Tree Canopy Assessment 2011–2021

Columbus & Franklin County, OH

Tree Canopy Assessment 2011-2021
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Acknowledgements

Consultant Team

Project Manager
Brian Coolidge

Report Authors
Nina Safavi (Lead) , Brian Coolidge, Jarlath O'Neil-Dunne, Mayra Rodriguez, Mike Galvin

UVM SAL Tree Canopy Assessment Team

Ernie Buford	Murphy Peisel
Anna Royar	Olivia Ting
Kelly Schulze	Sam Gelpi
Viv Karins	Amelia Sherman
Andrew Zilka	Leslie Campbell
Clare West	Katelyn Key
Grace Dymoke	Liviya Kovacevic
Jonas Peters	Jack Knight
Noah Harris	Jake Gess
Luke Schaefer	Emma Hoyt
Maeve Naumann	Doug Whiting

Columbus and Franklin County Project Team

Columbus Recreation and Parks Department
John Bowers – Urban Tree Canopy Assessment Project Manager
Rosalie Hendon – Environmental Planner
Jonathan Hillman – Arborist
Steven Horhut – City Forester

Franklin Soil and Water Conservation District
Josh Garver – GIS and Special Projects Director

Franklin County Public Health
Jennie McAdams – Sustainability Supervisor

Franklin County Auditor
Matt Shade – GIS Director

Franklin County Engineer's Office
Abigail Obert – Drainage Project Engineer Intern
Aaron Glanville –GIS Mapping Technician

A Message from the Project Team

The City of Columbus and Franklin County are proud to make this report possible. The 2011-2021 Tree Canopy Assessment is the first comprehensive study of our region's trees, as well as their change over time. Central Ohio is facing intense population growth and development pressures over the next decades, as well as climate change and public health challenges. Trees are integral to our residents' quality of life because they provide benefits such as filtering and cooling the air, producing shade, and increasing positive mental health outcomes. Understanding our regional urban forest is an important step to prioritizing, expanding, and growing tree canopy over the coming decades, especially in those areas impacted by pollution and historic disinvestment.

In 2015, the City of Columbus' first Urban Tree Canopy Assessment found that 22 percent of Columbus is covered with trees and recommended a strategic plan for tree canopy growth. This led to the creation of the Urban Forestry Master Plan, which was approved by Columbus leadership in April 2021. The Urban Forestry Master Plan incorporated feedback from numerous sources including community leaders, nonprofits, developers, universities, and industry experts. Conducting an updated tree canopy assessment was a key recommendation in the Urban Forestry Master Plan. The goals of the Urban Forestry Master Plan include the following: Goal 1: Reach Citywide Tree Canopy Cover of 40%; Goal 2: Stop the Net Canopy Losses by 2030; and Goal 3: Invest in Equitable Canopy Across All Neighborhoods by 2030.

The City of Columbus and Franklin County partnered in 2022 to conduct a new and expanded tree canopy assessment. Instead of exclusively studying tree canopy within City of Columbus boundaries, as was done in the 2015 report, this Tree Canopy Assessment includes the entirety of Franklin County, which in itself includes 14 cities, 9 villages and 17 townships. Urban forests are regional assets, and the benefits they provide are not limited to jurisdictional boundaries. Recognizing this, the project team worked to gather data that was as inclusive as possible to create a holistic, regional summary. By studying and growing tree canopy across the County, we anticipate potential transportation safety improvements and increased stormwater drainage benefits. This report can be used to target tree plantings to provide critical health benefits: cleaner air, cooler temperatures, better mental health, and more walkable communities. Recognizing the benefits of preserving and increasing our regional tree canopy, we anticipate an ongoing partnership between Columbus and Franklin County agencies, including Franklin County Public Health, Franklin County Engineer's Office, Franklin County Auditor's Office, and Franklin Soil and Water Conservation District.

The data in this report can be used both as a retrospective analysis as to how policies and initiatives have impacted tree growth, as well as a future planning model and guide, highlighting areas of need and potential. As the report and analysis were possible through a robust partnership across our region, we hope that the work going forward will lead to increased partnerships between residents, local governments, and organizations. As our region continues to grow, it will be crucial to continue to study our urban forest. We hope this report can be used in conjunction with other plans and studies to create safe, healthy, and thriving communities in central Ohio.

Thank you,

Columbus and Franklin County Project Team

The Need for Green

Trees provide essential ecosystem services for Columbus and Franklin County. The annual benefits they produce in total for the County, including Columbus, are estimated to be over $10 million in avoided stormwater runoff, $8 million from carbon sequestration, and $15 million in avoided health care costs associated with air pollution[1]. Trees are an indispensable part of the region's infrastructure. Research shows that these green assets are associated with more favorable social indicators, such as higher voter turnout[2], lower crime rates[3], and higher property values[4]. Tree canopy is a crucial component for building a more livable and prosperous region, particularly where tree canopy and these favorable indicators do not exist.

As with any community, Columbus and Franklin County face a host of environmental challenges, while seeking to balance development and conservation. A healthy and robust tree canopy can help maintain this balance, providing residents with a resource that will impact the health and well-being of generations to come.

TREE CANOPY ASSESSMENT

The Tree Canopy Assessment[5] protocols were developed by the USDA Forest Service to help communities better understand their green infrastructure through tree canopy mapping and analytics. Tree canopy is the layer of leaves, branches, and stems that provide tree coverage of the ground when viewed from above. A Tree Canopy Assessment can provide vital information to help governments and residents chart a greener future by helping them understand the tree canopy they have, how it has changed, and where there is room to plant trees. This study assessed tree canopy for Columbus and Franklin County over the 2011-2021 period. This study is not related to other studies from the past.

Executive Summary

COLUMBUS & FRANKLIN COUNTY
TREE CANOPY ASSESSMENT SUMMARY FOR 2011-2021

Columbus

+3,353
Acres

Area change in tree canopy
from new plantings and incremental growth.
(7,871 acres of gain - 4,518 acres of loss)

+2.4%

Absolute change in
tree canopy coverage

19.6% 2011 Existing Tree Canopy %

22.0% 2021 Existing Tree Canopy %

4.8
Million
Estimated total trees

Franklin County (Including Columbus)

+9,712
Acres

Area change in tree canopy
from new plantings and incremental growth.
(19,202 acres of gain - 9,490 acres of loss)

+2.8%

Absolute change in
tree canopy coverage

21.1% 2011 Existing Tree Canopy %

23.9% 2021 Existing Tree Canopy %

13.6
Million
Estimated total trees

Key Terms

Existing Tree Canopy: The amount of tree canopy present when viewed from above using aerial or satellite imagery.

Possible Tree Canopy-Vegetated: Grass or shrub area that is theoretically available for **the** establishment of tree canopy.

Measuring Tree Canopy Change

**Area Change** - the change in the area of tree canopy between the two time periods.

Absolute % Change - the percentage point change between the two time periods.

EXECUTIVE SUMMARY (CONTINUED)

The Tree Canopy Assessment represents a quantitative measure of canopy change from 2011 and 2021. Canopy cover is the area of land covered by trees, as viewed from above, and measures the extent of a region's urban forest. The study area for the region is shown in Figure 1. Figure 2 shows the 2021 existing tree canopy map that was created for the study area. The City of Columbus Urban Forestry Master Plan defines urban forests as all trees within a city, across all lands (both public and private). Urban forests are dynamic regional systems that often do not conform to political boundaries. To understand patterns of canopy change, the assessment uses a study area that encompasses several political jurisdictions of different levels.

Map of Study Area

Figure 1: Map of study area for the 2011-2021 tree canopy assessment.
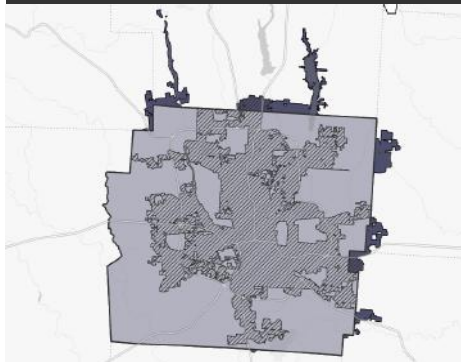
The study area is constructed of three components depicted in Figure 1.

City of Columbus corporate boundary

Franklin County includes 42 political jurisdictions total, 16 cities (including Columbus), 9 villages, and 17 townships.

Outlying areas that extend into neighboring counties. These areas were included because they are City of Columbus reservoirs, or one of seven political jurisdictions with a majority of land within the County but extending beyond.

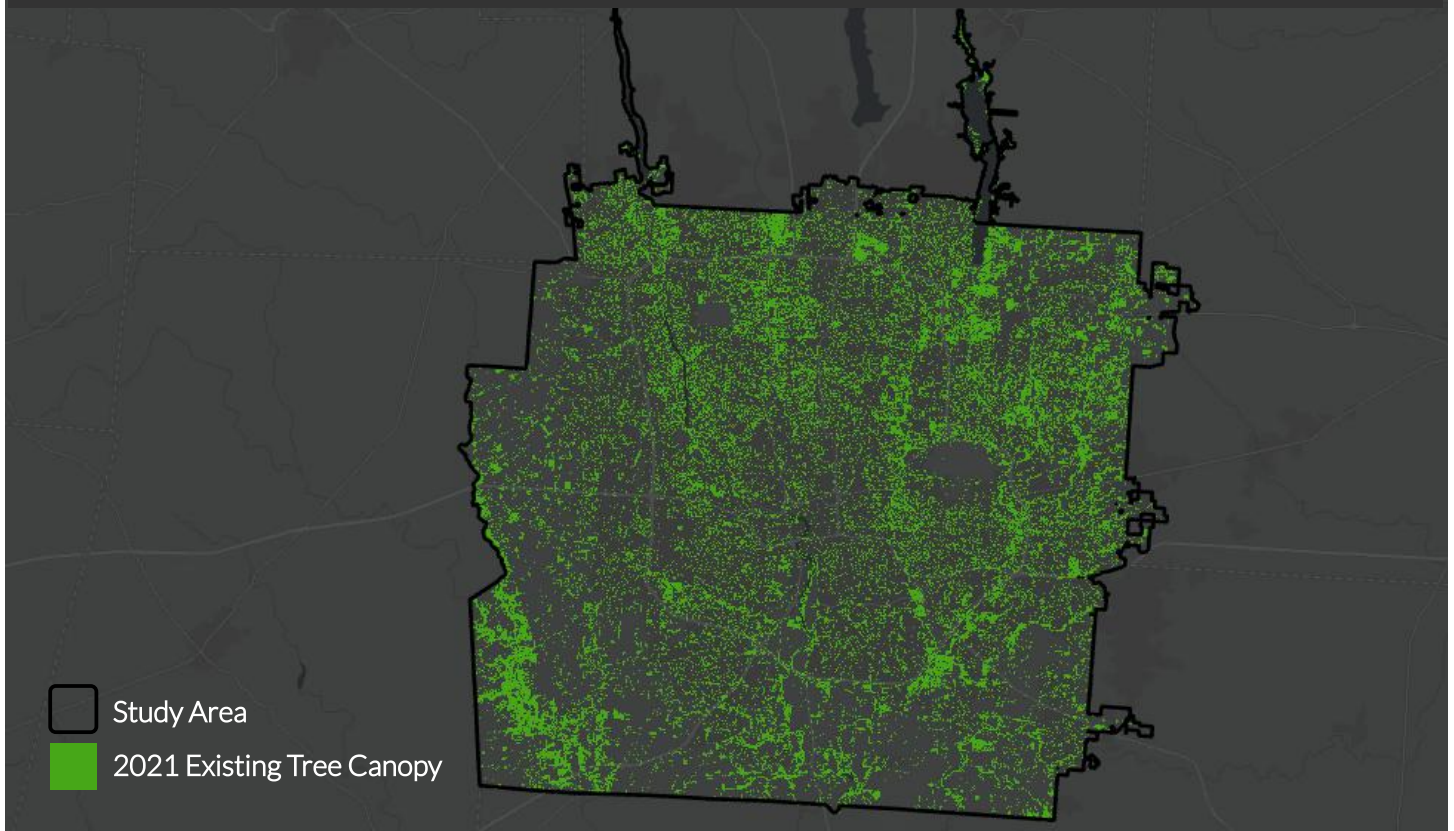## Map of Existing Tree Canopy for Study Area

Study Area

2021 Existing Tree Canopy

Figure 2: Map of existing tree canopy for the tree canopy assessment study area.

Between 2011 and 2021, tree canopy increased in both the City of Columbus (+2.4%) and Franklin County (+2.8%). As of 2021, existing tree canopy is 22% for the City and 24% for the County. This assessment offers the latest and most accurate account of the region's tree canopy available. While there has been positive change in canopy, the story is more nuanced.

Franklin County

There was widespread canopy gain (19,202 acres) and loss (9,490 acres). Land use history, invasive species, urban forestry initiatives, natural processes, and landowner decisions all influence the current state. The majority of the County's canopy is located in parks and open spaces, as well as residential property. These areas should play a key role when planning for canopy growth. The type of land associated with tree canopy loss varies from removal of individual trees in backyards to clearing of patches of trees for new construction. Suburban residential land had the most loss (3,500 acres), but the gains in suburban lands (5,700 acres) outpaced loss, resulting in a net gain of canopy. There is room to plant more trees in the County, without removing hard surfaces, with an estimated 163,000 acres of possible tree canopy-vegetated area.

City of Columbus

The City had widespread gain (7,871 acres) and loss (4,518 acres) in canopy cover, amounting to net gain of 3,353 acres from new plantings and incremental growth. The majority of canopy is on residential and parks and open space properties. The right-of-way (ROW) also played a key role in canopy gain. ROW, an important type of land use that is managed by the City, grew by nearly 480 acres of canopy, showing that the City's work to manage trees along roads has paid off. Tree removals on suburban and urban residential land caused the most canopy loss (2,175 acres). Twenty four communities in Columbus fall below the citywide canopy cover of 22%, with Italian Village and Downtown having the least canopy, at 12%.

Environmental Justice

The environmental justice analysis revealed census blocks in need of additional canopy investment. In this section, population dynamics such as median household income, asthma prevalence, air pollution, and urban heat are compared with tree canopy to help inform where trees can provide the most benefit.

Comparison to the 2015 Tree Canopy Assessment

To map and quantify tree canopy change for this study area, this assessment used new high resolution light detection and ranging (LiDAR) and aerial imagery data. The data and methods used here are not comparable to past studies for the area. This study calculated and completely reanalyzed 2011 and 2019/2021 data for all of Franklin County including Columbus, based on 2021 political boundaries and using updated methods. It is not possible to compare conclusions from the 2015 study and this 2011-2021 study, due to the differences in methods and data.

COLUMBUS RECOMMENDATIONS

Use this report to measure progress toward Columbus' canopy goals; investigate causes of canopy loss; and develop solutions to protect and enhance the urban forest.

Protect trees during development on residential land, as the majority of canopy loss occurred on suburban (1,439 acres) and urban (736 acres) residential land.

Protections for trees during development can preserve canopy growing on commercial and residential land.

Plant new trees in communities where existing tree canopy is low, such as Italian Village (12%), Downtown (12%), and other communities that fall below the citywide coverage of 22%.

Protect trees on City property to encourage canopy growth, as there is 49% existing canopy on these parcels, amounting to an estimated 735,000 trees.

Proactively manage street trees to continue increasing canopy in the ROW, as tree canopy in the ROW grew by 2%.

Develop a prioritization strategy for canopy protection and enhancement in vulnerable communities to improve environmental equity.

Manage the urban forest to have a broad age distribution and a variety of species to support a robust and healthy tree canopy over time.

Repeat the UTC assessment over an appropriate time interval, usually every 5 to 8 years.

Educate residents and community leaders about the value of trees and how they can contribute to preserving and growing canopy.

Invest in LiDAR and imagery to support these assessments and other mapping needs.

Conduct on-the-ground inventories to collect field data on public trees, including tree species, size, and health.

FRANKLIN COUNTY RECOMMENDATIONS

Preserving existing tree canopy is the most effective means for securing future tree canopy, as loss is an event but gain is a process.

Prioritize tree planting on residential and publicly owned land, where there is the greatest potential for tree canopy.

Proactively care for trees in parks and open space, as tree canopy in parks and open space grew by 5%, but also lost 868 acres.

Use available resources to ensure urban trees are prioritized, protected, and planted according to best practices.

The County can improve environmental equity by prioritizing tree plantings in jurisdictions most susceptible to environmental risk.

Manage the urban forest to have a broad age distribution and a variety of species to support a robust and healthy tree canopy over time.

Repeat the UTC assessment over an appropriate time interval, usually every 5 to 8 years.

Community education is crucial if tree canopy is to be maintained over time. Tap into local and national resources, such as ODNR Forestry, federal funding, partners from park districts, and educational organizations.

Invest in LiDAR and imagery to support these assessments and other mapping needs.

Encourage on-the-ground tree inventories to collect field data on public trees, including tree species, size, and health.

Methods & Analysis

MAPPING TREE CANOPY FROM ABOVE

Data Sources

Tree canopy assessments rely on remotely sensed data in the form of light detection and ranging (LiDAR) and aerial imagery. These datasets, which have been acquired by various governmental agencies in the region, are the foundational information for tree canopy mapping. This analysis used the most recent datasets available: LiDAR collected in 2019, and imagery from 2021.

Using LiDAR and imagery together increases the accuracy of the tree canopy assessment. Imagery provides information that enables features to be distinguished by their spectral (color) properties. As trees and shrubs can appear spectrally similar or be obscured by shadow, LiDAR technology separates trees from shrubs and captures trees in shadow.

