2020 State of Canopy Report

Akron, Ohio

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Prepared for:
The City of Akron

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DAVEY Resource Group

Executive Summary

This report was developed for the City of Akron, Ohio by Davey Resource Group, Inc. "DRG". The primary components of this project include a GIS assessment and a summary report of the findings. The purpose of this summary report is to review the GIS findings by analyzing recent changes and trends, and provide tools, data, and resources to guide future community forest management and reforestation efforts.

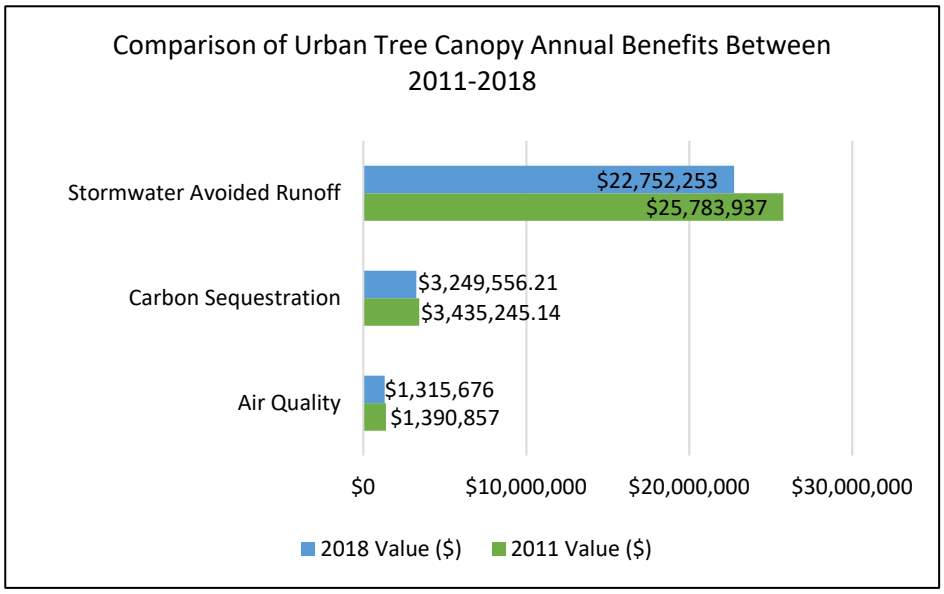


Figure 1. 2011 to 2018 comparison of annual tree benefits.

DRG completed an urban tree canopy (UTC) assessment of the City of Akron using 2018 aerial imagery. The results were compared to a 2013 study that used 2011 imagery. The ecosystem benefits and functions provided by the community's trees were quantified using i-Tree Eco and i-Tree Hydro (Figure 1). A prioritized planting plan was developed based on the UTC assessment and other community data. Future canopy scenarios were explored to aid future tree planting based on goals established by the city. Details of these analyses can be found in the sections that follow.

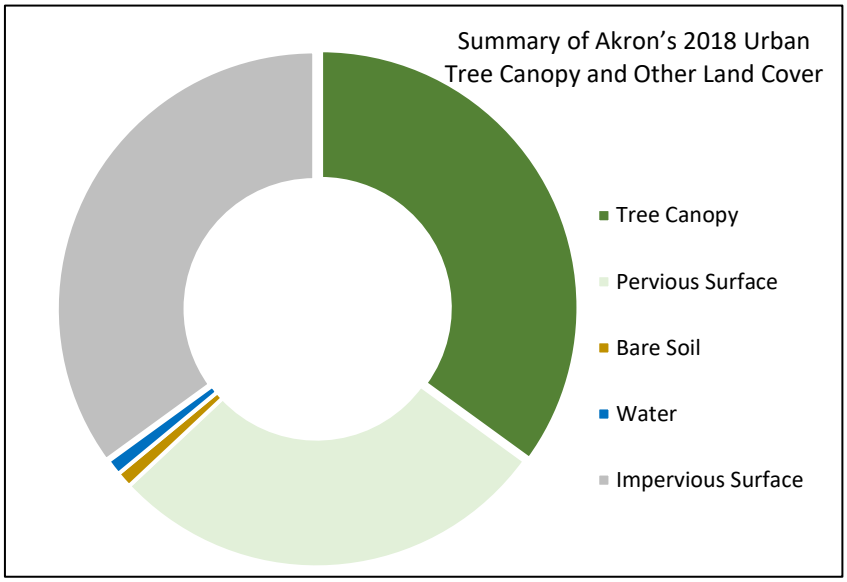


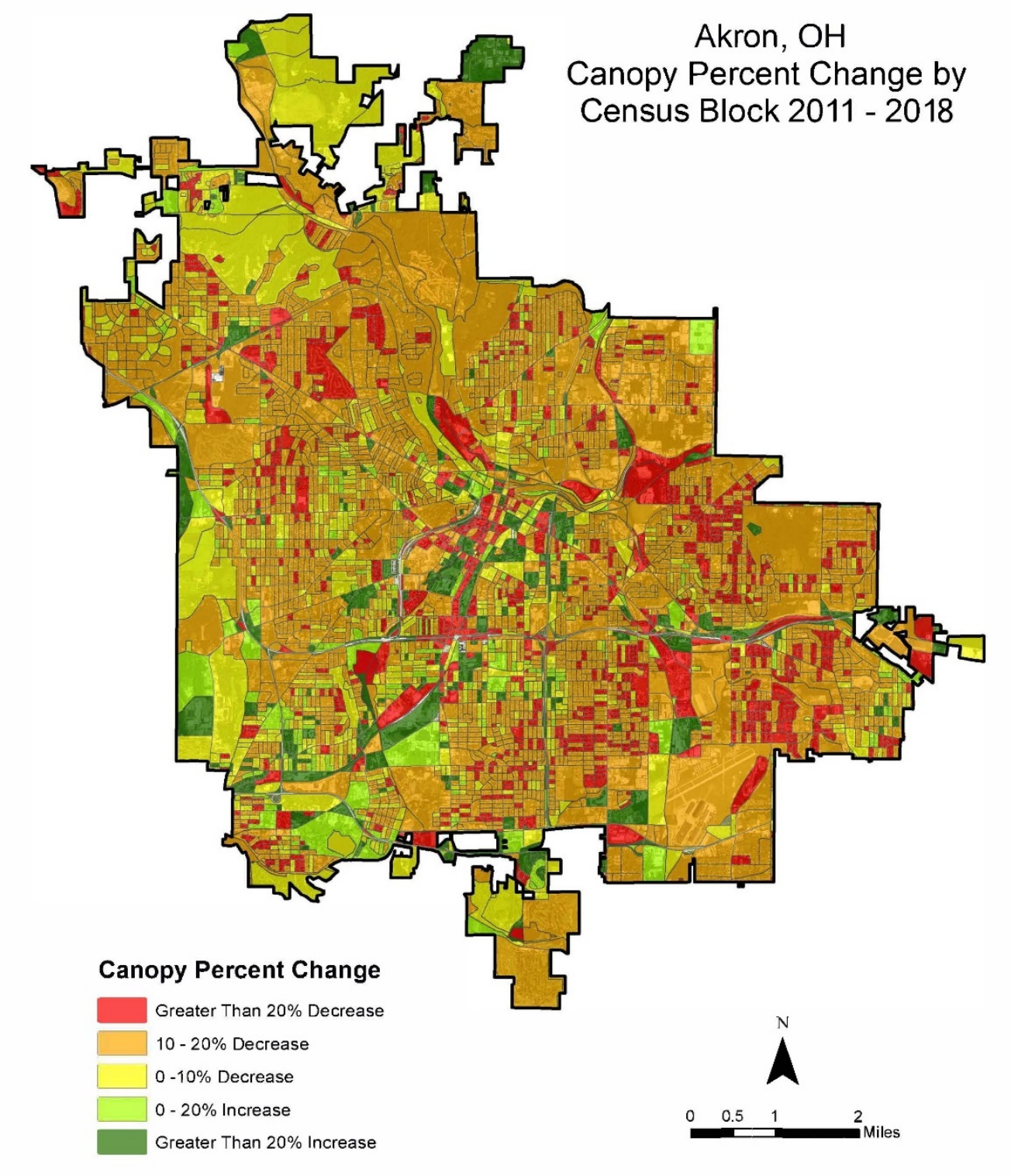
Figure 2. 2018 Akron land covers by percentage.

The UTC assessment found that tree canopy covers 34.85% of the city's 39,840 acres, and impervious surfaces cover 35.13%. There was a decrease (-1.93%) in the overall UTC from 2011 to 2018. If all suitable and realistic plantable locations were covered in tree canopy, Akron's maximum potential UTC tree canopy coverage would reach 62.74% (Figure 2). The maximum potential UTC tree canopy coverage would include both the existing tree canopy coverage and the pervious surface area. This is somewhat of an unrealistic expectation; however, it lends insight into what the upper level of what is achievable. A more attainable expectation is to assume 75% of the pervious surface is viable for suitable tree plantings as illustrated in the Future Tree Canopy Strategies Scenario 4 (Vision) model.

Urban tree canopy provides benefits to the entire community by removing pollutants and carbon from the air and reducing peak stormwater flows. The annual benefits Akron received from its tree cover in 2018 was estimated to be approximately $27,317,485. Tree canopy in Akron removed an estimated 1,186,980 pounds of pollutants and 70,113 tons of carbon from the air while slowing more than 255 million gallons of stormwater from entering storm drains during peak storm events.

DRG assessed and prioritized planting areas; these areas are preferred because planting these locations will maximize ecological, public health, and safety services, such as stormwater interception. These priority planting areas can be assessed individually for their suitability, potential capacity for new trees, and species selection to purposefully maximize the benefits provided by Akron's tree canopy. Figure 3 illustrates where the biggest differences in canopy cover can be found between the two studies within individual census blocks. This analysis shows areas within the city that could benefit the most and be most receptive to additional planting activities.

It is not enough to simply plant more trees to increase canopy cover and benefits. Planning and funding for tree care and management, public outreach, and education must complement planting efforts to ensure the success of new plantings. The city only has direct influence over approximately 18% of urban forest. To help ensure the benefits desired are being realized, a management strategy towards maintaining a healthy urban forest must involve partnerships in both public and private sectors. To make a difference, the City of Akron, its residents, and partners can support the urban forestry program by promoting the benefits that trees offer to the community, fulfilling routine maintenance for both public and private trees, and maximizing the space available for new trees.



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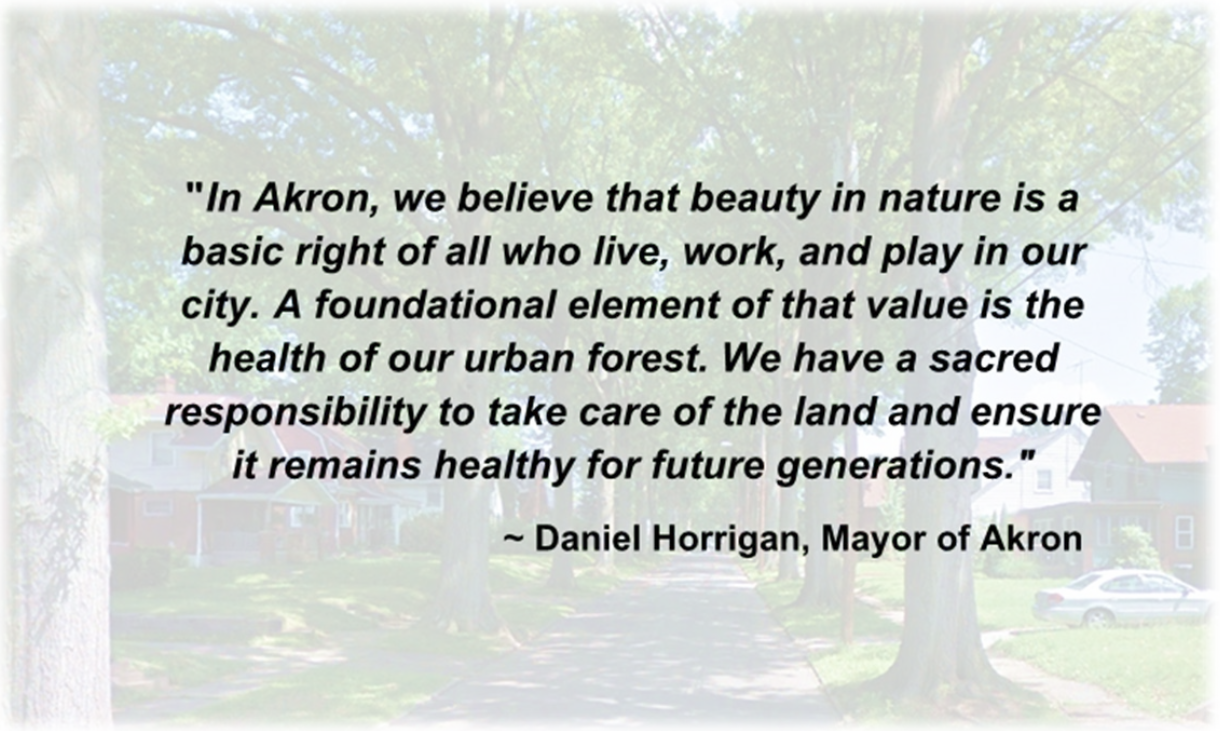
A big thank you goes to The Office of Integrated Development for taking the lead on this project. This study will help facilitate the growth measures needed to grow the Akron population in their Five-Year Strategic Framework 2019–2024. In addition, special thanks goes to City Arborist and Horticulturist Jon Malish; Development Engineering Manager Michelle DiFiore, PE; Applications Manager Darren Rozenek, GISP; and Deputy Mayor James Hardy, MPH; for their invaluable assistance at many stages of this project.

DANIEL HORRIGAN, MAYOR


"In Akron, we believe that beauty in nature is a basic right of all who live, work, and play in our city. A foundational element of that value is the health of our urban forest. We have a sacred responsibility to take care of the land and ensure it remains healthy for future generations."
~ Daniel Horrigan, Mayor of Akron

Introduction

To address perceived threats to canopy cover from recent emerald ash borer (*Agrilus planipennis*) infestations and the combined sewer overflow (CSO) project, the city has invested in understanding the impacts of those events and other policies on the urban tree canopy cover. To help guide these efforts, Akron completed urban tree canopy (UTC) assessments using data from 2011 and 2018 to determine the trend in canopy coverage for the city.

