URBAN FORESTRY MANAGEMENT PLAN

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CITY OF LITTLETON
GROUNDS AND FORESTRY
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Littleton
Colorado

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INTRODUCTION AND OVERVIEW

The City of Littleton is home to about 50,000 people on about 9,000 acres. Urban tree canopy covers approximately 1,700 acres of the city. Approximately 20% of the total land is tree canopy while 36% of is impervious surfaces, like roads, buildings, water and sidewalks.

The City of Littleton is responsible for maintaining approximately 4400 trees on about 80 total acres. Historically, Littleton has not kept detailed records on tree management, nor does it have any official plans in place for past, present, or future. This document is intended to be a working document that will evolve as conditions and resources change. Existing conditions and expected challenges have been compared to develop long term goals for the City of Littleton with associated work plans to support these goals.

In pursuit of producing data in a digestible and equitable form, most of our gathered information in this plan is arranged within 40 neighborhood layers that have also been divided into 10 "general neighborhood" layers. The 10 general neighborhood layers, outlined in red, are: Centennial, Downtown, Goddard, Heritage, Ketring Park, NE Littleton, South, Southwest, Sterne Park, and Trailmark.

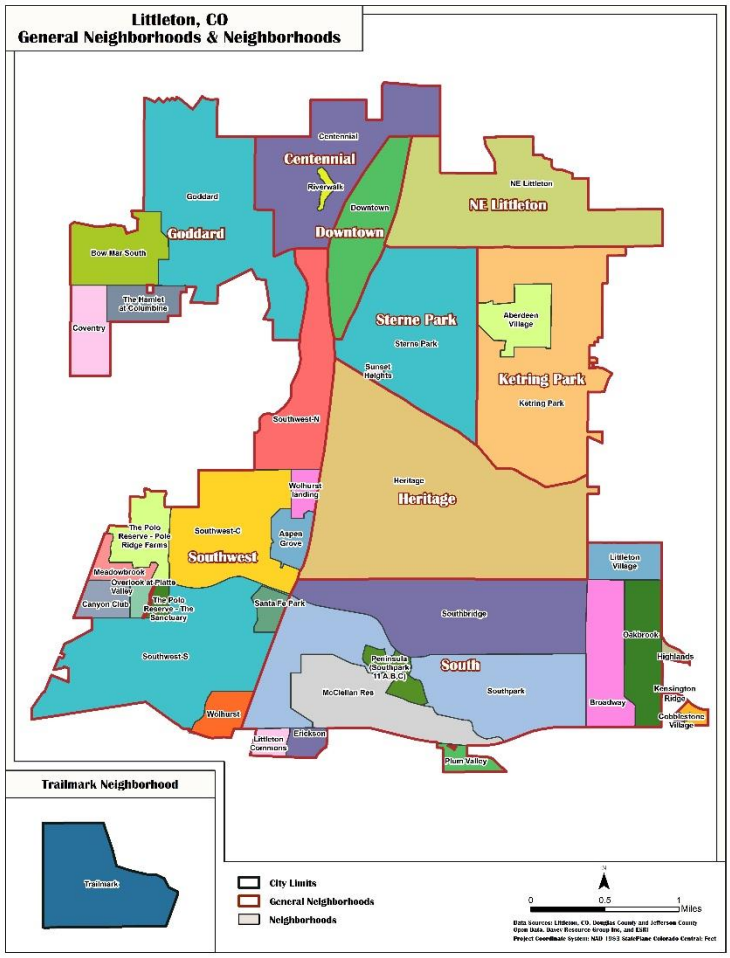


Figure 1. A map showing the 10 general neighborhoods subdivided by the 40 smaller neighborhoods

URBAN FOREST DEFINED

All trees within a municipality or community (on private and public lands) comprise the urban forest. This includes trees in backyards, parks and open spaces, street trees, and commercial land areas.

Urban forestry is a specialized branch of forestry that integrates the art, science, and technology of managing trees and forest resources in and around urban and suburban areas for the psychological, sociological, aesthetic economic, and environmental benefits trees provide society.

Littleton Colorado

FORESTRY DIVISION

The Forestry Division is a branch of the Grounds, Open Space and Natural Resources Division under Public Works. The division was formally established in 2021 after the City of Littleton hired its first City Forester to lead efforts in establishing a vision for the city, developing long term goals and initiate planning efforts. An additional forestry position was approved and established January 2023. This second position aids in decreasing outsourcing from contract workers, promoting proactive mitigation, furthering forestry development, and increasing overall standards of practice.

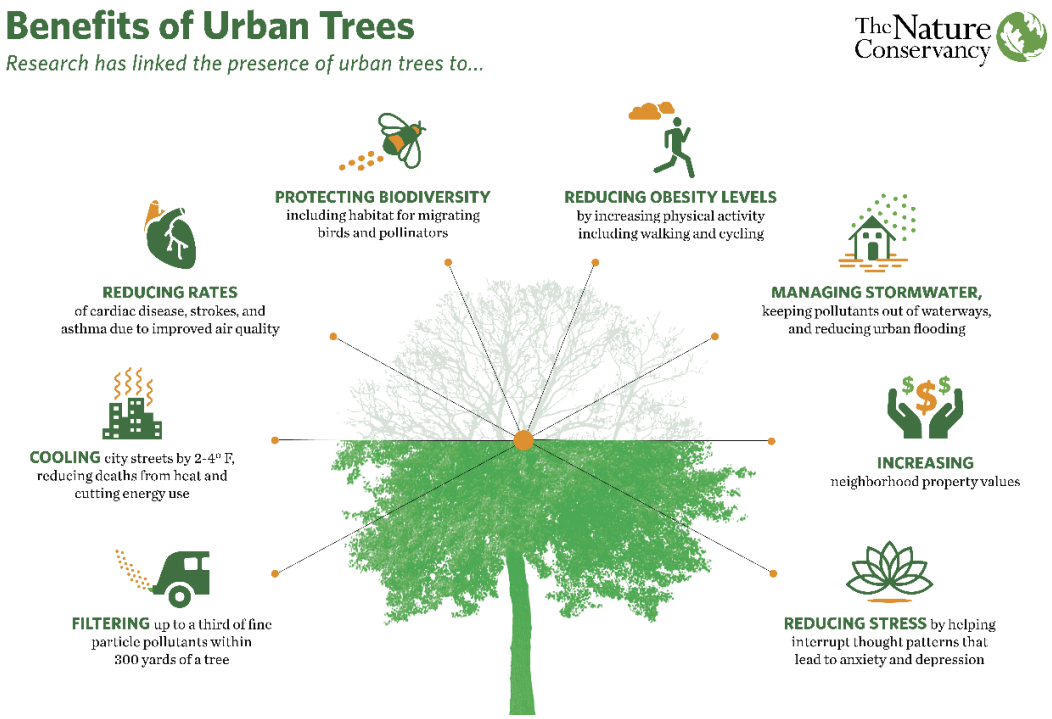
PURPOSE OF PLAN

Urban Forestry Management plans are intended to serve as a guiding document on how to manage trees within City Limits. Managing an urban forest considers economic, environmental, political and social values of the community to develop a comprehensive plan.

The plan will consider what we have, what we want and how get there. There will be an increased focus on defining a sustainable canopy, management within a changing climate, land use planning to fit into the greater community planning efforts and enhancing a canopy that focuses on equitable benefits for all Littleton residents.

BENEFITS OF URBAN TREES

Mature trees provide countless benefits. Environmentally, trees produce oxygen, clean air, help manage storm water, reduce urban heat island effect, and increase pollinator habitat. Socially, trees are directly tied to decreased asthma rates, and are also positively correlated with lower levels of both cardiovascular disease and obesity percentages, and reduced stress rates. Economically, trees increase property values, decrease cooling costs, and, when utilized correctly, can help prolong



infrastructure replacement rates. When properly maintained, trees are the only City asset that increases in value over time.

GOALS AND OBJECTIVES

The main goal of this plan is just that; to have a plan. In comparing the last tree canopy data available for the City of Littleton from 2013 to the study done in 2023, we were able to see areas of concern. In the past 10 years, the City's population has increased about 10% (41,469 to 45,652 people) and it has lost about 5% of its canopy. We can attribute this loss to many natural and anthropogenic forces such as tree planting and removal, development, natural regeneration, storms, insects and diseases. These forces won't go away, but with a comprehensive plan we can set ourselves up for success in supporting and enhancing Littleton's urban tree canopy.