Tree Canopy Mapping

Tree canopy mapping is performed using a scientifically rigorous process that integrates cutting-edge automated feature extraction technologies with detailed manual reviews and editing. This combination of sensor and mapping technologies enabled tree canopy to be mapped in greater detail and with better accuracy than ever before; from the canopy of a single street tree along a roadside, to a continuous patch of tree canopy in a park.

Land Cover Mapping

Tree canopy is one of seven classifications from the high-resolution land cover map (Figure 4) that forms the foundation of this project. Compared to national tree canopy datasets, which map at a resolution of 30-meters, this project generated maps that were over 1,000 times more detailed and better account for all of the region's tree canopy.

Tree Canopy Mapping

Figure 3: Locations of individual trees and their crowns derived from the 2019 LiDAR, overlaid on 2021 aerial imagery (top), and the 2019 LiDAR map (bottom).
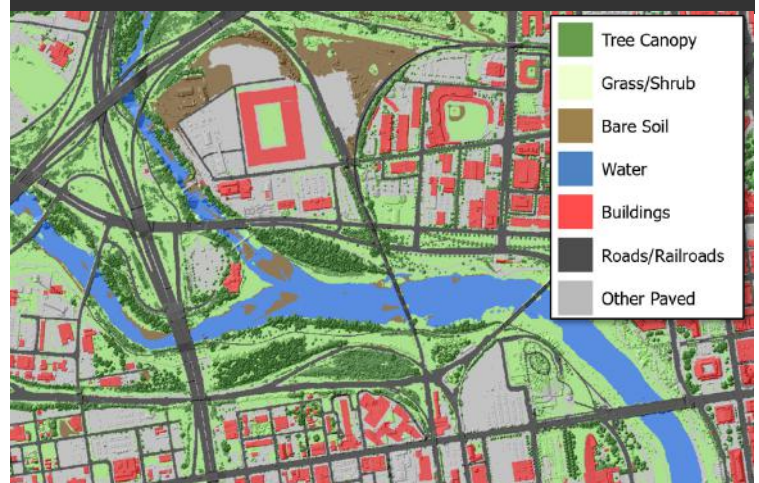
Land Cover Map

Figure 4: High-resolution land cover developed for this project depicting downtown Columbus along the Scioto River.

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TREE CANOPY ANALYSIS

Tree Canopy Metrics

Tree canopy metrics (Figure 5) are comprised of tree canopy and tree canopy change summaries for different geographical units of analysis. This report is based on a selection of data from this exhaustive geospatial database, which includes over a dozen geographic analyses.
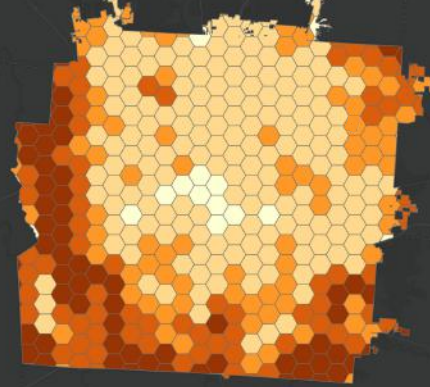
Tree Canopy Geospatial Database

The geographical units of analysis include hexagons that provide a standard mechanism for visualizing the distribution of tree canopy without the constraints of other geographies that have unequal area (e.g., zip codes). Metrics also include boundaries of formally defined areas for different planning purposes, such as land use, property parcels, census boundaries, and community boundaries.

Existing & Possible Tree Canopy

Combined with the 2021 landcover map for Columbus and Franklin County, the tree canopy metrics provide information on the area of existing tree canopy and possible tree canopy for each geographical unit. This report includes key metrics, and the comprehensive geospatial dataset of metrics is available as a supplement.

Examples of Tree Canopy Metrics

Possible Tree Canopy -Vegetated by Hexagons

Existing Tree Canopy by Columbus' Communities & Franklin County Jurisdictions
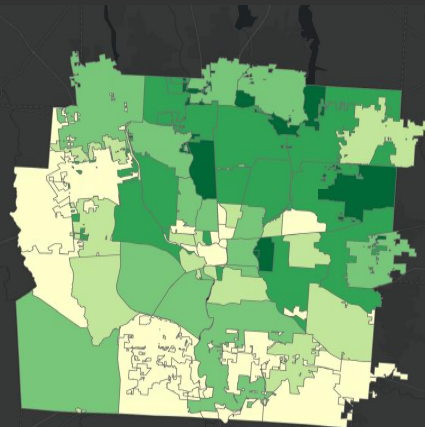
Absolute % Change by Land Use

Figure 5: Examples of metrics from the geospatial dataset. Top is possible tree canopy-vegetated by hexagons. Middle is existing tree canopy by Columbus communities & Franklin County jurisdictions. Bottom is absolute % change by land use.

THE TREE CANOPY ASSESSMENT PROCESS

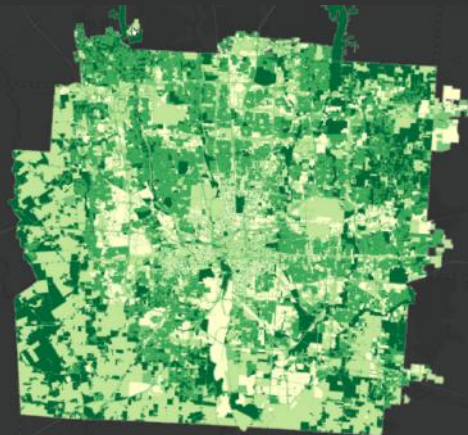This project employed the USDA Forest Service's Urban Tree Canopy assessment protocols and made use of federal, state, and local investments in geospatial data. Tree canopy assessments should be completed at regular intervals, and many communities select 5 year intervals to assess canopy change.

Remotely sensed data forms the foundation of the tree canopy assessment. We use high-resolution aerial imagery and LiDAR datasets to map tree canopy and other land cover features.

The land cover data consist of pervious features of tree canopy, grass/shrub, bare soil, and water. Impervious features are buildings, roads/railroads, and other impervious surfaces.

The land cover data are summarized by various geographical units, ranging from the property parcel to the watershed to the municipal boundary.

The report (this document) summarizes the project methods, results, and findings.

The presentation, given to partners and stakeholders in the region, provides the opportunity to ask questions about the assessment.

The tree canopy metrics data analytics provide basic summary statistics in addition to inferences on the relationship between tree canopy and other variables.

These summaries, in the form of tree canopy metrics, are an exhaustive geospatial database that enable the Existing and Possible Tree Canopy datasets.

Geospatial Data

This assessment would not have been possible without the region's investment in high-quality geospatial data, particularly LiDAR, to map tree canopy change for this study area.

Tree Canopy Assessment Results

TREE COUNT

4.8

million trees in Columbus

13.6

million trees in Franklin County

The tree canopy assessment offers an estimate of millions of individual trees-- that's **5 trees per person for Columbus** & **10 trees per person for Franklin County**.

Tree Crowns

Approximately 4.8 million trees grow in Columbus, and 13.6 million trees grow across Franklin County. Based on 2021 population estimates from American Community Survey, this translates to five trees per Columbus resident and 10 trees per Franklin County resident. In addition to quantifying tree canopy acreage and percent coverage, this study used LiDAR to produce centroid points (location of individual trees, where it is growing out of the ground) and circular polygon representations of tree crowns (the spread of the canopy of an individual trees' branches), shown in Figure 6.

Protecting trees on public land is one way Columbus and Franklin County can encourage canopy growth. On land owned by Columbus, there are nearly 734,000 estimated trees, with over 673,000 located in parks. Franklin County has an estimate of nearly 1.1 million trees in parks. The tree crown map offers a helpful alternative for places lacking tree inventories, such as County jurisdictions and natural areas that are difficult to access. While not a replacement for field-based inventories, LiDAR provides a unique advantage in that all trees can be counted.

Tree Crown Map

Figure 6: Tree centroids (dots) and tree crowns (circles) mapped from the 2019 LiDAR. Tree mapping from LiDAR involves finding relative high points for each tree, then tracing down until a height inflection point is reached, marking the edge of the crown. This approach to individual tree mapping is most accurate where there is a clear differentiation in tree crowns and is less accurate in forested stands where crowns may overlap.

Tree Canopy Assessment Results

TREE COUNT

4.86

million trees in Columbus

12.8

million trees in Franklin County

The tree canopy assessment offers an estimate of millions of individual trees-- that's **5 trees per person for Columbus** & **10 trees per person for Franklin County**.

Tree Crowns

Approximately 4.86 million trees grow in Columbus, and 12.8 million trees grow across Franklin County. Based on 2021 population estimates, this translates to five trees per Columbus resident and 10 trees per Franklin County resident. In addition to quantifying tree canopy acreage and percent coverage, this study used LiDAR to produce centroid points (location of individual trees, where it is growing out of the ground) and circular polygon representations of tree crowns (the spread of the canopy of an individual trees' branches), shown in Figure 6.

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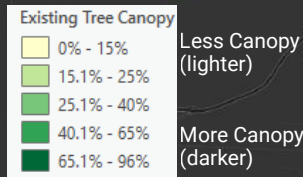
EXISTING & POSSIBLE TREE CANOPY

Cities and counties commonly have uneven distributions of tree canopy, a pattern that applies to the City of Columbus and Franklin County. The visualization of canopy distribution with uniform areas was accomplished by using standardized hexagons, each covering 1,000 acres. For each of the hexagons in Figure 7, the percent of existing tree canopy and possible tree canopy were calculated by dividing each variable by the land area, which excludes water.

This unequal distribution of canopy can be traced back to the region's history of development patterns and open space planning. Residents who live and work in areas with more trees, represented by dark green (Figure 7 top), disproportionately receive more benefits that trees provide. Conversely, the more urbanized regions with lower amounts of tree canopy receive fewer ecosystem services from trees. For Columbus (Figure 7 top) and Franklin County (Figure 8 top), there are some hexagons with less than 15% tree canopy and others with over 75% tree canopy.

There is available space in Columbus (Figure 7 bottom) and Franklin County (Figure 8 bottom) to plant more trees (darker orange hexagons). In this assessment, any areas with no trees, buildings, roads, or bodies of water are considered possible tree canopy - vegetated, where trees could theoretically be established without having to remove hard surfaces. Maps of the possible tree canopy - vegetated can assist in strategic planning, but decisions on where to plant trees should be made based on field verification.

Columbus Existing Tree Canopy % by Hexagons

22% of land in Columbus is covered by tree canopy

Existing Tree Canopy
- 0% - 15%
- 15.1% - 25%
- 25.1% - 40%
- 40.1% - 65%
- 65.1% - 96%

Less Canopy (lighter)

More Canopy (darker)

Columbus Possible Tree Canopy-Vegetated % by Hexagons

37% of land in Columbus could possibly be planted with trees

Possible Tree Canopy
- 4% - 25%
- 25.1% - 40%
- 40.1% - 55%
- 55.1% - 75%
- 75.1% - 100%

Less possible space to plant (lighter)

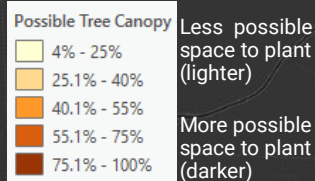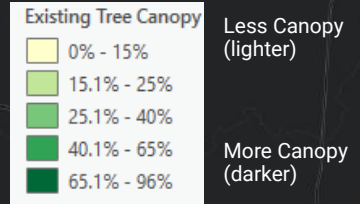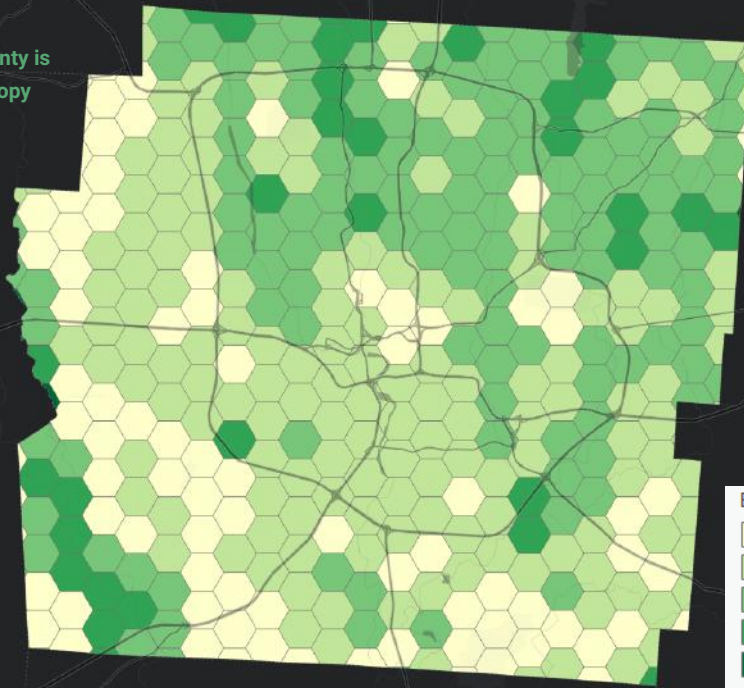More possible space to plant (darker)

Figure 7: Columbus existing (top) and possible tree canopy-vegetated (bottom) percentages summarized by 1,000- acre hexagons and 2021 land cover conditions.

Franklin County Existing Tree Canopy % by Hexagons

24%
of land in Franklin County is
covered by tree canopy

Existing Tree Canopy
- 0% - 15%
- 15.1% - 25%
- 25.1% - 40%
- 40.1% - 65%
- 65.1% - 96%

Less Canopy (lighter)

More Canopy (darker)

Franklin County Possible Tree Canopy-Vegetated % by Hexagons

48%
of land in Franklin County
could possibly be planted
with trees

Possible Tree Canopy
- 4% - 25%
- 25.1% - 40%
- 40.1% - 55%
- 55.1% - 75%
- 75.1% - 100%

Less possible space to plant (lighter)

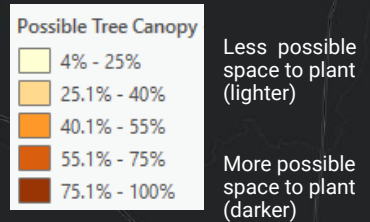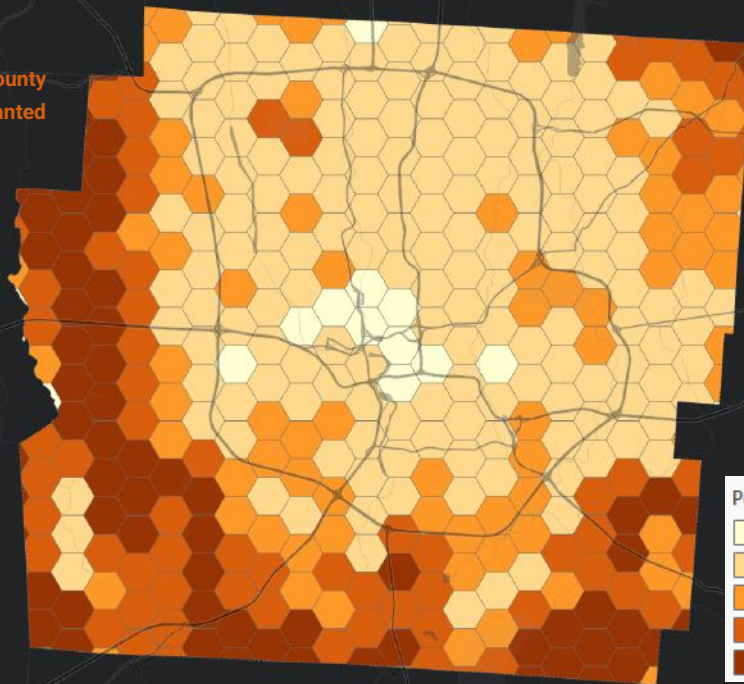More possible space to plant (darker)

Figure 8: Franklin County existing tree canopy (top) and possible tree canopy-vegetated (bottom) tree canopy percentages summarized by 1,000-acre hexagons and 2021 land cover conditions.

Many factors go into deciding where a tree can be planted with the necessary conditions to flourish, including land use, landscape conditions, existing infrastructure, social attitudes towards trees, and financial considerations. For example, areas such as golf courses, airports, clear zones for County road ROW, and recreational fields may have open space to plant trees, but there is a direct conflict in use. Thus, the possible tree canopy category should serve as a guide for further field analysis, not a prescription of where to plant trees.

Additionally, varying ownership and administration of land can impede consensus of how to preserve and grow canopy. Public entities may have policies to protect and restore canopy with application only to public land, which commonly represents a small portion of overall land area. Therefore, it may be advantageous to create policies that enable cooperation across administrative boundaries.

Franklin County can potentially plant trees on over 163,000 acres, or 48%, of its land. Similarly, Columbus has 53,000 acres of possible tree canopy-vegetated, comprising 37% of the City. There remain significant opportunities for planting trees that will improve tree canopy in the long term. Planting new trees in areas where tree canopy is low or in locations where there has been tree canopy removed are ways to grow canopy. Of the 48% of Franklin County land that could potentially have tree canopy, 46,000 acres or approximately 28%, is agricultural. Although agricultural land use is not currently available for tree plantings, it could increase tree canopy in the future. As cities grow, agricultural land is likely to be developed into areas with land uses more suitable for trees. This shows the need to establish an urban tree canopy plan, such as setting aside areas for parks and requiring tree plantings for new residential areas.