Photograph 1. Tree crews planting trees. The City of Akron has pledged to plant 1,200 trees in 2020 (Stock Photograph).

Akron recognizes that trees are a major component of the city's infrastructure that provide much more than traditional values of aesthetics and shade. From watershed protection to improving property values, trees provide numerous quantifiable environmental, economic, and human health benefits. In particular, trees are key to reducing air pollution and particulate matter, which results in reduced asthma rates in dense urban environments. Properly placed trees can assist in cooling cities, reduce the urban heat island effect, and assist in mitigating the impacts of climate change, which also results in fewer respiratory illnesses. Trees have received significant attention for their positive impact on stormwater management. In short, urban tree canopy is a significant and valuable asset that addresses multiple community goals and priorities.

Akron's urban forest continues to face significant challenges. Tree diseases and pests along with city infrastructure improvement projects have led to substantial tree losses. Moreover, the larger threats of climate change and weather events challenge even the most well-established urban forest. However, Akron's tree canopy also has reason for optimism. To offset some of the CSO project impacts on canopy loss, Akron plans on plantings trees in the right-of-way (ROW) and other public spaces. This tree planting is in addition to the CSO projects' planned reforestation efforts. This report can serve to leverage opportunities for engagement with Akron's non-profit and business community on tree canopy issues. It will require extensive private partnerships to impact canopy beyond public property.

Purpose

The intent of this project is to provide Akron with valuable data that will support efforts to develop community goals, prioritize tree plantings, and establish the importance of the community's tree resources. This *2020 State of the Canopy Report* will be especially valuable to develop data-backed strategies and plans for the area's current and future urban forest and green infrastructure.

The GIS assessment establishes urban tree canopy baseline information; identifies and quantifies the current contributions of urban trees; and examines canopy gains and losses between 2011 and 2018. Additionally, a prioritized planting analysis was conducted by comparing tree canopy data with other GIS information such as socioeconomic data from the U.S. Census and additional environmental data. This information was presented to the City of Akron as a series of custom maps, analysis spreadsheets, and an UTC assessment geodatabase.

The *2020 State of the Canopy Report* explores various strategies for the city's future canopy. The information contained within this report is a continuation of initiatives that are needed to support Akron's investment in its urban forest. The UTC data is a tool, along with public tree inventories, management plans, and tree codes and policies that help guide urban forest management. UTC data can be an effective way to set urban forestry program goals and to measure progress.

Figure 4. Overview of tasks associated with Akron's 2020 UTC Analysis Project.

The UTC data, maps, and other management tools (e.g., tree inventories and management plans) are all necessary components that assist and guide community reforestation efforts to maximize ecological benefits and urban forest sustainability. As management progresses, Akron is encouraged to refer back to these results, utilize these data for additional analyses, and continue to seek new tools and information to measure progress, report accomplishments, and inform management decisions.

Process and Methods

The project was organized in seven distinct tasks (Figure 4). A majority of the tasks centered around the GIS assessment of the canopy and determining changes found in the seven-year interim. Analysis was performed to quantify benefits of the urban forest and to explain socio-economic impacts of canopy coverage. Metrics for prioritization of future tree plantings were described and outlined as future tree canopy strategies for consideration.

National Agriculture Imagery Program (NAIP) aerial imagery from 2018 was used to find suitable planting locations within public rights-of-way (ROW) as well as private property. Further analysis to identify the most suitable locations was also conducted by analyzing each planting location to assign a priority ranking for stormwater, social equity, and a composite overall ranking.

Each data source utilized the most current version available and is described in the subsequent sections. U.S. census data were taken from the five-year American Community Survey (ACS) estimates ranging from 2014–2018. The 2018 NAIP Imagery was collected from the United States Department of Agriculture (USDA). Public health data were gathered from the 2019 Center for Disease Control (CDC) 500 Cities project. Finally, The Child Opportunity Index 2.0 was completed in 2015 and was gathered from the Diversity Data Kids website, which is housed at the Institute for Child, Youth and Family Policy at the Heller School for Social Policy and Management at Brandeis University.

In order to create a priority planting plan, the locations for planting must first be determined. Planting location polygons were created by taking all grass/open space and bare ground areas and combining them into a single dataset. Non-feasible planting areas such as agricultural fields, recreational fields, major utility corridors, airports, ROWs, etc. were removed from the possible planting areas. The remaining planting space was consolidated into a single feature and then exploded to multipart features, creating separate, distinct polygons for each location.

Urban Tree Canopy Assessment Results

Based on the most recent aerial imagery from 2018, Akron's current urban tree canopy is 34.85%, which compares favorably with other northeastern cities of similar size. However, the city is losing canopy over time. Using the 2011 data, the tree canopy measured 36.78%. In seven years, from 2011 to 2018, the Akron tree canopy lost 1.93%, which amounts to a loss of 768.12 acres of canopy. This loss in canopy is, at least in part, due to the introduction of EAB, recent capital improvements such as the CSO projects, and general loss in the private sector.

Tree canopy is just one of five land cover classifications generated by this assessment. Additional land cover data, including pervious surfaces, impervious surfaces like pavement, roofs, etc., bare soils, and water, were quantified using Akron's city boundary as the project area (Figure 5 and Table 2). This information can be used to gain an understanding of Akron's tree canopy distribution. Table 1 provides a comparison of similar cites' UTC and perspective of their goals and corresponding goal target dates.

Once the overall canopy analysis was completed, the data were segmented and examined further to identify trends, including:

- Combined Sewer Overflow (CSO) Districts
- Great Streets Districts
- Parks
- Wards
- Zoning / Land Use
- Census Blocks
- Watersheds
- Land Value
- Health and Socioeconomic

While this report presents general findings and trends of Akron's tree canopy, these data can be examined and analyzed in a multitude of ways. Akron is encouraged to apply these data as new ideas, interests, or as priorities arise.

Table 1. Comparison of Tree Canopy in Several Similar Cities

Location	UTC	Year	Population	UTC Goal	Goal Target Date
Atlanta, GA	48%	2008	474,509	Increase	Ongoing
Stow, OH	41%	2013	34,744	Increase	Ongoing
Pittsburgh, PA	40%	2011	306,107	60%	20-year plan (2031)
Cincinnati, OH	38%	2011	296,020	Increase	Ongoing
New Haven, CT	38%	2009	129,779	Add 10K trees	5-year plan (2014)
Louisville, KY	37%	2013	597,337	40%	Ongoing
Akron, OH	**35%**	**2018**	**198,006**	**-**	**-**
Boston, MA	29%	2006	576,690	49%	10-year plan (2016)
Lexington, KY	25%	2013	310,010	30%	Ongoing
New Orleans, LA	23%	2009	283,214	Increase	Ongoing
Providence, RI	23%	2007	174,998	30%	10-year plan (2020)

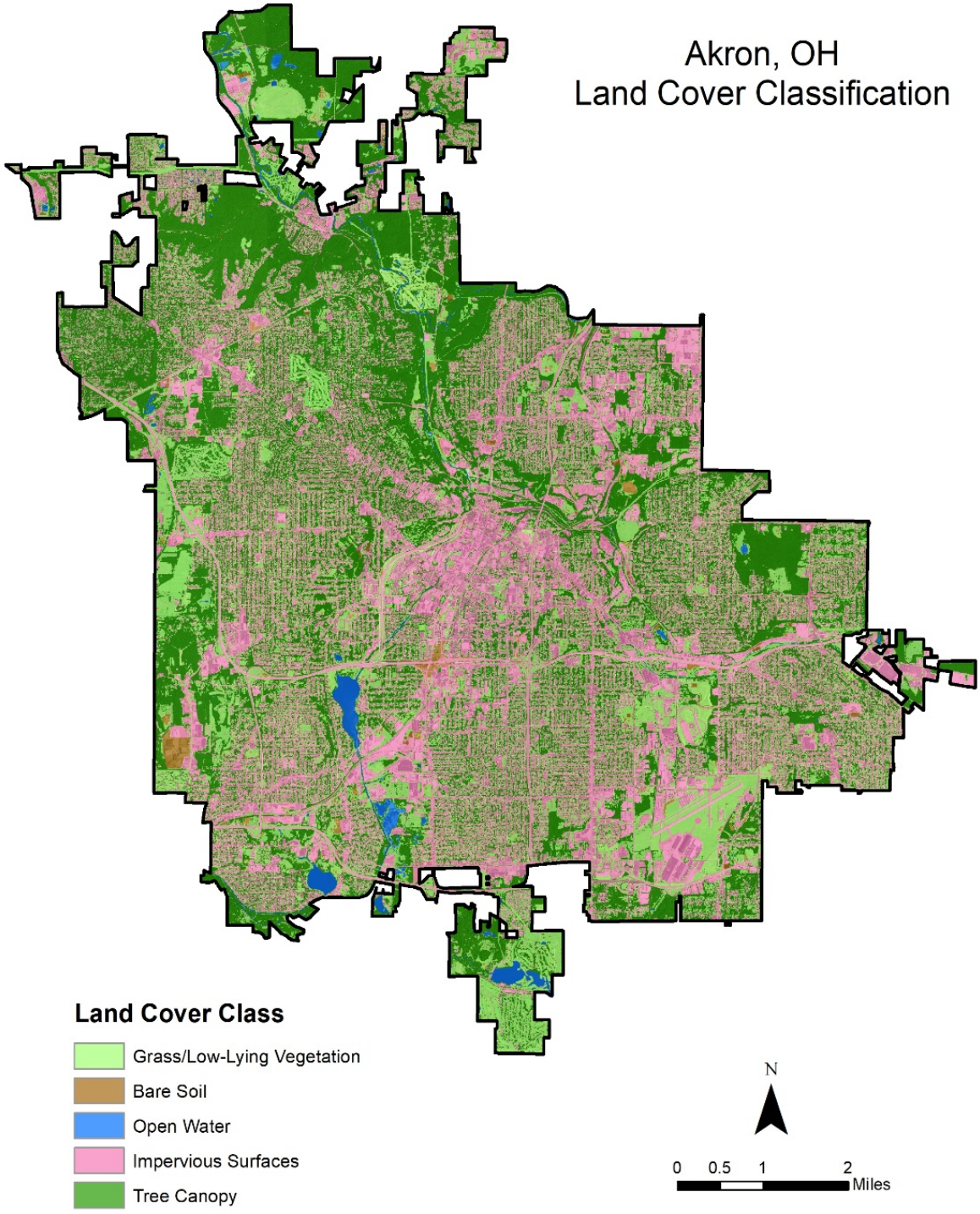


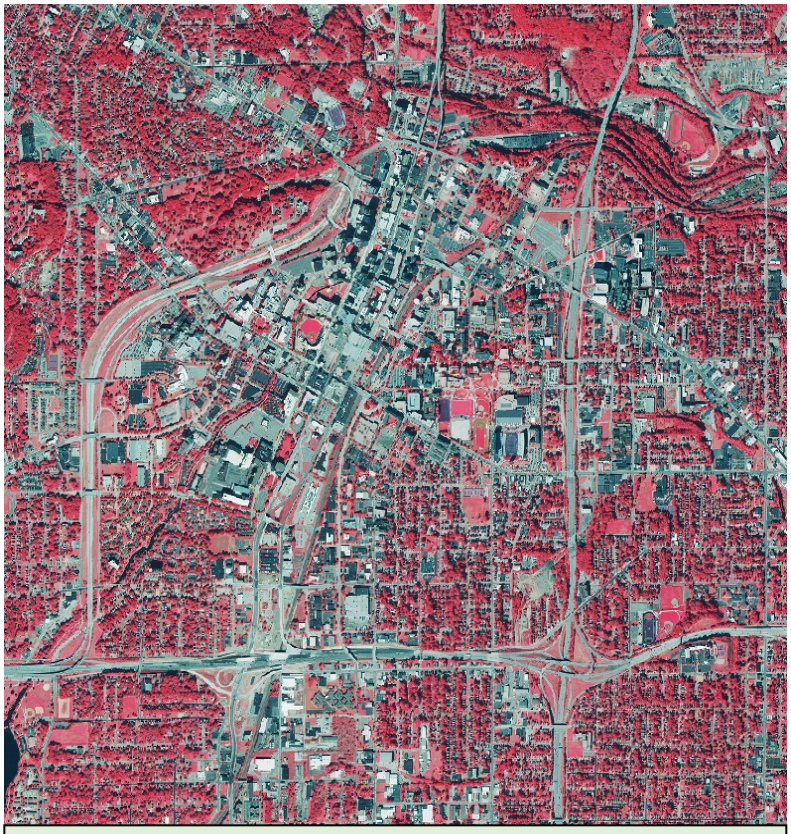
Figure 5. Akron's 2018 land cover classification distribution.

Historical Land Cover Change

Results from the study from the 2011 UTC data were compared to that of the 2018 UTC data. Between 2011 and 2018, the City of Akron lost 1.93% of tree canopy, decreasing from 36.78% to 34.85%. Figure 6 shows how analysis of tree canopy changes between 2011 and 2018 in the Downtown neighborhood illustrated a dramatic decrease in canopy on an individual parcel level.

