk of every resident. Research summarized by the U.S. Department of Agriculture (2006) and tools developed by the U.S. Forestry Service clearly documents the effect that trees and vegetation in parks have on reducing stormwater runoff and promoting air quality, which in turn provides additional health benefits to residents. Tyrvainen et al (2005) document the effects that trees have on the urban landscape, including lowering temperatures. Woolley (2003) and many others list a wide variety of economic benefits including higher property values from trees.

Rationale for study on equity and OPS

These and other benefits of OPS are supposed to be non-exclusive public goods; they should be available to all members of the community. Nonetheless, some Arlington residents have limited OPS within walking distance due to Arlington County's policies to site OPS elements, tree preservation and reforest developed areas.

P&R evaluates equity based on proximity to OPS—specifically, tree canopy and OPS—across a number of different groups of the population based on race, neighborhood median income, and residence type. Using Arlington's open data on parks, properties, recreation facilities, and geography in combination with census surveys and APS elementary enrollment data, P&R develops a county-wide overview of equitable proximity to nature within Arlington county.

The objective of this white paper was to describe how proximity to Arlington County OPS compares across groups that are often cited as getting less-than-equitable treatment. Although there are many definitions of equity, P&R focused its analysis on Arlington County as a whole to see whether groups defined by race, neighborhood median income, and residence type are disadvantaged relative to each other in terms of their proximity to OPS.

Other groupings or smaller groups within Arlington may have disadvantaged proximity to OPS, however, they are beyond the scope of this study. Moreover, P&R's analysis does not determine whether residents self-select into certain

areas or groups have diminished proximity to OPS for other reasons. However, P&R's analysis does provide insight into how equitable proximity to OPS today, and how proximity equity will be affected by projected park and residential development.

It is important to note that whereas previous ACCF resolutions may not have addressed equity issues, this report reflects the subsequent cultural shift and equity focus that our community now seeks and the County Board has highlighted as a priority. ACCF is attempting to use publicly available data to discern where and whether equity issues may exist in terms of public proximity to OPS.

Methodology

The equity analysis utilized data primarily from four sources (see Data Appendix for full descriptions): Arlington Open Data, ARLGIS, the U.S. Census Bureau, and Arlington Public Schools. Three separate measures of proximity to OPS were analyzed:

- Nearby OPS tree canopy computed as a percentage of the land in every census block group and every APS planning unit.[1]
- Total walking distance to OPS.
- Per capita proximity to OPS.

To compute OPS within walking distance, P&R took three steps:

1. **OPS is identified by taking the inventory of all county parks and subtracting space for buildings, parking lots, and recreational facilities within the parks' boundaries.**[2] Natural space provides health and recreation benefits. However, those benefits do not materialize from parking lots and buildings, so those spaces are removed. Reservable facilities bring some of the benefits of OPS, but are not unrestricted publicly available space, so are also excluded from the analysis.[3]

(There are a number of potential alternate ways to define OPS within Arlington county including the consideration of NPS, NVRPA, sports fields, and APS. Following the completion of the study, new analysis was run with various combinations. See Appendix pages 18-22 for an overview of the alternate calculations and findings.)

2. **Total OPS is determined for each geographical feature by examining a 500-meter buffer around census block groups and APS planning units, meant to approximate a 10- to 15-minute walk zone for each resident or student.** [4] (See illustrated descriptions in Appendix 15-16). This 500-meter buffer is intersected with all OPS and multiplied by the share of each park that is not covered by buildings, parking lots, or reservable outdoor facilities. This provides an estimate of the total amount of OPS within walking distance of each resident.

3. **Total OPS per capita is determined by defining which parks are within the 500-meter buffer zone around each census block group.** Assuming each person has an equal share of that park, each resident's "share" of all of the parks to which the resident can walk is calculated.

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[1] Development and natural growth and death of trees may have led to changes in canopy since the data was last updated. We do not expect that these changes have a significant impact on the analysis, however.

[2] APS open-space and park facilities are excluded from this analysis. APS has considerable open space; however, APS policy significantly restricts the public from using this space, particularly during sports practices and school hours.

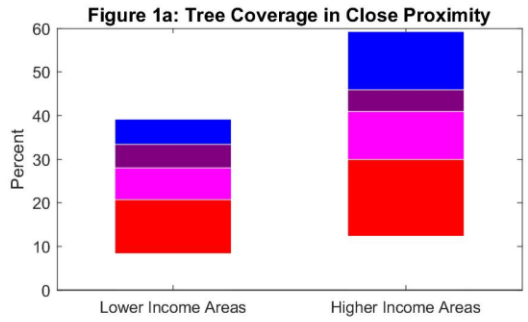
[3] We exclude reservable facilities from our baseline analysis because they are reservable spaces, and hence exclude public use during times when they are reserved. However, in general, the public has access to the parks during times when they are not reserved, and they can provide some of the benefits of walkable OPS. Therefore, for robustness, we conduct the same analysis for the case in which they are considered OPS, and we find that all of the qualitative results are the same.

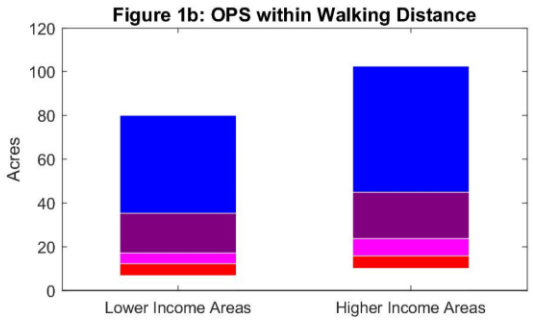
[4] This "walk-zone" is approximate, actual walking time can vary by each resident's location within the geographic area as well as the availability of pedestrian routes to the park.

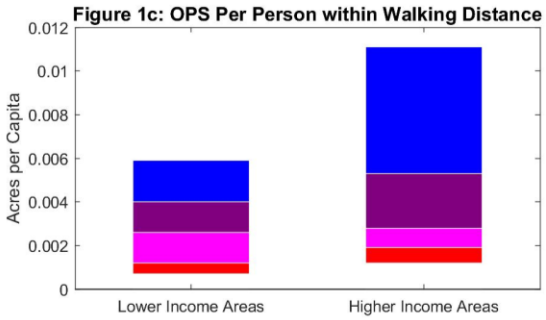
Findings

In the subsequent analyses, three ways of measuring equity in OPS proximity—tree canopy, total OPS, and OPS per capita—demonstrated significant differences when residents were grouped by:

- Neighborhood median income
- Residence type
- Race
- Elementary student race







Figures 1a-1c: OPS by Area Income
Blue: 70-90% quartile (excellent proximity)
Purple: 50-70% quartile (above average proximity)
Magenta: 30-50% quartile (below average proximity)
Red: 10-30% quartile (relatively poor proximity)

Neighborhood Median Income

As noted by Schwartz et al (2015), there is a strong relationship between resident income and park proximity. Figure 1a examines this relationship, in which two groups of people: the "Lower Income Areas" (residents from census block groups in which the median income is below $125,000) are compared with the "Higher Income Areas" (residents from census block groups in which the median income is above $125,000) in terms of proximity to tree coverage.

Figure 1a shows people who live in higher income areas with excellent proximity to trees (blue group), typically enjoy tree canopy of about 45-60 percent. However, excellent proximity to trees for people who live in a lower income area is a tree canopy closer to 35-40 percent. Excellent proximity to trees among higher income area such as Yorktown (just under 60 percent tree canopy) is different from excellent proximity to trees among lower income areas such as the western part of Columbia Forest, the northwest corner of Douglas Park, or the northwestern part of Fairlington (just under 40 percent tree canopy).

Being above average—the purple part of the bar, second from the top—means that residents living in higher income area have 40-45 percent tree canopy if in a, but only 30-35 percent if residing in a lower income area.

Finding: Residents in higher income areas enjoy better tree coverage than residents in lower income areas. Therefore, Arlingtonians living in higher income areas have greater proximity trees and their benefits.

Figure 1b highlights the amount of OPS within walking distance of a typical resident by measuring the available OPS within 500 meters of each census block group, which is approximately a 10-minute walk.[5] In this case, each colored component in the bar representing the Higher Income Area is slightly higher than the

[5] A 500-meter boundary from the edge of a census block group is not the same for every resident in the block group. Therefore, the actual time to walk to the boundary may vary for individual residents depending on the starting point and availability of walking routes.

same colored bar representing the Lower Income Area. The difference is not dramatic, however, which does not indicate a large difference in OPS.

Figure 1c accounts for some OPS being more crowded than others by calculating OPS within walking distance for each resident. When accounting for population, there is a substantial difference between proximity to open space between residents in higher income areas and lower income areas. Excellent proximity to OPS in the higher income areas, shown by the blue part of the bar, is much higher than excellent proximity among lower income areas.