In the most densely urbanized areas, especially in Columbus, significantly increasing the tree canopy will be difficult; nevertheless, it remains vitally important to strive for canopy gains. In residential areas, healthy natural regeneration of the existing tree canopy, and planting new trees will be important. There is often a "plant and forget" cycle in residential areas, where trees are planted at the time homes are built, without replacement of trees when they decline, to establish the next generation of canopy. Field data collection efforts should be used to complement this assessment as information on tree species, size, planting date, and health can only be obtained through on-the-ground inventories.

Columbus and Franklin County experienced a canopy net gain from 2011 to 2021 of 2.4% and 2.8%, respectively, but the story of change is more nuanced, with a mix of loss and gain. Residents may choose to remove or plant a new tree in their backyards. A development project can lead to loss of canopy from the construction of new buildings, pavement, and other infrastructure. The same development project can lead to canopy gain, if existing trees are protected and new trees are integrated in the early stages of planning and design.

The change in tree canopy is measured by subtracting the 2011 canopy from the 2021 canopy. Negative values (purple) indicate canopy loss, and positive values indicate gain (yellow and green). Figure 9 summarizes tree canopy change by 1,000-acre hexagons for the City of Columbus. The central urbanized areas of the City experienced the most canopy loss as shown in the purple hexagons, and low rates of canopy growth, shown in yellow. The south and western areas of the City experienced the most canopy growth (dark green). Changes in tree canopy over the ten year period ranged from losses of -15% to gains of 10%. Franklin County (Figure 10) experienced higher rates of canopy gain (green) than Columbus, with up to 26% tree canopy gain.
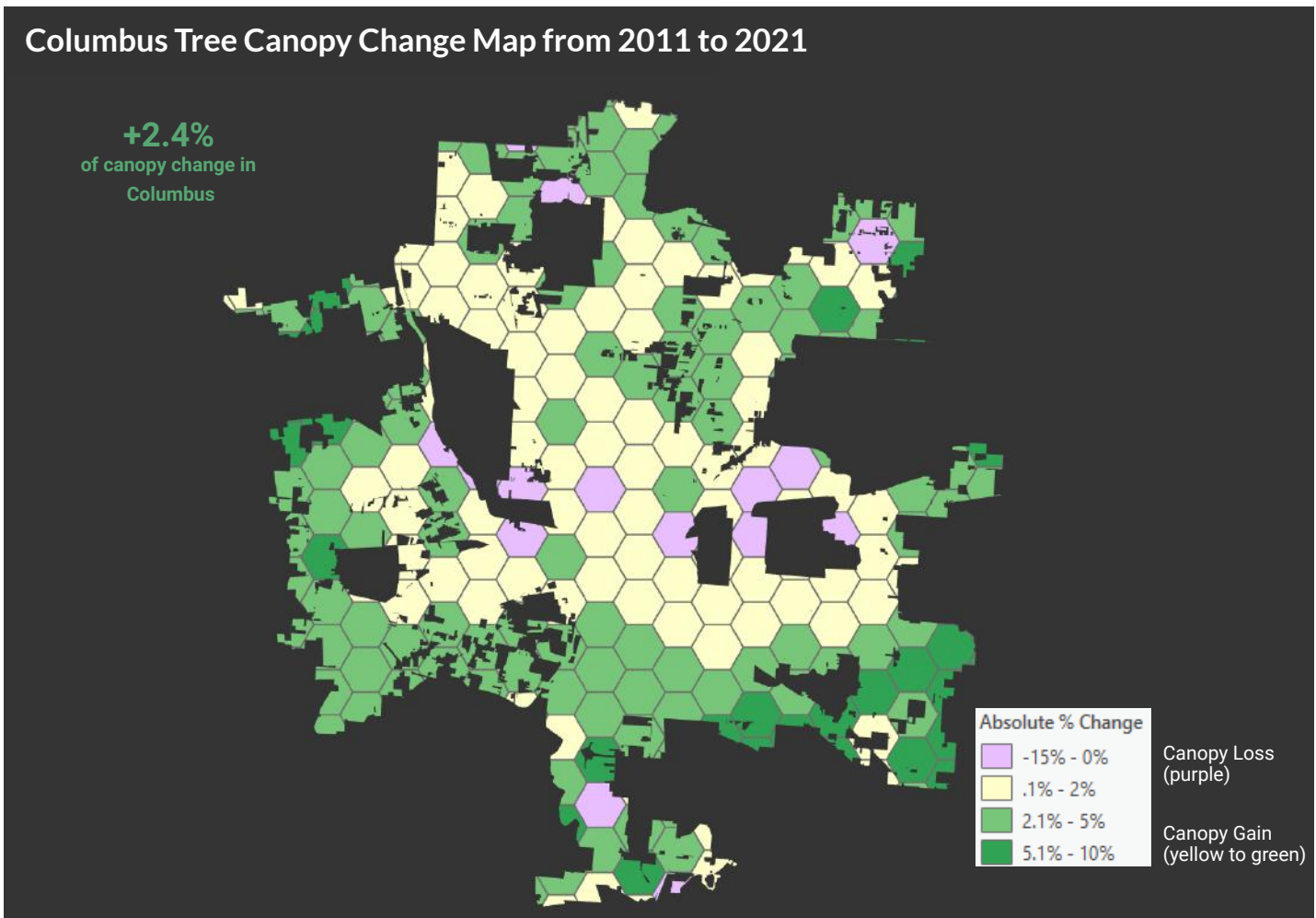

Figure 9: Tree canopy change metrics summarized by 1,000-acre hexagons for the City of Columbus. Absolute change for each hexagon is calculated by using the formula (2021 canopy %)- (2011 canopy %). Negative values (purple) indicate loss, and positive values (yellow and green) indicate gain.

The trajectory of the region's tree canopy in the future is uncertain. During the time period of this study, the region's public tree population was decimated by Emerald Ash Borer infestation, leading administrators to expect an overall loss in canopy. The gain revealed by this study was not only surprising, but also exemplifies the difficulty in predicting the future state of a complex urban forest. Beyond insects, there are many other environmental and anthropogenic risks facing canopy cover. Invasive species could pose a serious threat if not identified and controlled early. Natural events such as storms can have a mixed impact on the canopy. In conserved areas, tree canopy will return through natural growth, but in urbanized areas, trees lost to storms will need to be replanted. Climate change may cause trees to grow more quickly, but could also result in inhospitable conditions for native species. Anthropogenic factors include preservation and conservation efforts.

Managing these risks will be key to achieving canopy growth. Adopting ordinances that protect trees on both public and private property can reduce canopy loss and assist a jurisdiction in reaching its canopy goals, as in the case of Columbus' goal to reach 40% tree canopy by 2050. Planting a variety of tree species can provide resilience against future invasive pests. Tree planting requirements can ensure new trees are planted as part of new development projects. Landscape grading changes and the use of heavy machinery can have harmful effects on trees. Giving trees adequate space, care, and monitoring during construction is important for maintaining healthy trees before they are damaged.

Franklin County Tree Canopy Change Map from 2011 to 2021

+2.8%
of canopy change in
Franklin County

Absolute % Change
- -15% - 0%
- .1% - 2%
- 2.1% - 5%
- 5.1% - 10%
- 10.1% - 26%

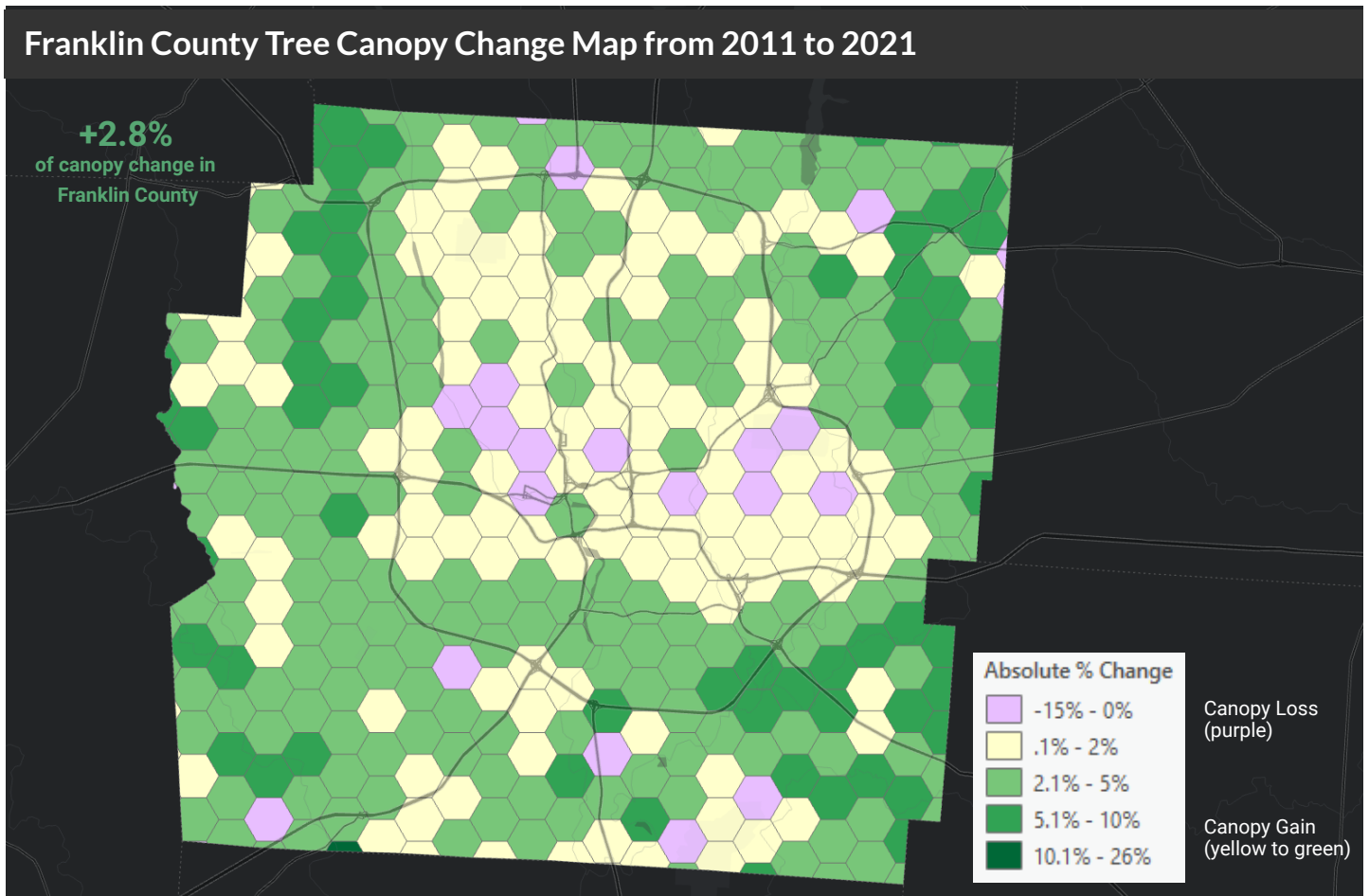Canopy Loss (purple)

Canopy Gain (yellow to green)

Figure 10: Tree canopy change metrics summarized by 1,000-acre hexagons for Franklin County. Absolute change for each hexagon is calculated by using the formula (2021 canopy %)- (2011 canopy %). Negative values (purple) indicate loss, and positive values (yellow and green) indicate gain.

The differences in canopy are the result of land use history and changes to the built environment. Jurisdictions with large parks and open space, or those that have lower density development, tend to have more canopy, while jurisdictions that are more dense with commercial or industrial use tend to have less tree canopy. Across all jurisdictions of Franklin County, the average existing tree canopy was 27.4%. Sixteen jurisdictions had over 30% canopy, and no jurisdiction had less than 12%. Figure 11 shows existing tree canopy by jurisdiction. Darker green indicates the highest canopy cover of 40-60%, and yellow indicates the least canopy cover.

The majority of jurisdictions experienced a positive absolute change, but there were 4 jurisdictions that had a net loss as depicted in Figure 12 below by the orange bars. To improve canopy, jurisdictions can tap into local, state, and national resources, such as the Ohio Department of Natural Resources (ODNR) Division of Forestry, federal funding opportunities, partners from park districts, and educational organizations. Community education is crucial if tree canopy is to be maintained over time. Adopting a technical tree manual can help establish good tree care and management practices. The City of Columbus' technical manual could be a helpful resource for jurisdictions of the County to use according to their needs.

Franklin County Jurisdictions - Existing Tree Canopy %

Existing Tree Canopy %
13% - 20%
20% - 25%
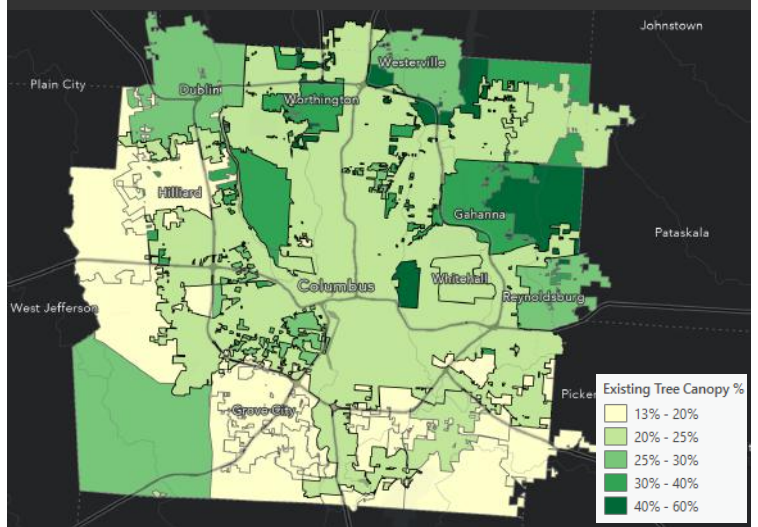25% - 30%
30% - 40%
40% - 60%

Figure 11: Existing tree canopy percentage for 2021 conditions summarized by jurisdictions of Franklin County.

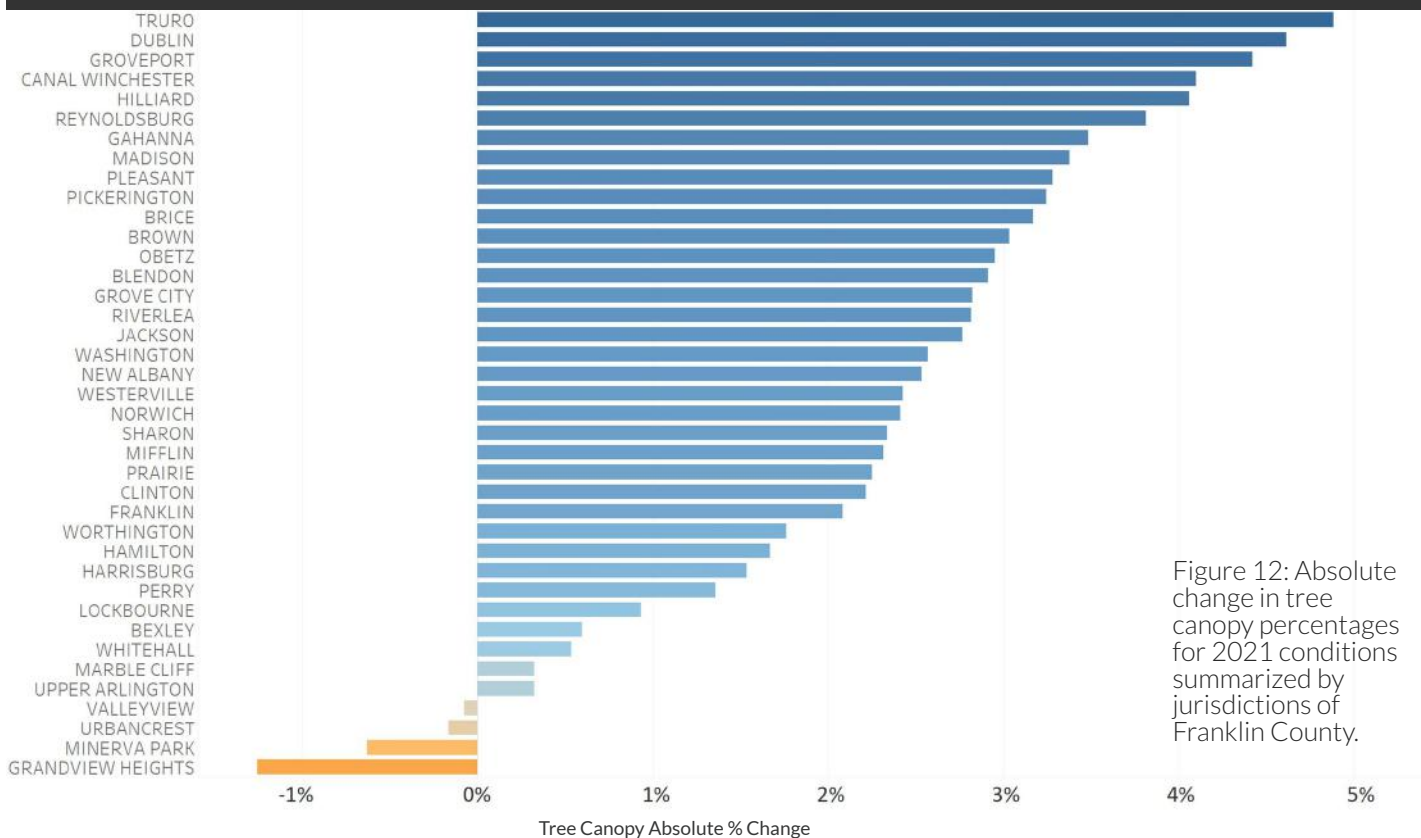**Franklin County - Tree Canopy Absolute % Change by Cities, Townships, and Villages 2011-2021**

Figure 12: Absolute change in tree canopy percentages for 2021 conditions summarized by jurisdictions of Franklin County.