Table 2. Akron's 2018 Land Cover Classification Distribution Breakdown

2018 Land Cover	Land Cover Size (Acres)	Land Cover Percentage
Entire City of Akron	39,840	100%
Impervious Surfaces	13,996	35.13%
Pervious Surfaces	11,113	27.89%
Bare Soil	372.65	0.94%
Open Water	475.16	1.19%



Akron's Downtown Neighborhood and University of Akron

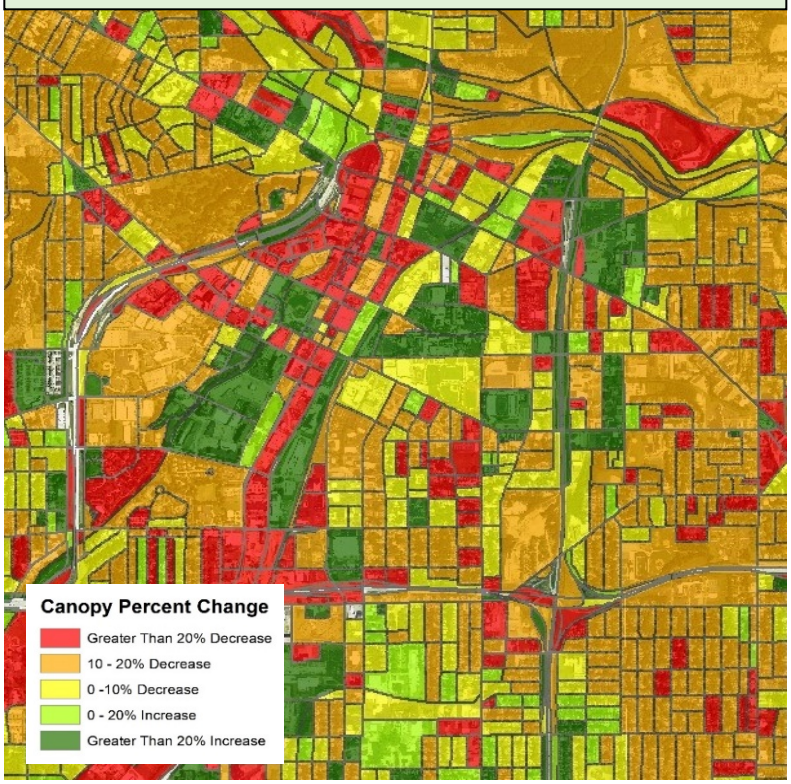


Figure 6. Illustration of 2018 tree canopy identified (upper), and percent change found from 2011 UTC (lower) in the Downtown Neighborhood and University of Akron.

Tree Canopy by Wards

Analyzing various geographies can aid in revealing localized patterns of tree canopy gains or losses.

City council wards are complicated geographies, and Table 3 reveals the observed losses or gains within each of Akron's wards. With over a 9% decrease in overall canopy, Wards 6 and 10 in the southeast of the city observed the greatest degree of canopy loss. With just an approximate 1% gain, Ward 9 was the only ward to have observable canopy gain from 2011 and 2018.

Wards are created based upon electoral boundaries determined by a mixture of neighborhoods, population, and historical landmarks. Given their variation of geographic size, shape, and population, the best method to evaluate the need for canopy is by comparing canopy and impervious surface.

Table 3 and Figure 7 both evaluate the relationships between area coverages between impervious surfaces, maximum canopy, and the 2018 existing canopy for each ward. As the area of impervious surfaces increases, there is less space for trees and the maximum canopy potential decreases. On average, all wards are short of their maximum canopy potential by +/- 25%.

Ward 7 is unique in that it was found to have the highest pervious surface of all the wards, which is an indicator of available space where trees could be planted. Ward 7 additionally was found to have one of the lowest overall canopy percentage. While it didn't have the largest decrease in canopy between the two study time periods, it may offer the largest opportunity to find viable potential for future planting efforts (Figure 8).

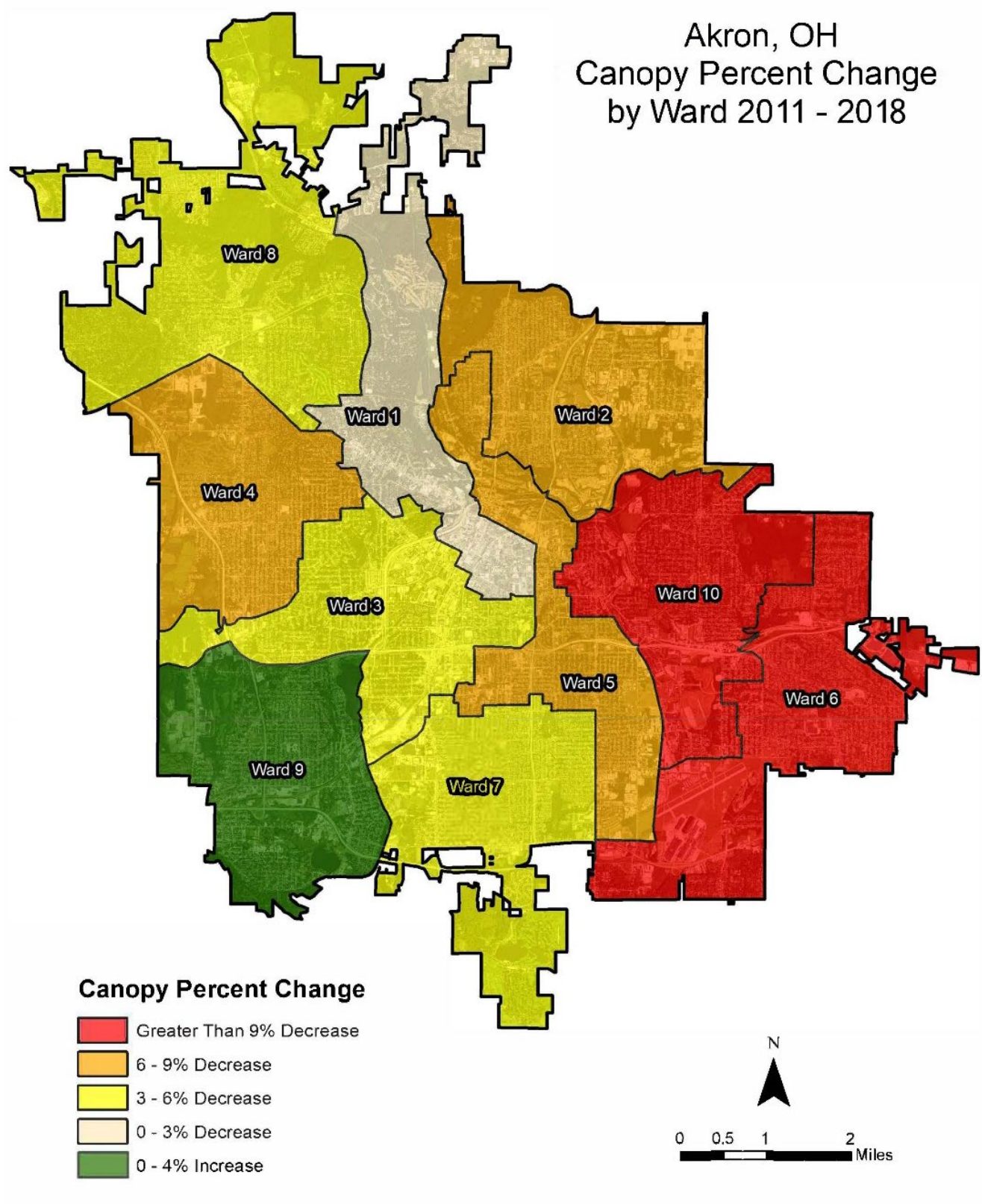


Figure 7. Tree canopy percent change between 2011 and 2018 by Akron wards.

Table 3. Percent Change from 2011 to 2018 by City of Akron Wards

Ward	Acres	Canopy Percent	Impervious Surface	Pervious Percent	Maximum UTC	Difference in Acres 2011-2018	Percent Change 2011-2018	Absolute Change
Ward 1	3,647.65	43.82%	30.99%	23.61%	66.06%	-44.28	-2.70%	-1.21%
Ward 2	3,901.38	36.80%	40.44%	21.53%	57.50%	-110.27	-7.13%	-2.83%
Ward 3	3,567.40	26.48%	44.94%	26.45%	52.76%	-47.23	-4.76%	-1.32%
Ward 4	3,494.83	34.07%	31.95%	33.14%	60.37%	-88.86	-6.95%	-2.54%
Ward 5	3,107.20	26.87%	44.42%	28.08%	53.66%	-63.68	-7.09%	-2.05%
Ward 6	4,541.70	26.98%	39.88%	32.36%	53.12%	-151.19	-10.98%	-3.33%
Ward 7	3,759.80	26.22%	34.40%	34.97%	50.10%	-49.78	-4.81%	-1.32%
Ward 8	6,222.38	53.01%	21.76%	23.44%	73.86%	-107.69	-3.16%	-1.73%
Ward 9	3,842.50	29.53%	35.30%	28.60%	56.89%	39.98	3.65%	1.04%
Ward 10	3,757.64	32.87%	36.54%	29.15%	61.84%	-145.19	-10.52%	-3.86%

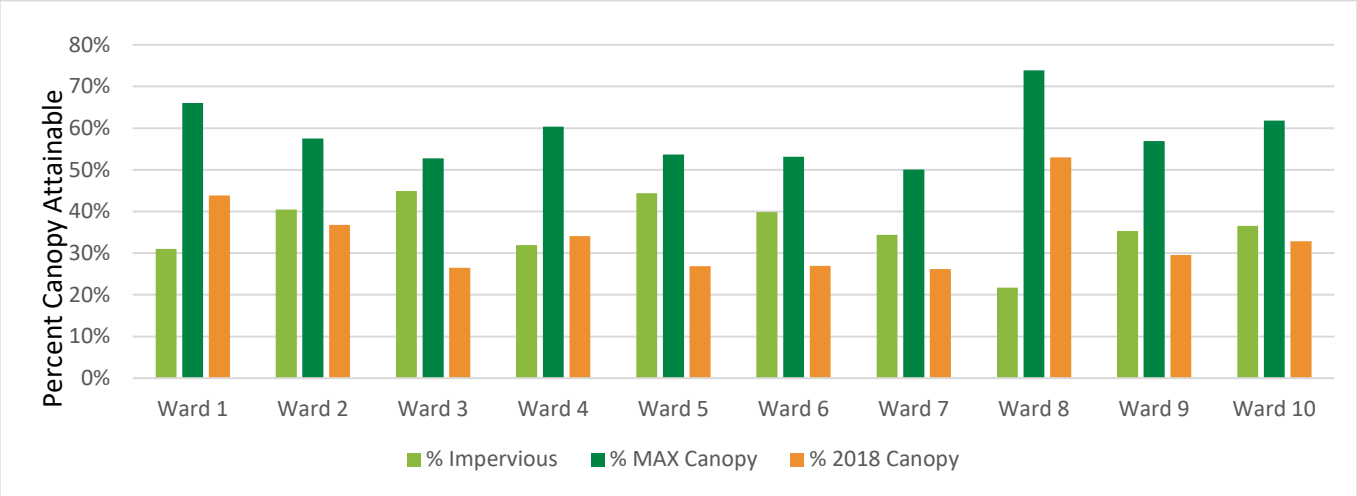


Figure 8. Maximum percentage of canopy attainable by City of Akron wards.

Tree Canopy by Neighborhoods

Urban tree canopy results were further examined by neighborhood boundaries. Neighborhoods are often used to understand tree canopy as they tend to reflect geographies that are well understood by community members and social institutions. Exploring canopy distribution at this level can help facilitate community outreach and education activities as well as develop a deeper understanding of tree canopy at a meaningful community scale.

Figure 9 and Table 4 show the distribution of neighborhood canopy levels across the city. Areas in the east had greater losses of canopy. These neighborhoods are primarily residential in nature. Gains were primarily areas in the southwest. The maximum canopy potential was also calculated. Current and past canopy coverage by Akron's 24 neighborhoods are identified in Table 4.

Similar trends are noticed at the neighborhood scale as observed in the wards. The difference between potential canopy and actual is an average of 23.88%. The potential canopy pervious surface area that is suitable to planting by excluding agricultural fields, recreational fields, major utility corridors, airports, etc. Additionally, an average loss of 32.04 canopy coverage acres (-5.31%) was found across all the neighborhoods.

A majority of the residential neighborhoods has a greater potential planting percentage than neighborhoods with more commercial or institutional zoning, such as the Downtown Akron, Chapel Hill, and University of Akron neighborhoods (Figure 10).

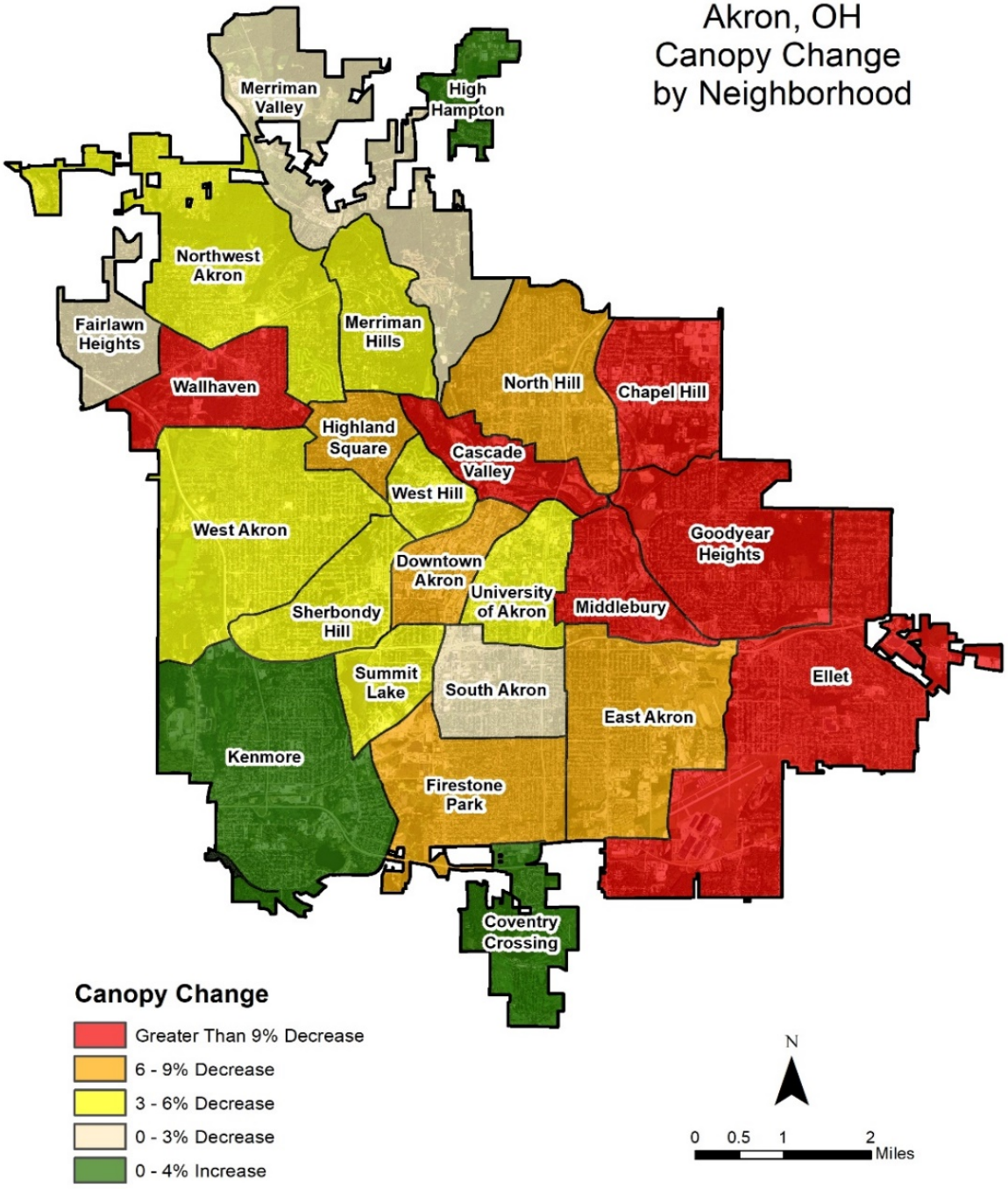


Figure 9. Tree canopy percent change between 2011 and 2018 by Akron Neighborhoods.