This plan details operational and maintenance plans for our internally managed trees as well as larger strategic plans for the city as a whole with a focus on equity for Littleton residents.

We've collected data to be more intentional with decision making. We've identified the biggest known challenges that the city will be facing over the next 10 years and we've developed short-, mid- and long-term goals to preserve and grow the city's urban tree canopy.

"In the past 10 years, the City's population has increased about 10% and it has lost about 5% of its canopy."

EXISTING CONDITIONS

DATA COLLECTION

Data collection is the foundation of creating any management plan. Two primary sets of data were collected to aid in this plan. First, an internal inventory and risk assessment was done to better understand what the City of Littleton is responsible for and aid in developing an operations and maintenance plan. The second was a citywide canopy study to gain a more comprehensive view of the City and guide long term goals for the larger urban canopy.

INVENTORY AND RISK ASSESSMENT

In August of 2022, the city partnered with PlanIT Geo to conduct a fully inclusive inventory and risk assessment. The inventory included recording the genus, species, GPS points, photos, DSH, and a tree risk assessment for each tree. Data was collected from all of the trees that are maintained by Littleton's Forestry Division. Additionally, data was collected along two sections of the High Line Canal in preparation for the city acquiring those sections for storm water management. The field inspector was a Tree Risk Assessment Qualified (TRAQ) arborist and entered all information directly into the City's asset management system, Cartegraph. The risk assessment was done utilizing Colorado Tree Coalition's (CTC) 6 step measurement method that quantifies each individual tree's score.

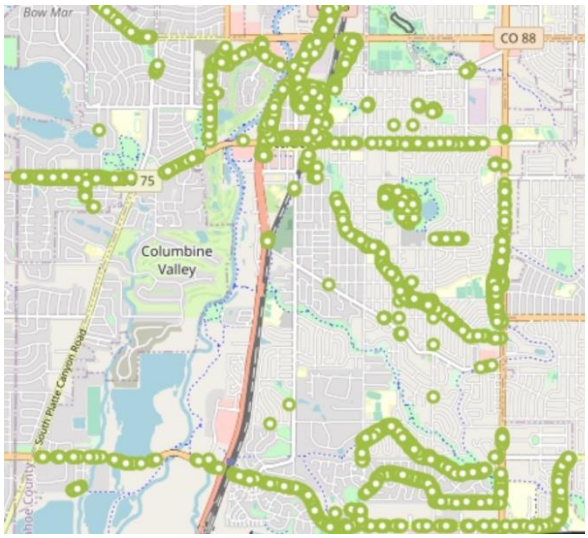


Figure 2. Littleton's trees mapped in Cartegraph

a. The CTC method ranks:
   i. Likelihood of failure – What is the likelihood of the tree failing, i.e., falling over, during normal weather conditions?
   ii. Likelihood of Target Impact – If the tree fails, how likely is it to hit the identified target?
   iii. Consequence of Failure – What degree of personal injury, property damage or disruption would be caused due to tree failing?
   iv. Species - Certain species are naturally more structurally sound than others. I.e., small evergreens such as junipers have a low risk while larger trees prone to internal wood issues such as Cottonwoods have a high risk.
   v. Action - These include removal, hazard mitigation, such as pruning, reevaluate during next inspection or no action recommended.

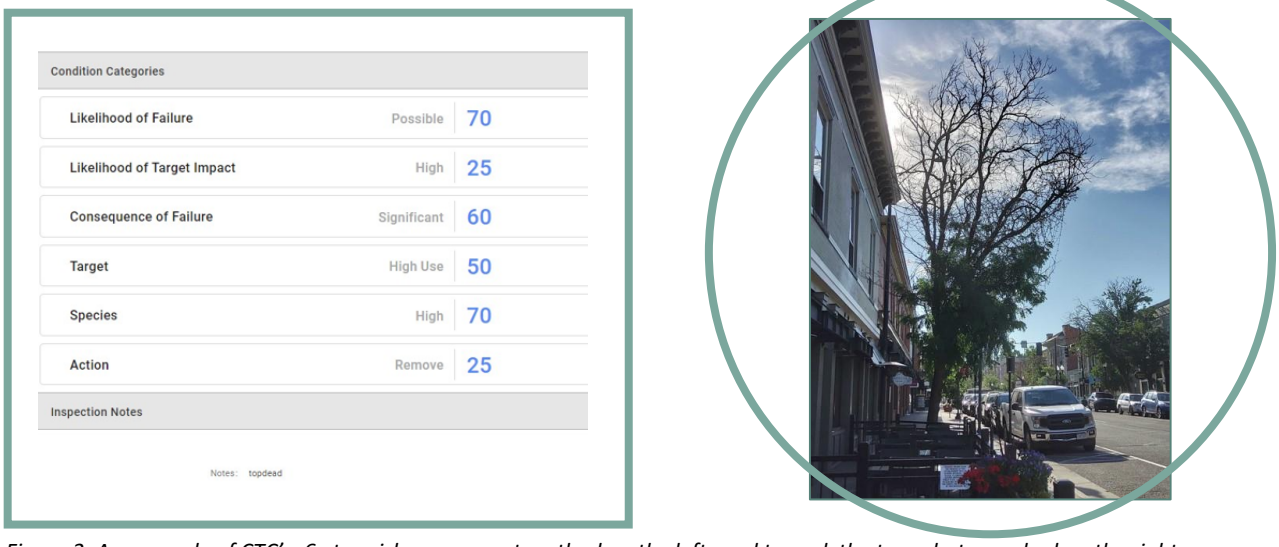


Figure 3. An example of CTC's 6-step risk assessment method on the left used to rank the tree photographed on the right.

Risk Assessment Results: At the end of the assessment, a recommended action is proposed for each tree. These actions are removal, hazard mitigation, re-evaluate during next inspection or no action required. At the time of inventory, the city maintained 4,115 trees. These are the results for our internally maintained trees: 46% of our canopy, or 1893 trees, are recommended for prompt hazard mitigation action. 297 of those trees are immediate removal (7% of total canopy). You will see in the map above, Littleton's trees mapped in Cartegraph, that many our trees fall along thoroughfares. This increases the city's risk when considering potential tree failure and recommended actions. This plan contains a risk reduction strategy that addresses this specific issue.

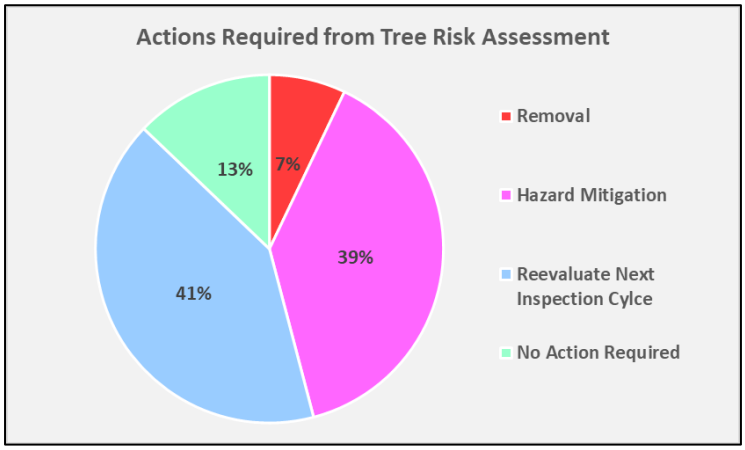


Figure 4. A chart of the recommended actions per the contracted arborist's risk assessment

Inventory Results: The top three genera in Littleton are Fraxinus (Ash), Populus (Cottonwood) and Pinus (Pine), making up over 1/3 of the total trees that the city maintains. This is concerning in that the more diverse the canopy we have, the less unforeseen financial variability we face in the future of pests and disease. This is further addressed in our long-term goals, but for perspective of the inventory results, the city does not want any more than 5% of the same genus. You will see in the chart that "Other" is a large portion (16%) of the whole. This is due to the fact that the city has over 45 different genera and the pie chart would be too small and thus ineffective, if every percentage was visually displayed.