Tree Canopy Absolute % Change

Communities of Columbus

The City of Columbus' official community geographic boundaries are a useful way to summarize tree canopy and draw broad comparisons between communities. The Columbus communities map represents areas generally recognized as a "community", which often comprise a number of neighborhoods and are used by City departments for planning and reporting purposes. These communities are generally where people live and work.

Figure 13 shows the existing canopy map by community. Figure 14 shows the Citywide percentage of canopy coverage of 22% and the individual tree canopy cover of each Columbus community. Twenty four communities had canopy cover below 22%. Clintonville has the most existing canopy (37.9%). Italian Village (11.5%), and Downtown (11.9%), have the least existing canopy of the communities where people live.

Columbus Communities - Existing Tree Canopy %

Existing Tree Canopy %
- 6% - 14%
- 14% - 20%
- 20% - 25%
- 25% - 32%
- 32% - 45%
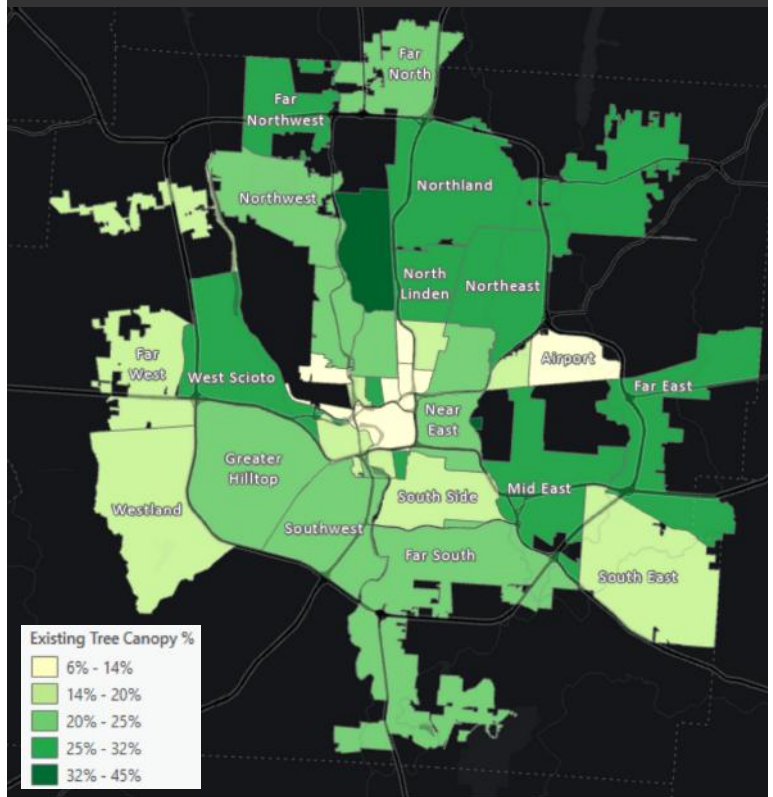
Figure 13: Existing tree canopy percentage for 2021 conditions summarized by community. A few communities are labelled for reference.

Columbus - Existing Tree Canopy by Columbus Community

22% Citywide Canopy Coverage

Existing Tree Canopy %

Figure 14: Existing tree canopy percent by community. Six Columbus communities lack a significant residential population: Airport, Dublin Road Corridor, Fort Hayes, Harmon Road Corridor, State of Ohio, and Wolfe Park.

21

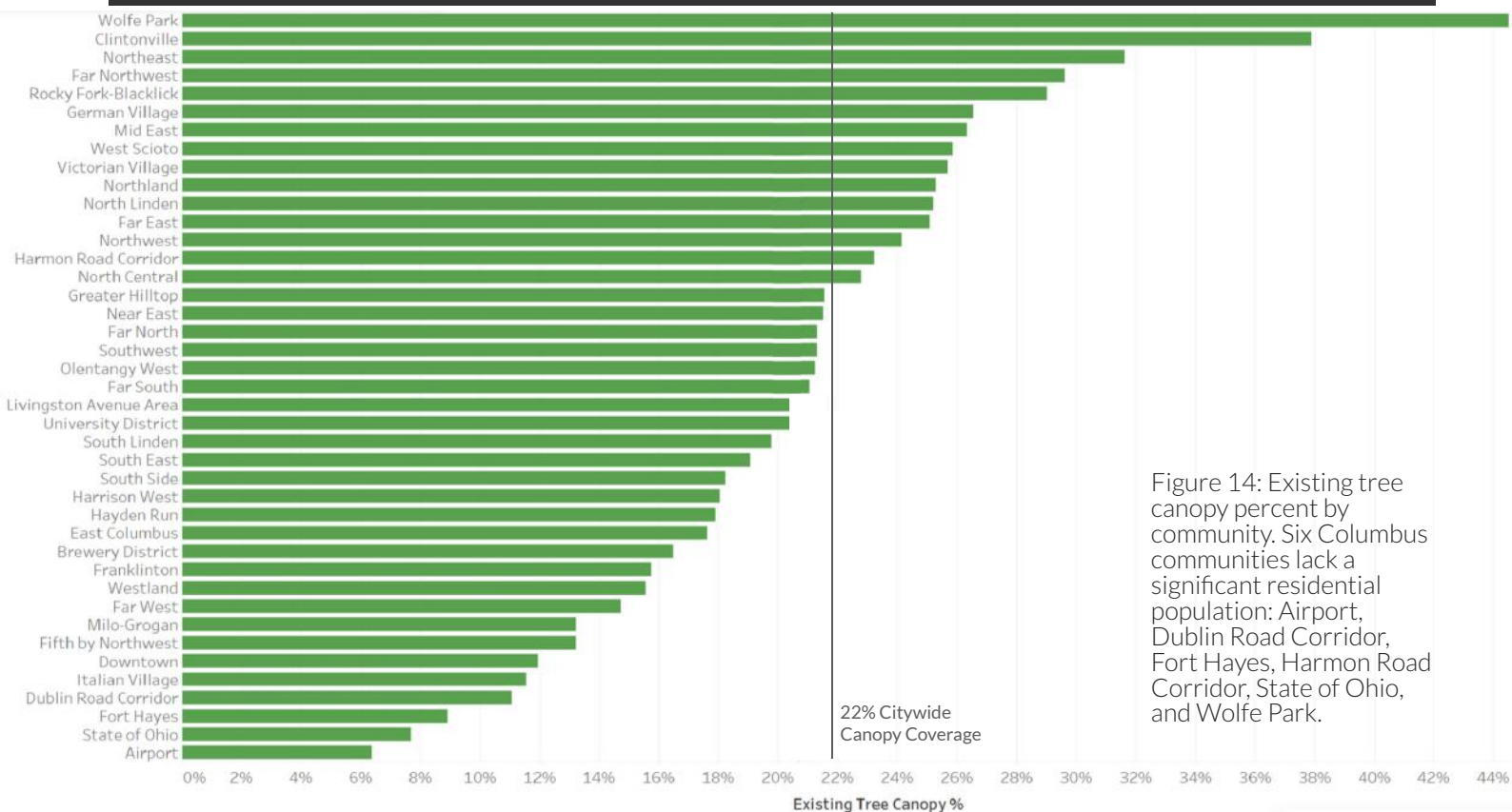In most communities of Columbus, gain outpaced loss. The Far South gained the most canopy with 774 acres but had a loss of 328 acres. Northland experienced the most loss with over 400 acres and gained 590 acres, resulting in a positive absolute change. Figure 15 indicates tree canopy absolute change by community. The South East had the most positive absolute change of 5%, amounting to over 500 acres of new canopy.

Five communities experienced a negative absolute change in canopy: East Columbus (-1.4%), Fifth by Northwest (-0.7%), Italian Village (-0.5%), Milo-Grogan (-0.4%), and University District (-0.4%). The Dublin Road Corridor experienced the most loss with -7% absolute change, amounting to 25 acres lost, as a result of a forest patch removed for development. Loss occurs for many reasons. For example, there has been an influx of commercial and residential development in Fifth by Northwest and Italian Village. Trees were removed to make space for the new buildings. While some new trees were planted, they won't contribute significantly to canopy gain for decades to come, resulting in loss outpacing gain for the time period of this assessment.

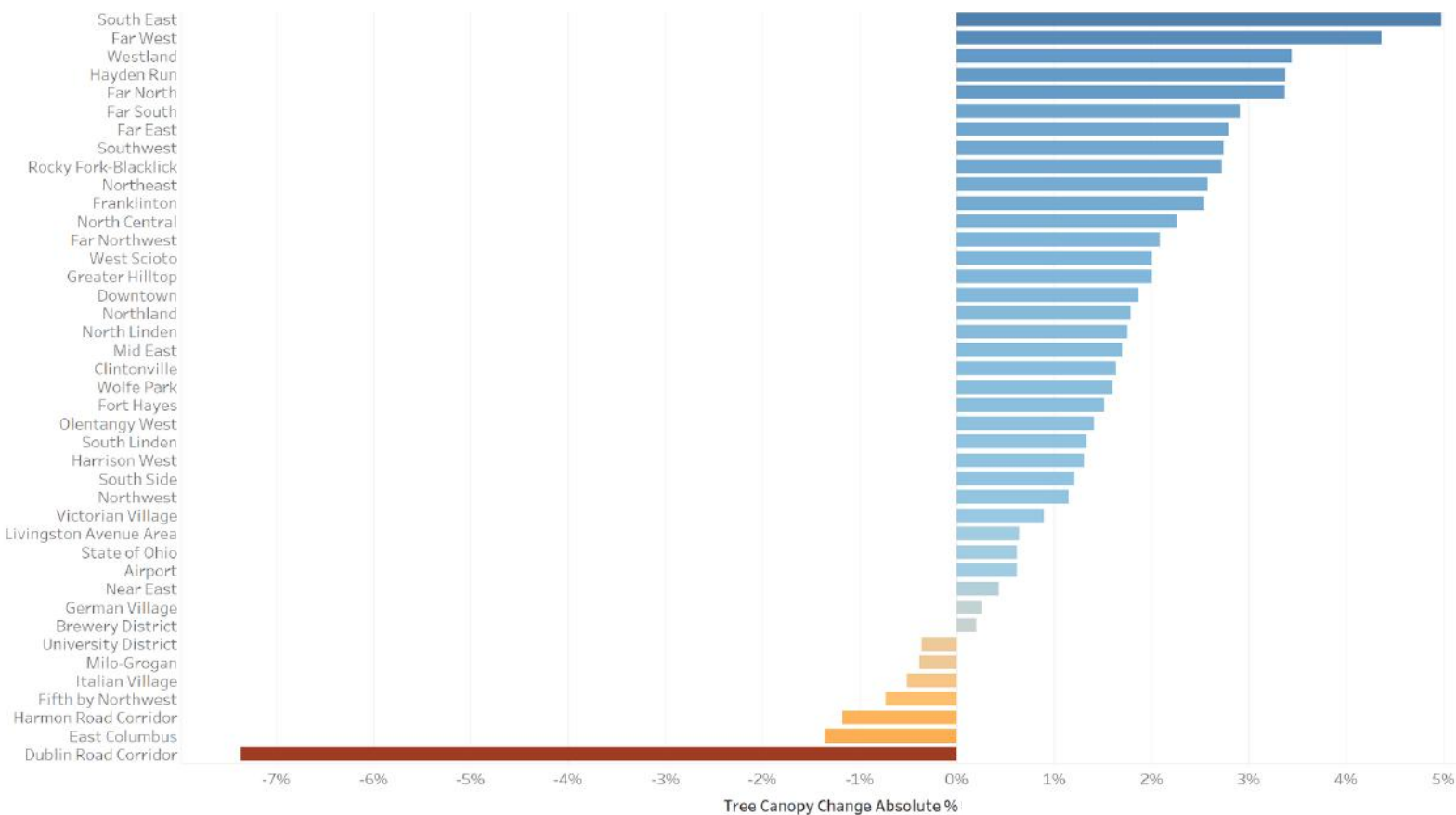## Tree Canopy Absolute Change by Community 2011-2021

Figure 15: Tree canopy absolute change percentage for 2011-2021 conditions summarized by Columbus communities.

Land Use

Land use is how humans make use of the land, including where they live, work, and play. Land use is different from land cover, which summarizes landscape features such as trees, buildings, water, and other classes. For example, residential land use can contain trees, buildings, impervious ground cover, grass, and other land cover features. Land use can significantly influence the amount of tree canopy and the room available to establish new tree canopy.

Franklin County Land Use Map
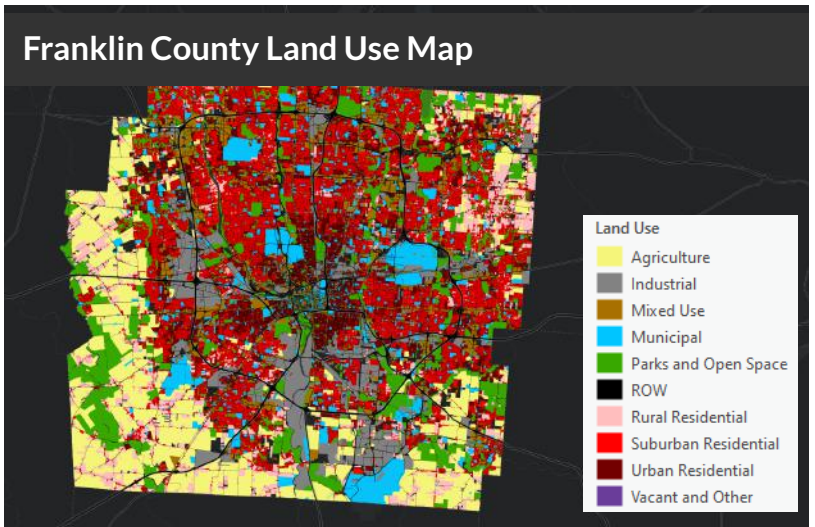
Figure 16: Simplified land use categories for Franklin County including Columbus.

Franklin County Land Use

For the County, residential land use makes up the majority of existing tree canopy and consists of nearly 37,000 acres of suburban, urban, and rural land. Suburban residential land has the most canopy by area with about 22,500 acres, followed by parks and open space with about 17,400 acres. Canopy gain outpaced loss for all land use categories, for an absolute change of 1% to 6%. Figure 17 shows canopy land use metrics summarized by existing tree canopy, tree canopy absolute change, and possible tree canopy-vegetated.

Franklin County - Tree Canopy By Land Use
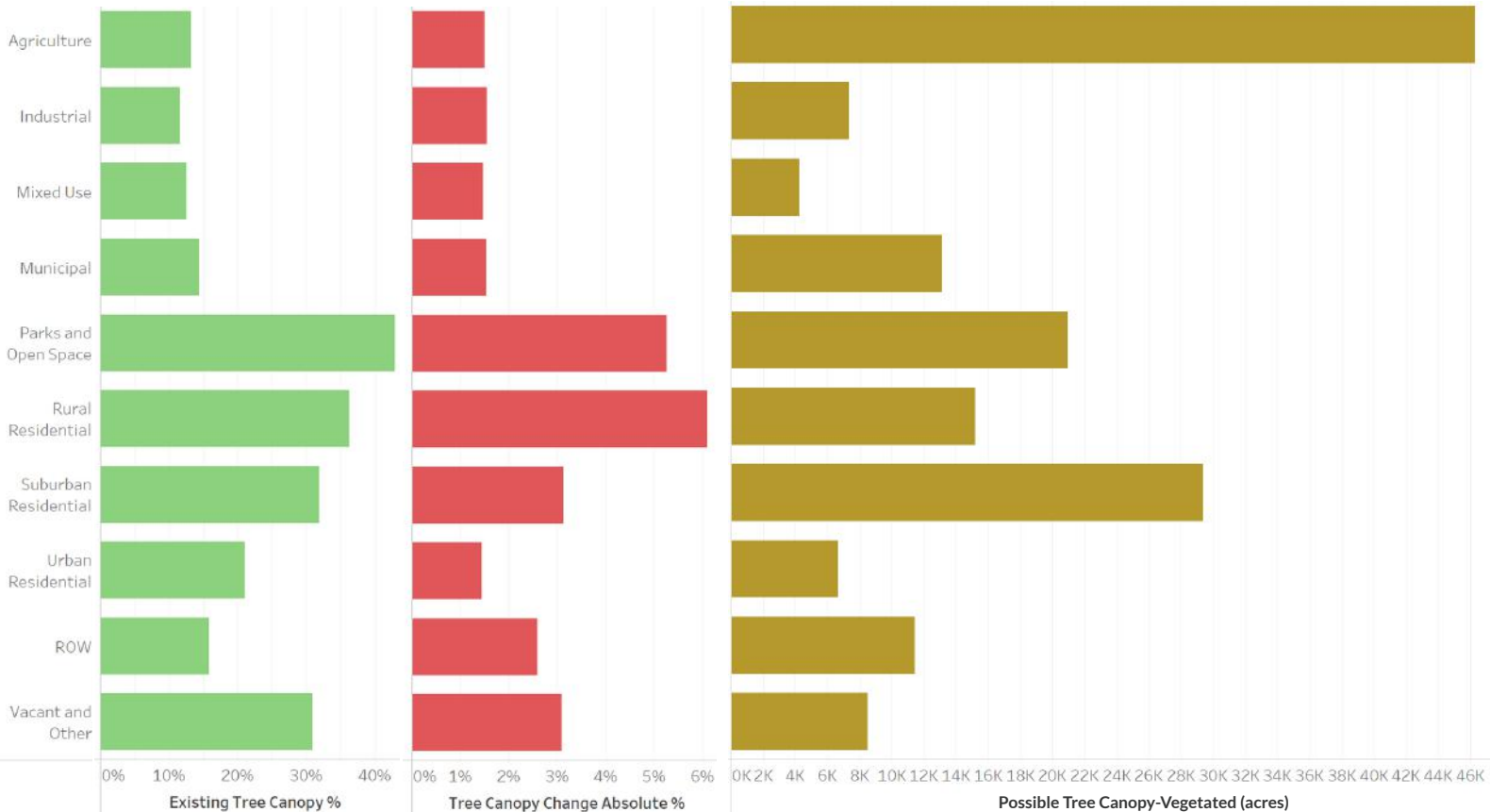
The most available space to plant trees is on agricultural (over 46,000 acres possible-vegetated) and residential (over 51,000 acres of possible-vegetated) land shown in Figure 17. There is a direct conflict between agricultural operations and planting trees. However, tree planting and preservation activities that focus on the conservation benefits, such as riparian buffers, may help integrate trees into these landscapes and even support agricultural practices by serving as windbreaks.