Table 4. Percent Change from 2011 to 2018 by City of Akron's Neighborhoods

Neighborhoods	Canopy Acres	Canopy Percent	Impervious Percent	Pervious Percent	Maximum UTC	Difference in Acres 2013-2019	Absolute Change
Cascade Valley	407.03	46.71%	30.68%	20.34%	65.80%	-40.53	-4.29%
Chapel Hill	396.89	28.30%	49.87%	21.19%	49.52%	-52.84	-3.70%
Coventry Crossing	345.66	31.20%	12.51%	48.78%	46.20%	5.41	0.20%
Downtown Akron	73.31	9.51%	69.43%	20.11%	29.31%	-6.68	-0.49%
East Akron	492.88	20.11%	44.18%	34.91%	53.98%	-44.16	-1.89%
Ellet	1228.97	26.85%	39.88%	32.51%	53.22%	-152.39	-3.15%
Fairlawn Heights	467.99	57.97%	19.49%	22.30%	79.87%	-13.1	-2.03%
Firestone Park	422.57	21.95%	44.61%	28.80%	49.12%	-34.21	-2.05%
Goodyear Heights	1031.41	41.67%	29.87%	27.25%	68.67%	-121.02	-5.33%
High Hampton	179.27	35.85%	30.38%	32.52%	69.13%	0.58	-0.15%
Highland Square	247.28	37.81%	38.74%	23.35%	59.50%	-17.93	-3.19%
Kenmore	1081.37	30.05%	36.39%	29.10%	57.92%	37.63	1.05%
Merriman Hills	727.3	62.34%	16.07%	20.53%	82.50%	-45.03	-3.66%
Merriman Valley	1737.47	59.00%	12.22%	24.59%	81.98%	-3.78	0%
Middlebury	251.95	25.79%	47.77%	25.06%	49.74%	-25.00	-2.21%
North Hill	628.16	32.07%	43.23%	23.75%	54.84%	-47.03	-1.93%
Northwest Akron	1502.91	51.54%	24.51%	22.96%	69.62%	-52.2	-1.46%
Sherbondy Hill	350.77	30.85%	38.52%	29.58%	59.92%	-18.21	-1.15%
South Akron	235.73	21.58%	51.10%	24.70%	48.11%	-3.98	-0.42%
Summit Lake	166.21	22.43%	32.38%	30.56%	52.46%	-5.14	-0.57%
University of Akron	172.91	18.20%	61.74%	19.45%	36.89%	-6.44	-0.80%
Wallhaven	507.05	40.53%	33.99%	23.83%	63.84%	-54.87	-4.47%
West Akron	1037.86	34.23%	30.81%	34.53%	61.16%	-62.68	-1.77%
West Hill	166.14	32.86%	43.37%	23.73%	49.25%	-5.31	-1.14%

To address inequities in neighborhood canopy cover, tree preservation, planting, and care activities should be prioritized in neighborhoods that are below the average neighborhood canopy cover.

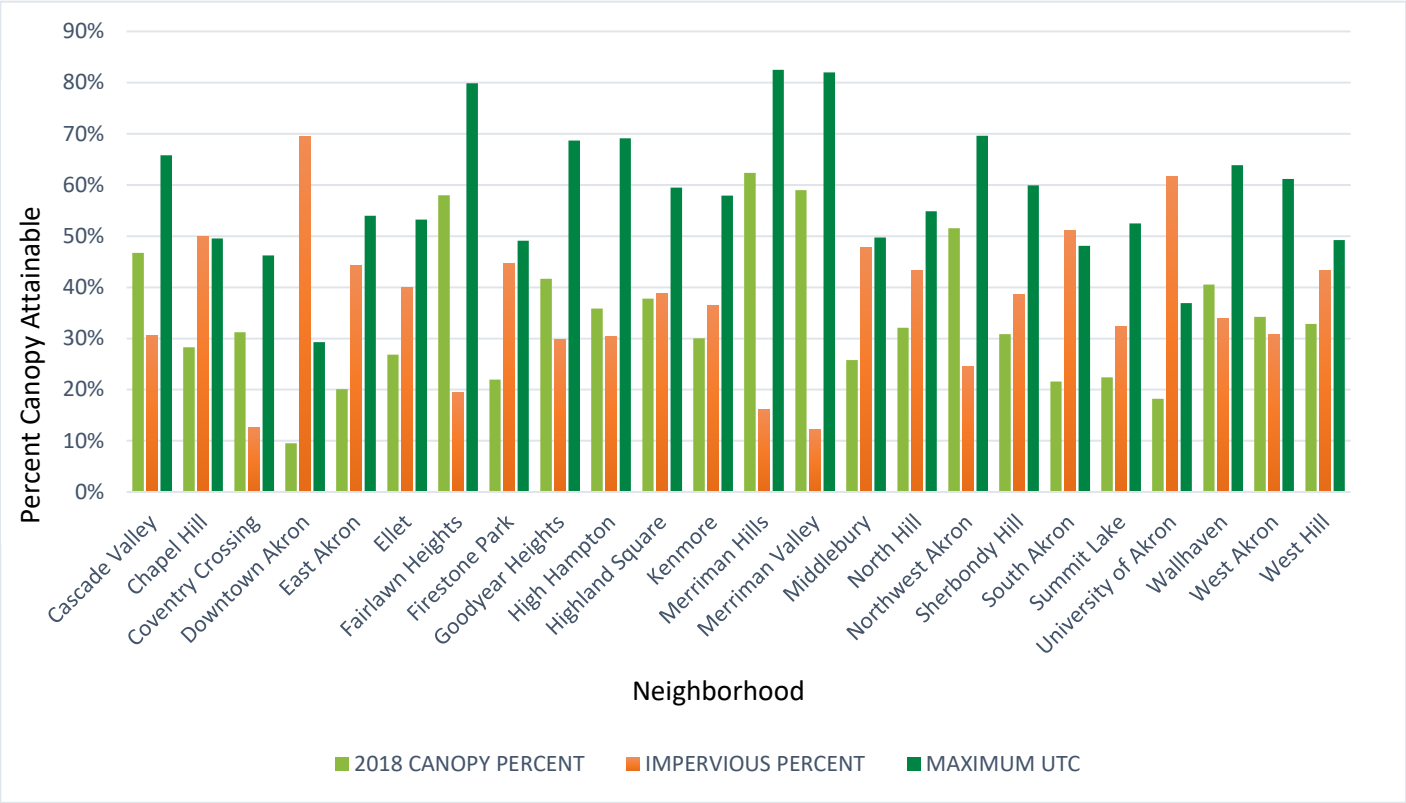


Figure 10. Maximum percentage of canopy attainable by City of Akron's neighborhoods.

Tree Canopy by Combined Sewer Overflow District (CSO)

The combined sewer overflow (CSO) districts are a response to the mandated improvements put forth by the EPA water quality standards. Figure 11 and Table 5 show how UTC has changed over time within these districts. CSOs occur when stormwater and sanity sewers flow together in a single pipe and during heavy rainfall events discharge into a nearby body of water due to the limited capacity of the sewer system. These districts and the proposed plans vary in scope and size and include green infrastructure elements. The new integrated plan was submitted in 2015. Some elements of these projects include removal of trees to facilitate construction of sewer separations.

In order to quantify the significance these capital improvements have had on the overall canopy loss over the last seven years, an approximation of those impact areas was created (Figure 12). An analysis was completed to determine the total area of canopy lost specific to those areas. When compared to the overall canopy loss of the city, the effect of the CSO infrastructure improvement projects was found to be substantial.

Of the 768.12 acres of canopy loss experienced between the study years, 60.61 acres came from the CSO impact areas that were identified. This means that 7.89% of the total canopy lost during that seven-year time period was the result of these projects. This is meaningful when put into the context of how much the CSO project areas comprise the whole city. These areas only encompass 0.45% of the whole city; however, they comprise 7.89% of the total canopy loss between the study years.

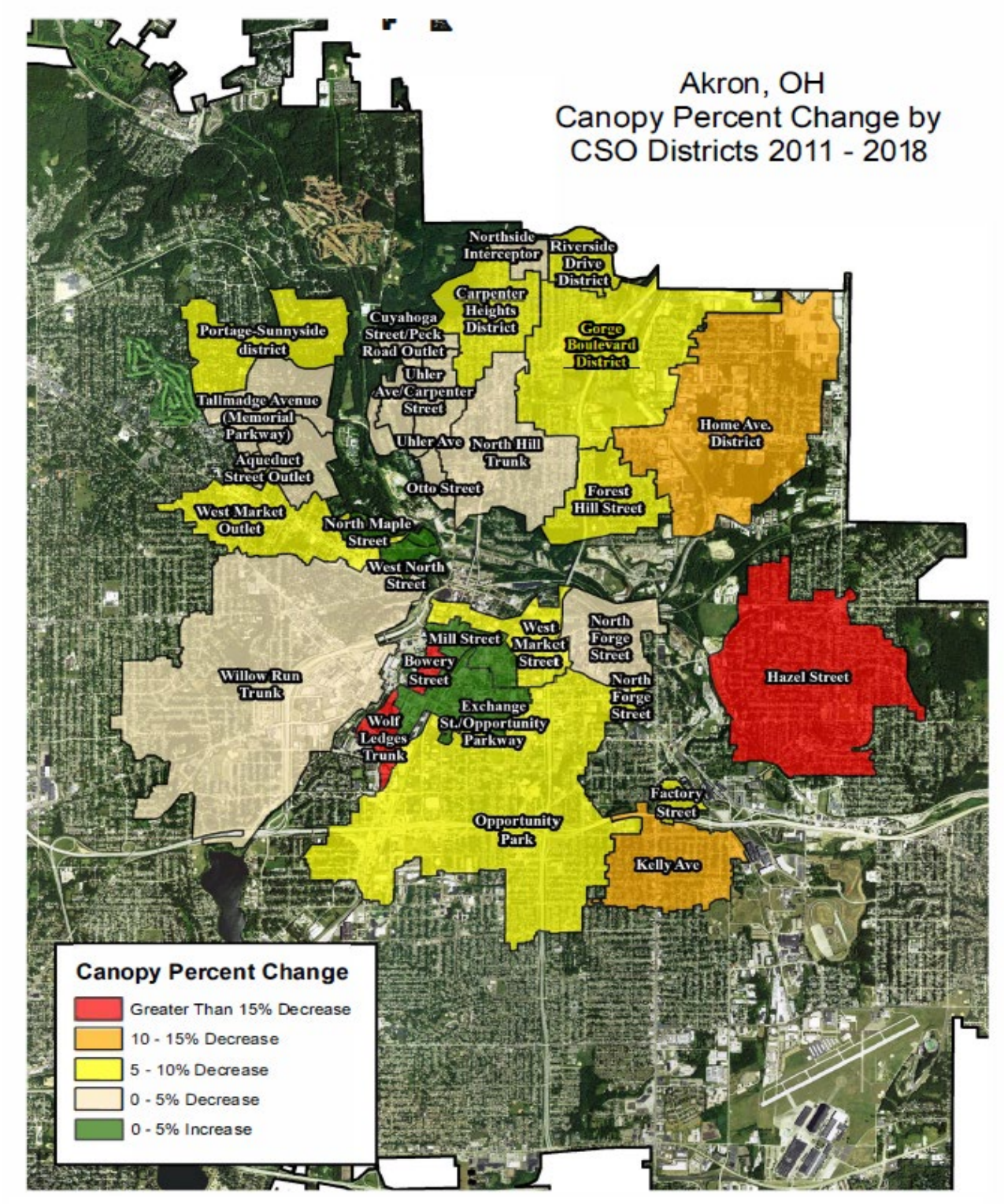


Figure 11. Percent change from 2011 to 2018 by City of Akron's CSO Districts.

Figure 12. Illustration of one of the identified CSO infrastructure improvement project areas (Cascade Village Storage Basin) adjacent to the Forest Hill Street CSO District.