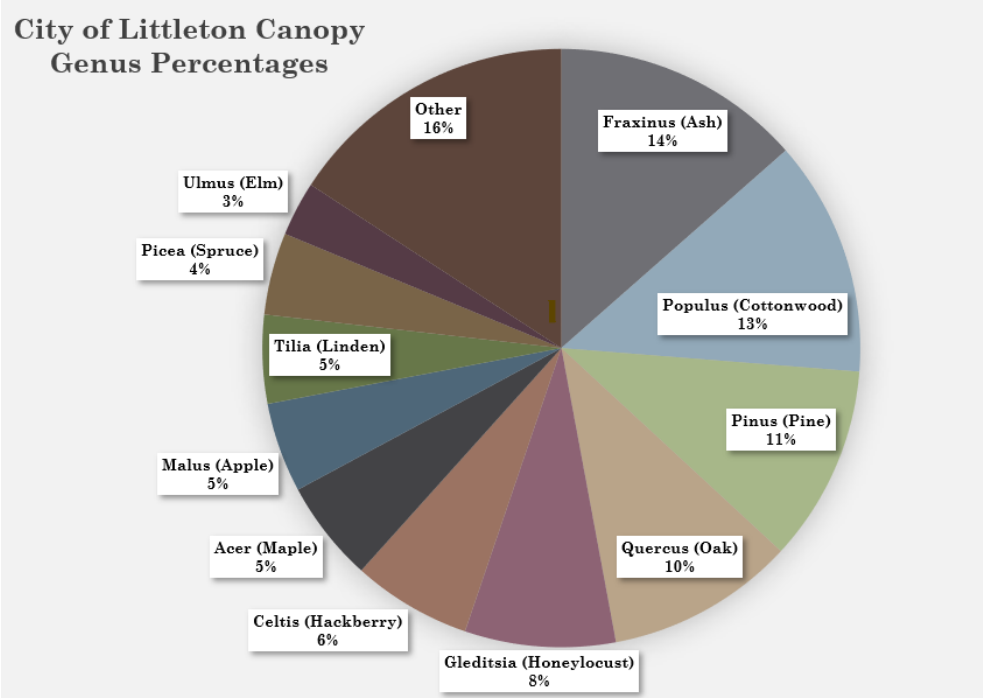


Figure 6. All trees in the City of Littleton divided by genus percentage. Ash, Cottonwood, and Pine make up our top 3 most common species.

CITYWIDE URBAN TREE CANOPY (UTC) ASSESSMENT

Urban Tree Canopy (UTC) assessments were first developed by the U.S. Forest Service in 2006 to understand distribution of tree canopy within cities. The process involves using high-resolution GIS data to create a map of the community's tree canopy that is then overlayed with different data. Early 2023, we contracted Davey Resource Group to conduct an assessment that overlayed tree canopy with four major categories: land cover classification, land use, neighborhood and census block group, and urban heat temperatures. Combing the data from these maps, a socio- economic equity map was formed. This allows us to see a holistic framing of where minority populations are not receiving equal distribution of environmental benefits.

What is 'Tree Canopy'? Collectively, "tree canopy cover" is the footprint or surface area of the land covered by the combined leaves, branches, and trunks of all standing trees in a given area.

The previous data we were working with was from a 2013 Metro Denver Urban Forest Assessment conducted by USDA Forest Service, Pacific Southwest Research. Though the data was a helpful estimated starting point, technology has increased so that we can make greater distinctions. For example, in the 2013 study, tree and shrub cover was combined. However, for the 2023 report, the grass and shrubs are separated from the canopy cover. The new UTC allowed us to customize our preferences so that the city can prioritize environmental equity as well as allowing us to see land cover changes from the past 10 years.

Impervious surface is defined as an area that does not allow rainfall to infiltrate the soil; typically includes buildings, parking lots, and roads.

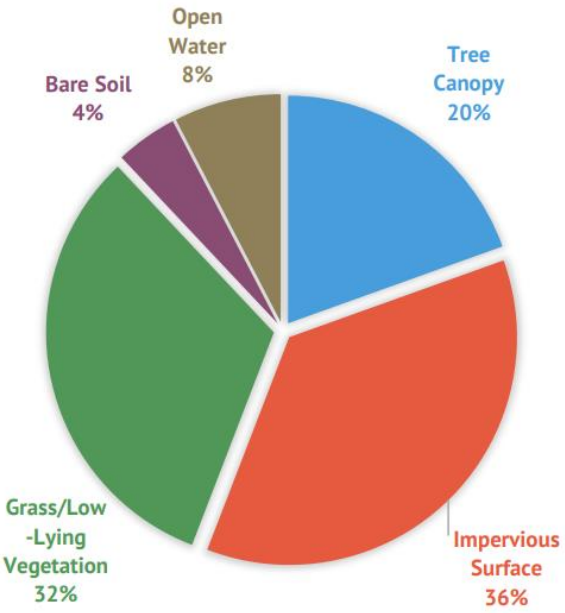


Figure 7. Figure 1. Land Cover Classification in Littleton, CO.

Comparing the Datasets over 10 Years			
2013 Classification Category	**2013 Percentage Results**	**2023 Classification Category**	**2023 Percentage Results**
Trees/ shrubs	25%	Tree Canopy	20%
Grass	24%	Grass and Vegetation	32%
Bare Soil	6%	Bare Soil	4%
Buildings, Roads, other Impervious	37%	Impervious Surfaces	36%
Water	8%	Open Water	8%

Table 1. Comparing land cover classification from the 2013 datasets to the 2023 data.

Land Cover Classification- Land cover identifies the physical land type. It is the baseline of the analyses in which the other classifications rely.

Residential areas make up the largest land use category in the city covering 37.3% of the land. This land use also has the highest tree canopy percentage at 31.6%. The second highest percentage of canopy exists on land classified as **Park/Recreation**, with 15.2% canopy (17.8% of total acreage). The lowest percentage of canopy exists on land classified as **Industrial/Utility**, 6.7%, and **Commercial**, 8.6%. Generally, parks

tend to be the highest representors of tree canopy, but an important note when analyzing Littleton's **Park/Recreation** data is the considerable amount of **open water**, which covers 28.6% of its land. While the Platte River contains its own ecological benefits, there is a relatively high percentage grass/low-lying vegetation (42.9%) which can provide tree planting opportunities.

Land Use	Total Land		Land Cover Classification Percent				
	Acres	Percent	Tree Canopy	Impervious Surface	Grass/Low-Lying Vegetation	Bare Soil	Open Water
Residential	3,280	37.3%	31.6%	31.7%	34.3%	2.1%	0.3%
Park/Recreation	1,564	17.8%	15.2%	4.9%	42.9%	8.3%	28.6%
Transportation	1,519	17.3%	11.7%	70.6%	14.6%	2.9%	0.2%
Vacant/Agricultural	948	10.8%	12.9%	6.3%	51.1%	7.9%	21.9%
Commercial	632	7.2%	8.6%	72.2%	14.7%	4.4%	0.01%
Institutional	411	4.7%	11.7%	51.7%	31.5%	4.9%	0.1%
Mixed Use	307	3.5%	10.3%	60.6%	23.7%	5.4%	0.00%
Industrial/Utility	136	1.5%	6.7%	66.6%	21.5%	4.5%	0.8%

Table 2. Charting out land use cover from greatest percentage to least percentage.