The urban forest is a public resource that offers benefits across public-private boundaries. While the County does not have direct influence over privately held land, establishing trees on residential, industrial, and mixed use land can be achieved through collaboration and partnerships with industry, homeowners, and developers. The amount of loss on residential land (nearly 5,000 acres) is cause for new strategies such as yard tree giveaways, public education about the benefits of trees, and consideration of tree protection policies. Figure 18 shows County tree canopy gain and loss summarized by land use. On publicly held land, parks and open space gained the most canopy (5% absolute change) shown in Figure 17. The County can continue to support trees in parks and open space through monitoring and routine tree care.

Franklin County- Tree Canopy Gain/Loss by Land Use
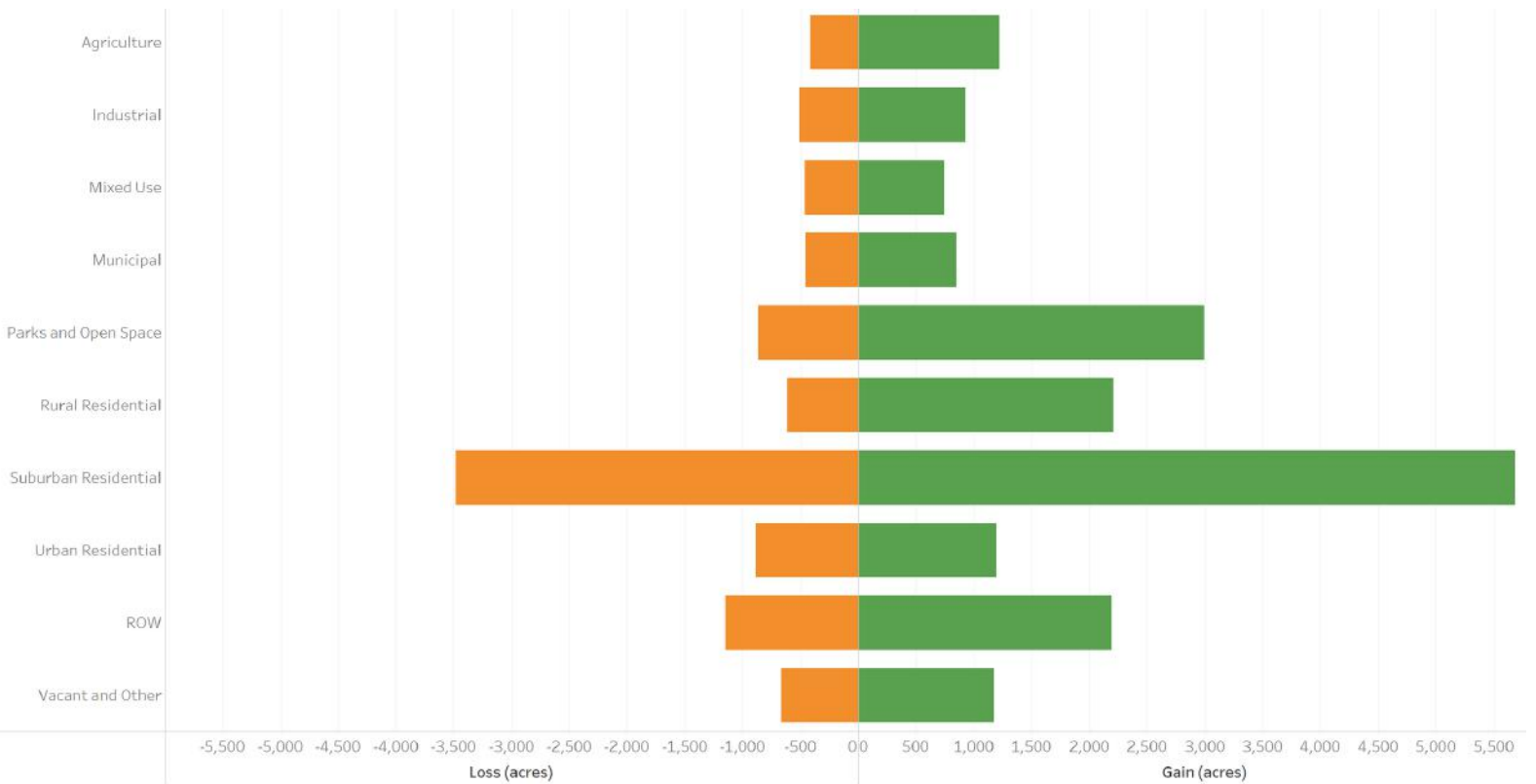
Figure 18: County tree canopy land use metrics summarized by gain/loss (acres).

For the City of Columbus, residential land use makes up the majority of existing tree canopy and consists of nearly 13,500 acres of suburban, urban, and rural land. Suburban residential land has the most canopy by area with about 9,000 acres, followed by parks and open space with over 6,000 acres. Canopy gain outpaced loss for all land use categories, for an absolute change of 1% to 6%. The most available space to plant more trees is on suburban residential and municipal land use with 12,801 acres and 7,249 acres, respectively. Figure 19 shows canopy land use metrics summarized by existing tree canopy, tree canopy absolute change, and possible tree canopy-vegetated.

Columbus - Tree Canopy By Land Use
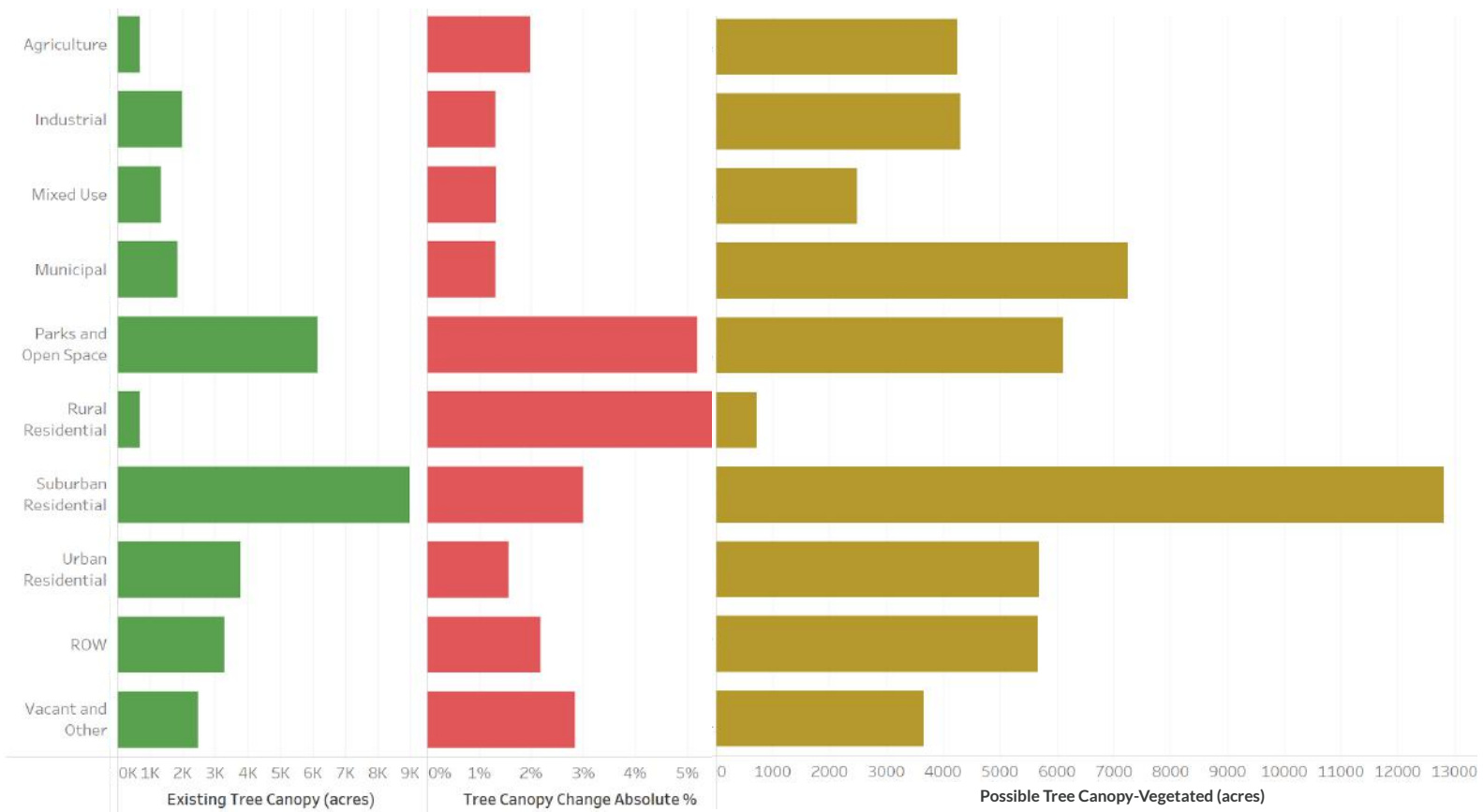
Figure 19: City tree canopy land use metrics summarized by existing tree canopy (acres), and tree canopy absolute change (%).

The City of Columbus may not have direct influence over residential land. Similar to the County, establishing trees on residential property can be achieved through partnerships with homeowners and housing developers. The amount of loss on residential land is over 2,200 acres and is cause for new planting and tree protections strategies. The City can explore possibilities for yard tree giveaways, public education about the benefits of trees, and tree protection policies.

The ROW (650 acres loss) and parks and open space (380 acres loss) also lost significant canopy. The City can support trees in these public land uses through monitoring and routine tree care. Figure 20 shows City tree canopy gain and loss summarized by land use. Trees along roads are aesthetically pleasing, play an important role in reducing stormwater runoff and decreasing the urban heat island effect. They improve air quality by removing particulate matter, and volatile organic compounds, as well as regulate sound pollution. The ROW gained over 1,100 acres of canopy in 10 years, but with a loss of 649 acres, there is room for improvement. Trees in the ROW face inhospitable conditions associated with their close proximity to roads. Regular salting, compaction, vehicular collisions, limited space, and clearance pruning are some of the challenges that limit canopy establishment and growth in these harsh environments. While canopy loss was offset by gain, long term monitoring is important. The gain in the ROW is a sign of the City's effective tree management, investment in the urban forestry assessments and planning, and continued funding that are appreciating over time.

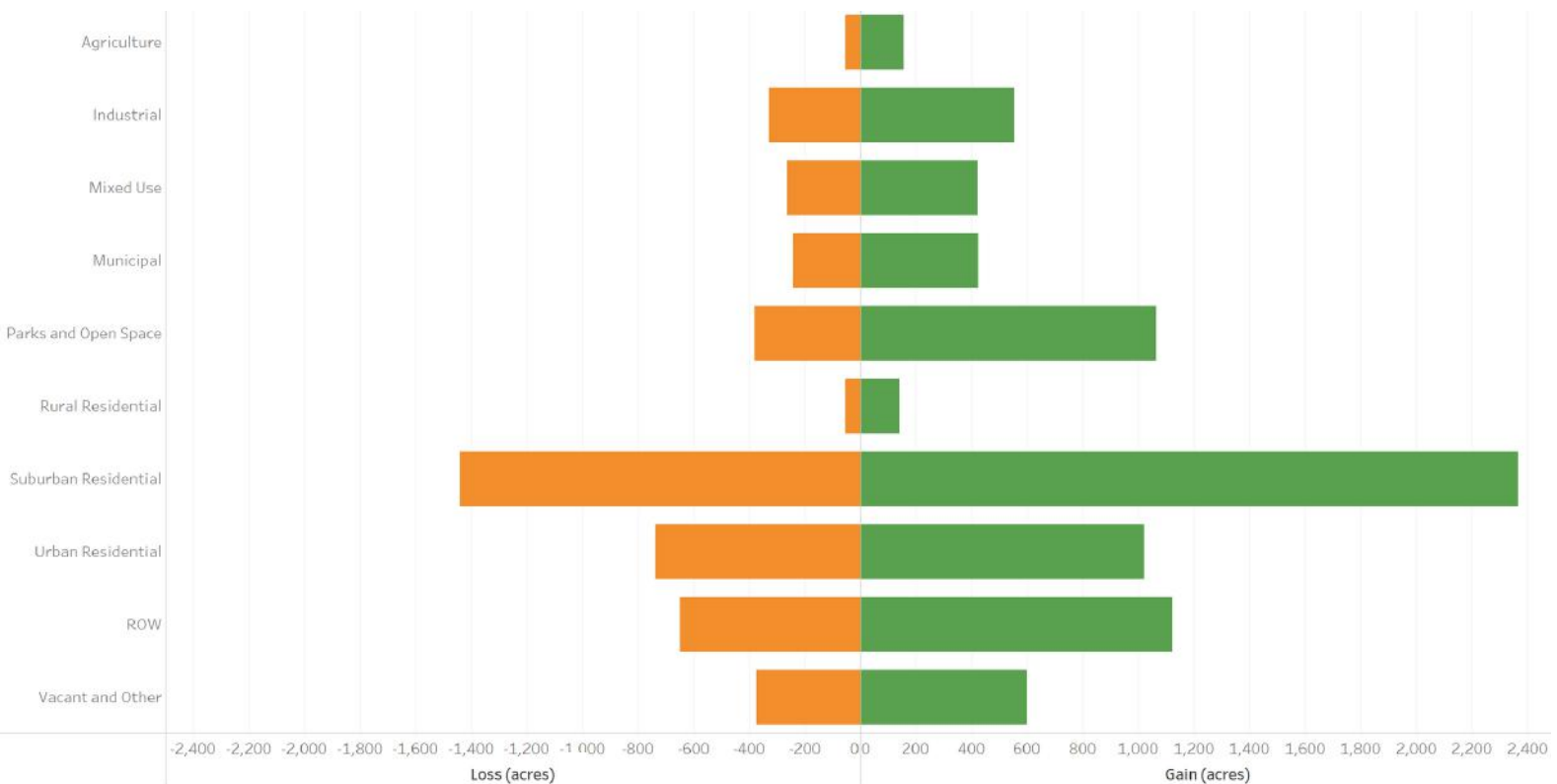## Columbus- Tree Canopy Gain/Loss by Land Use

Figure 20: City tree canopy land use metrics summarized by gain/loss (acres).

Numerous factors contribute to the wide range of tree canopy change patterns of Columbus and Franklin County as shown in previous sections of this assessment. The examples that follow illustrate canopy change on the ground and how they are captured by the LiDAR and imagery data used for this assessment. Examining patterns and processes over the past decade can provide insights into how the canopy may change in the future.