Finding: Residents living in areas with median incomes below $125,000 typically have very different proximity to health and recreation benefits of OPS than residents who live in areas with median incomes above $125,000.

For example, among the higher income areas (those areas with median income of $125,000 or higher), some of the best OPS proximity is concentrated in Donaldson Run, Gulf Branch, Dover Crystal, and Bellevue Forest (Figure 2, blue). Among the lower income areas (those with median income of $125,000 or less), those with the best proximity to OPS are Claremont and Douglas Park (Figure 2, red).

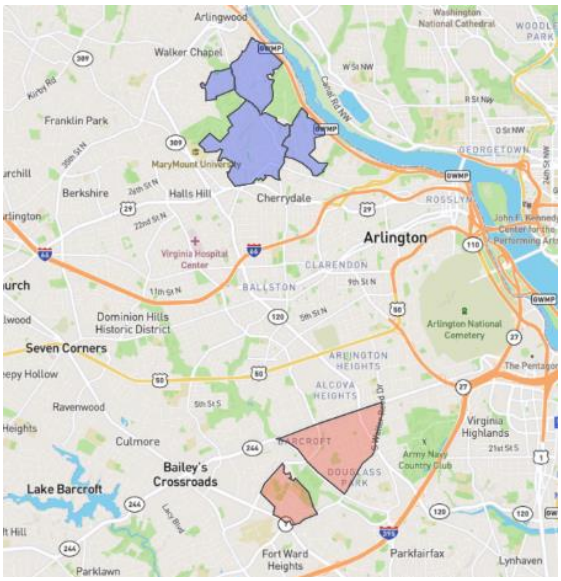
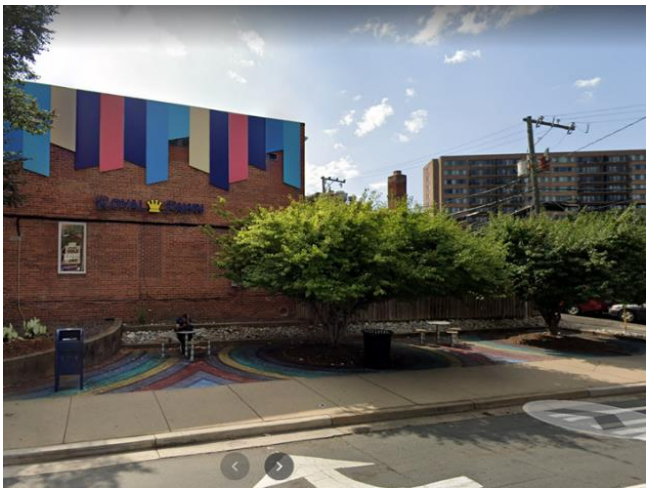


Figure 2 Image generated by OpenStreetMap and geojson.io. ©OpenStreetMap contributors.

Finding: Even though the red and the blue areas have the most parks within walking distance in their respective income groups, the areas in the blue have nearly twice the proximity to OPS within walking distance and higher tree coverage than those in red.

Residence Type

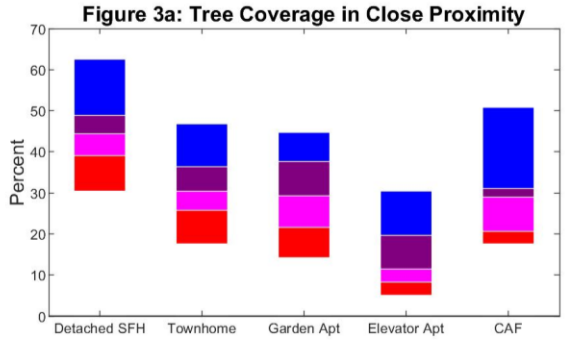
TPL lauds Arlington for offering an extremely high percentage of its residents' proximity to public open space. **This proximity, however, is adjusted neither for quality nor quantity.** Parks such as the 23rd Street South and South Eads Street Park are within walking distance to urban residents but provide a very small space (0.07 acres in this example) to a very large number of people.

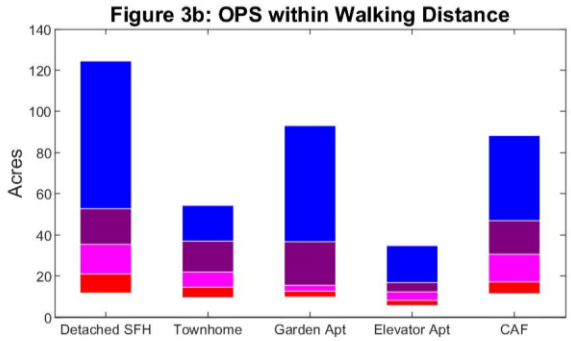


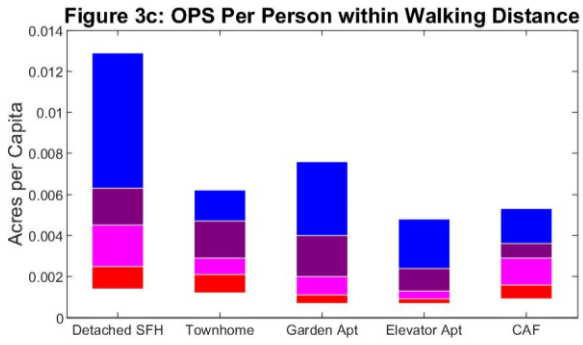
23rd Street South and South Eads Street Park

Therefore, this study analyzed both the total size of OPS and the per capita OPS available to each resident, in addition to, the type of residence. Urban areas are significantly disadvantaged compared to the suburban areas of the county. In short, OPS such as the 23rd Street South and South Eads Street Park, which are tiny slivers of land abutting buildings and busy intersections, fall short as a meaningful substitute for the OPS enjoyed by residents of detached single-family homes (SFH) in other parts of the county.

Figures 3 a, b, and c, assesses how proximity to tree canopy and OPS within walking distance differs among residents by housing type. Using data on Arlington properties to statistically estimate







Figures 3a-3c: OPS by Residence Type
Blue: 70-90% quartile (excellent proximity)
Purple: 50-70% quartile (above average proximity)
Magenta: 30-50% quartile (below average proximity)
Red: 10-30% quartile (relatively poor proximity)

how many residents there are for each type of residence in each census block group, allows an estimated ratio of parks and trees to resident type.[6]

To locate all of the Arlington properties in their census groups where apartment buildings for which location data is inaccurate or missing, the property is located by looking at maps, which is an imperfect process. Therefore, some apartments may be located in adjacent census block groups. Nonetheless, tree canopy proximity and OPS within walking distance are typically similar across neighboring census block groups. Therefore, even if a handful of properties are located in the wrong census block groups, it is unlikely that these errors lead to a meaningful change in the reported results.

Figure 3a shows local tree canopy percentage by household type. The left bar shows 80 percent of Arlingtonians living in SFH live in areas with 30-62 percent tree canopy while residents in townhomes, 80 percent of Arlingtonians live in areas with 20-40 percent tree canopy.

Finding: People in townhomes live in areas that have significantly less tree canopy than those living in SFH.

Almost 90 percent of all Arlingtonians who live in elevator apartments live in areas with less than 30 percent tree canopy.

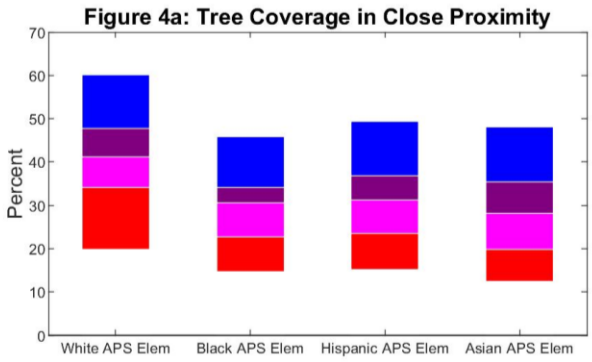
Finding: People living in elevator apartments have far less tree canopy compared to residents of SFH or even town house or garden apartment residences.

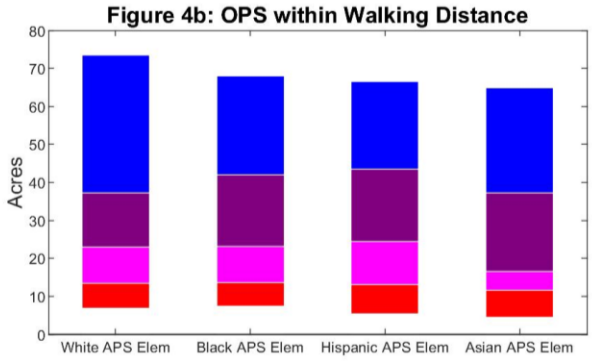
The same holds true for OPS, both in terms of total OPS available and OPS per resident, Figure 3b and 3c. However, there is also much higher variation in proximity to OPS among residents of SFH: as shown in those two panels, the size of the bright blue part of the graph shows that there are a number of houses with exceptional proximity to OPS.