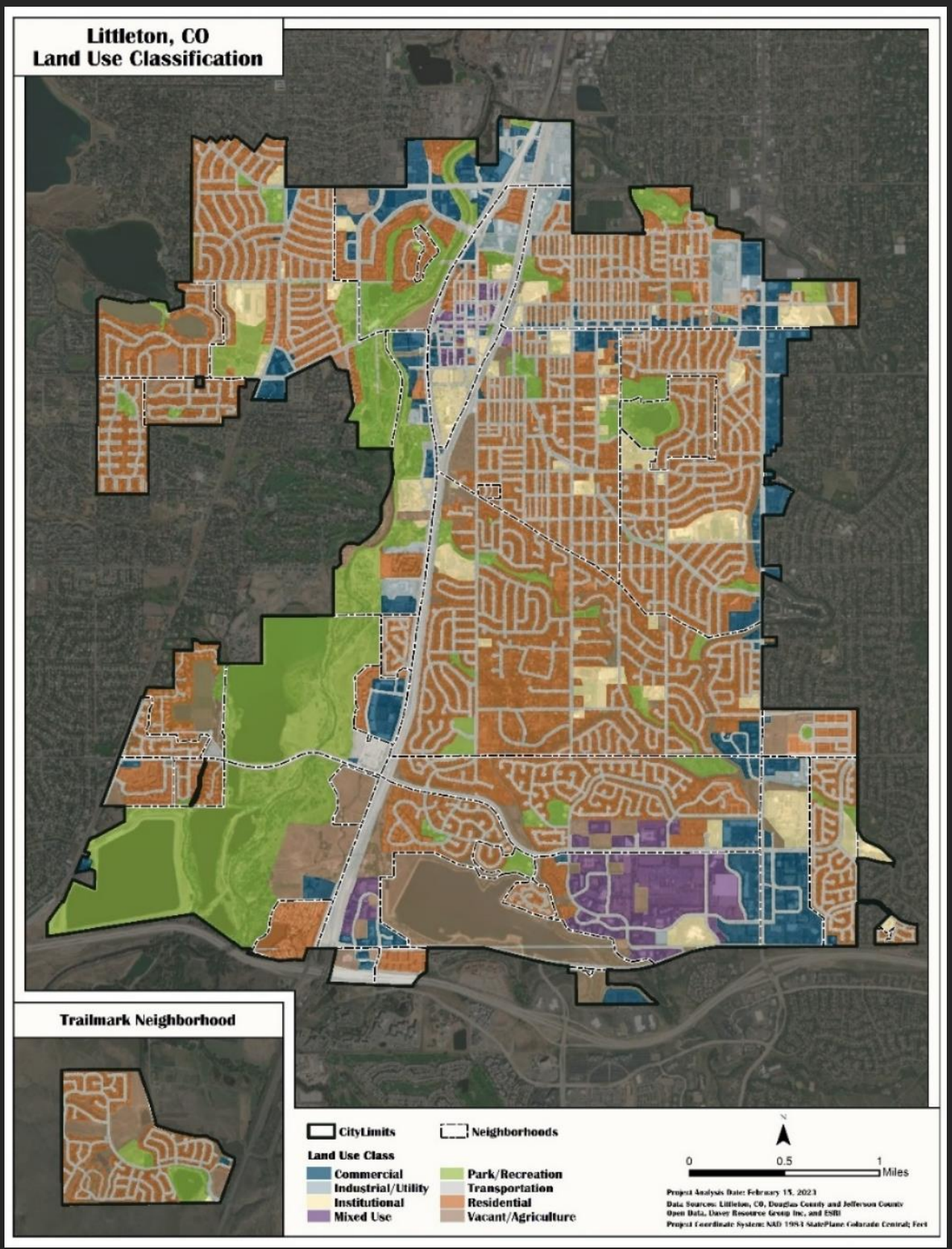


Figure 8. Figure 5. A map of Land Use Classification in Littleton. Residential (orange) makes up the largest amount while Industrial (beige) makes us the smallest percent.

Tree Canopy by Neighborhood- the City's GIS team created a neighborhood layer for us to use displaying data. This allows us to distribute data in familiar form while, hopefully, encouraging neighborhood pride! There was much discourse around the way data was to be presented - council districts felt too political, census blocks felt impersonal, but neighborhood names are already familiar and doesn't allow room for any biases. As mentioned in the introduction, we created 40 neighborhood layers that have also been divided into 10 "general neighborhood" layers. The 10 general neighborhood layers, outlined in red, are: Centennial, Downtown, Goddard, Heritage, Ketring Park, NE Littleton, South, Southwest, Sterne Park, and Trailmark. The table below shows the 40 neighborhoods listed from greatest to least amount of tree canopy cover. It shows Coventry (38.0%), Sunset Heights (37.4%), and The Hamlet at Columbine (35.0%) with the highest tree canopy. The lowest tree canopy is found in Erickson (1.4%), Littleton Village (0.3%), and Littleton Commons (0.2%).

Tree Canopy Percent by Neighborhoods			
Neighborhood	Total Land		Tree Canopy Percent
	Acres	Percent	
Coventry	102	1.2%	38.0%
Sunset Heights	5	0.1%	37.4%
The Hamlet at Columbine	76	0.9%	35.0%
The Polo Reserve - The Sanctuary	19	0.2%	33.7%
Heritage	1174	13.3%	31.5%
Oakbrook	152	1.7%	30.5%
Overlook at Platte Valley	21	0.2%	28.6%
Aberdeen Village	110	1.2%	27.4%
Bow Mar South	171	1.9%	26.5%
Sterne Park	559	6.4%	26.0%
Peninsula (Southpark 11 A,B,C)	47	0.5%	25.1%
Ketring Park	696	7.9%	25.0%
The Polo Reserve - Pole Ridge Farms	109	1.2%	24.5%
Riverwalk	10	0.1%	23.9%
Southbridge	520	5.9%	23.4%
Meadowbrook	41	0.5%	23.3%
Kensington Ridge	15	0.2%	22.6%
Southpark	245	2.8%	22.0%

Cobblestone Village	4	0.0%	20.9%
NE Littleton	585	6.7%	19.7%
Goddard	643	7.3%	19.5%
Wolhurst landing	36	0.4%	16.3%
Southwest-N	268	3.1%	14.9%
Plum Valley	34	0.4%	14.2%
Wolhurst	58	0.7%	13.8%
Broadway	174	2.0%	12.9%
Southpark	356	4.0%	12.9%
Southwest-S	619	7.0%	12.4%
Downtown	237	2.7%	11.0%
Trailmark	344	3.9%	10.7%
Canyon Club	55	0.6%	10.2%
Highlands	10	0.1%	9.4%
Aspen Grove	59	0.7%	8.6%
Centennial	448	5.1%	7.6%
Southwest-C	349	4.0%	7.0%
McClellan Res	269	3.1%	6.8%
Santa Fe Park	35	0.4%	4.1%
Erickson	32	0.4%	1.4%
Littleton Village	81	0.9%	0.3%
Littleton Commons	28	0.3%	0.2%

At a visual level, the following map, Canopy Percentage by Neighborhood, shows, higher percentages of tree canopy (darker blue) are seen in the northwestern, central, and southeastern neighborhoods and respective block groups. The lowest level of canopy cover (lightest blue/white) is located on the central north, smaller southeastern, and eastern border neighborhoods, and block groups. Similar census block group and neighborhood relationships will be explored in the Socio-Economic Equity Analysis section.