New Commercial Construction

There is substantially less tree canopy in Franklin County's industrial (12% existing canopy) and mixed use (13% existing canopy) areas compared to other land uses (Figure 17). Trees are often removed to provide space for commerce, despite their advantage to reduce urban heat and stormwater runoff in these impervious surface-dominated areas. An example is the large patch of forest removed for commercial development at Polaris Parkway in the Far North area. Tree protection ordinances on privately-held land can help reduce the loss of canopy resulting from commercial development. Figure 21 also shows newly planted trees (small green circles) in the business parking lot. With proper care, these trees may grow and contribute more canopy over decades. Redevelopment projects that prioritize trees can dramatically increase tree canopy. Implementation of a tree code can help protect trees on private land and grow canopy in commercial and industrial areas where canopy is currently low.
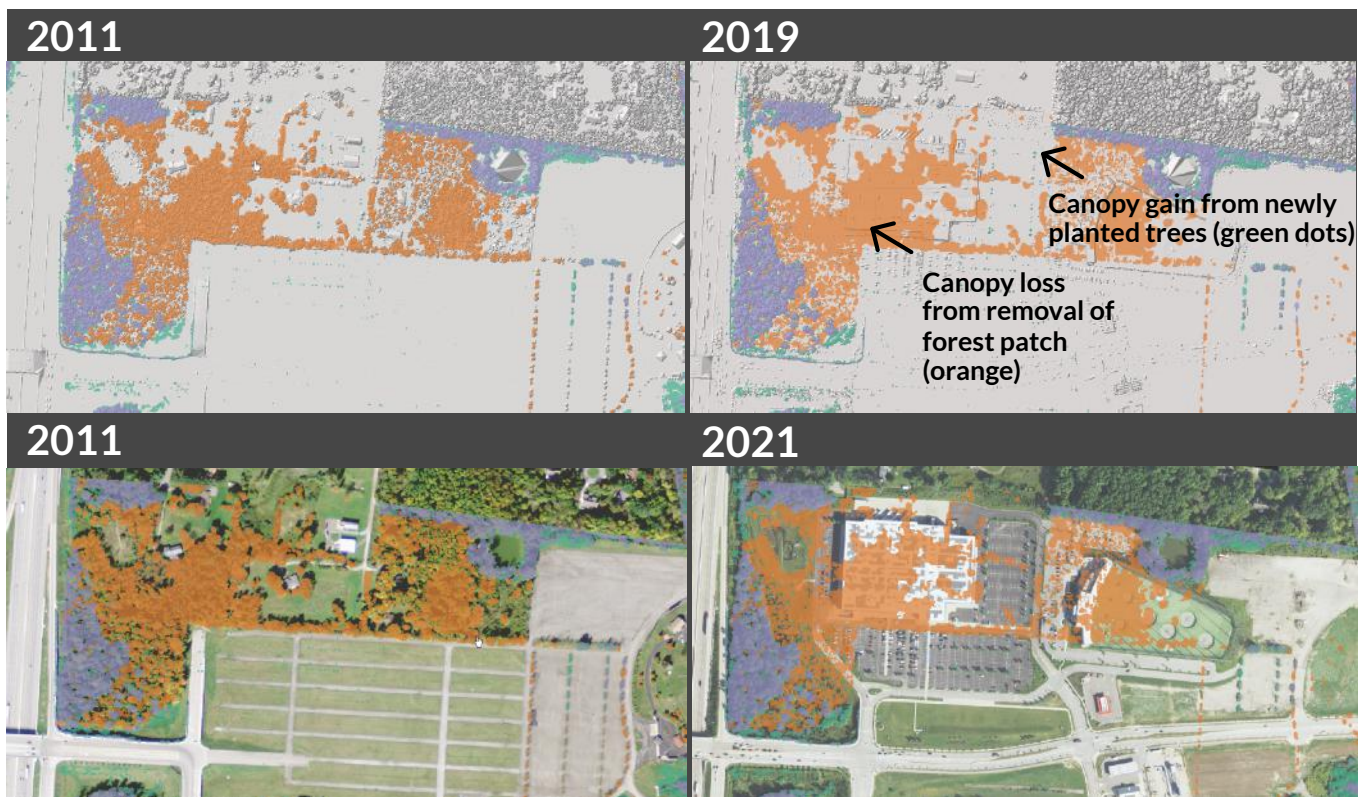

Figure 21: A mix of canopy loss (orange) and gain (green) from the commercial development at the Polaris Parkway. Canopy change is overlaid on LiDAR from 2011 and 2019 (top) and imagery from 2011 and 2021 (bottom). The small green dots represent newly planted trees that don't have substantial canopy yet, but can grow with proper care.

New Housing Construction

Suburban residential land lost the most canopy in Columbus and Franklin County. For example, Gahanna, a highly suburban city in Franklin County, had a net gain of 3.5% in tree canopy, but despite the growth, there was a loss of over 300 acres of canopy. Figure 22 shows the loss of a forest patch in Gahanna to new houses. Forest patches provide essential ecosystem services relating to wildlife habitat and reduced runoff. Their removal is a concern because forest patches can be removed in a matter of days, but take decades to regrow. The same figure shows a ring of growth (green) around trees that have been left alone.
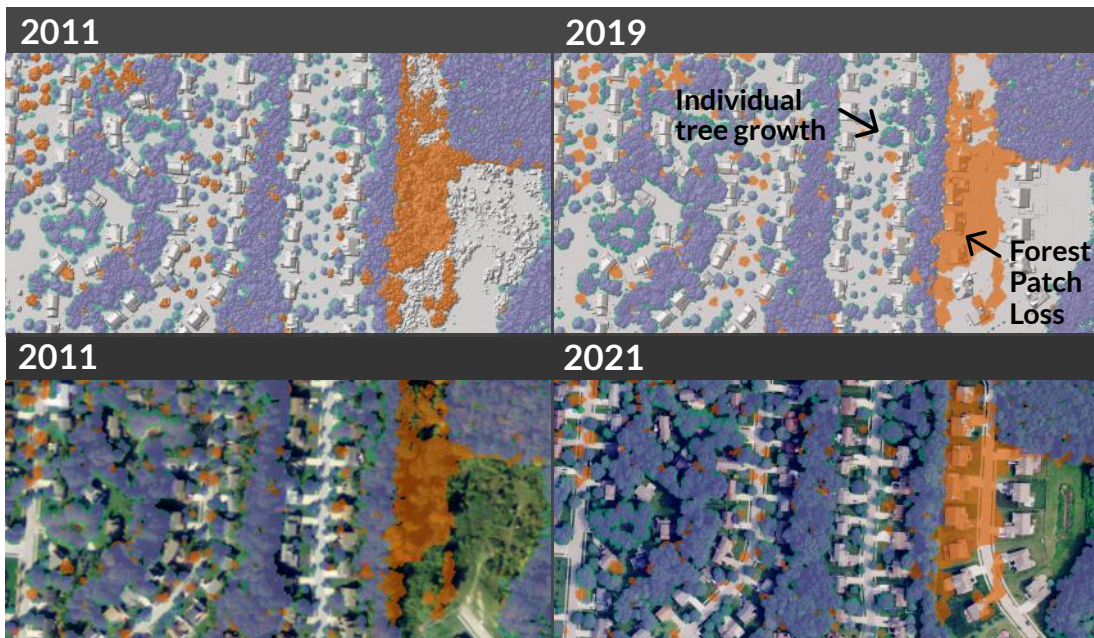
Figure 22: A mix of gain and loss in Franklin County's Gahanna jurisdiction. A patch of forest (orange) was removed for residential development. There were also street tree removals. Canopy was gained by individual trees that were left alone. Canopy change is overlaid on LiDAR from 2011 and 2019 (top) and imagery from 2011 and 2021 (bottom).

Forest Regeneration

Allowing trees to grow is the best way to gain canopy. Natural regeneration of forest is visible in areas of Columbus. West Scioto experienced 3% canopy gain, largely contributed by canopy regeneration along the Scioto Trail, directly south of Dublin Road Corridor in Figure 23.

Figure 23: Canopy gain (green) along the West Scioto Trail in Columbus is overlaid on LiDAR from 2011 and 2019 (top) and imagery from 2011 and 2021 (bottom). The distortion of water bodies in the LiDAR maps results from the reflective quality of water on the light beams during LiDAR data capture.

Industrial Transformation

Trees continue to grow and contribute canopy in more established neighborhoods, but when a neighborhood is transformed from one type of land use to another, it can contribute to canopy loss. As a result, losses may outpace gains over time if replacement trees are not planted. The Dublin Road Corridor in Columbus experienced widespread canopy loss, resulting from clear cutting for construction of mixed use development on a former landfill.
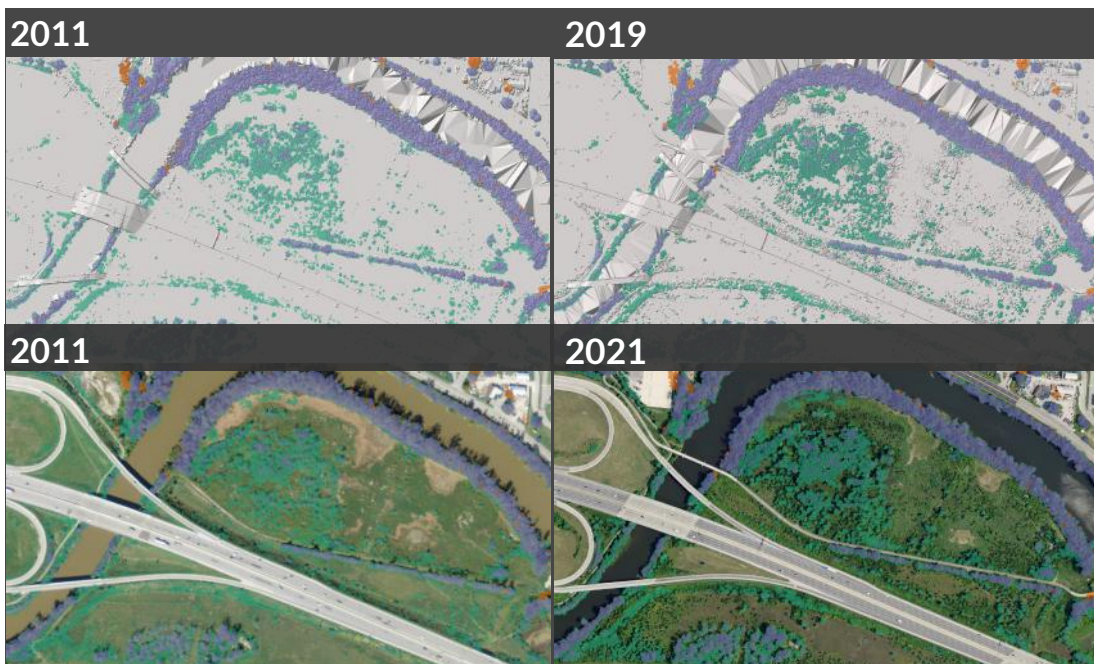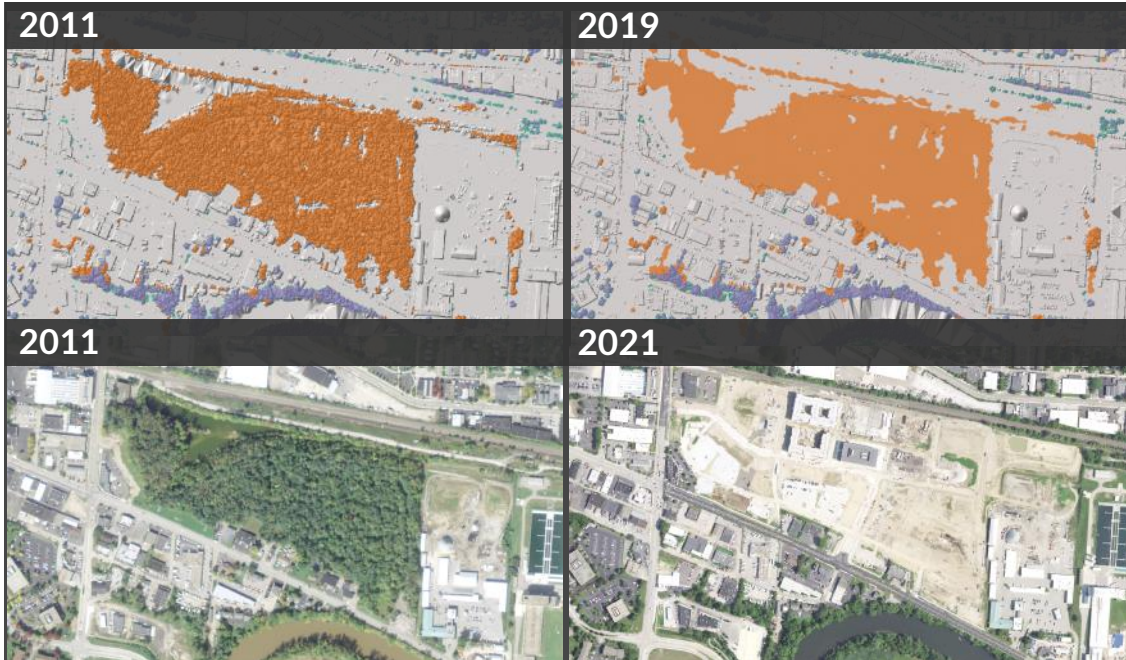

Figure 24. Canopy loss from change in land use of Dublin Road Corridor. Canopy loss (orange) is overlaid on LiDAR from 2011 and 2019 (top) and imagery from 2011 and 2021 (bottom).

Protecting Canopy During Change

In order for Columbus and Franklin County to maintain and grow their tree canopy into the future, government, institutions, businesses, and residents must all be involved and see the value in this crucial green infrastructure asset. Removing trees before they reach maturity hampers the possibility for a community to receive its full canopy potential. The best way to increase tree canopy is to retain mature trees that are already providing benefits today, versus replacing mature trees with young trees that will take decades to provide the same benefits and canopy cover. Canopy loss is often the result of an event, but gain is a process. Preservation of trees and development can be creatively integrated to balance multiple goals. Opportunities vary from one situation to another.

TREE HEIGHT DISTRIBUTION

Diverse height structure corresponds to a healthy and diverse tree age distribution. Tree height is a useful proxy for tree age. Even-aged urban tree canopy, stemming from tree plantings done around the same time, creates a situation in which the trees may all die off around the same period, resulting in a sudden loss of canopy. Age diversity prevents a significant loss in tree canopy when many mature trees die at the same time. The height from the 2019 LiDAR data were used as an estimate of age distribution of trees for Columbus and Franklin County.

In Franklin County (Figure 25 top) and Columbus (Figure 25 bottom) the most prevalent height of trees is 30-50 feet, with the number of trees in each 10-foot height class greater than 50' dropping dramatically as the height of trees increases (up to 100 feet tall). There are few 110 foot trees, as would be expected in an urbanized region. Fifty feet is low for the dominant class height for many tree species usually found in cities, indicating that trees may not be reaching their maximum height potential. The data tell us what is happening but not necessarily why. Generally speaking, in urbanized areas, people may proactively remove trees because of perceived risk of storm impacts to their safety and property. Lacking a tree ordinance that requires preservation of the largest trees, individuals may decide to remove trees without consideration of trees as a public good. Many other factors, such as invasive species can play a large role in the distribution of tree heights.

Mature trees have greater capacity to offer ecosystem services to urban residents. Loss of taller, more mature trees results in loss of those benefits and potential impacts to the overall canopy cover. It will be important to preserve trees in the 50-80 foot height range, while planting a variety of new trees to continue the lifecycle.

Proper care and monitoring will help to develop the next generation of trees that reach maturity and balance the distribution. Having trees with a broad age distribution, as well as a variety of species, will ensure that a robust and healthy tree canopy is possible over time. Specific information on individual trees is collected via on-the-ground field inventories and was not captured in this assessment.

Tree Height Distribution

Franklin County Tree Height Distribution
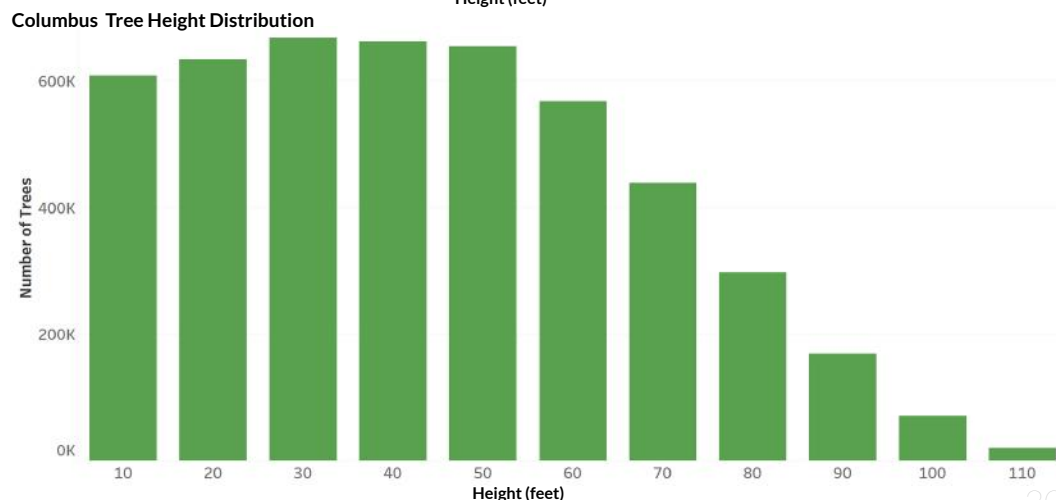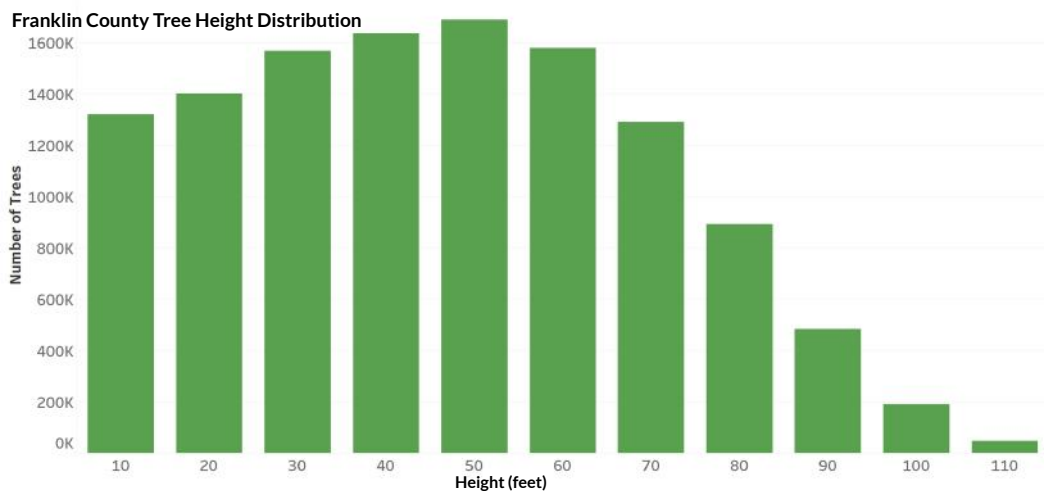

Columbus Tree Height Distribution

Figure 25: For Franklin County (top) and Columbus (bottom), the tree canopy was segmented into polygons approximating individual trees. Each of these polygons was then attributed with the height from the 2019 LiDAR data.