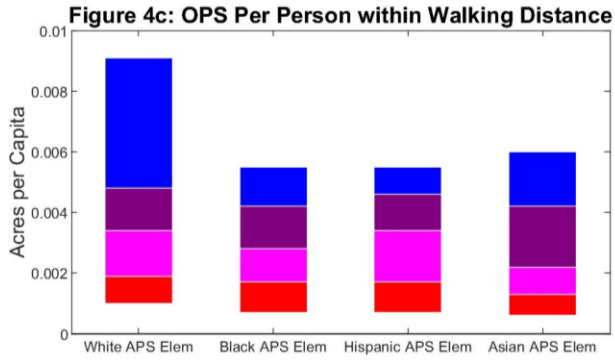
Finding: Residents in SFH generally have much greater proximity to OPS than residents of any other type of housing.

Figure 3c shows that among SFH, there is a subset that has truly exceptional proximity to OPS. The blue bar for SFH ranges from 0.006 acres to 0.013 acres per person, a range which far exceeds the proximity afforded to all other groups of people in all other types of housing. This group of SFH with exceptional per capita park proximity is concentrated in the Donaldson Run, Glencarlyn, and Bluemont.[7] Outside of those geographic areas, however, the inequity between SFH and other types of residences is smaller. OPS proximity among residents of SFH is still higher but more similar to proximity for other types of residences.

[7] These areas include some neighboring civic associations as well.







Figures 4a-4c: OPS for APS Elementary Students by Race
Blue: 70-90% quartile (excellent proximity)
Purple: 50-70% quartile (above average proximity)
Magenta: 30-50% quartile (below average proximity)
Red: 10-30% quartile (relatively poor proximity)
Note: these statistics are calculated using APS planning units. Do not compare these statistics to those presented in the other figures, as they are calculated from different geographic units.

Finding: Many residents of elevator apartments have exceptionally poor proximity to OPS, both in terms of total OPS and OPS per person.

However, committed affordable units are generally sited near OPS as often as other similar types of housing, even if some of these parks tend to be crowded. Residents of CAF housing units have similar or better proximity to OPS than anyone except residents of SFH.

APS Elementary Students by Race

Figures 4a, 4b, and 4c represent tree and OPS proximity for APS elementary students, broken down by race.[8] Tree canopy available to elementary students by races is shown in the top panel of Figure 4.

Finding: White APS elementary students have greater proximity to tree canopy than do Black, Hispanic, or Asian APS elementary students. Total OPS within walking distance, Figure 4b, is generally distributed similarly among all four groups. Nonetheless, the magenta and red blocks of Asian APS elementary students are significantly lower than the same color blocks for white, Black, and Hispanic children. Therefore, there is a significant population of Asian APS students who live a further distance from OPS than similar students in the other groups. According to APS data, these students tend to be located in Columbia Heights and, to a lesser extent, in the Crystal Towers complex in Crystal City.

OPS that is within distance, on a per-student basis, is examined in Figure 4c. Most white APS students appear to have similar proximity to OPS as Black and Hispanic elementary students. However, there is a population of white students who have exceptional per capita OPS within a close proximity that is unmatched by any meaningful number of students in any other racial group of APS elementary students. As before, Asian students with below-average proximity to OPS have unusually poor proximity to OPS compared to similarly situated white, Black, and Hispanic kids. This group of Asian students is largely located predominantly in Columbia Heights, with a few in the Crystal Towers residential complex in Aurora Highlands.

Finding: A significant population of Asian students living predominantly in Columbia Heights and Crystal Towers have significantly lower proximity to OPS than similar students in other racial groups.

[8] Data comes from the APS documents released as part of the 2020 Fall Boundary Planning Process; details about the data are presented in the Appendix.

Racial Group

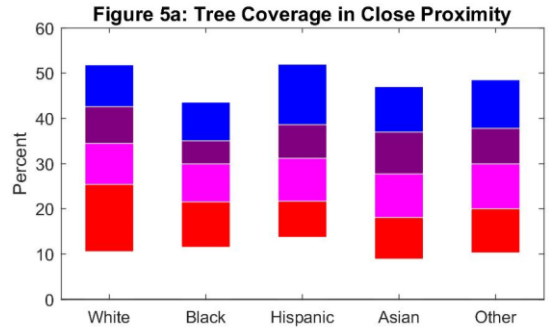
Figure 6: Image generated by OpenStreetMap and geojson.io.

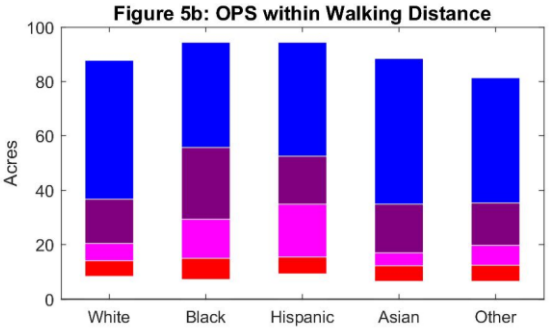
Figure 5a, 5b, and 5c examines tree canopy and park proximity by race in the county. Figure 5a, shows the differences in tree canopy coverage by race. It is hard to identify any systemic differences in proximity to tree canopy by race, although non-Hispanic white residents and Hispanic residents have slightly higher proximity overall to tree canopy than both Asian and Black residents. Moreover, Asian residents described by the magenta and red portions of the bar tend to have proximity to less tree canopy than similarly situated Black and white residents.

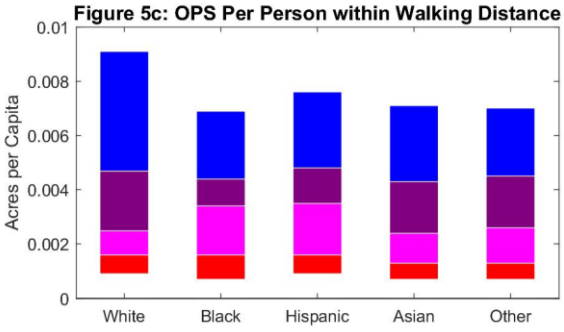
Similar results with respect to OPS are found. Figure 5b shows that a number of Black residents have slightly better proximity to total OPS than white or Asian residents. However, some of this advantage disappears when considering OPS per resident in Figure 5c.

Finding: Asian residents with below-average proximity to OPS, concentrated predominantly in Columbia Heights, live farther from OPS than similar Black, Hispanic, white residents.

There is a community of Asian residents and students who are proximate to high-value OPS and tree canopy, though a lot of that green space belongs to the Army Navy Country Club, which is private property and is not open to the public for general use (Figure 6). [Note: The W-L High School golf team plays at this club.]







Figures 5a-5c: OPS for Arlington Residents by Race
Blue: 70-90% quartile (excellent proximity);
Purple: 50-70% quartile (above average proximity);
Magenta: 30-50% quartile (below average proximity);
Red: 10-30% quartile (relatively poor proximity)

Will New Parks Address Inequities?

The 2019 PSMP lists a number of priorities for park expansion and land acquisition. Table 1 is summary of the planned park developments and expansions, specifically the "recreational and leisure" and the "natural resource acquisition" categories.

Inequities in OPS related to income exist and will be exacerbated with county approved development plans. As noted earlier, higher income areas have much better proximity to OPS than do low-income areas.

Table 1 highlights ***21.25 of the 26 acres of*** **planned parks are located in block groups with median income above $125,000.** Although some are located near neighborhoods with lower median incomes, the vast majority of projects are bolstering park resources in areas that are already comparatively well-off. Some of the park expansions are planned for the wealthiest areas of the county.