Table 5. Percent Change from 2011 to 2018 by City of Akron's CSO Districts

CSO Districts	Acres	Canopy Acres	Canopy Percent	Difference in Acres 2011-2018	Absolute Change
Aqueduct Street Outlet	161.02	89.98%	55.88%	-2.95	-1.83%
Bowery Street	30.03	0.80%	2.68%	-0.23	-0.78%
Carpenter Heights District	282.77	117.71%	41.63%	-9.09	-3.21%
Cuyahoga Street/Peck Road Outlet	59.07	32.58%	55.16%	-1.48	-2.5%
Exchange Street/Opportunity Parkway	193.92	17.61%	9.08%	0.62	0.32%
Factory Street	38.01	10.47%	27.56%	-0.75	-1.97%
Forest Hill Street	232.36	79.85%	34.37%	-8.72	-3.75%
Gorge Boulevard District	745.67	186.64%	25.03%	-20.18	-2.71%
Hazel Street	891.96	289.41%	32.45%	-51.12	-5.73%
Home Ave. District	977.04	263.48%	26.97%	-37.84	-3.87%
Kelly Avenue	322.37	90.24%	27.99%	-13.58	-4.21%
Mill Street	103.3	6.79%	6.58%	0.08	0.08%
North Forge Street	231.16	72.31%	31.28%	-3.24	-1.40%
North Hill Trunk	430.5	119.78%	27.82%	-5.56	-1.29%
North Maple Street	52.47	28.87%	55.03%	0.14	0.27%
Northside Interceptor	55.03	28.06%	50.99%	-0.93	-1.69%
Opportunity Park	1394.79	287.54%	20.62%	-17.31	-1.24%
Otto Street	43.98	27.56%	62.67%	-0.97	-2.21%
Portage-Sunnyside District	316.13	178.1%	56.34%	-18.57	-5.87%
Riverside Drive District	107.27	51.16%	47.70%	-4.42	-4.12%
Tallmadge Avenue (Memorial Parkway)	231.5	132.56%	57.26%	-5.47	-2.36%
Uhler Avenue	88.64	40.95%	46.19%	-1.39	-1.56%
Uhler Avenue/Carpenter Street	131.71	66.50%	50.49%	-3.18	-2.41%
West Market Outlet	342.59	103.8%	30.30%	-7.65	-2.23%
West Market Street	171.12	14.91%	8.71%	-1.61	-0.94%
West North Street	37.38	14.26%	38.15%	0.67	1.79%
Willow Run Trunk	1616.72	469.02%	29.01%	-24.3	-1.5%
Wolf Ledges Trunk	64.7	4.16%	6.43%	-0.76	-1.18%

Tree Canopy by Great Streets Districts

The Great Streets Districts are smaller designated geographies of Neighborhood Business Districts. The Districts represent placemaking in action by sharing interests of aesthetics, urban design, and public space. Figure 13 illustrates the distribution of these Great Streets Districts throughout the city and corresponding canopy change during the seven-year study time period.

A primary facet of the Great Streets Districts initiative revolves around improving the overall aesthetics of public spaces around these commercial areas. A concerted effort should be made to improve the streetscapes associated with these commercial districts. Emphasis should be placed on the trees within those plans both in species diversification and size distribution. Special emphasis should be placed both in the number of trees to be planted as well as the preservation of the trees already established on site.

Studies have suggested that there is a correlation between increased spending habits (9%–12% increase for goods and services) in areas with central business districts that have a high-quality tree canopy coverage. Additionally, a sense of shopping in a safe space is core to the Great Streets Districts' initiative. Studies have shown green spaces have a calming effect and lower aggressive behaviors, thus reducing crime. This carries over to driving within these districts as well. Reductions in stress has also been noted in association with driving along streets lined with natural views like street trees.

Table 6 includes quantity and percentages of impervious and pervious surfaces. Where there are areas of larger impervious surfaces, there are smaller areas of possible tree planting. Akron's Great Street Districts have experienced an average canopy loss of 6.96% per district between the study dates which suggests these areas could benefit from a stronger existing tree preservation policy and new tree planting plan.

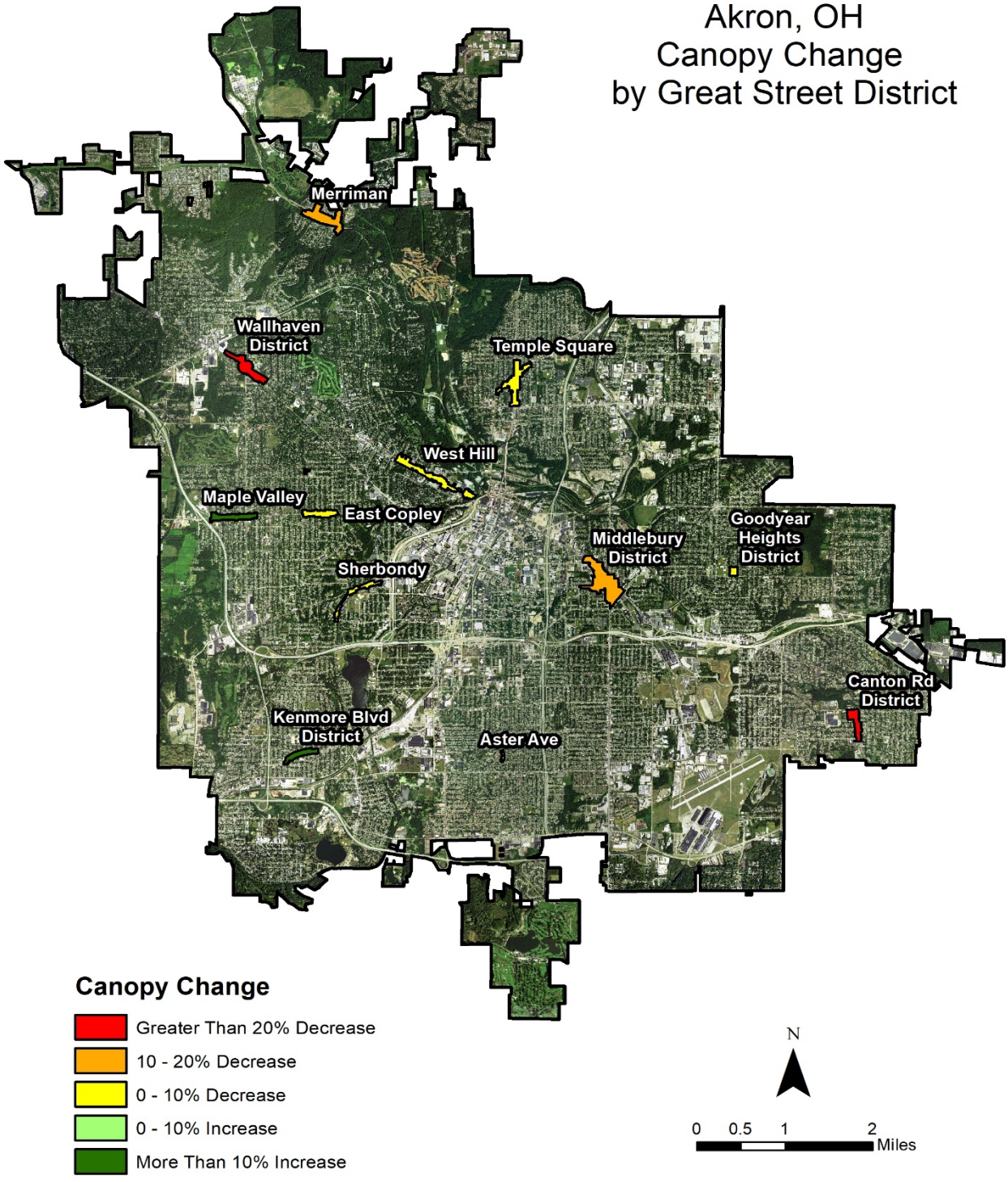


Figure 13. Percent change from 2011 to 2018 by City of Akron's Great Streets Districts.

Table 6. Percent Change from 2011 to 2018 by City of Akron's Great Streets

Districts	Acres	Canopy Acres	Canopy Percent	Impervious Acres	Impervious Percent	Pervious Acres	Pervious Percent	Absolute Change	Maximum UTC
Aster Avenue	2.41	0.29	12.22%	1.94%	80.39%	0.18	7.39%	0.69%	19.81%
Canton Road	21.17	0.72	3.40%	18.63%	88.02%	1.82	8.58%	-1.99%	11.96%
East Copley	20.77	2.22	10.68%	14.58%	70.20%	3.92	18.87%	-0.72%	29.73%
Goodyear Heights	6.07	0.62	10.17%	4.94%	81.33%	0.52	8.5%	-1.09%	18.56%
Kenmore Boulevard	17.56	0.8	4.57%	15.39%	87.65%	1.37	7.78%	0.72%	12.31%
Maple Valley	24	1.61	6.69%	20.24%	84.32%	2.11	8.77%	0.98%	15.57%
Merriman	42.51	3.69	8.68%	34.26%	80.58%	4.54	10.67%	-1.10%	18.77%
Middlebury	75.47	7.76	10.28%	55.13%	73.05%	11.64	15.42%	-2.08%	26.88%
Sherbondy	19.6	2.77	14.14%	12.26%	62.55%	4.56	23.28%	-0.49%	37.38%
Temple Square	42.72	5.62	13.16%	32.10%	75.15%	4.73	11.06%	-1.39%	24.72%
Wallhaven	34.3	2.5	7.29%	31.31%	91.27%	0.49	1.43%	-2.91%	8.72%
West Hill	47.57	4.23	8.89%	38.55%	81.03%	4.75	9.99%	-0.28%	17.46%

Benefits of Urban Tree Canopy

Trees provide a myriad of benefits to Akron. Trees conserve energy, reduce carbon dioxide levels, improve air quality, and mitigate stormwater runoff. In addition, trees provide numerous economic, psychological, and social benefits.

In 2018, Akron's tree canopy provided approximately $27.3 million in ecosystem benefits annually. This means approximately $138 provided annually to each resident of Akron, and this equates to each neighborhood receiving roughly $1,138,229 per year in ecosystem benefits. These benefits were quantified using the i-Tree Eco model and i-Tree Hydro hydrologic equations. The i-Tree eco tools models air quality and carbon storage and sequestration, and the i-Tree Hydro tool models stormwater runoff.

Stormwater Interception

Trees intercept rainfall in their canopy acting as a mini reservoir during storm events. Intercepted rainfall evaporates from leaf surfaces or slowly soaks into the ground, reducing and slowing stormwater runoff, and lessening the impacts of rainfall on barren soils. The growth and decomposition of tree roots increases water holding capacity and infiltration rates of soils, allowing for greater absorption of rain. Each of these processes greatly reduces the flow and volume of stormwater runoff, reducing flooding and erosion and preventing sediments and pollutants from entering waterways. Infiltrating and treating stormwater runoff on site can reduce runoff and pollutant loads by 20–60%.

Photograph 2. As this tree grows, it will increasingly provide benefits to the community. Trees of all ages and shapes and sizes draw pollutants, sequester carbon from the air, and protect water quality while helping to manage stormwater (Stock Photograph).

Planting trees in and adjacent to rights-of-way provides a unique opportunity to increase the effectiveness of grey and green stormwater systems. Existing stormwater management systems are not always adequate to accommodate runoff. When a system is overtaxed, peak flows can blow manhole covers off the ground, backing up stormwater and causing flooding. Where existing systems are challenged by common stormwater events, planting additional trees is a cost-effective solution to improve functional capacity.

In 2018, using i-Tree Hydro, Akron's trees intercepted an estimated 255,643,293 gallons of stormwater (Figure 14). That is enough water to fill 387 Olympic-size swimming pools. This benefit is calculated to provide approximately $22,752,253 in infrastructure value.

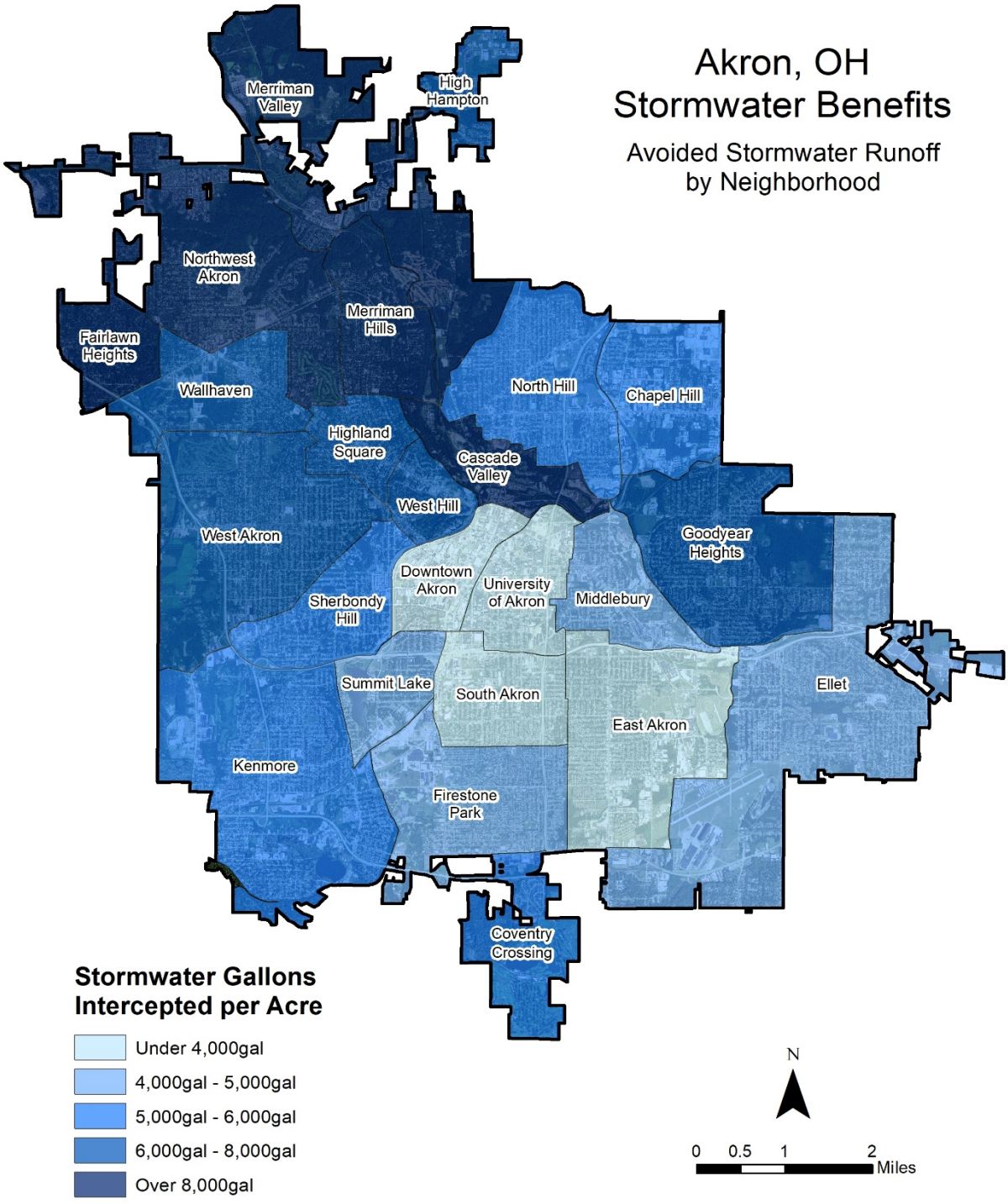


Figure 14. Avoided stormwater runoff by neighborhood.