ENVIRONMENTAL JUSTICE

Environmental Risks and Challenges

Like many areas in the United States, the City of Columbus and Franklin County face environmental risks and challenges relating to the urban environment. Trees can serve as a pathway to create a landscape that is able to overcome such risks and challenges. However, proper care and maintenance is necessary to avoid unintended outcomes or disservices such as damages caused by fallen branches.

Mitigating The Urban Heat Island Effect

The urban heat island effect occurs when natural land cover is replaced with large quantities of paved surfaces and buildings that absorb and retain heat. Thus, this issue considerably affects cities by negatively impacting residents. Specifically, the high temperatures associated with this phenomenon can result in heat-induced illness and sometimes fatality.

Local vegetation, especially trees, have the capacity to mitigate rising temperatures. The map below indicates the relationship between tree canopy and daytime temperature. Census tracts with lower tree canopy experience higher daytime temperature (dark pink with white outline in Figure 26). The urban tree canopy of Franklin County and the City of Columbus, especially in highly developed areas, must be maintained and expanded to relieve residents from extreme heat.
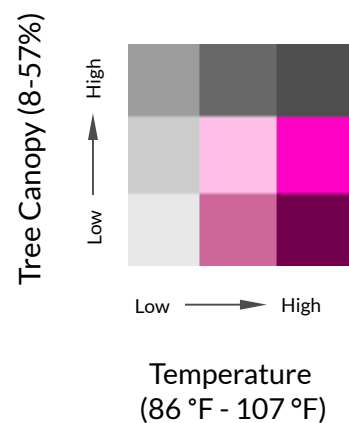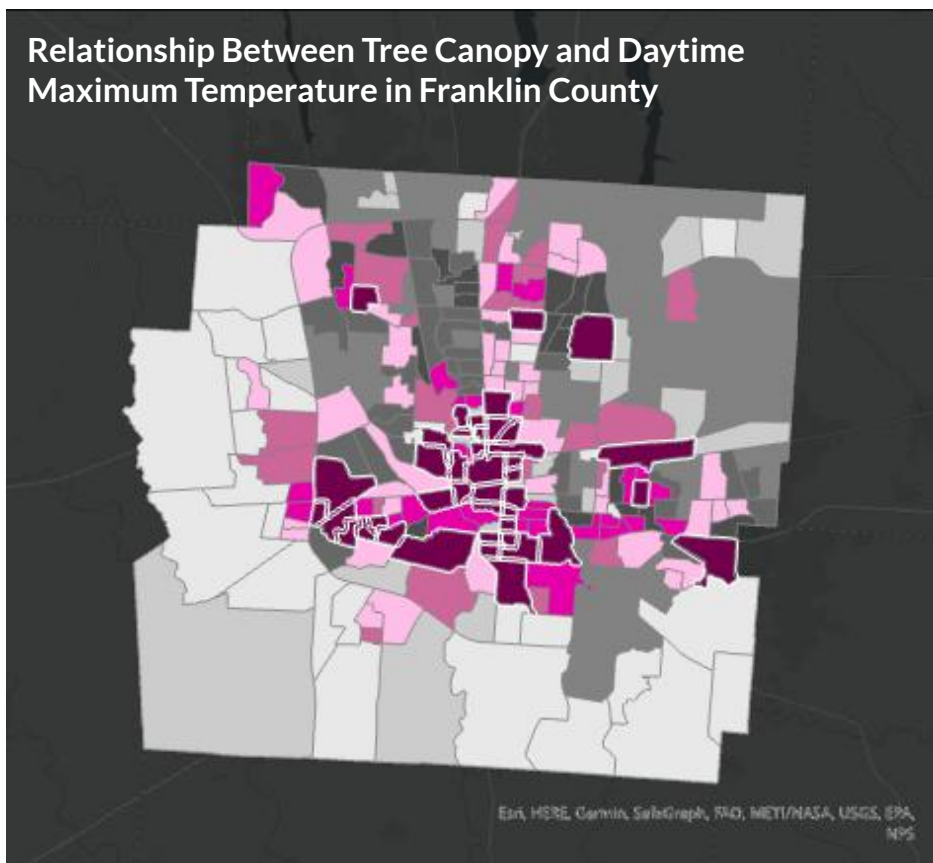

Figure 26: Tree canopy at census-track level relative to daytime maximum temperature[6]. Census tracts with high temperature and low tree canopy are outlined in white. Minimum and maximum values for tree canopy and daytime maximum temperature appear in parentheses in the legend.

A CLOSER LOOK INTO HEAT EXPOSURE:
## The City of Columbus Heat Island Project

The following text is from the project description published by the City of Columbus in 2022[7] for the City of Columbus Heat Island Project. The text has been edited for clarity.

> "Columbus has the fastest-growing urban heat island effect of major U.S. cities. This impacts [human] health, wildlife, and the economy. Extreme heat kills more Americans than any other weather event... [It] can lead to illnesses such as heat stroke and exhaustion", but some populations are at higher risk. "A 2021 Environmental Protection Agency report concluded that Black and African American individuals are 40-59% more likely than non-Black and non-African American individuals to currently live in high-impact heat mortality areas."

> "Columbus is one of 16 cities that received a National Oceanic and Atmospheric Administration (NOAA) funded project to map out the heat islands through a community-led campaign." Specifically, NOAA-funded Climate Adaptation Planning + Analytics (CAPA) Strategies, LLC "work[ed] with local partners and the community in the summer of 2022 to collect data necessary to protect disproportionately affected neighborhoods. Using heat sensors mounted on their own cars or bikes, [78] volunteer citizen scientists", led by the City of Columbus, Franklin County Public Health, Franklin Soil and Water Conservation District, and other partners, "traverse[d] their neighborhoods in the morning, afternoon, and evening" on August 12, 2022.

CAPA developed the heat map in Figure 27 for the 252 square miles covered in the study[8]. The map below is the result of this effort. A comparison to the City's urban tree canopy is provided for reference.

Morning (AM) Temperature
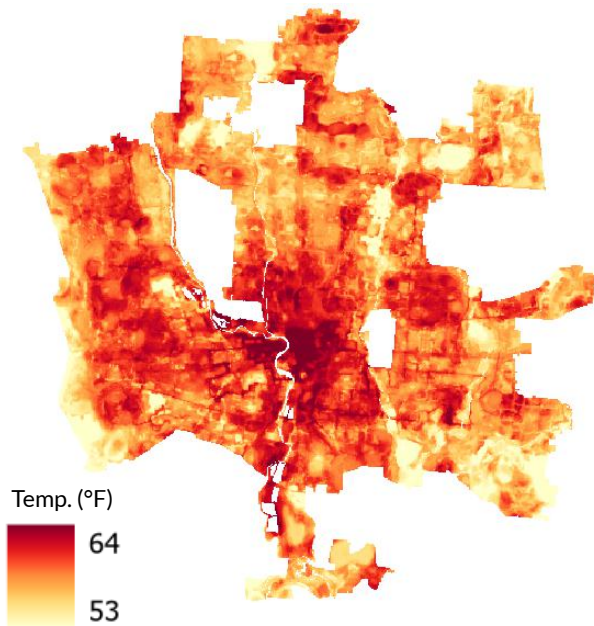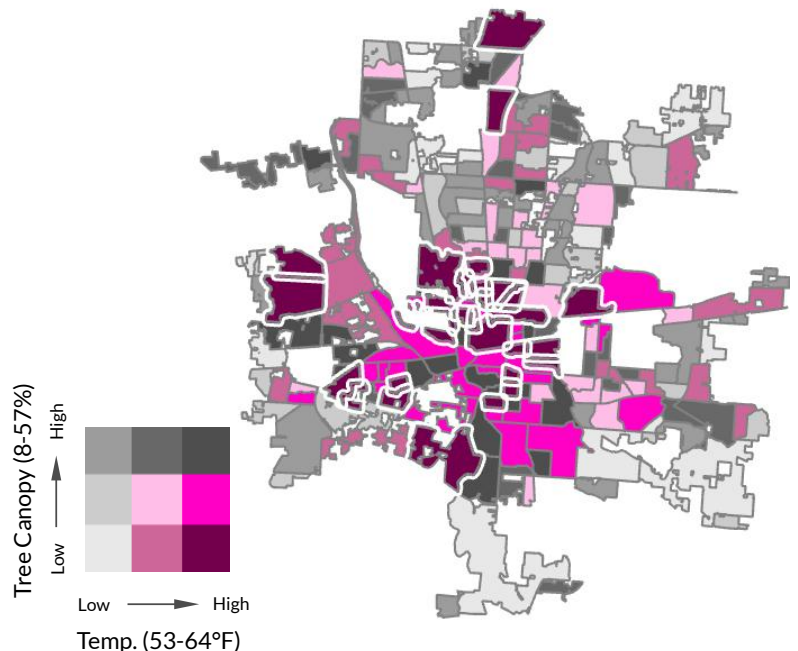
AM Temperature and Tree Canopy

Figure 27: Morning temperature (left) and its relationship with tree canopy (right). For right map, census tracts with low tree canopy percentage and high temperatures appear in dark pink and are outlined in white. Minimum and maximum values for tree canopy and morning temperature appear in parentheses in the map's legend.
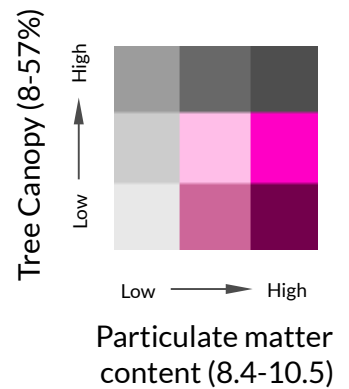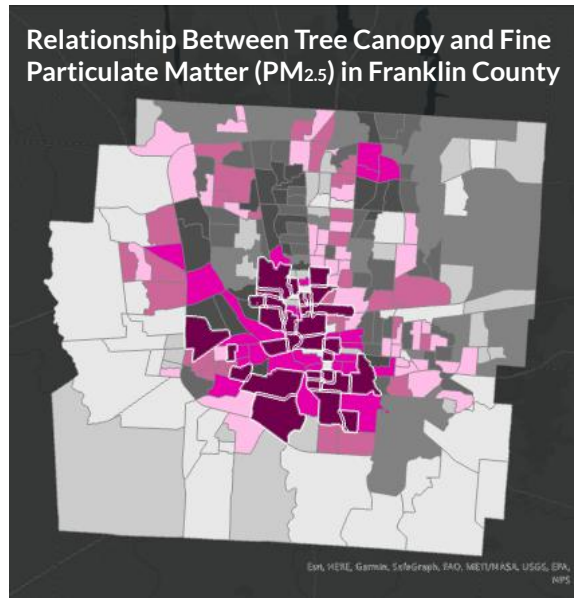
Mitigating Air Pollution

Fine particulate matter (or PM2.5) are pollutants found in the air that can decrease visibility, making the air look hazy. Fine particulate matter can come from vehicular emissions, industrial activities and other sources. Most of Columbus and Franklin County has a particulate matter content of 8.4 to 10.5 micrograms per cubic meter of air that are 2.5 micrometers in diameter and small enough to be inhaled into the deepest regions of the lung[9]. The national health standard is between 9 and 10 micrograms per cubic meter of air.

Having high concentrations of particulate matter can be a risk to all residents, but especially those who have asthma. Areas with greater asthma rates, according to Centers for Disease Control and Prevention (CDC) data[10], are depicted with dark orange colors in Figure 28 - bottom map.

To address the heightened vulnerability of residents in certain census tracts to pulmonary issues, future initiatives aimed at expanding tree canopy cover could prioritize the strategic distribution of trees to mitigate exposure to air pollutants. This is because trees have the ability to capture and filter particulate matter. The leaves and branches of trees act as physical barriers, trapping these particles and preventing them from being inhaled. This is especially beneficial in areas with high pollution levels from vehicular emissions and industry.

When comparing census tract-level data on particle matter that are 2.5 microns or less[9] with tree canopy percentage in Columbus and Franklin County (Figure 28 top map), there is a clear concentration of air pollutants at the urban core (dark shades of pink). There is also higher asthma prevalence[10] in several of these urban census tracts (dark shades of orange) as shown in Figure 28 - bottom map.

Relationship Between Tree Canopy and Fine Particulate Matter (PM2.5) in Franklin County

Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS

Asthma Prevalence (%)

Tree Canopy (8-57%) — Low → High

Particulate matter content (8.4-10.5) — Low → High

	<8
	8-9
	10-11
	12-13
	>13
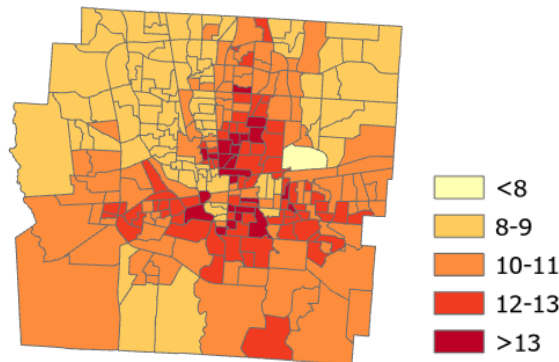
Figure 28: Percent of tree canopy at census-track level relative to particulate matter content[9] (top map). Areas in dark pink and outlined in white have high particulate matter content and low tree canopy. Census tracts without high asthma prevalence are shaded. Minimum and maximum values for tree canopy and particulate matter content appear in parentheses in the legend. Asthma prevalence[10] is provided as reference in the bottom map.

Ecological resiliency refers to the ability of a specific landscape to prepare for and overcome environmental risks and challenges. However, a crucial component of achieving landscape-level resilience, especially in urban areas, is its community members. An urban area cannot be truly resilient if all of its urban residents are not equitably resilient as well. Equitable resilience refers to the concept of building resilience in a way that is fair, just, and inclusive for all individuals and communities, particularly those who are disproportionately affected by social, economic, and environmental challenges. Thus, to enhance urban resilience, it is important for the City of Columbus and Franklin County to target neighborhoods lacking proper access to tree canopy.

Alleviating Tree Inequity

Relationship Between Tree Canopy and Median Household Income in Franklin County

Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA

Figure 29: Percent of tree canopy is shown at census-tract level relative to median household income[12]. Areas with low tree canopy and low median income appear in dark pink and are outlined in white. Minimum and maximum values for tree canopy and median household income appear in parentheses in the legend.

Tree Canopy (8-57%)

High

Low

Low ——→ High

Income ($6,250-$163K)

Tree inequity refers to the inequitable distribution of tree canopy. Previous assessments, like the City of Columbus' Urban Forestry Master Plan[11], have identified income as one of the key factors of tree inequity in the City. By comparing tree canopy coverage to income, and other factors, areas can be identified with low canopy and coincidence of these key factors, in pursuit of equitable canopy growth.

In the map to the left, areas in dark pink (also outlined in white) indicate census tracts with very low percentages of tree canopy and the lowest median household income. Among the census tracts with the lowest income, there are more with the least amount of tree canopy (darkest shade of pink) than with the most amount of it (darkest shade of gray).

This is a nationwide phenomena, where low income areas generally have little access to an abundant and healthy canopy. Targeting census tracts with this problem can be a first step towards addressing tree inequity in Franklin County and the City of Columbus.

Equitable Planning

Income is tightly associated with other social variables like race and ethnicity. In fact, in the United States, redlining and racially biased investment and development has led to pronounced income segregation in cities. Thus, it is crucial to account for historically marginalized populations, like racial and ethnic minorities, when prioritizing areas for neighborhood revitalization and, in this case, tree canopy expansion.

In 2020, stakeholders during the Urban Forestry Master Plan process identified susceptible populations in the city that needed adequate access to abundant tree canopy the most[11]. Community stakeholders voted for different key factors that should be studied, along with tree canopy, to prioritize areas for tree planting and care. These factors included race, ethnicity, income, education, health and crime rates. Today, the high-priority areas identified continue to be in need of more tree cover, as shown below in the darkest shade of pink (highest equity priority with the lowest tree canopy).