Table 1: Proposed Recreation and Natural Resource Acquisitions in the 2019 PSMP

Name	Acres	Block Group	Median Income
Maury Park Expansion[1]	0.96	1019003	$224,327
Clarendon 10th Street Park[1]	0.97	1019001	$159,167
Virginia Highlands Park Expansion[1,2]	0.23	1035022	n/a
20th Street South and South Ives St Park Expansion[1,2]	2.27	1036011	$219,063
Benjamin Banneker Park Expansion[2]	3.12	1011004	$171,932
Madison Manor Park Expansion[2]	0.56	1011003	$171,845
Bon Air Park Expansion[2]	0.66	1013001	$211,750
Cherrydale Park Expansion[2]	0.81	1005002	$250,000*
Douglas Park[2]	1.29	1027022	$65,833
Drew Park Expansion[1]	0.32	1031002	$42,936
Fort Scott Park Expansion[2]	0.17	1037002	$181,429
South Ives Street Park Expansion[2]	2.49	1037002	$181,429
Lang Street Community Gardens Expansion[1,2]	2.47	1037002	$181,429
Glencarlyn Park Expansion[1]	n/a	1028014	$79,185
Jennie Dean Park Expansion[1]	1.19	1029012	$101,667
Shirlington Park Expansion[1,2]	1.41	1029012	$101,667
Mosaic Park Expansion[1]	0.65	1014041	$127,651
Oak Grove Park Expansion[2]	0.56	1006002	$185,875
Penrose Square Expansion[1]	0.31	1025002	$94,583
Tuckahoe Park Expansion[2]	0.65	1001004	$210,789
Glencarlyn Park Expansion #2[2]	1.71	1021001	n/a
Powhatan Springs Park Expansion[2]	0.74	1012001	$128,487
Rocky Run Park Expansion[1]	0.21	1018024	$63,064
Windy Run Park Expansion[2]	2.46	1004003	$250,000*
Total	26.22**		

Sources: Arlington County Property database, 2019 PSMP, U.S. Census Bureau, and authors' calculations. Acres are calculated by including parcels that appear consistent with the maps in the 2019 PSMP; these calculations are just estimates, however, and may differ from official plans. * Median income is top-coded at $250,000. ** Total is an approximate and does not include the Glencarlyn Park Expansion. [1] The park appears to be within walking distance to a building at least as dense as a garden apartment. [2] The park is located within a neighborhood of detached, single-family houses.

Inequities in OPS related to residence type exist and will be exacerbated with county approved development plans. Approximately 11 of the 26.25 acres are located within walking distance of these types of residences.[9] About 22.6 of the 26.25 acres are located within a neighborhood of SFH suggesting that equity across residence types will probably be made worse if all of these projects are completed. ***Moreover, only one of the eight "generational" opportunities highlighted in the 2019 PSMP—Army-Navy Golf Course—is located in any area that could improve equity along the dimension of resident type.*** Lastly, none of these properties are located near Columbia Heights and would probably do very little to address inequity in OPS for the Asian community located there. While the 2019 PSMP identifies the Army-Navy Golf Course as a "generational" acquisition opportunity, this property seems unlikely to be acquired this generation.

[9] Each of the projected parks are classified depending on whether it is proximate to some residence, is within walking distance from a garden, mid-rise, or elevator apartment or condominium and, whether or not it is located in an area with predominately detached single-family houses by looking at the satellite image that accompanied the prospective park or natural space expansion in the 2019 PSMP.

Conclusion

In general, Arlington needs to add significantly more OPS to meet stated goals, plans, and policies already voted on by the County Board. The findings of this study highlight that additional OPS acquisition must be facilitated to address systemic inequities by neighborhood median income, residence type, APS elementary students by race, and racial groups summarized as:

Neighborhood Median Income

- Residents living in areas with median incomes below $125,000 typically have significantly less proximity to OPS.

Residence Type

- Though TPL lauds Arlington for providing an extremely high percentage of its residents with public open space within walking distance, **this benchmark fails to fully assess the quality of that space or its quantity on a per capita basis.** Urban parks are proximate to many urban residents but provide a very small space for a very large number of people.
- Residents of townhomes live in areas with significantly fewer trees.
- Residents of elevator apartments live in areas with significantly fewer trees, typically having a fewer number of parks in close proximity and less park acreage per capita compared to residents of detached single-family homes (SFHs), townhomes, or garden apartments.

Arlington Public Schools (APS) Elementary Students by Race

- White APS elementary students have greater proximity to tree canopy than do Black, Hispanic, or Asian APS elementary students.

Racial Groups

- Asian residents with below-average proximity to OPS (concentrated predominantly in the Columbia Heights neighborhood) live a greater distance from OPS assets than do Black and white residents.

Arlington County's PSMP and related plans, policies, and practices will NOT address inequities. The 2019 PSMP priorities for park expansion and land acquisition, specifically in the "recreational and leisure" and the "natural resource acquisition" categories, will not ameliorate inequities along the dimensions identified without concurrent strategic investment to add more OPS in more densely populated neighborhoods.

The stark inequities in OPS proximity related to income and race will be exacerbated by the plans in the 2019 PSMP. Although some of these assets are located near neighborhoods with lower median incomes, the vast majority of projects will bolster park resources in areas that are already, comparatively speaking, better resourced. Furthermore, none of these properties are located near Columbia Heights and would probably do very little to address inequity in OPS within walking distance for the Asian community located there.

The inequities found for residents of elevator apartments will be further aggravated by planned County projects with aggressive, high-density site plans that remove scarce existing tree canopy and replace remaining pervious surfaces with impervious ones.

Moreover, adding more residents to these high-density corridors further degrades the ratio of residents to public park/recreational acre within walking distance. Negotiations with developers for rooftop green space, an internal courtyard, or a pocket park—all very small spaces that frequently are not open to the public—is not a balanced exchange for additional housing units in terms of equitable per capita OPS acreage.

Special Note: Other groups or smaller population subsets not identified in this report also may be disadvantaged with respect to deficits in OPS, but they are beyond the scope of the current study. Moreover, P&R's analysis does not determine the impact of residents who may self-select by moving to certain areas or may have diminished proximity to OPS for other reasons. However, P&R's analysis does broadly demonstrate certain inequities among various groups in their proximity or walking distance to forested areas, parks, recreational and similar public spaces and how OPS equity can be improved or worsened depending upon the policies, planning and development strategies that Arlington County pursues.

Recommendations

This analysis suggests that Arlington leadership must reevaluate its planning processes to provide additional OPS more equitably in terms of proximity, quality and quantity, especially in areas of increased density. This may include, but not be limited to the following:

- Restructuring calculations for density. This report highlights the stark inequities that elevator- apartment residents face in terms of having less tree canopy and fewer publicly available park and recreational acres proximate to where they live. While TPL and other national groups use the absolute number of parks as a measure, they ignore the quality and per capita acreage of park and recreational space that is available to urban corridor dwellers. Increasing density away from the Metro corridors may marginally improve equity across residence type. However, in this case, any potential equity gains come at the expense of reducing OPS within walking distance for all types of residences. The County leadership must more equitably balance what is good for residents versus what is good for developers. A ½-acre pocket park to support an additional 400 units simply is not equitable.
- Reconsidering land acquisition in high-density locations. This report underscores the necessity of improving equity with respect to OPS and tree canopy coverage by acquiring public OPS in high-density areas.
- Accelerating general parkland acquisition. Given the County's desire to increase the population while concurrently pursuing PSMP goals, expediting parkland acquisition is essential. Acquisition of the Army-Navy golf course, though desirable, is highly unlikely.
- Reorganizing space uses. This report does **not** imply that removing tree canopy or parkland and green space in areas with single-family homes is the answer to Arlington's OPS equity problems. In net increases in publicly owned and privately owned (with public use rights legally guaranteed in perpetuity) OPS, Arlington must focus efforts to increase the quality of and public proximity to alternative open space. For example, rooftop "green space" and restricted courtyards may serve as amenities to a building's occupants, but they cannot address inequitable deficits in high-quality OPS that is within walking distance or in tree canopy coverage. Furthermore, building up or down in order to create new park/recreational/natural space or to preserve existing OPS assets should be considered an equitable tradeoff in the development process.

Parks are one of the few common assets that allow neighbors to gather as a community in a healthy environment to enjoy all the benefits nature can bestow, irrespective of age, race, physical ability, or socioeconomic status. In summary, park, natural and recreational spaces provide an equal opportunity for us to build stronger, healthier and more enjoyable communities. These important benefits should extend to all Arlingtonians, equitably.

Submitted respectfully by the Arlington County Civic Federations Park and Recreation Committee, December 2020. Special thanks to Dr. Jon Huntley for his data analysis. Drafted by ACCF Park and Recreation members: Dr. Jesse Boeding and Kari Klaus and contributions by Adam Rasmussen, Suzanne Sundburg, Duke Banks, Michael Cantwell, and additional members of the public

Data Appendix

ARLGIS

Census Block Group Polygons: This is data on the 181 Census Block Groups, areas of the county for which various statistics such as population, race, median income, and other indicators are reported.

2016 Tree Canopy Polygons: This is a database of about 36,000 polygons, each of which is a contiguous area tree coverage in Arlington.

Building Polygons: These 43,500 polygons show the footprints of buildings in Arlington, including buildings that are located on county parkland.