Air Quality Improvements

Not only do trees take in carbon dioxide and produce oxygen, but they can also capture fine pollutants and particulate matter on the surfaces of their leaves. Combined, these processes can improve a city's air quality. Recent studies have shown a strong correlation between total tree canopy and reduced rates of pulmonary and cardiovascular disease.

i-Tree Canopy estimates carbon storage and sequestration and air pollutant removal. Air pollutants included in estimates are carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10}), and sulfur dioxide (SO_2). Every year, Akron's urban forest removes 1,186,980 pounds of pollutants from the air. These include: 8,560 pounds of carbon monoxide (CO), 81,880 pounds of nitrogen dioxide (NO_2), 680,260 pounds of ozone (O_3), 52,120 pounds of sulfur dioxide (SO_2), and 364,160 pounds of dusts, soot, and other particulate matter. Combined, this equates to approximately $1,315,676 in value annually (Figure 15).

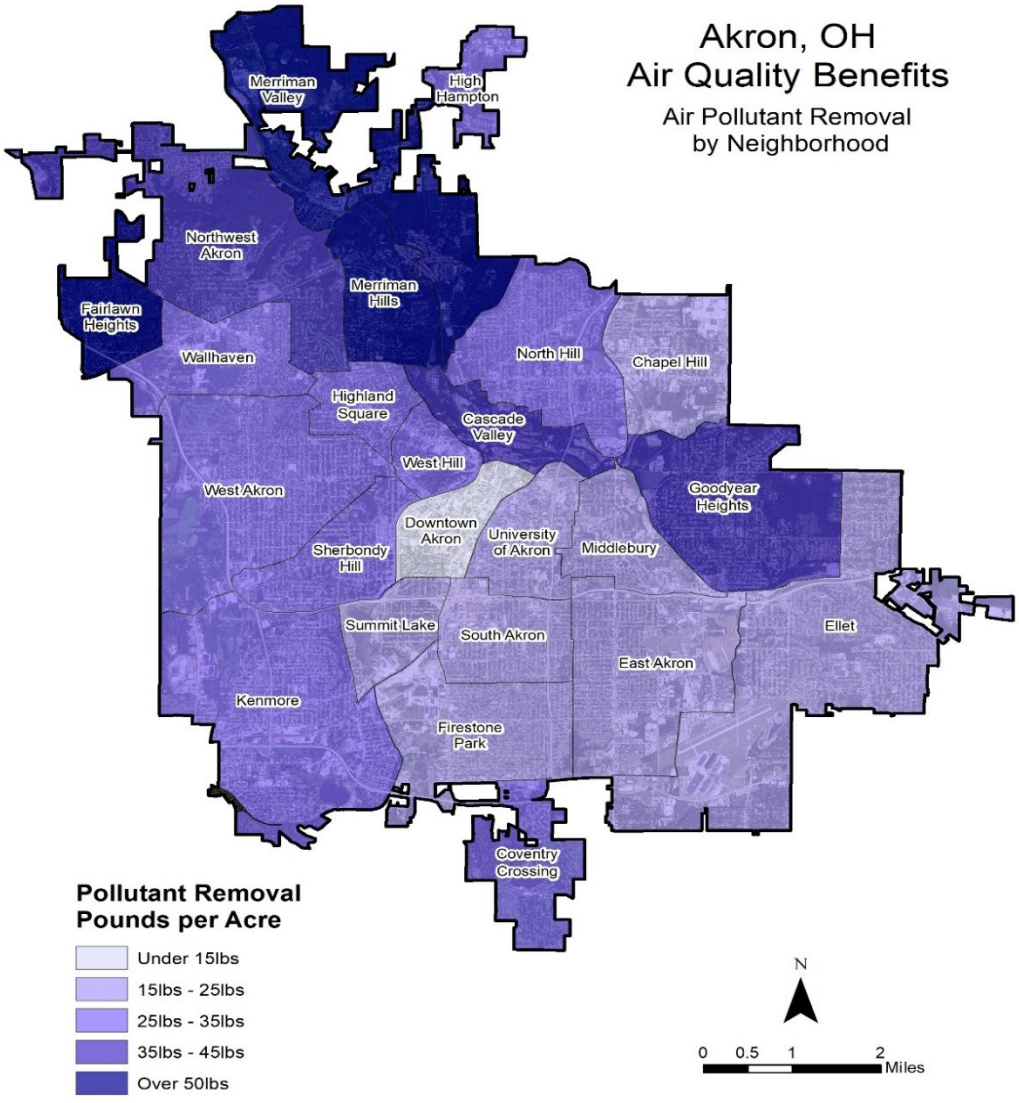


Figure 15. Air pollutant removal by neighborhood.

Carbon Reduction

As sunlight strikes the Earth's surface, it is reflected back into space as infrared radiation (heat). Greenhouse Gases (GHGs) absorb some of the infrared radiation before it can be released into space, trapping this heat in the atmosphere, and increasing the Earth's surface temperature. As GHGs increase, the amount of energy radiated back into space is reduced as more heat is trapped in the atmosphere, leading to higher surface temperatures. Changes in the Earth's average temperature may result in changes in weather and land use patterns which can impact human health. Many chemical compounds in the atmosphere act as greenhouse gases, including methane (CH_4), nitrous oxide (N_2O), carbon dioxide (CO_2), water vapor, and human-made gases/aerosols. In the last 150 years, due in large part to large-scale industrialization, the level of some GHGs, including CO_2, have increased by 25%.

Urban trees reduce atmospheric CO_2 directly through growth and the sequestration of CO_2 in wood, foliar biomass, and soil. Trees store massive amounts of carbon in their woody tissue. Carbon storage is the volume of carbon stored as wood and foliar mass, and as trees grow, they store more carbon as new wood and starch reserves. When trees die and decay, they release much of the stored carbon back to the atmosphere. In urban environments, most trees that die are removed and chipped or disposed of as firewood, releasing stored carbon. Thus, carbon storage is an indication of the amount of carbon that can be lost if trees die and are left to decompose. In addition to the annual benefits, Akron's tree canopy has amassed 1,760,806 tons of carbon valued at $81,608,550 for total carbon storage.

With a change in the overall canopy coverage for the city comes a change in the ecosystems benefits those trees provide. Table 7 provides insight into that loss of ecosystems benefits over the course of the seven-year study time period.

Table 7. Comparison of the Annual Ecosystem Benefits

Provided by Akron's UTC							
Ecosystem Factor		2011 UTC 36.78%		2018 UTC 34.85%		Seven-Year Difference	
		Units	Value	Units	Value	Units	Absolute Change
Air Quality[1] (pounds)	CO	9,060	$4,491.73	8,560	$4,248.94	-500	-
	NO_2	86,560	$7,128.09	81,880	$6,742.79	-4,680	-
	O_3	719,140	$605,309.39	680,260	$572,589.96	-38,880	-
	SO_2	55,100	$2,143.99	52,120	$2,028.09	-2,980	-
	PM_{10}	384,980	$771,783.88	364,160	$730,065.83	-20,820	-
	Subtotal	**1,254,840**	**$1,390,857.08**	**1,186,980**	**$1,315,675.61**	**-67,860**	**-5%**
Carbon[1] (tons)	Sequestration	74,120	$3,435,245.14	70,113	$3,249,556.21	-4,006	-
	Subtotal	**74,120**	**$3,435,245.14**	**70,113**	**$3,249,556.21**	**-104,624**	**-5%**
Stormwater (gallons)	Runoff	289,707,163	$25,783,937.00	255,643,293	$22,752,253.00	-34,063,870	-
	Subtotal	**289,707,163**	**$25,783,937.00**	**255,643,293**	**$22,752,253.00**	**-34,063,870**	**-13%**
Total			**$29,993,110.01**		**$27,317,484.82**		**-7%**

Heat Island Effect

The heat island effect refers to the tendency of cities and other population hubs to be higher in ambient temperature compared to surrounding areas. Urban heat islands are created by absorption of the sun's heat and subsequent reflectivity. Heat islands are directly associated with tree canopy loss which result in surface temperature spikes, creating degraded air quality, water quality, and public well-being.

Using newly-available satellite imagery, an analysis was conducted to determine the heat island effect citywide (Figure 16). Land surface temperatures were mapped and analyzed. Years of incremental tree canopy loss has increased the heat island effect in dense population centers in Akron. Expanding our tree canopy now can help mitigate the growing urban heat islands within the city and increase public health.

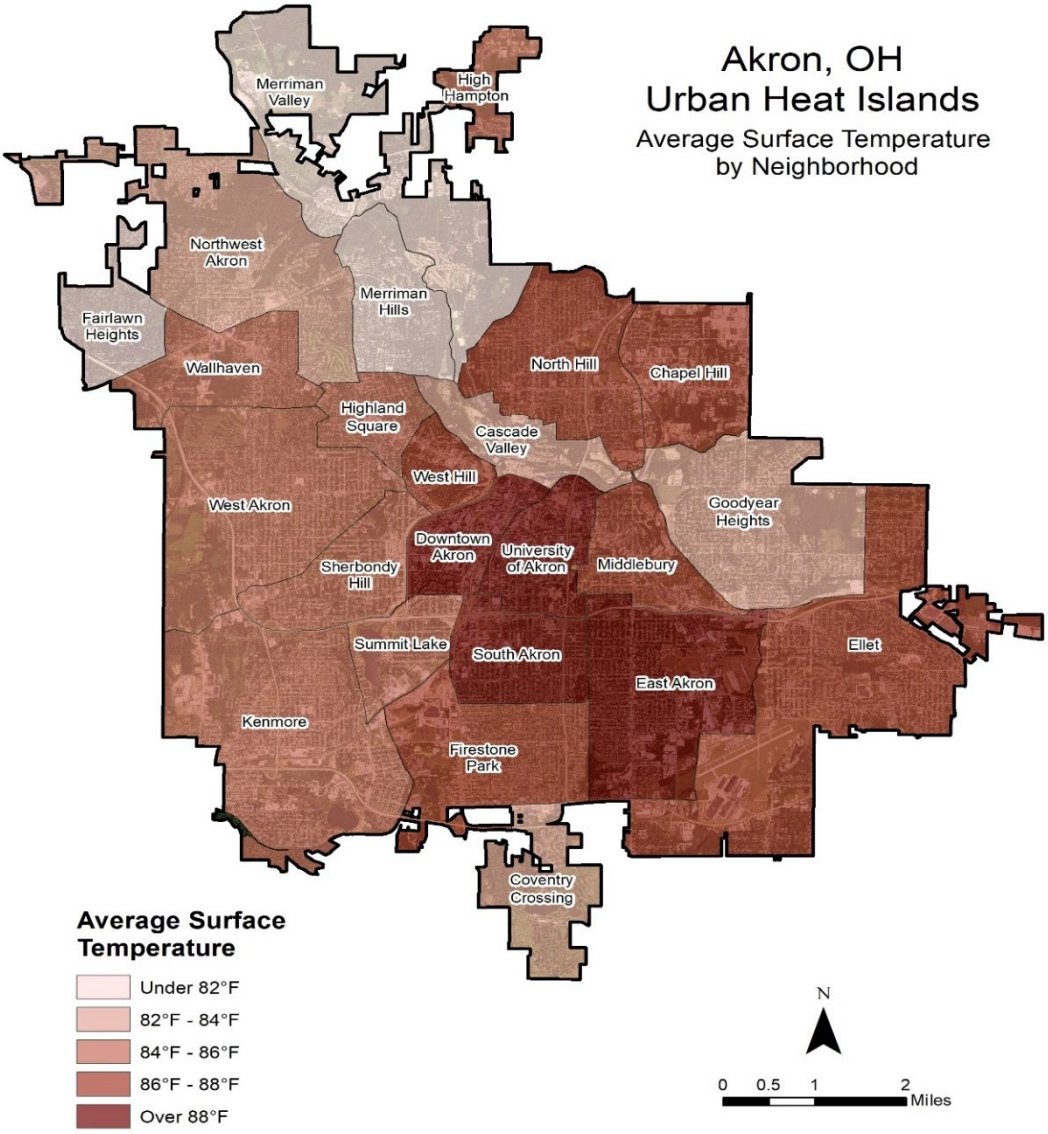


Figure 16. Map illustrating the heat island effect by way of average surface temperature (measured July-early September) by neighborhood.

Public and Private Canopy Composition

From the urban tree canopy assessment, it was determined that the majority of tree canopy in the city is privately owned and managed (Table 8). For cities to manage their urban forest, collaboration, and voluntary commitments on the part of private property owners can be a beneficial strategy that encourages desirable tree care and retention practices. In many cases with incentive programs, cities have established minimum tree density requirements and are utilizing incentives to allow property owners some flexibility with the minimum tree density.

With the city having authority to care for approximately 18% of the city's entire tree canopy, other methods to encourage or require tree planting/protection will be needed for the community to have influence over tree care in the remaining 82% of the urban forest. Some strategies that have been engaged in at other municipalities include the fee in-lieu programs to support variances in any tree replacement obligations, Heritage Tree Programs that protect special trees, arborist business licensing to encourage best practices in tree care, and incentive programs.