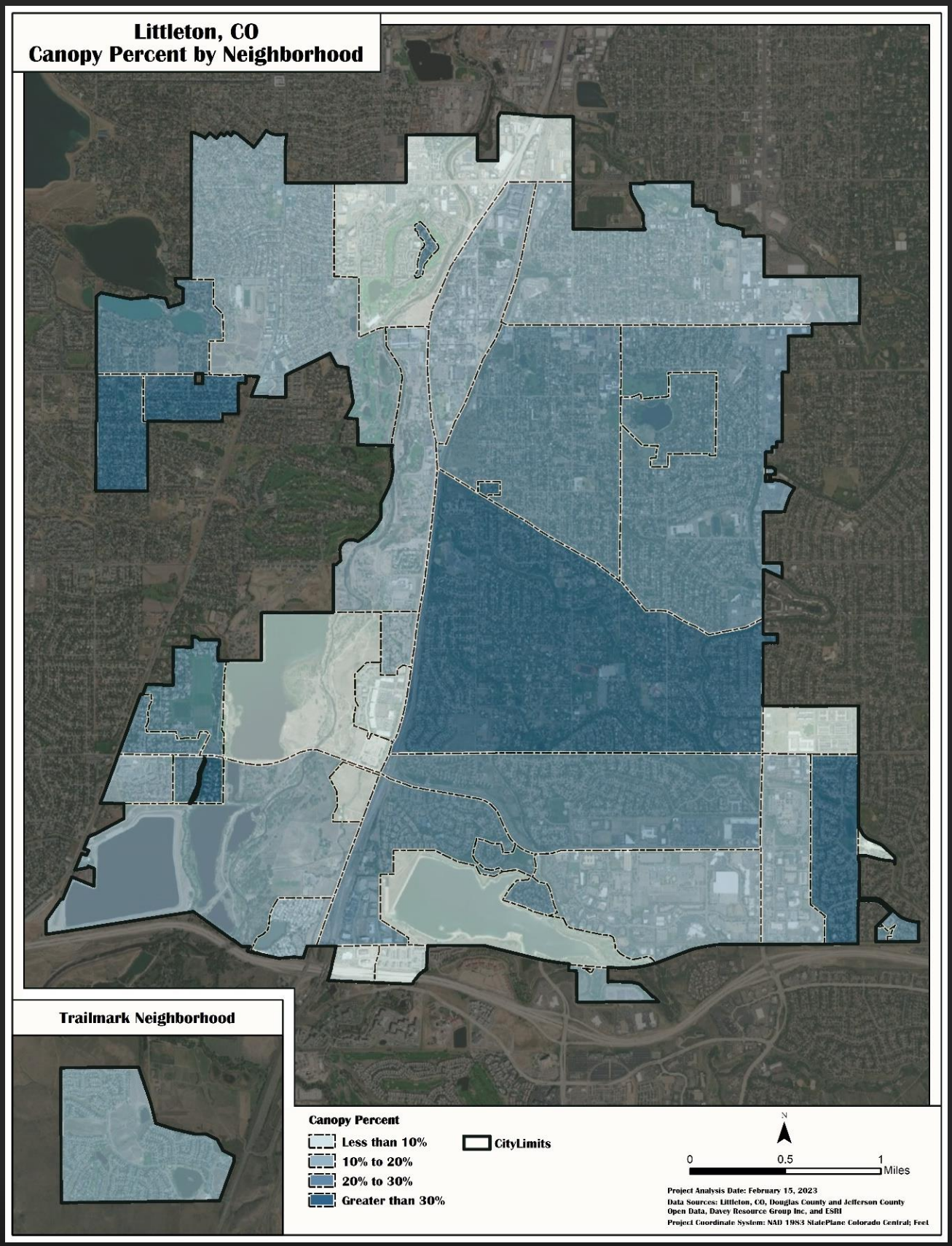


Figure 9. A map of canopy percent by neighborhood. The darker the blue, the denser the canopy cover.

Land Surface Temperature by Neighborhood- Heat islands are urbanized areas that experience higher temperatures than outlying areas. Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies. Research has found that urban heat island (UHI) effect is largely due to the removal and replacement of tree canopy with impervious surfaces. Heat related illnesses cause more deaths than any other natural disaster each year in the US (Anderson 2011) and the shade from trees has been shown to reduce summer temperatures by 2°F to 9°F (EPA).

"Heat related illnesses cause more deaths than any other natural disaster each year."

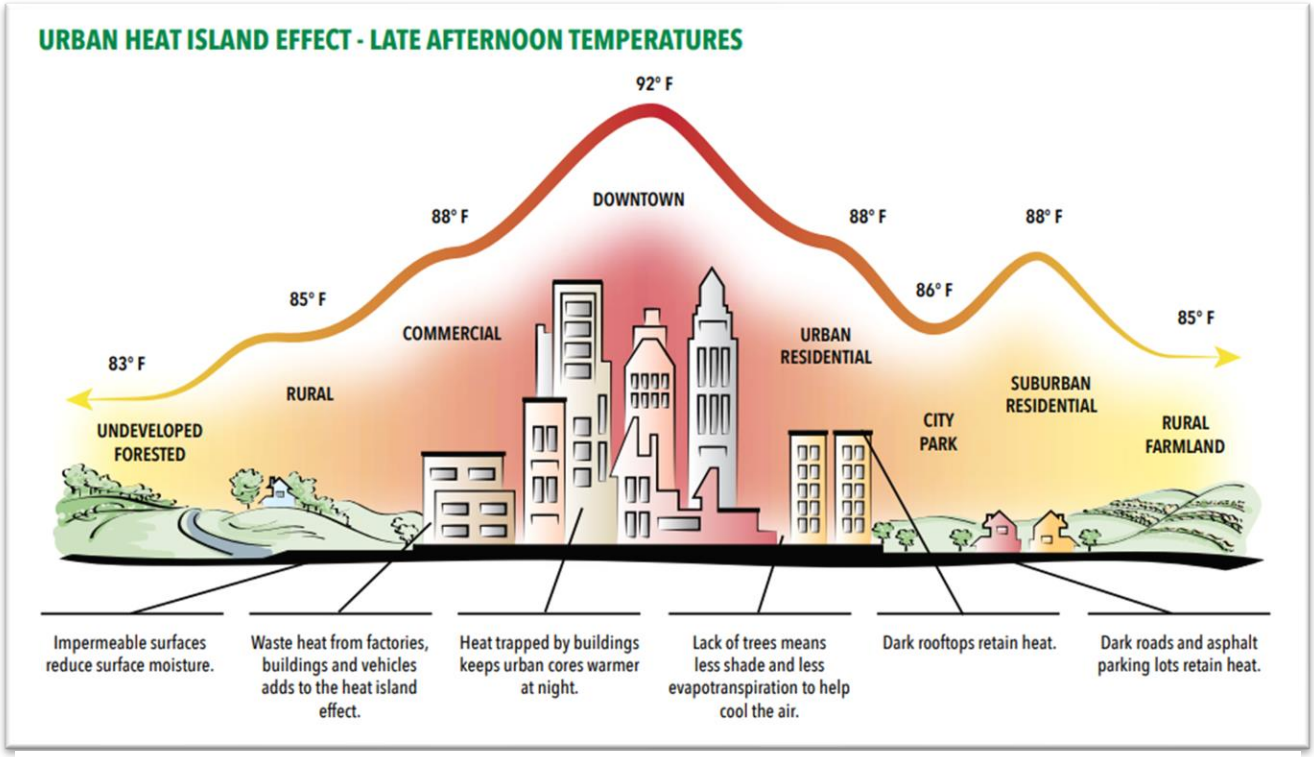


Figure 10. A visual example of the urban heat island effect

Using a surface temperature analysis in conjunction with the tree canopy analysis further identify areas of Littleton that are currently suffering from the UHI effect and need attention. The highest average temperature observed was 91.8°F in Aspen Grove, while the lowest was at the McLellan Reservoir at 78.3°F. The average temperature across all neighborhoods was 87.7°F