Parking Lot Polygons: This dataset has about 2,900 polygons which comprise the areas of the county reserved for vehicle parking, including areas located on county parkland.

APS Planning Unit Boundaries: These are the boundaries for the 347 planning units that APS uses in its school planning, projections, and boundary development processes.

Park Polygons: A list of and boundaries for 185 Arlington county parks and private open spaces. We removed a few parks that are currently closed, under construction, or otherwise unavailable including Nauck Town Square, Mosaic Park, and Henry Clay Park.

Arlington Open Data

Properties: A list of almost 70,000 properties in Arlington. In most cases, this data includes their locations, property type, number of units, square footage, and other identifying variables.

Interiors: This dataset has about 138,000 records describing the interior properties of residential dwellings in Arlington including number of bathrooms, bedrooms, finished space, and other properties. Using the real property code, we link this data with the properties dataset.

Parks and Recreation Facility Reservations: This data of nearly 500,000 records lists all reservations of parks and recreation facilities. We use this data to identify the outdoor spaces that can be reserved, space which is removed from the inventory of Arlington's open-space parks for our equity analysis.[10] We find 193 reservable outdoor fields that are part of Arlington's county park system that are included in our analysis. Additional fields and facilities may be reserved; however, they are often indoors or attached to APS facilities.

U.S. Census Bureau

Race: American Community Survey 2018 Five-Year Estimates: Table B03002

Language: American Community Survey 2018 Five-Year Estimates: Table C16002

Income: American Community Survey 2018 Five-Year Estimates: Table B19013

Population: 2010 Decennial Census: Table P1

(Note, links not available for data. Data is accessed through the portal at data.census.gov.)

Arlington Public Schools

Fall 2020 Boundary Process**:** The data released by APS as part of the Fall 2020 Elementary School Boundary Process – Phase 3 of Elementary Planning for 2021 contains comprehensive data on enrollees' race by planning unit.

[10] Excluded are open-space parklands owned by APS.

Reserved Field Dimensions

Ballfield Dimensions Guide: Used for the typical dimensions and space required for of a variety of sizes of baseball and softball fields.

Athletic Field Sizes: Provides dimensions for a variety of common fields used in Arlington including soccer, bocce, tennis, volleyball, and football.

Technical Appendix: Computing the Population by Residence

To compute the number of people in each type of residence, there was a variety of data used. The process is roughly outlined in this paper. First, every residence in the county was located and assign it to its geographical census block and census block unit using county data, mapping tools, and a variety of other public real estate resources and address databases.[11] Using this information to statistically estimate the "population generation factors," which are similar to APS student generation factors, indicates the average number of people living in each type of residence instead of the average number of students.[12]

Having these estimates allows us to estimate how many people live in every building in Arlington. Then we know how many people live in each type of building for each census block group. Using the walkable distance to a park (described below), we can create a distribution of the tree canopy, total OPS proximity, and per capita OPS proximity for each type of residence.

Geographical Analysis

Most of the data, including the geographical data, is processed by python. These are the main libraries that aid us in our analyses:

pandas: This is used to read and process data on all of the maps objects from flat csv files.

numpy: This is a library with tools for common mathematical operations, particularly on lists of data.

scipy: This is another library with tools for common mathematical and scientific operations. We use this library for statistical kernel estimation to help us locate potential differences in parkland and tree canopy across different groups.

pyproj: We use this library for projections. Map polygons in the aforementioned datasets are defined by latitude and longitude. These polygons need to be projected onto a surface that allows us to accurately measure distances and areas. This library provides the tools that aid in this part of the analysis.

functools: This library is used in conjunction with pyproj for projecting objects into something we can use more easily.
shapely: A powerful set of geometric tools in python. We use shapely to compute areas, draw the 500-meter buffer around points and areas, find the intersection of different objects (for example, buildings and parking lots with parks; or parks with census block groups), and otherwise do the bulk of the geographical analysis we use in our equity study.

As noted above, all of the geographic objects are reported in using latitude and longitude (coordinate reference system 4326). In most cases, typical units of measure such as meters are not the same for each degree of latitude and longitude. Therefore, we need to use these tools to project the map onto an Albers Equal Area projection so that we can employ commonly used geometric tools to work with the geographic objects.

[11] Most single-family residences are easily located using standard mapping tools. However, a number of properties, particularly apartment buildings, contain multiple buildings and must be manually identified on maps for them to be located in the correct census blocks and block groups. There are some errors, however, the errors typically put these units in the adjacent areas, which appears to have a minimal effect on this type of distributional analysis.

[12] We use a non-linear least squares method based on 2010 decennial census population data. We use non-linear least squares so that we force estimates that larger condominiums and houses to have at least the same number or more residents than smaller residences of the same types. Population generation factors will be revised with the publication of the 2020 decennial census.

Computing Tree Canopy Coverage

For each census block group or planning unit, tree canopy is computed as the share of that geographic area that is covered by trees. For an example of a generic census block group, see Figure 7. The census block group area is in purple. The areas of tree canopy are in green. The area of the census block group covered by tree canopy are the green shapes that intersect with the blue rectangle. Dividing this coverage by the area of the census block group results is tree canopy coverage. The same method is used to compute tree canopy coverage for APS school planning units.

Assumption: each resident in the census block group has proximity to the computed tree canopy. Therefore, census block groups with more people get greater weight when evaluating the allocation of green space among Arlingtonians.

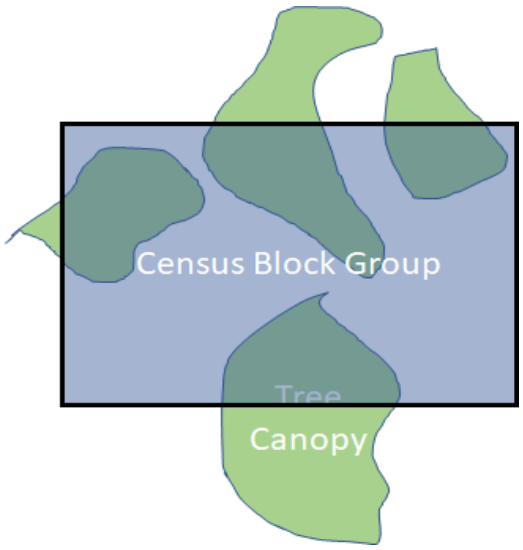


Figure 7: Illustration of tree canopy calculation. The purple block represents a census block group (planning unit in school analyses). The green shapes represent areas of tree canopy.

Computing Proximity to Total Open-Space County Park

To compute the proximity to total open-space county parkland, 500 meters of each census block group or planning unit is intersected with a 500-meter buffer zone around the geographic object for all of the 185 parks in the county. For each of the parks, multiply the size of the intersection by the share of park space that is actually open space (i.e. without buildings, parking lots, or reserved space). Then add up the amount of space among all of the parks that intersect with the area around the census block group or planning unit.

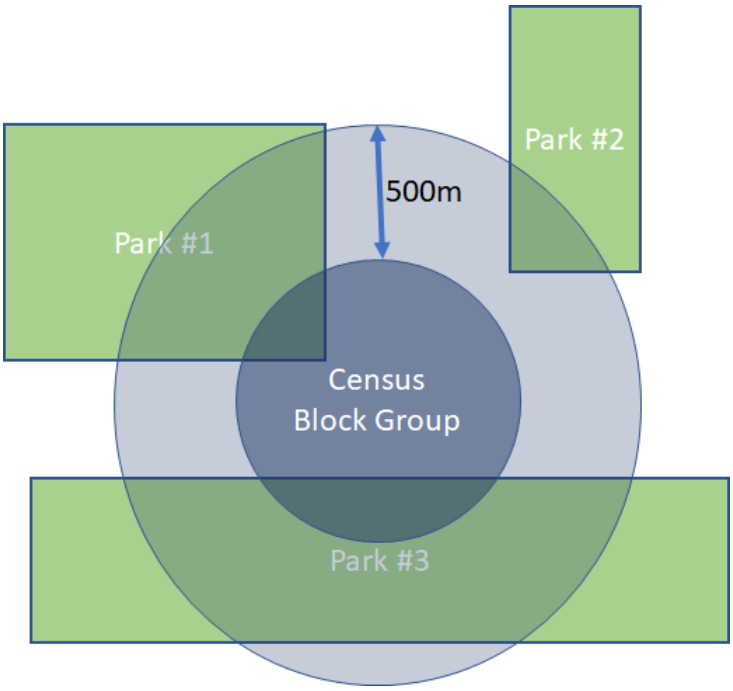


Figure 8: Illustrative example of how proximity to OPS is calculated. A hypothetical census block group (alternately an APS planning unit) is located at the center. The 500-meter buffer is the light purple circle surrounding the census block group. Three parks, #1, #2, and #3, overlap with various parts of the census block group or its buffer area.