Table 8. Comparison of the Canopy Composition within the Private and Public Sectors of the City

Sectors	Acres	Canopy Acres	Canopy Percent within Sector	Maximum UTC	Maximum Canopy Acres	Differential from Current	Trees Need for Maximum Canopy
Public Greenspaces	2,115	1,135	54%	77%	1,637	502	33,132
Public ROW	6,696	1,362	20%	36%	2,386	1,021	67,386
Private	31,029	11,387	37%	63%	19,694	8,307	548,262

Future Tree Canopy Strategies

Substantial efforts will be required to mitigate for the canopy loss the city is currently experiencing. The following scenarios offer context in terms of tree planting numbers and costs for various future canopy strategies. It is important for the city to recognize the importance of trees to the community, adopt a tree canopy vision for the future, and put into place the measures to obtain those vision objectives. If a long-term goal for the city is to increase the overall canopy coverage for the community, an initial step could be simply slowing the downward current trend with the intention to make incremental improvements that would lead to eventual gain in overall gain of canopy for the City of Akron (Figure 17).

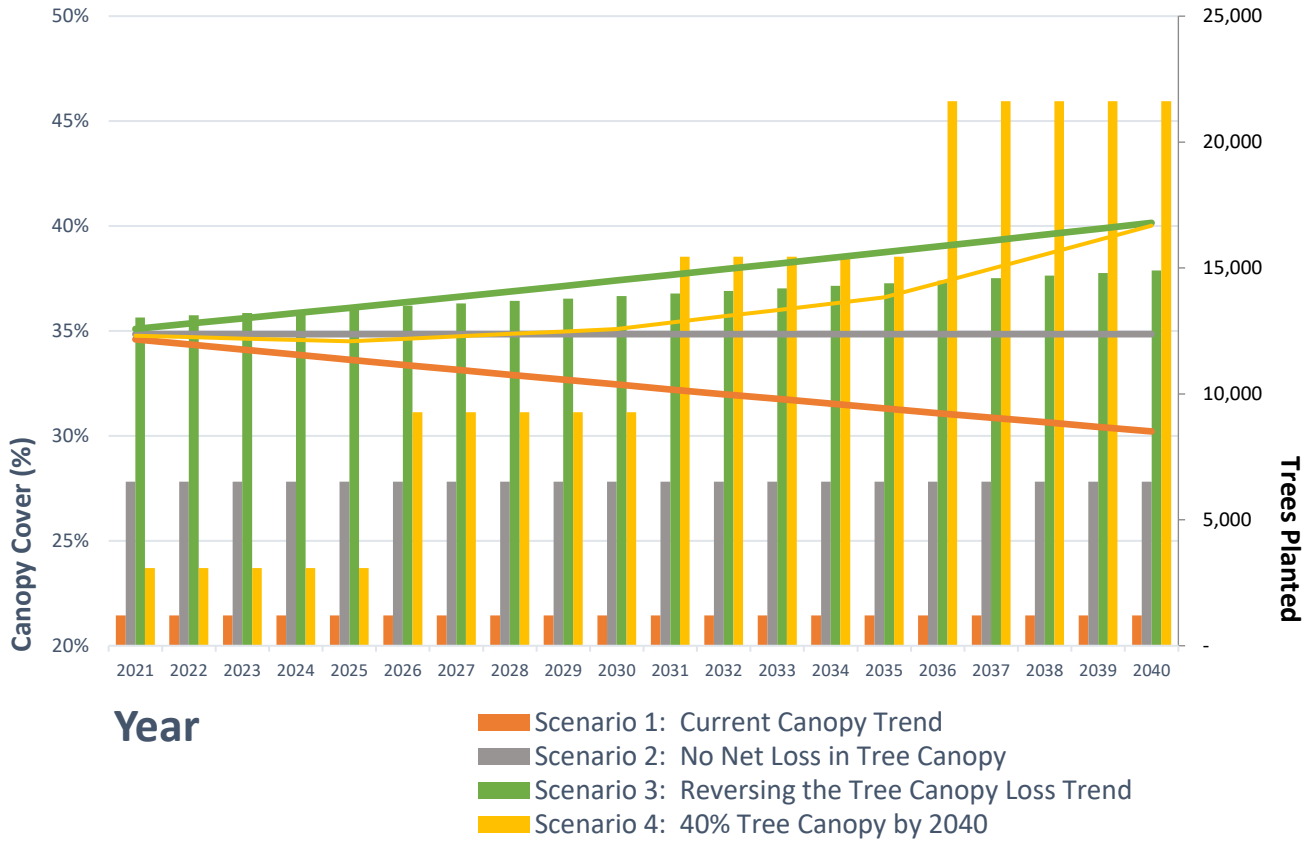


Figure 17. Outline of proposed future tree canopy strategies.

Exploring Canopy Goal Scenarios.

Four canopy goal scenarios were explored to see the impact different strategies would have on Akron's tree canopy cover. Understanding the implications of these scenarios and the resources needed to implement them can help inform the strategies the City of Akron deploys to reach their tree canopy goals.

The four scenarios explored are:

- *Scenario 1:* Current Canopy Trend (Status Quo)
- *Scenario 2:* No Net Loss in Tree Canopy
- *Scenario 3:* Reversing the Tree Canopy Loss Trend
- *Scenario 4:* 40% Tree Canopy by 2040

Each scenario presented provides the number of trees planted per year beginning in 2021 and the associated costs. All of the scenarios account for the current tree canopy mortality and the mortality rate of newly planted trees. Tree mortality rate refers the percentage of expected deaths in the tree population in an average growing season.

Canopy Scenario Model

The canopy goal scenario model used the following inputs and assumptions to determine the projected canopy change over time and the number of trees to be planted to achieve each scenario goal.

Trees Per Acre: 66

- Based on the number of medium-sized canopy trees with a 30-foot canopy spread fit on 1 acre.

Mortality Rate*

- Natural Annual Mortality Rate: 0.7% (x acres per year)

*Mortality Rates were established based on the following sources:

- Analysis of canopy loss between 2011 and 2018 based on Akron urban tree canopy assessment data.
- Hibert et al, *Urban Tree Mortality: A Literature Review. Arboriculture and Urban Forestry 45(5)*, September 2019 - p 167-200

Tree Planting Costs

- City of Akron Tree Planting: $375/tree (city estimate).

*$375/tree is an average estimated cost

SCENARIO 1: Current Canopy Trend
Trees Planted/Year: 1,200
Cost/Year: $450,000
Tree Canopy Cover 2040: 30.2%

- The Current Canopy Trend scenario finds that Akron's tree canopy is projected to fall to 30.2% by 2040, if no changes are made to current actions. The annual tree planting (avg. 1,200) does not make up for the annual 92-acre loss in tree canopy (est. 6,072 trees).
- This scenario is not without its costs. Akron will lose 0.23% in total canopy, or approximately $718,880 annually in tree benefits under this scenario.

SCENARIO 2: No Net Loss
Trees Planted/Year: 6,514
Cost/Year: $2.44 million
Tree Canopy Cover 2040: 34.85%

- The No Net Loss scenario focuses on stopping the canopy loss trend by maintaining Akron's canopy cover at 34.85%. Through this scenario, the number of trees planted is based on replacing the 97.20 acres of canopy lost each year to old age, disease, development, neglect, storms, and other causes.

SCENARIO 3: Reverse the Trend
Average Trees Planted/Year: 13,948
Average Cost/Year: $5.23 million
Tree Canopy Cover 2040: 40.15%

- This scenario looks at what would actually be needed to reverse Akron's canopy trend from canopy loss to canopy gain. The number of trees planted is based on planting 197.41 canopy acres/year or 97.20 acres to replace what is lost each year and 100.21 acres to grow the canopy.

SCENARIO 4: 40% Canopy Cover by 2040
Tier 1: Average Trees Planted/Year: 3,090, Tier 2: 9,269, Tier 3: 15,448, and Tier 4: 21,627
Tier 1: Average Cost/Year: Tier 1: $1.16 million, Tier 2: $3.48 million, Tier 3: $5.79 million, and Tier 4: $8.11 million
Tree Canopy Cover 2040: 40%

- To achieve Akron's current canopy goal of 40% by 2040 will require planting approximately 12,358 trees/year for the next approximately 20 years.
- Proposed is a tiered approach with a step increased in trees planted on a five-year increment. This approach will allow for a gradual increase in the cost associated with a long-term 40% canopy goal for Akron. Initially, there will be a decrease in the overall canopy and a gain in canopy by the second tier tree planting increase.

Prioritized Planting Opportunities

While a UTC analysis is helpful to understand existing tree canopy distribution and value, communities are often interested in expanding tree canopy to optimize the suite of socio-economic and ecosystem benefits provided by the urban forest. Therefore, it is common to start by calculating possible planting area based on the total of all land cover that is open ground—such as lawns, golf courses, and sports fields.

It does not make sense to plant trees in all of these "possible planting areas", such as in sports fields. Some locations are clearly better suited to meeting community goals than others. Therefore, this study analyzed additional data to develop a prioritized planting plan that seeks to maximize the socio-economic and ecosystem benefits provided by trees, such as reducing asthma rates and capturing stormwater.

Tree Canopy Socio-Economic Assessment

The distribution of tree canopy varies across the city, changing over decades, sometimes gradually, and sometimes abruptly due to weather, climate, disease, economics, and development factors. This variability leads to an inequitable distribution of tree canopy, meaning neighborhoods with lower tree canopy receive less benefits. Comparing social equity factors (like income, age, diseases, crime rate, etc.) and the distribution of tree canopy across the city can help prioritize tree planting and care in neighborhoods with fewer trees that can stand to benefit the most from additional trees and tree care (Table 9 and Figure 18).

Table 9. Top Five Socio-Economic Prioritization of Akron's Neighborhoods

Income	Mental Health	Race	Population	Child Opportunity	Combined Priority
Downtown Akron	Downtown Akron	Downtown Akron	University of Akron	Downtown Akron	**Downtown Akron**
Summit Lake	Summit Lake	Summit Lake	East Akron	Summit Lake	**Summit Lake**
University of Akron	University of Akron	University of Akron	South Akron	University of Akron	**University of Akron**
Middlebury	Middlebury	East Akron	Chapel Hill	Middlebury	**Middlebury**
South Akron	East Akron	South Akron	Firestone Park	South Akron	**South Akron**

Akron Neighborhood

Priority Ranking

To identify and prioritize planting potential based on a Social Equity, data were analyzed including Census, child opportunity, and health data. Census data included ethnicity, median household income, and population density. Health data were collected for asthma and mental health. Higher priorities of social equity give a focused effort of providing trees and tree canopy to all citizens regardless of social status or health. An aggregated value was derived using an equally weighted average of each of these factors as a variable. The resulting value was used to provide a prioritization to the overall socio-economic impact of an increased tree canopy for the neighborhood. These priority neighborhoods are deemed to have the greatest return on mental and physical health as well due to their importance of providing residents of the community equal access to nature.

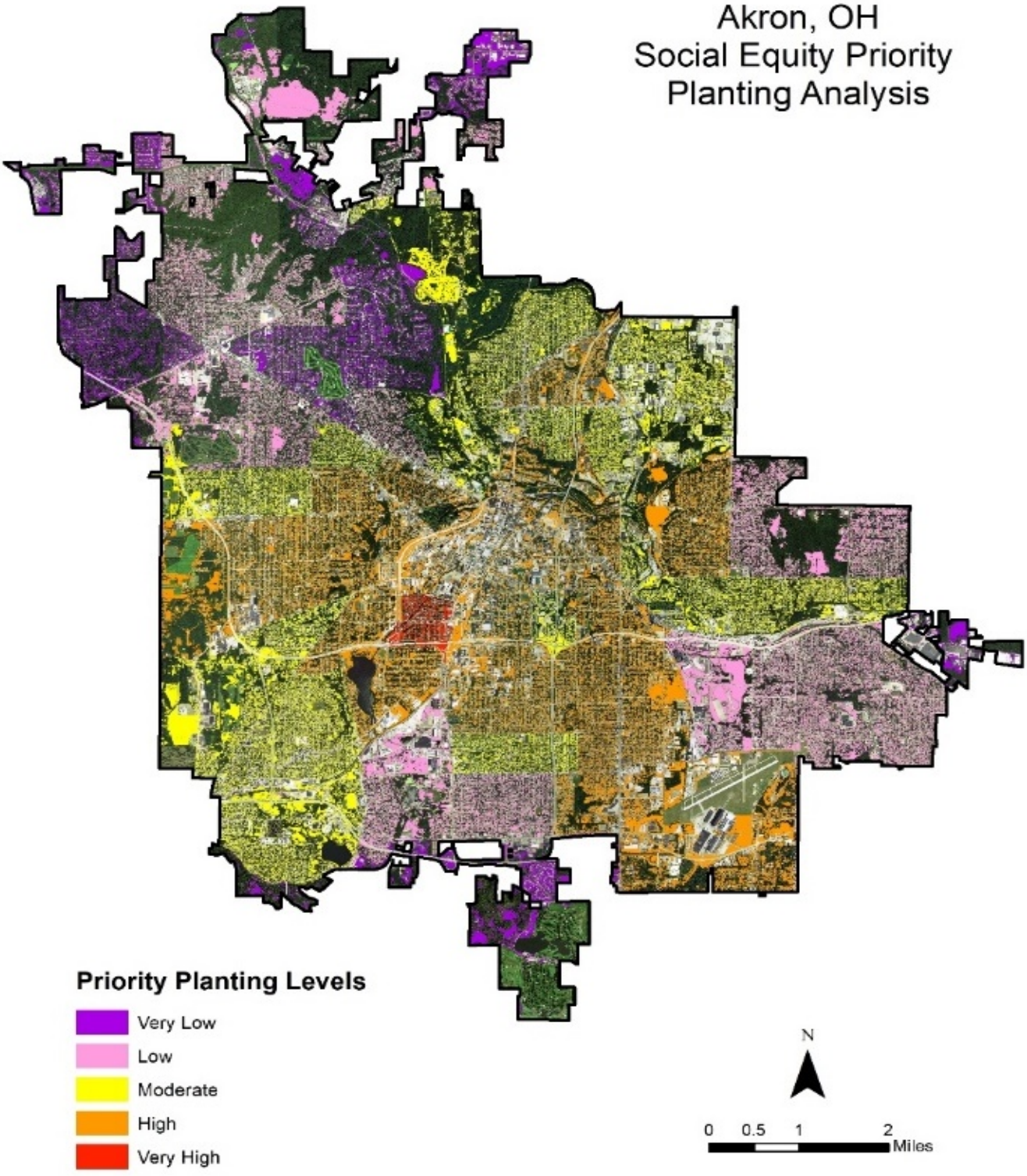


Figure 18. Priority of future plantings in accordance with social equity factors.