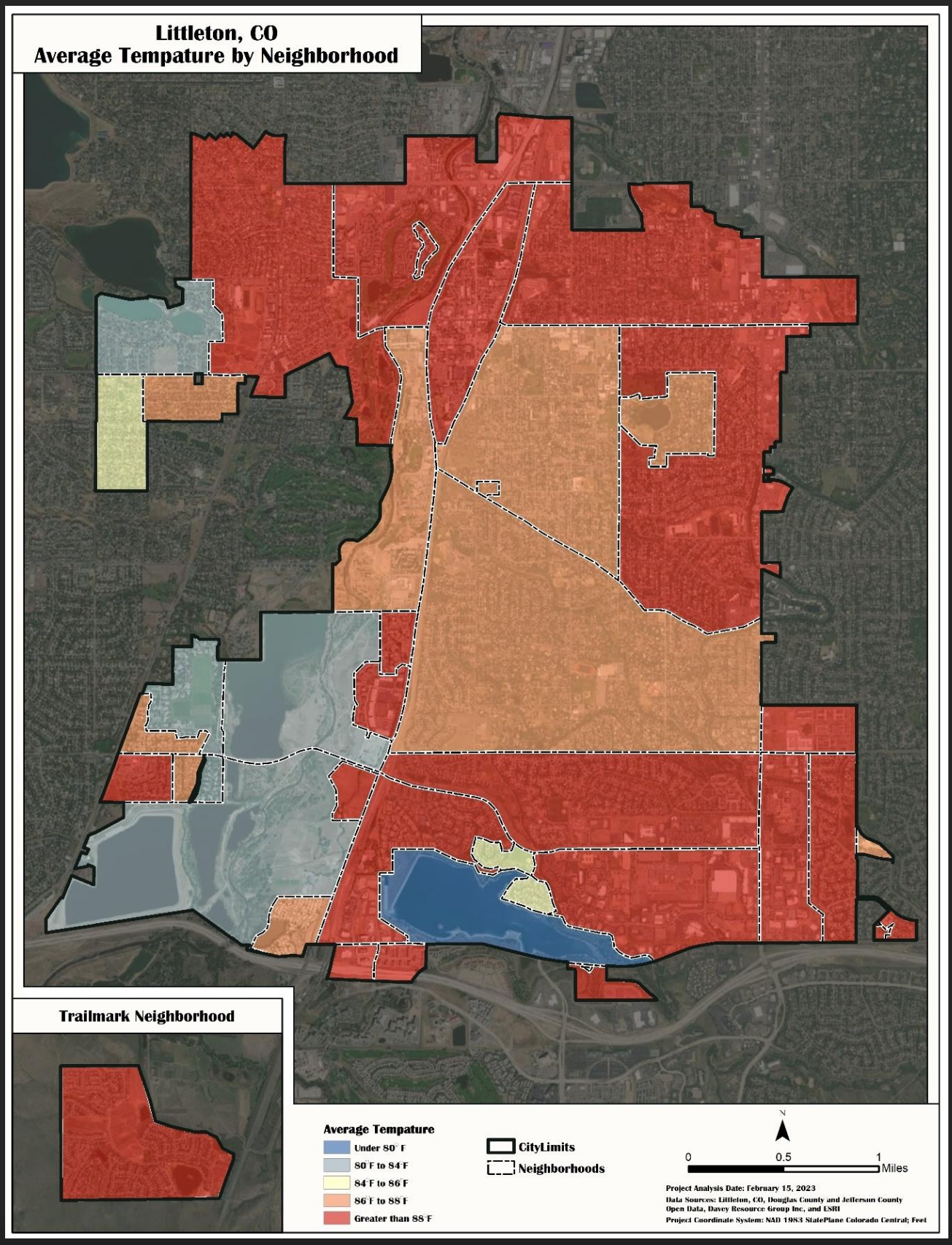


Figure 11. A map of the average surface temperature by neighborhood. The red areas are hot spots, or "urban heat islands." This map is in direct correlation with canopy cover percentages.

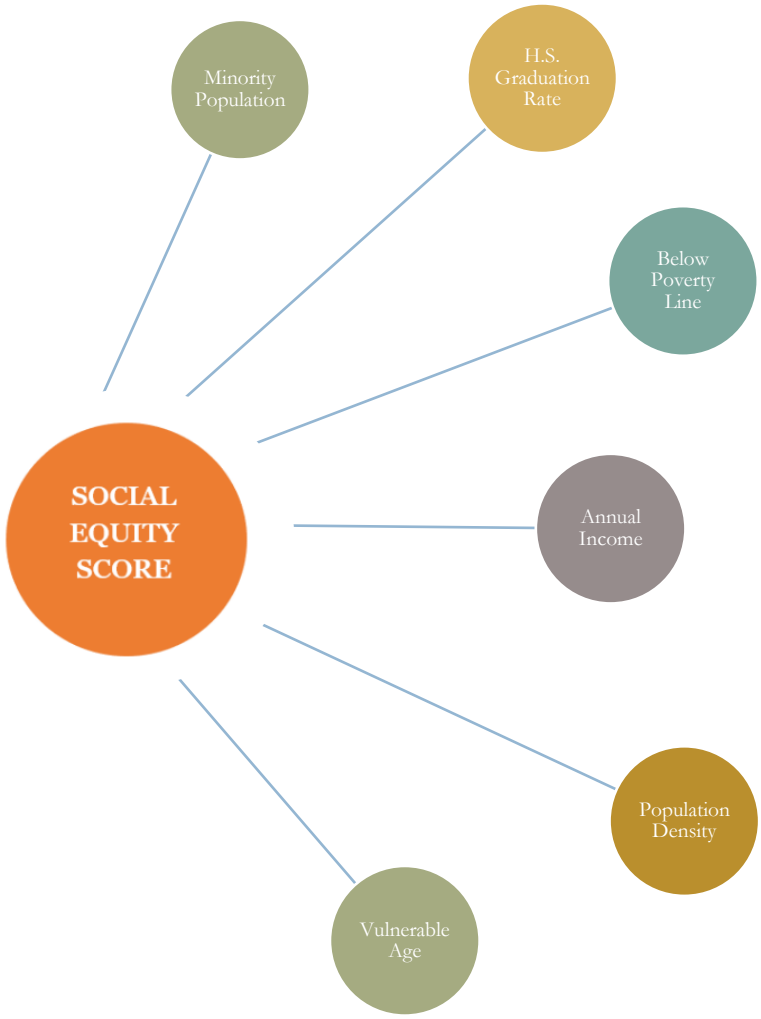
Social Equity Index and Canopy Percent by Census Block Group- These results will be further addressed in the Tree Equity section of the plan. For now, we want to provide analysis of how the data was collected and quantified. This data is not displayed within the neighborhood layers because the factors involved in creating the index score required public census data. With concern of unfairly blurring the boundaries lines, we decided to keep the data in its raw form, which is the census block groups.

An analysis of the 2021 urban tree canopy cover data was conducted to see how it related to a variety of socioeconomic factors. While some of these factors are correlated with tree canopy cover, correlation does not necessarily equal causation. The factors include Minority Population, High School Graduation Rate, Families Below Poverty, Median Annual Income Level, Population Density, Renter Occupied Percentages, Vulnerable Age Class (Under 17 years old and 65 and over)

The data from these factors were combined to create a composite social equity score (0=low need, 4=high need) for each census block group. We The equity scores were mapped along with tree canopy cover data to identify the census block groups with the highest need for tree canopy cover.

The higher the number, greater the citizen's need. Dark blue areas are indicative of a high social equity need and low tree canopy. Dark orange indicates areas that have a low need with a high observed tree canopy. Green areas represent those with a high need and high canopy suitable to meet that need. Gray areas show a low need and low canopy level.

This allows us to focus our efforts visually. We will prioritize work starting in the dark blue areas with high equity scores.