Figure 8 illustrates this process. The census block group (or APS planning unit for certain analyses) is the circle in the center. It contains a number of people or students. We draw a larger buffer or "walk-zone" around that geographic area. In this example, this expanded area intersects with three parks, Parks #1, #2, and #3. Assume that Park #1, which has a moderate two-acre overlap with the walk-zone. Of that, about 90 percent is open space—the rest are buildings, pavement, or reserved athletic fields. Therefore, Park #1 contributes 1.8 acres to the residents' parklands.

Park #2 has a very small overlap; assume that it is about 0.5 acres. Park #3 has a very large overlap with the "walk-zone"; assume that it is about 5 acres. Assuming that 80 percent of Park #3 has recreational facilities or parking lots, that leaves about 4 acres left of open-space county parkland. Therefore, the people have 0.5 + 1.8 + 4.0 = 6.3 acres of total park space available to the residents of that census block group.

Each resident in the census block group has OPS within walking distance. Therefore, census block groups with more people get greater weight when evaluating the allocation of parks among Arlingtonians.

Computing Per Capita Open-Space County Parks Within Walking Distance

Some parks are much more heavily subscribed than others; therefore we also compute per capital county park. The first step is to calculate how much space each resident gets.

Figure 9 shows two census block groups (alternately APS planning units) with a 500-meter "walk-zone" buffer around each of them. Park #1, between the two of them, has four acres. Since the park intersects with each of the two block groups—one with 100 people and the second with 300 people—it is assumed that all 400 people are within walking distance to this park. Therefore, the four acres is divided among 400 people, and there is a ratio of to 0.01 acres of open-space county parkland to each resident.

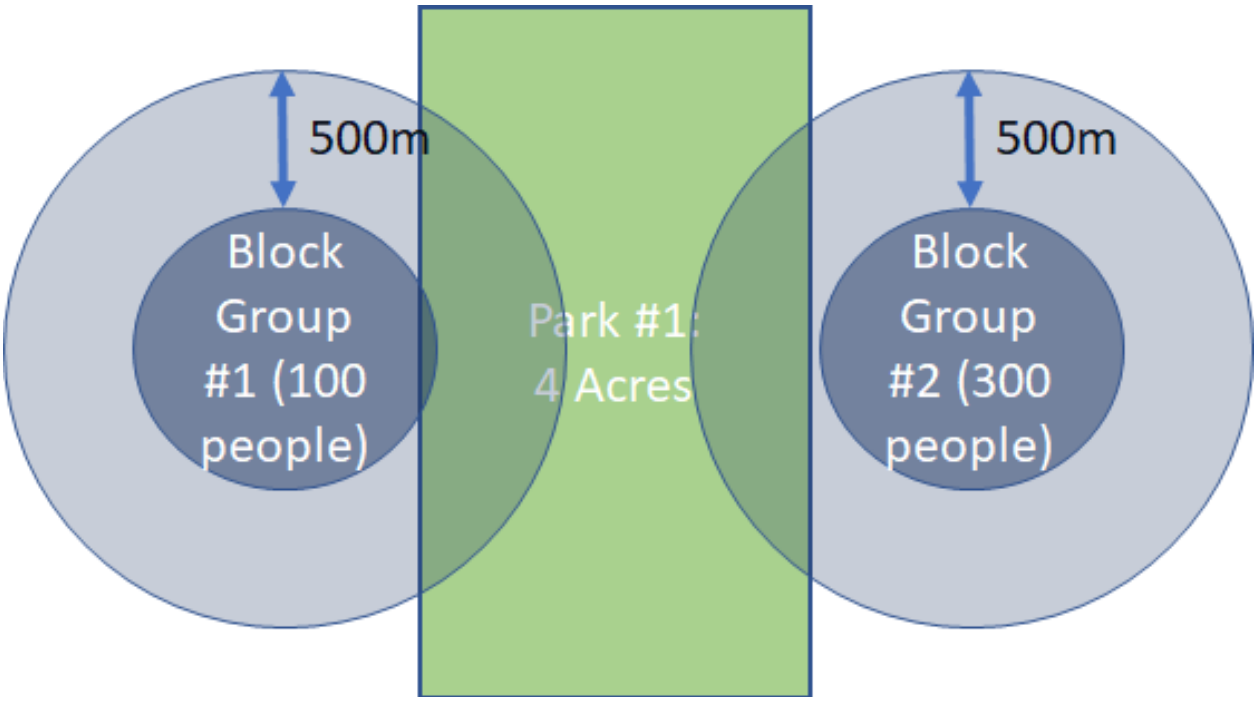


Figure 9: Illustrative example of how per capita proximity to OPS is calculated. Two hypothetical census block groups (alternately APS planning units) are drawn with a 500-meter buffer is the light purple circle. One park that is four acres large intersects with the "walk-zone" for both of these two census block groups.

This process was replicated for every combination of park and census block group (or planning unit). Adding up all of the OPS each resident has to across all of the OPR within walking distance, per capita proximity of each resident has within the county can be calculated and compared to residents of different racial, demographics, and income groups among one another.

Exploring alternate ways of defining OPS

There are a number of potential alternate ways to define OPS within Arlington County including the consideration of; National Park Service (NPS), Northern Virginia Parks Authority (NVRPA), sports fields, and Arlington Public School (APS) land. Following the completion of the study, new analyses were completed with these various alternate OPS definitions.

The results showed that even with various alternate definitions of OPS included or excluded from the core analysis, the inequity observations are not generally changed in any substantive way. In some cases, the inclusion of additional types of OPS, increased the inequity among Arlington residents. For example, including sport fields in the equity analysis of walkable OPS creates an even greater inequity of access among some groups; elevator buildings have even less access to OPS compared to single family home residences when sports fields are included as OPS. The following section outlines the ways in which the inclusion or exclusion of alternate definitional types of OPS affect the results;

- **Lands administered by the National Park Service (NPS)** were excluded in the core study. The alternate analysis included two NPS facilities that would qualify as walkable. Theodore Roosevelt Island and the Iwo Jima memorial which were within walking distance of about 1,000 and 7,000 residents, respectively. We found that including these two parks modestly increased the amount of per capita walkable OPS for elevator apartments and townhomes. Moreover, walkable OPS in total and per capita increased slightly for non-white residents. Nonetheless, even with these modest improvements, generally, the summary equity results were not affected.
- **Northern Virginia Parks Authority (NVRPA) parks** are included in our baseline specification because Arlington County's general fund does make contributions to their upkeep, in excess of $400,000 per year. The alternate analysis considers the exclusion of NVPRA and found that Asian residents and elevator apartment residents are somewhat less disadvantaged in this specification. Furthermore, residents in detached single-family homes appear to have a slightly smaller advantage in access to walkable OPS compared to residents in other types of housing.
- **Including sports fields:** In the core study, sports fields were not included as they are often reserved and inaccessible for most evening and weekends for most of the year, especially during high demand periods in early spring through early summer and late summer through early winter. Some fields are available primarily during the most inhospitable times of the year (December-Feb and July- August). Although sports fields are restricted, some of them could offer additional public, walkable OPS access during times when they are accessible to the general public. Including sports fields increases the inequity between detached single-family houses and all other housing types, excluding garden apartments. Including reservable athletic fields in the definition of OPS increases walkable OPS access among Hispanic APS elementary students.
- **APS land** is extremely restrictive, prioritized for student use and unavailable to most everyone for most days of the week, including after school hours. Additionally, a large amount of the space is covered by athletic fields, Therefore, we excluded APS space from all of our analyses.