Tree Canopy (8-57%)

High / Low

Low ———→ High
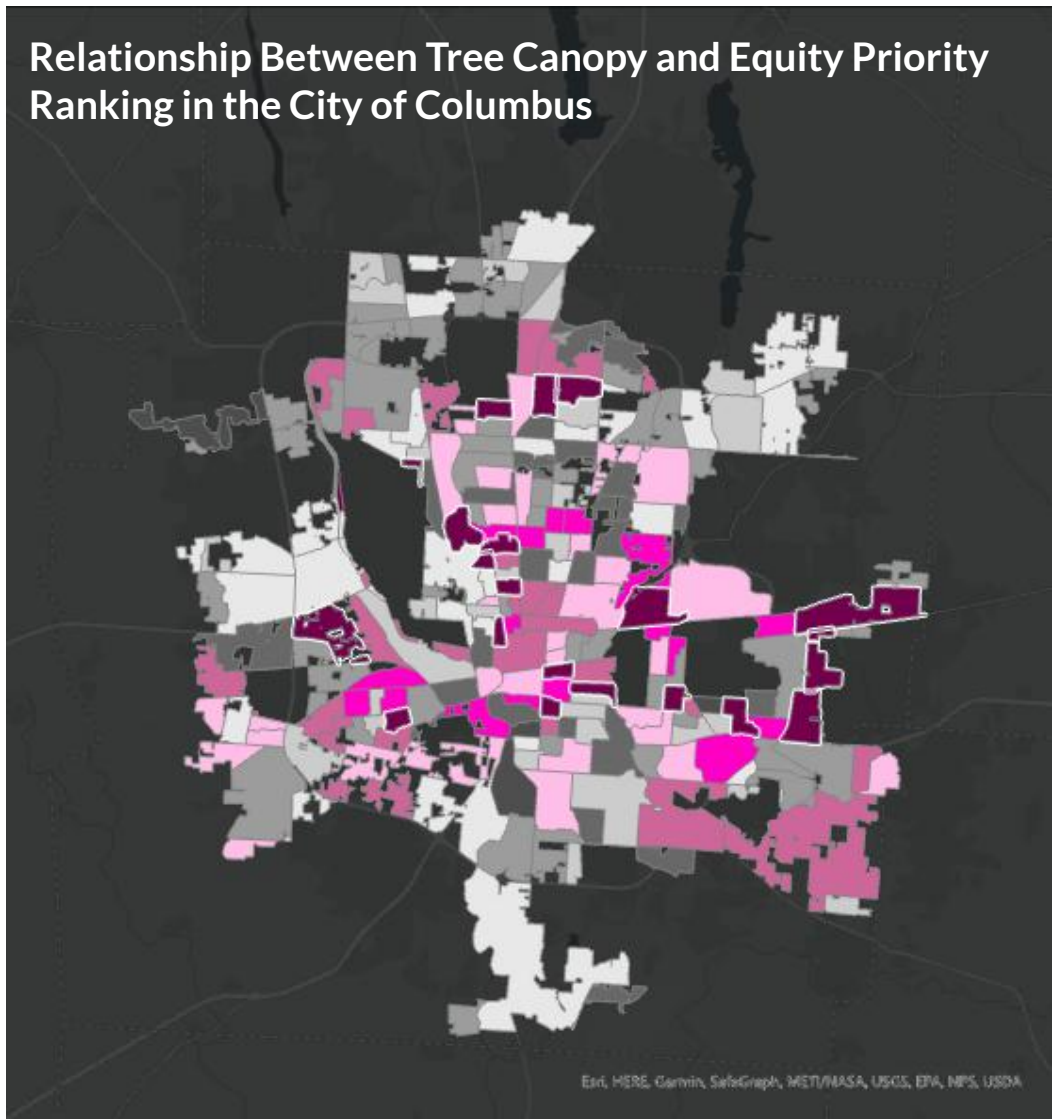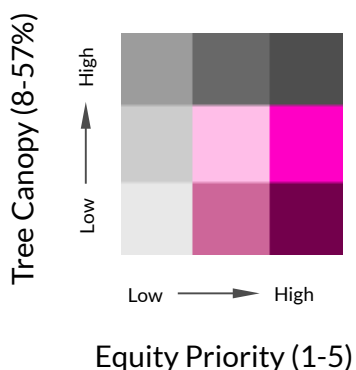
Equity Priority (1-5)

Figure 30: Percent of tree canopy is shown at census-tract level relative to the distribution of equity priority areas for the City of Columbus. Priority areas were previously identified through the Columbus Urban Forestry Master Plan[11]. Areas in the darkest shade of pink and outlined in white are high priority for promoting equity while also having low tree canopy. Minimum and maximum values for tree canopy and the equity priority score used appear in parentheses in the legend.

Relationship Between Tree Canopy and Equity Priority Ranking in the City of Columbus

Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA

Occupancy

Real estate property values and desirability of property to residents and businesses are linked to tree canopy. In the U.S. Census, "occupancy" refers to the housing status of a particular housing unit. The Census Bureau collects data on the occupancy status of housing units to understand how housing is utilized and to provide valuable insights into housing trends and patterns. The map below pinpoints census tracts with low occupancy rates and low tree canopy cover (darkest pink) in the City of Columbus and Franklin County.

Although independent from one another, these two variables can be used to assess different aspects of the livability and environmental health of a community. The occupancy rate is relevant for understanding housing demand and the overall residential stability in a given area. A higher occupancy rate may indicate a robust housing market, a strong sense of community, or an attractive neighborhood for residents to live in. Meanwhile, tree canopy abundance is important for assessing the urban environment's ecological health and residents' overall quality of life. A higher tree canopy abundance can provide various environmental benefits, like improved air quality, reduced urban heat island effect, and increased aesthetic appeal. Green spaces and tree-lined streets also contribute to residents' well-being and overall satisfaction with their community.
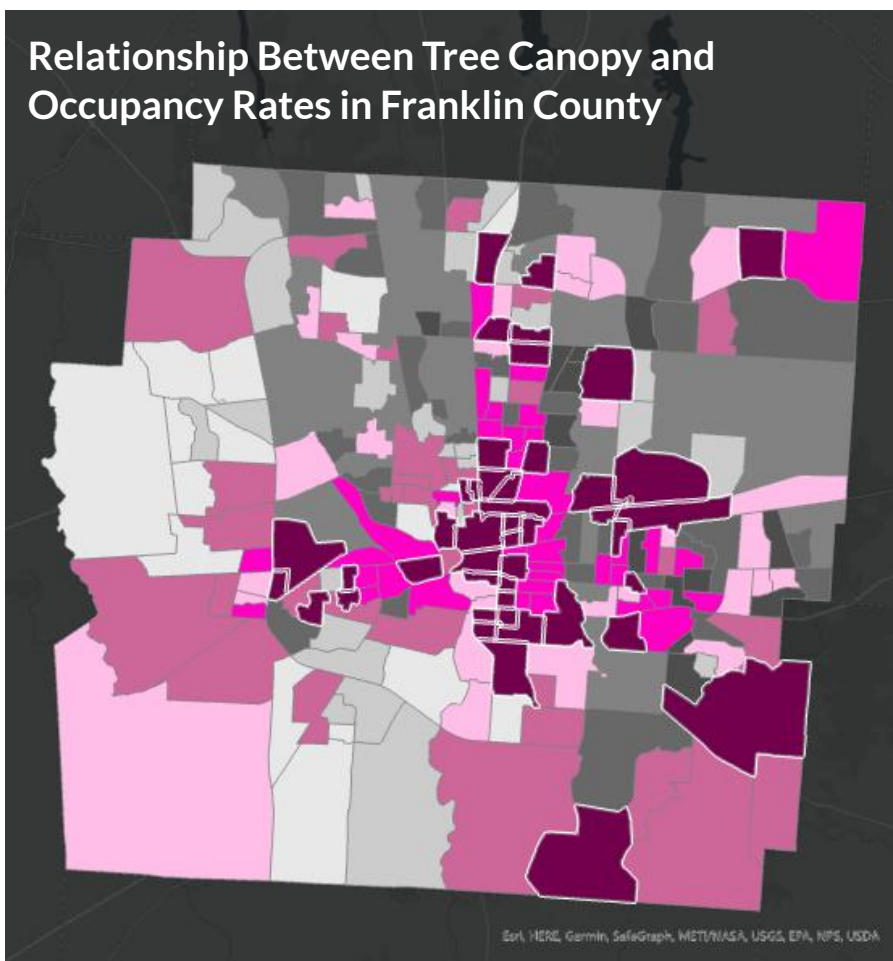
Thus, urban planners and policymakers often consider occupancy rates and tree canopy abundance together to create more sustainable and livable communities. Increasing tree canopy abundance in urban areas can positively impact residents' quality of life, potentially leading to increased demand for housing in those areas and, in turn, affecting the occupancy rate.

Relationship Between Tree Canopy and Occupancy Rates in Franklin County
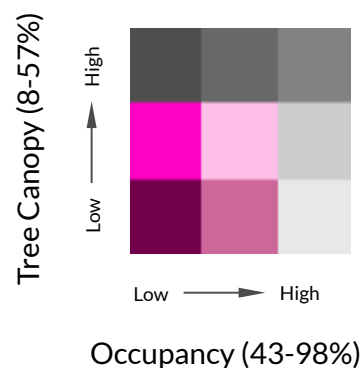
Figure 31: Percent of tree canopy is shown at census-tract level relative to occupancy rate[13]. Census tracts in the darkest shade of pink and outlined in white have both the lowest occupancy rate and the lowest tree canopy percentage. Minimum and maximum values for tree canopy and occupancy rates appear in parentheses in the legend.

Resources

This section of the report was written by the project team and is intended to share helpful resources and potential next steps for residents, organizations, and local leaders.

Strengthen Tree Policies

1. Consider reviewing, updating, or creating policies to protect the community's urban forest. Examples include ordinances or policies to protect trees on public or private property. Organizations like the Arbor Day Foundation and the International Society of Arboriculture provide guidance on creating tree protection ordinances.

Invest in Public Trees

1. Conduct a street tree inventory.

An on-the-ground inventory of individual street trees provides key information to proactively manage the urban forest, such as species, locations, condition, and size. Up-to-date inventories allow for long-term planning of priority tree planting and care. If conducting an inventory across the whole jurisdiction is not feasible, consider inventorying trees in specific areas that are priorities for tree planting and care, such as downtowns.

2. Proactively maintain public trees.

As with any public infrastructure (roads, bridges and utilities), public trees need proactive care and routine maintenance for longer lifespans, reduced hazards, higher resident satisfaction, and equity of care (as resident requests tend to come from more affluent neighborhoods). Routine inspections via a pruning cycle of 7-10 years are recommended for increased tree health (Columbus UFMP).

Tree Planting Recommendations

1. To combat canopy loss, replace public trees that are removed. If a healthy tree is removed for a construction project, consider requiring replacement of multiple trees or a fee-in-lieu based on the size, condition, or species of the removed tree, otherwise known as "mitigation".
2. "Right Tree, Right Place." Consider all limitations of the site, such as nearby buildings, sidewalks, and overhead or underground utilities. Choose a species with a mature size that will not come into conflict with nearby infrastructure.
3. Plant the largest tree possible for the growing space. Large trees, like bur oaks or American Lindens, provide up to five times more benefits than small trees, like crabapples or redbuds. They also contribute more to overall canopy.
4. Consider planting a diverse mix of trees to avoid vulnerability to future diseases and pests like Emerald Ash Borer. This will also increase biodiversity and produce a healthier, more sustainable ecosystem.
5. Choose climate resilient species that will survive in warmer, wetter climates. Use tools like the USDA Forest Service's Climate Change Tree Atlas, or the National Wildlife Federation's Climate Smart Communities to select the most appropriate trees.
6. Avoid planting invasive trees, such as Callery pear, tree-of-heaven, white mulberry, and Siberian elm. The Ohio Department of Agriculture lists plants that are invasive in Ohio.

Access Available Resources

1. Use local, state, and national urban forestry resources.

Communities in our region have excellent resources to start working on improving their local tree canopy. For example, local nonprofits give away and plant thousands of seedlings each spring and saplings each fall. Ohio State University Extension has knowledgeable staff and fact sheets to guide residents on tree-related questions. Local soil and water conservation districts often host tree sales and provide technical expertise. Ohio Department of Natural Resources Division of Forestry staffs six regional foresters, including a Central Ohio forester, who are available to provide technical expertise to communities. National organizations like the USDA Forest Service, the Arbor Day Foundation, and American Forests have tools like the Vibrant Cities Lab Urban Forestry Toolkit and the Tree Equity Score to help communities understand, prioritize, protect, and sustain their urban forests.

2. Make the case for increased funding.

Urban forestry is a long-term investment in assets that require management for decades to come. Budgets will not automatically grow as the trees do, so it is important to show the need for sufficient funding. The Vibrant Cities Lab lists potential funding sources, and you can also compare your community's budgets to national urban forestry spending in the Urban and Community Forestry Census.

3. Hire professionals who are accredited through a reputable association to conduct tree work.

International Society of Arboriculture, American Society of Consulting Arborists, and Society of Municipal Arborists are professional organizations whose members demonstrate competency in proper tree care. Ohio State Extension has tips on how to hire a certified arborist. Find certified arborists in your area online on sites like treesaregood.org and trees4ohio.org.

Encourage Trees on Private Property

1. Incentivize private property plantings.

Privately owned property has more opportunity for tree planting, so offering discounts or free trees to residents and business owners is one way to encourage tree planting. In Central Ohio, the Community Backyards program offers eligible residents $50 for planting a native tree. Local nonprofit Green Columbus gives away thousands of seedlings and saplings each year, as well.

2. Engage and educate the public about urban forestry.

Share the benefits of trees and key data with residents to improve communication and build support for urban forest management. Teach interested residents about trees and empower them to care for public or private trees, through a program similar to Pittsburgh's Tree Tenders or Baltimore's TreeKeepers. Explore apprenticeships and workforce development to incentivize careers in urban forestry. Communicate and celebrate canopy growth as a source of community pride and identity.

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Appendix A

Franklin County Jurisdictions 2011-2021 Tree Canopy Assessment Summary Table

Franklin County Jurisdiction	Existing Canopy %	Acres of Gain	Acres of Loss	Absolute % Change 2011-2021	Estimated Number of Trees
BEXLEY	40.8	118	109	0.6%	82,691
BLENDON	41.3	216	123	2.9%	261,307
BRICE	20.8	3	1	3.2%	1,600
BROWN	16.1	466	96	3.0%	315,946
CANAL WINCHESTER	17.2	259	64	4.1%	117,087
CLINTON	24.4	53	33	2.2%	32,077
DUBLIN	25.4	1182	459	4.6%	612,026
FRANKLIN	25.7	241	152	2.1%	177,685
GAHANNA	31.9	580	301	3.5%	404,256
GRANDVIEW HEIGHTS	24.8	47	57	-1.3%	29,700
GROVE CITY	16.7	555	249	2.8%	310,380
GROVEPORT	22.6	337	95	4.4%	216,251
HAMILTON	17.5	216	132	1.7%	148,788
HARRISBURG	23.3	5	4	1.5%	2,846
HILLIARD	17.3	537	172	4.1%	250,980
JACKSON	18.8	496	177	2.8%	351,297
JEFFERSON	40.1	762	310	5.0%	592,529
LOCKBOURNE	18.6	12	7	0.9%	15,640
MADISON	17.5	678	170	3.4%	435,132
MARBLE CLIFF	37.4	9	9	0.3%	9,170
MIFFLIN	38.7	91	61	2.3%	83,720
MINERVA PARK	35.0	26	28	-0.6%	20,142
NEW ALBANY	22.2	628	383	2.5%	355,337
NORWICH	32.7	128	81	2.4%	90,874
OBETZ	12.9	154	48	3.0%	77,865
PERRY	36.1	97	79	1.4%	65,858
PICKERINGTON	18.3	11	5	3.2%	5,484
PLAIN	32.2	434	111	5.6%	299,080
PLEASANT	27.2	1201	299	3.3%	1,250,886
PRAIRIE	15.8	464	191	2.3%	304,409
REYNOLDSBURG	27.3	491	221	3.8%	300,455
RIVERLEA	46.9	9	6	2.8%	5,741
SHARON	56.5	123	80	2.3%	170,894
TRURO	31.0	34	11	4.9%	22,235
UPPER ARLINGTON	34.1	436	416	0.3%	268,987
URBANCREST	19.9	20	21	-0.2%	14,600
VALLEYVIEW	30.0	6	6	-0.1%	4,386
WASHINGTON	14.9	64	20	2.6%	37,244
WESTERVILLE	29.5	558	362	2.4%	365,707
WHITEHALL	22.0	152	134	0.5%	116,565
WORTHINGTON	37.9	240	178	1.8%	186,617

Appendix B

Columbus Communities 2011-2021 Tree Canopy Assessment Summary Table

Columbus Community	Existing Canopy %	Acres of Gain	Acres of Loss	Absolute % Change 2011-2021	Estimated Number of Trees
Airport	6.4	41	25	0.6	29,002
Brewery District	16.5	16	16	0.2	10,765
Clintonville	37.9	286	222	1.6	200,631
Downtown	11.9	69	41	1.9	30,574
Dublin Road Corridor	11.1	12	36	-7.4	6,960
East Columbus	17.6	32	45	-1.4	25,656
Far East	25.1	587	322	2.8	382,313
Far North	21.3	319	146	3.4	162,784
Far Northwest	29.6	305	212	2.1	177,154
Far South	21.1	774	328	2.9	526,964
Far West	14.7	353	97	4.4	143,575
Fifth by Northwest	13.2	26	31	-0.7	14,248
Fort Hayes	8.9	7	4	1.5	2,804
Franklinton	15.8	70	37	2.5	34,584
German Village	26.5	16	15	0.3	9,196
Greater Hilltop	21.6	518	320	2.0	342,806
Harmon Road Corridor	23.2	6	8	-1.2	5,688
Harrison West	18.1	18	14	1.3	10,435
Hayden Run	17.9	140	56	3.4	66,634
Italian Village	11.5	11	12	-0.5	5,293
Livingston Avenue Area	20.6	39	35	0.6	21,343
Mid East	26.4	435	307	1.7	297,156
Milo-Grogan	13.2	23	26	-0.4	13,521
Near East	21.5	131	120	0.4	73,673
North Central	22.8	133	78	2.3	89,638
North Linden	25.2	202	147	1.8	112,465
Northeast	31.6	421	254	2.6	343,068
Northland	25.3	590	403	1.8	380,662
Northwest	24.2	316	243	1.1	215,658
Olentangy West	21.2	125	88	1.4	79,918
Rocky Fork-Blacklick	29.0	498	284	2.7	379,778
South East	19.1	665	152	5.0	331,992
South Linden	19.8	59	45	1.3	30,582
South Side	18.2	207	153	1.2	129,003
Southwest	21.3	351	169	2.7	231,620
State of Ohio	7.7	10	7	0.6	4,962
University District	20.6	96	103	-0.4	62,504
Victorian Village	25.7	19	17	0.9	10,485
West Scioto	25.9	391	257	2.0	275,099
Westland	15.6	532	169	3.4	256,961
Wolfe Park	44.5	7	5	1.6	4,208