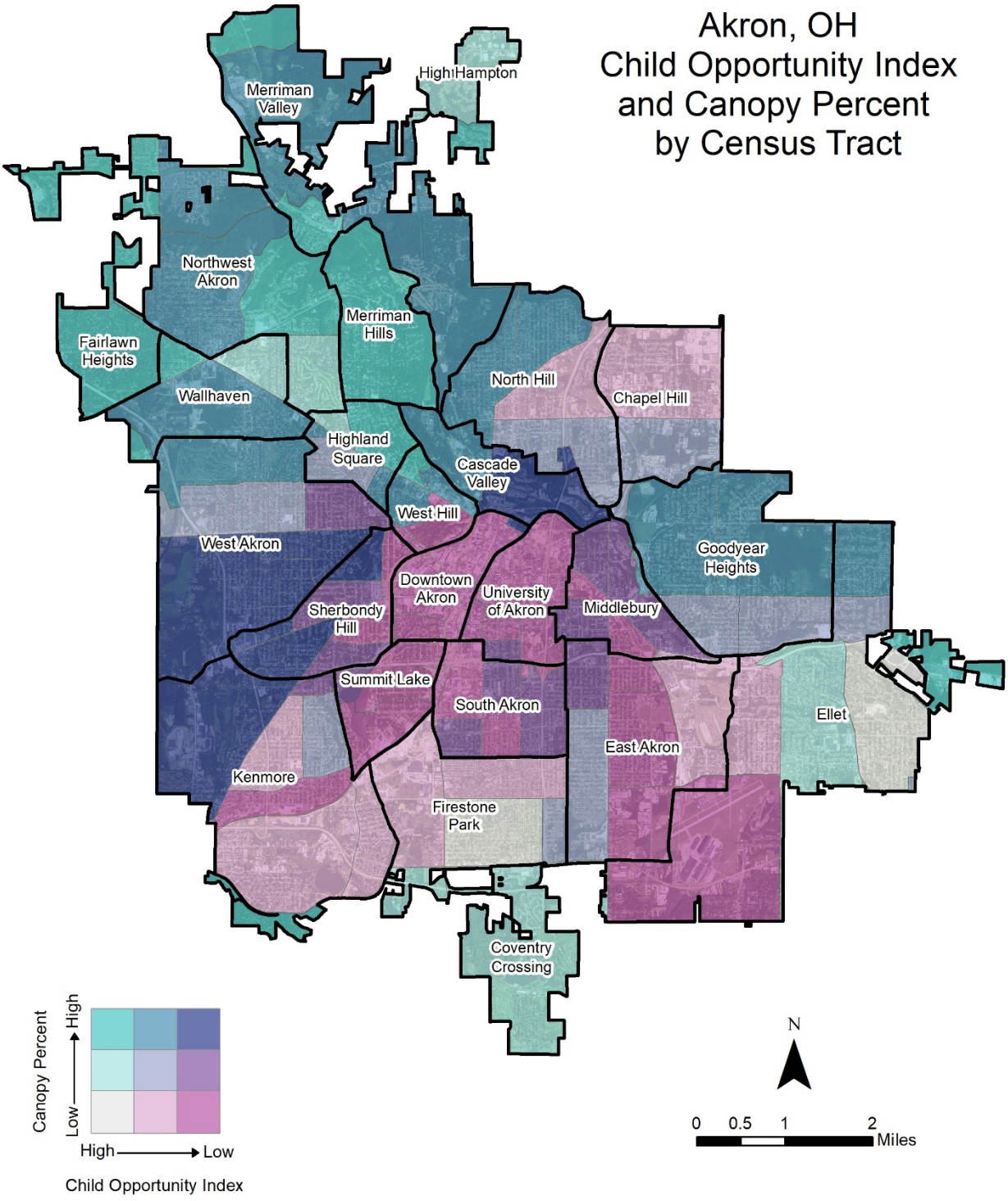


Figure 19. Priority of future plantings in accordance with the Child Opportunity Index and percent of canopy.

Child Opportunity Index

The Child Opportunity Index (COI) measures the access to opportunity for children within specific census tracts. There are 29 indicators that comprise the composite index score. These indicators are grouped into three main categories, including education, social, and environmental.

From the associated map, it can be ascertained that the largest need can be found in the southern and southeastern quadrants of the city (Figure 19).

Median Household Income

Using the census data, we can look at the median household income for individual census tracts and compare them with the canopy coverage for those areas.

Planting in these high priority areas may help address social equity issues and provide residents equal access to nature.

Asthma

Asthma rates among children have increased steadily worldwide. While the actual causation is not known, it is theorized to be linked to environmental and lifestyle changes. These links are most apparent in poor urban areas where socioeconomic disparities are most prevalent.

Trees are known to provide air quality benefits, especially in the urban environment. With the strong association between air pollution and prevalence of childhood asthma, increasing tree canopy could help decrease local incidence rates. Strategic planting in areas where asthma rates are highest and tree canopy is lowest could maximize the impact of the activity (Figure 20).

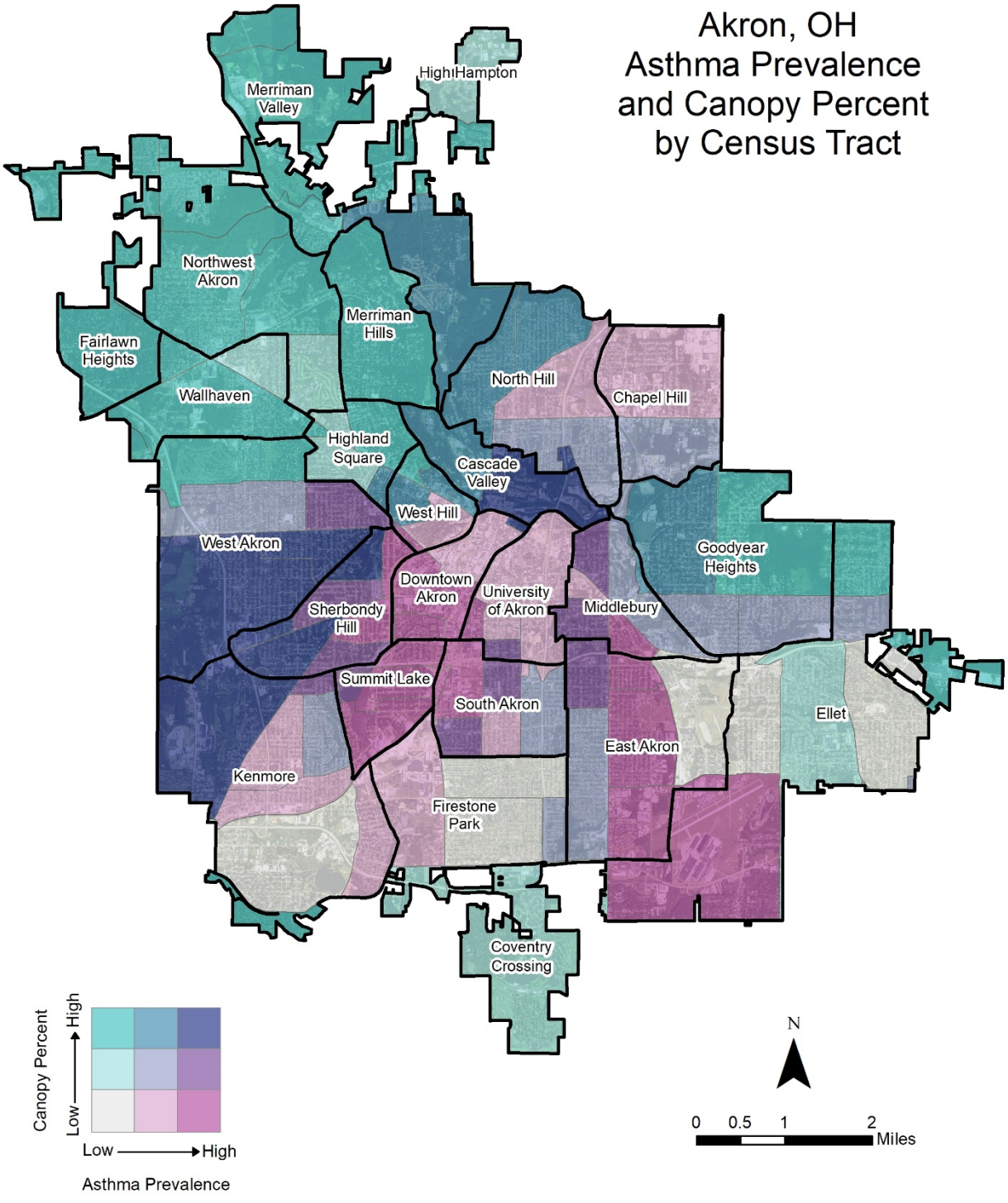


Figure 20. Priority of future plantings in accordance with asthma prevalence and percent of canopy.

Planting to Maximize Stormwater Interception

One of the most valuable benefits provided by the urban forest is its capacity to mitigate and intercept stormwater. Without trees, cities would have to undertake massive expansions of their stormwater systems to handle the increase in stormwater runoff. In fact, many cities are utilizing trees as part of a comprehensive approach to updating their stormwater systems and achieving compliance with local and federal regulations.

To identify and prioritize stormwater runoff risk potential, a number of environmental data were assessed, including proximity to hardscape, soil permeability, location within a floodplain, slope, and a soil erosion factor (K-factor). Overlapping these data produced a runoff priority rating ranging from Very Low to Very High based on a calculated average. Through this prioritization, sites were ranked based on stormwater reduction.

While all available planting sites in Akron may ultimately be planted over the next several decades, the trees that are planted in the next several years should be planned for areas of greatest need and sites that will provide the most benefits and return on investment.

Akron has an estimated 14,437 planting spaces that should be considered High or Very High priority planting areas to maximize stormwater interception. In total, these locations represent 717 acres or approximately 6.2% of the city's land area (Table 10). Figure 21 shows priority planting locations across the city. It appears that many of the High priority areas are located in commercialized or industrial districts or along the Little Cuyahoga River corridor. Specifically, the East Akron, Firestone Park, South Akron, Sherbondy Hill, and West Akron neighborhoods have significant opportunities for plantings that target stormwater interception. These planting locations are city-wide and may represent both public and private properties. Regardless, these priority locations show a significant opportunity to expand tree canopy and improve Akron's urban forest stormwater interception capacity.

Table 10. Locations and Total Area of Planting Opportunities to Maximize Stormwater Benefit within the Public Sector

Priority for Stormwater	Planting Opportunities	
	No. of Locations	Area (acres)
Very Low	10,174	438
Low	12,298	749
Moderate	12,685	608
High	6,125	418
Very High	8,312	299
Total Opportunities	49,594	2,512

Figure 21. Planting priority areas that maximize stormwater interception.

Conclusion

Akron's urban forest is an important community asset that provides numerous environmental benefits. With the appropriate care, Akron's urban forest is expected to increase in value over time as the city embarks on significant efforts to protect and expand its urban forest.

Continue stewardship of the tree infrastructure	Maintain a comprehensive inventory
	Develop and implement a management plan for city-owned trees
	Undergo an operational review of city

Within the six years between the studies of 2011 and 2018, Akron's urban tree canopy has decreased by 1.93%. In the face of climate change, severe weather events, and invasive pests, urban forests are facing more threats than ever before. To increase the urban tree canopy, it is not enough to simply plant trees. Instead, Akron will need to develop a multifaceted approach to expanding tree cover that includes emphasis on tree planting, maintenance, tree preservation, and community outreach and education to develop wide public support for Akron's efforts.

Photograph 3. Trees should be selected to improve species diversity and plant the right tree in the right place. Here, volunteers are planting new trees to a city greenspace during an Arbor Day Event (Stock Photograph).

This analysis was designed to help document Akron's urban forest, quantify the value and benefits that it provides, and develop recommendations for future planting efforts. This study should be considered as a starting point—a place from which to begin conversations and the exploration of opportunities that seek to enhance the city's tree canopy. Based on this analysis, some key recommendations emerge:

- Akron is encouraged to expand its planting palette to include new tree species.
- Many opportunities for impacting Akron's priorities of intercepting stormwater and socioeconomic factors are within core commercial and industrial areas. To meaningfully expand canopy, Akron should explore opportunities to improve infrastructure that supports trees and engage property and business owners in community forestry efforts.

- Planting is only part of the equation to expand tree canopy. Preserving or protecting old established trees can often have a greater impact on urban canopy levels while the newly planted trees are growing. Akron should examine policies to identify any barriers or potential incentives to protecting and expanding tree canopy community wide.
- The prioritized planting plan in this report provides a great starting point for urban greening efforts that will have immediate impacts on managing stormwater and addressing socioeconomic concerns. Akron should use these data to strategically plant trees in a way that provides the greatest community benefits.
- Akron should explore the future tree canopy strategies presented and advocate for adopting a tree planting plan that aligns the city's commitment to increase tree canopy with increased benefits to the community.
- This report represents one way in which these data can be analyzed. With additional datasets or new questions, these data can further be used to help Akron manage its urban forest. Therefore, Akron is encouraged to continue to use these data to analyze additional relationships and connections that can help develop community objectives, understand challenges, and frame management decisions.

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