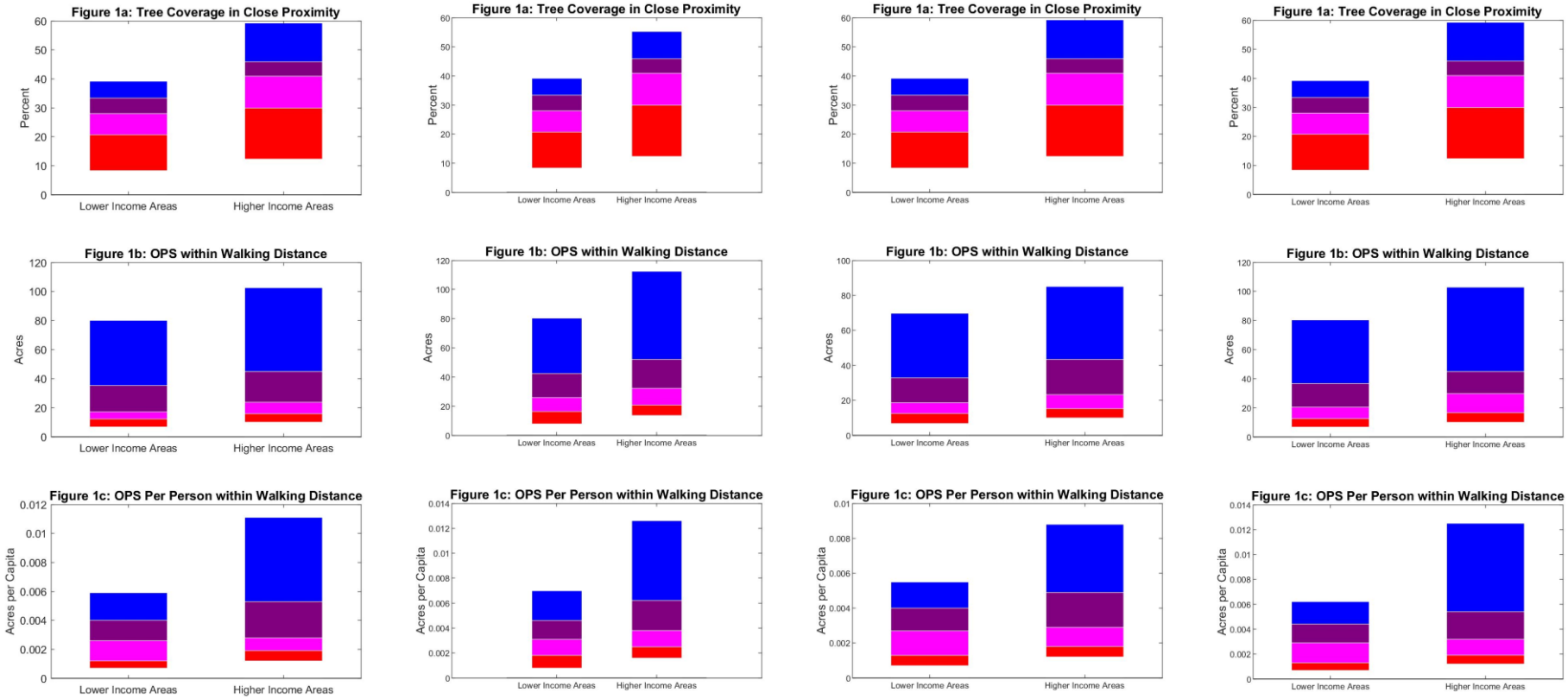
Walkable OPS Alternate Comparisons

We provide the following four graphs to illustrate the core study and the effect that three alternate types of OPS (NVRPA, NPS, and sports fields) and their inclusions and exclusions have on the subject groups; Neighborhood Median Income, Residence Type, Arlington Public Schools and Elementary Students by Race, and Racial Groups.

(1) The left graph is the baseline specification used for this white paper. It does not include sports fields, it does include NVRPA spaces, and it does not include federal parklands.
(2) Alternate Analysis 1: includes sports fields, includes NVRPA spaces, and does not include federal parklands.
(3) Alternate Analysis 2: does not include sports fields, does not include NVRPA spaces, and does not include federal parklands.
(4) Alternate Analysis 3: does not include sports fields, does include NVRPA spaces, and does include federal parklands.

Walkable OPS by Income Under Different Specifications

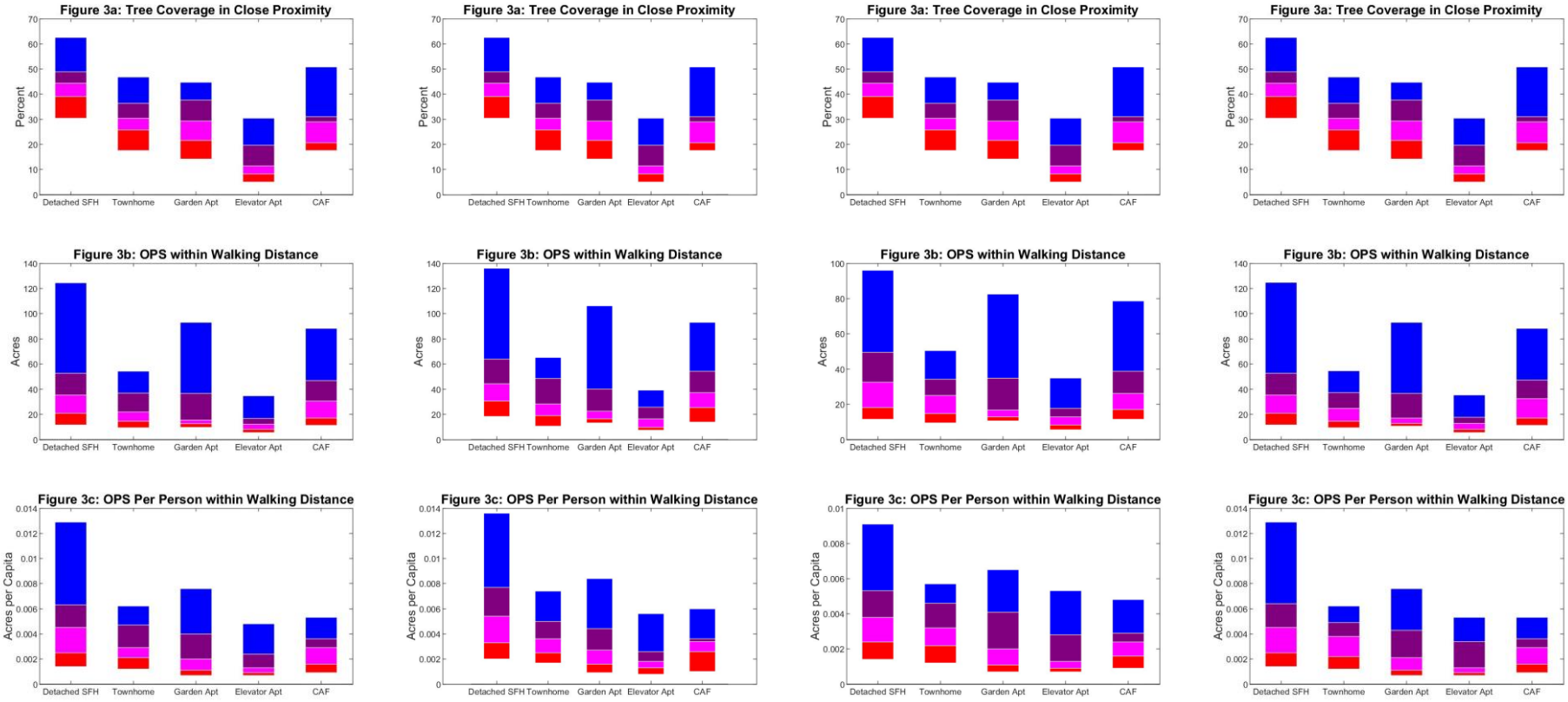
This study's specification:	**Alternate analysis 1:**	**Alternate analysis 2:**	**Alternate analysis 3:**
Sports fields – omitted NVRPA spaces – included federal parklands – omitted	Sports fields – included NVRPA spaces – included federal parklands – omitted	Sports fields – omitted NVRPA spaces – omitted federal parklands – omitted	Sports fields – omitted NVRPA spaces – included federal parklands – included



Figures 1a-1c: OPS by Area Income
Blue: 70-90% quartile (excellent proximity)
Purple: 50-70% quartile (above average proximity)
Magenta: 30-50% quartile (below average proximity)
Red: 10-30% quartile (relatively poor proximity)

Walkable OPS by Residence Type Under Different Specifications

This study's specification:	**Alternate analysis 1:**	**Alternate analysis 2:**	**Alternate analysis 3:**
Sports fields – omitted NVRPA spaces – included federal parklands – omitted	Sports fields – included NVRPA spaces – included federal parklands – omitted	Sports fields – omitted NVRPA spaces – omitted federal parklands – omitted	Sports fields – omitted NVRPA spaces – included federal parklands – included



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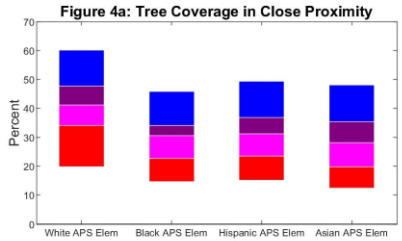
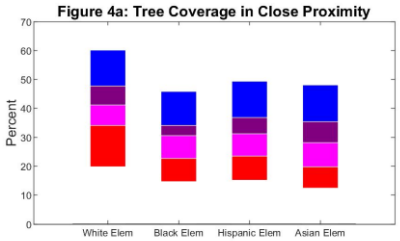
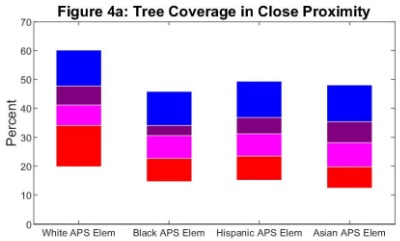
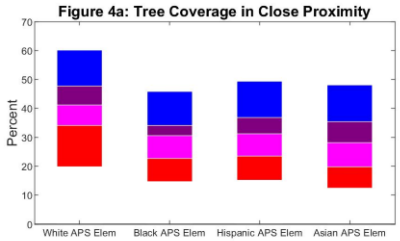
Walkable OPS by Race Under Different Specifications