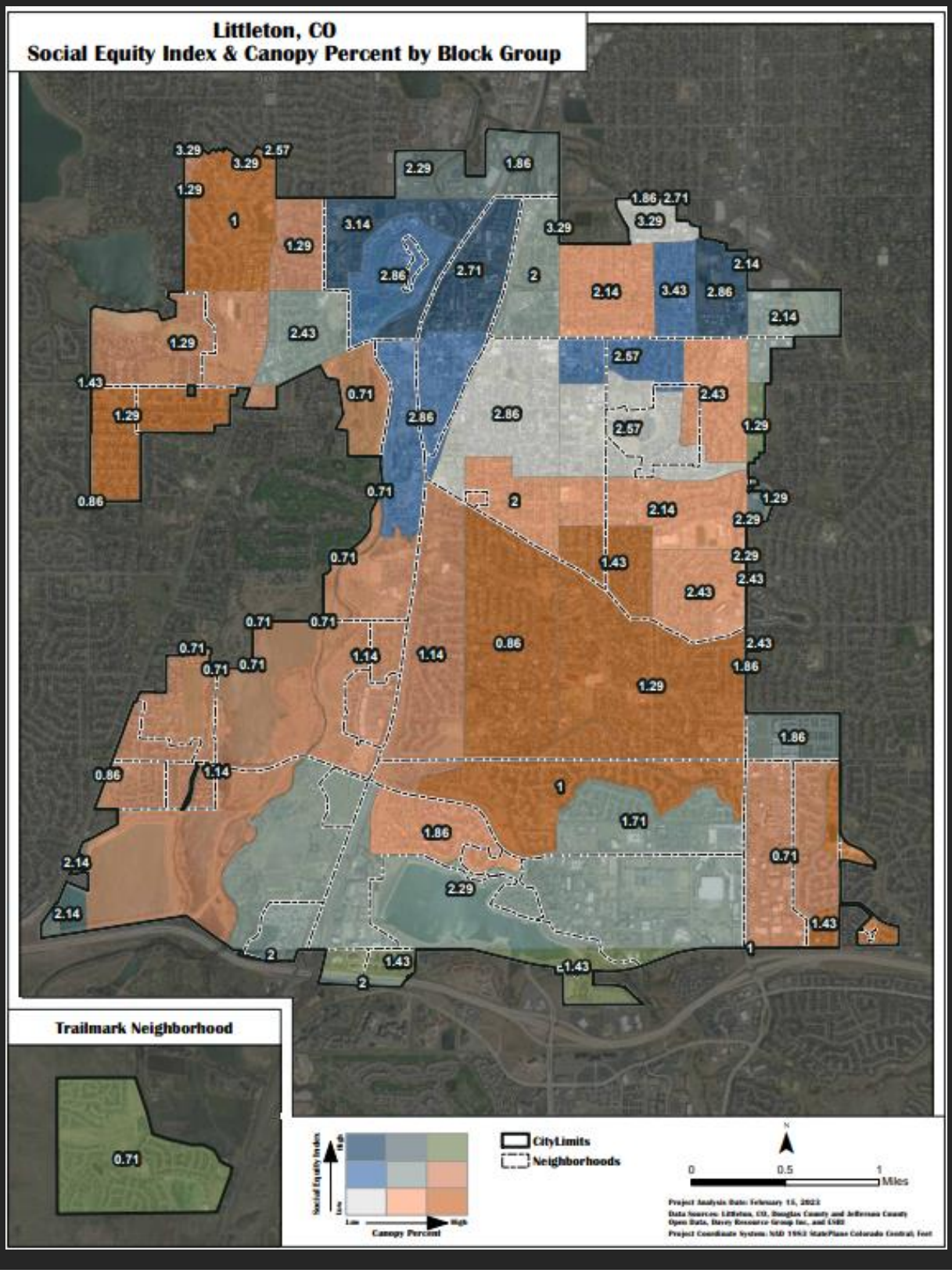


Figure 12. Figure 5. A map ranking social equity index scores in comparison to canopy cover percentages. The higher the number value, the higher the need. Blue equals high need with low canopy (areas of focus for the City), Orange equals low need with high canopy

TREE EQUITY

WHAT IS "TREE EQUITY" AND WHY DOES IT MATTER?

The non-profit group, American Forests, defines tree equity as having enough trees in an area so that everyone can experience the health, climate and economic benefits. Tree equity is simply ensuring trees are in every part of the city rather than centralized around wealth.

We have already discussed many of the benefits of a healthy urban copy. Tree equity acknowledges that trees in cities provide health, employment and climate resiliency benefits that everyone should have equal access to. Research has shown that trees provide important benefits to neighborhoods, from cooling the environment to improving physical health (Ulmer et al., 2016; Roe et al., 2013) and making communities safer (Troy et al., 2012). All too often maps of canopy cove in cities nationwide is just a map of income and race. Littleton is not the exception, yet.

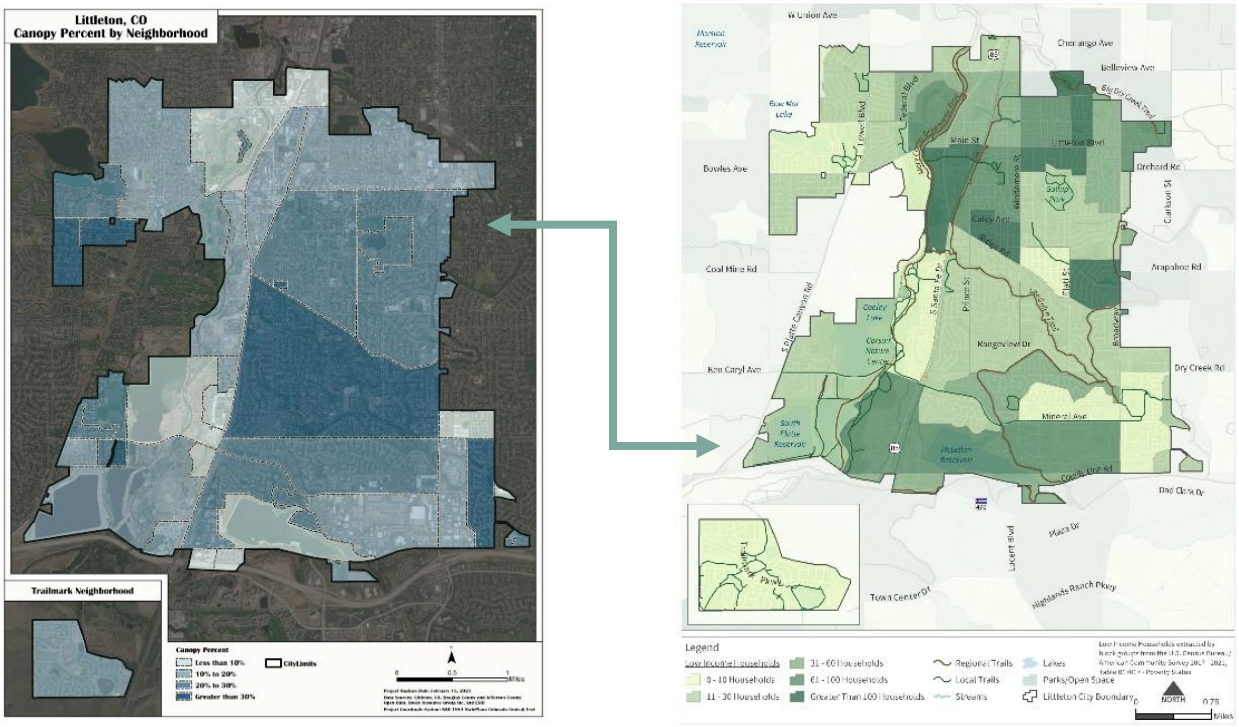


Figure 13. Tree canopy map (left) showing the darker the blue, the denser the canopy. Low-income household map (right) showing the darker the green, the greater the concentration of low-income families.

Comparing the two maps, we see a direct correlation of low canopy to low income.

UNDER-RESOURCED NEIGHBORHOODS

Environmental inequities are finally, getting formal attention. This is primarily due to increased data collection and mapping the results in an easily digestible form. The trend in North American is grossly unbalanced, Littleton is no exception. Comparably, trees are more limited in socioeconomically disadvantaged neighborhoods of color and more abundant in wealthier, whiter neighborhoods. As with most issues, causation is multi-faceted and dependent on the local culture and history. However, our nation wholly shares one overt contribution to the issue of tree inequity: former redlining policies. Redlining was an unethical practice that put financial and other services out of reach for entire neighborhoods where people of color lived. A 2021 study shows that formerly redlined neighborhoods have a notably lower canopy percentage compared to those that were never redlines (Locke, et. all, 2021).

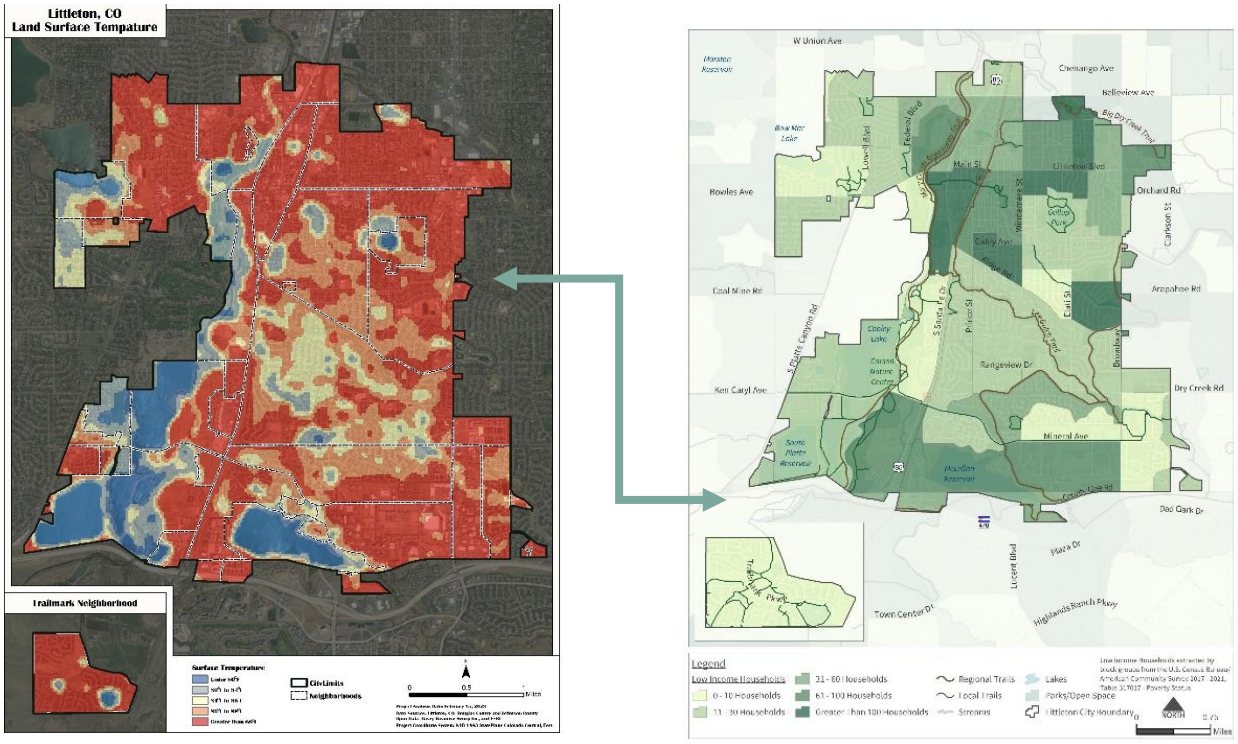


Figure 14. Summer heat island effect map (left) showing the hotter the area, the darker the red. Low-income household map (right) showing the darker the green, the greater the concentration of low-income families.