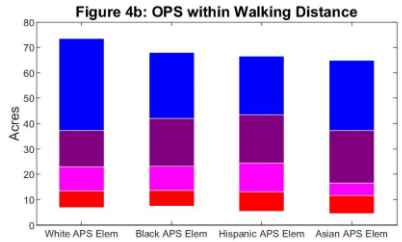
This study's specification:	**Alternate analysis 1:**	**Alternate analysis 2:**	**Alternate analysis 3:**
Sports fields – omitted NVRPA spaces – included federal parklands – omitted	Sports fields – included NVRPA spaces – included federal parklands – omitted	Sports fields – omitted NVRPA spaces – omitted federal parklands – omitted	Sports fields – omitted NVRPA spaces – included federal parklands – included

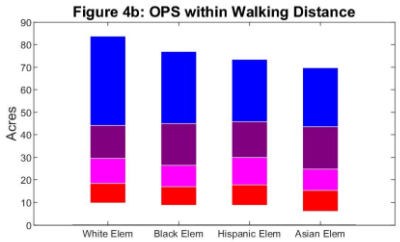


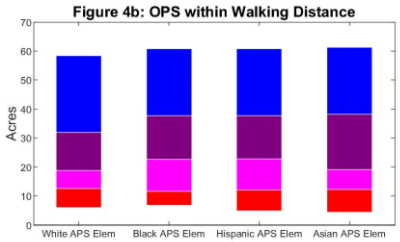


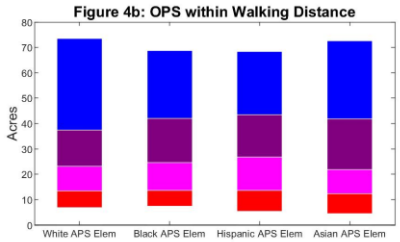


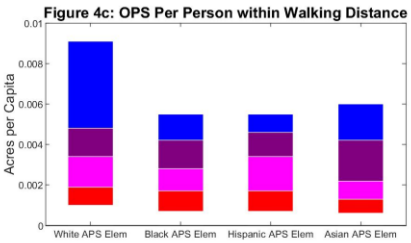


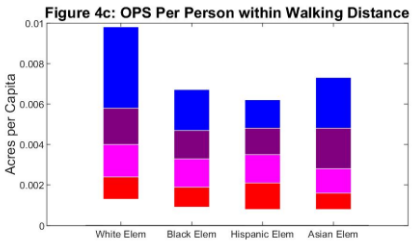


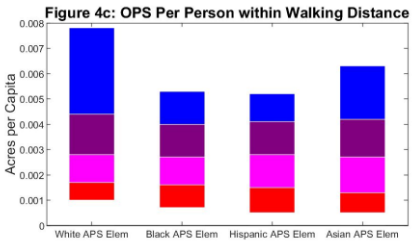


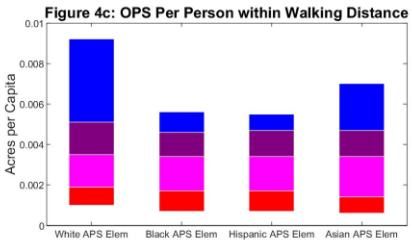












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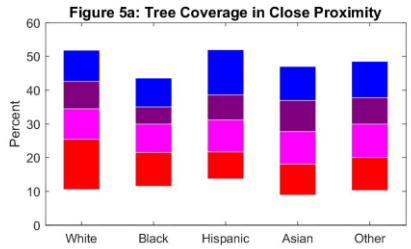
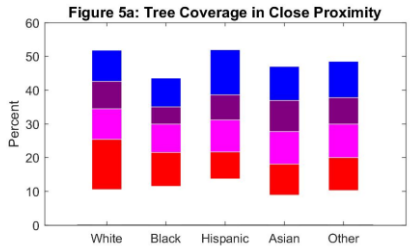
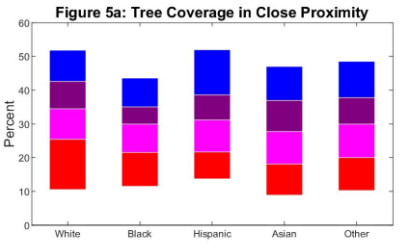
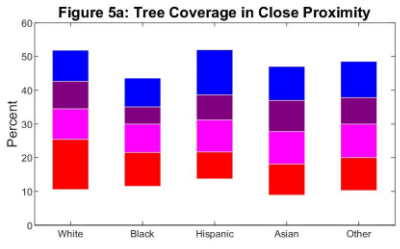
Walkable OPS by APS Elementary School Race Under Different Specifications

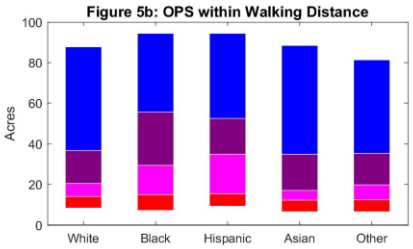
This study's specification:	**Alternate analysis 1:**	**Alternate analysis 2:**	**Alternate analysis 3:**
Sports fields – omitted	Sports fields – included	Sports fields – omitted	Sports fields – omitted
NVRPA spaces – included	NVRPA spaces – included	NVRPA spaces – omitted	NVRPA spaces – included
federal parklands – omitted	federal parklands – omitted	federal parklands – omitted	federal parklands – included

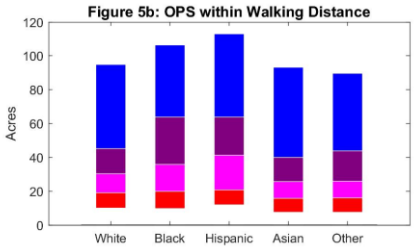


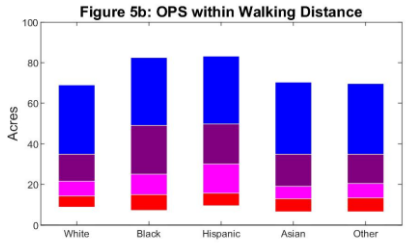


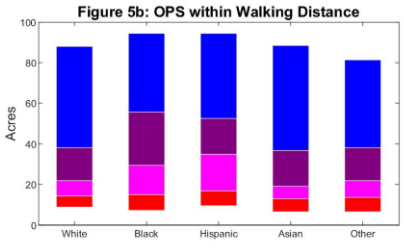


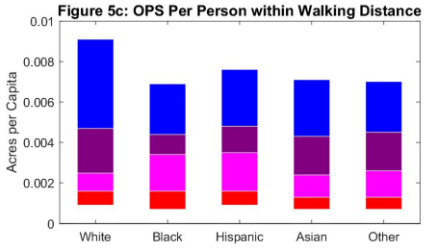


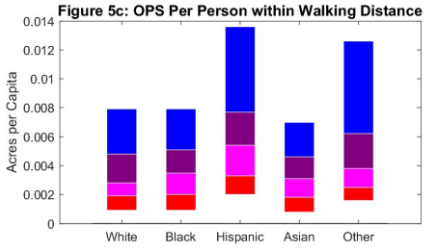


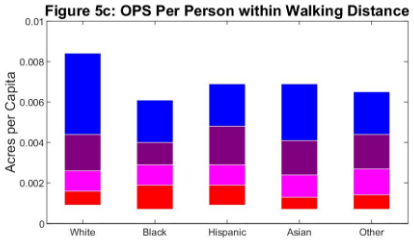


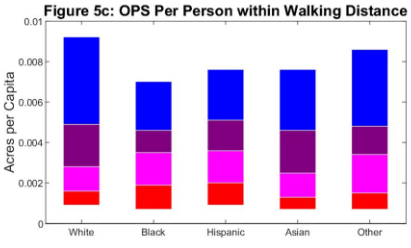












Figures 1a-1c: OPS by Area Income
Blue: 70-90% quartile (excellent proximity)
Purple: 50-70% quartile (above average proximity)
Magenta: 30-50% quartile (below average proximity)
Red: 10-30% quartile (relatively poor proximity)