QUANTIFYING TREE EQUITY

American Foresters, a non- profit organization, has created a public Tree Equity Score interactive map: https://www.treeequityscore.org/. Each score indicates whether there are enough trees in a neighborhood for everyone to experience the health, economic and climate benefits that trees provide. Scores are based on tree canopy, surface temperature, income, employment, race, age and health factors. A 0-to-100-point system makes it easy to understand how a community fares. In the scheme of Denver metro region, the City of Littleton is scoring fairly high at 94! For comparison, the City of Denver's score is 88 and the City of Westminster is 77. The map below shows the shading for all of included cities in the Front Range. Green is higher scoring (good) whereas orange is low scoring (bad). The zoomed in map is looking at one of Littleton's low-ranking areas. As you zoom into the map you can see that block group's exact ranking number and demographic matrix. In this example, the neighborhood scores a 75 whereas our entire city's average is 94.

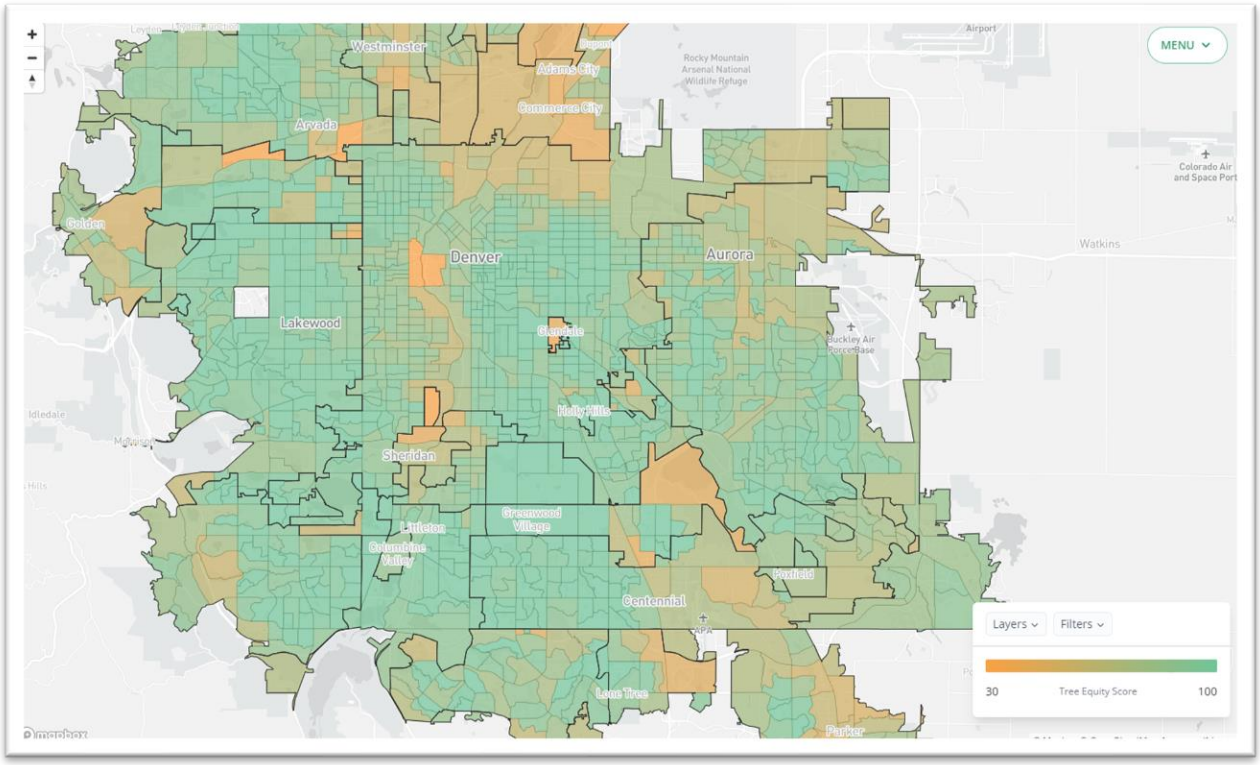


Figure 15. Mapping the tree equity scores in Denver metro. Orange is low scoring, green is high scoring

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Considering all of Denver metro, the City of Littleton is scoring high on the tree equity charts at 94!

Comparatively, the City of Denver's score is 88 and the City of Westminster is 77.

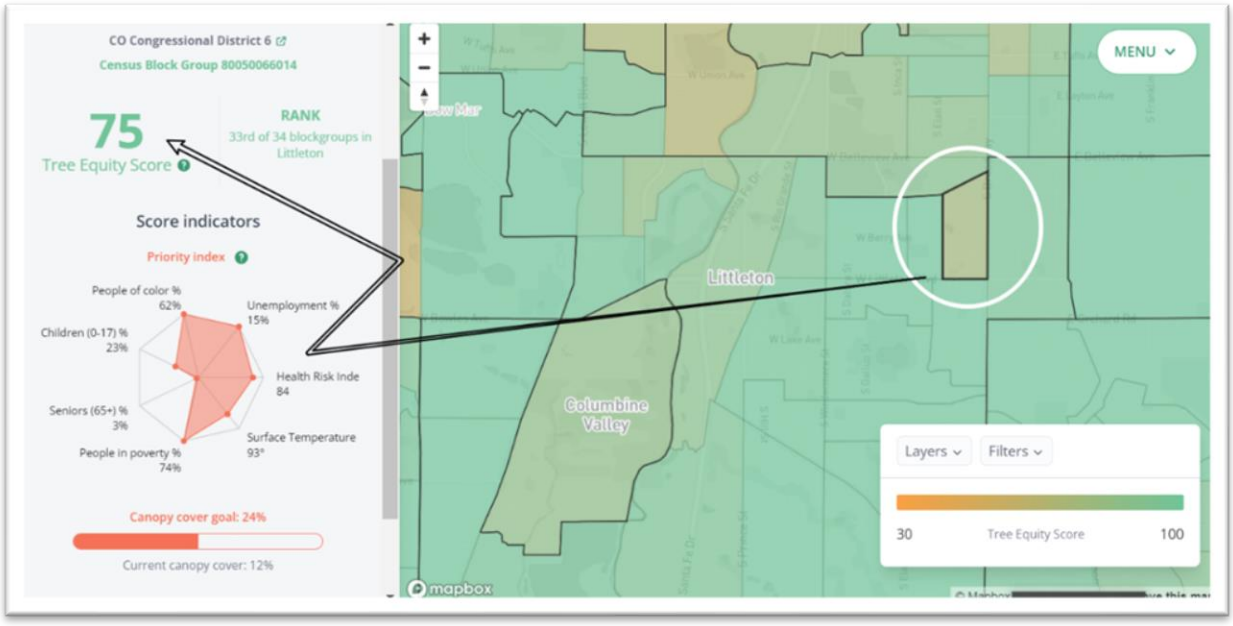


Figure 16. A zoomed in photo from the tree equity map. Looking at one of Littleton's neighborhoods of greatest need, scoring only a 75. Littleton's average is 94.

Planting and preserving trees in areas with low equity index scores is the most thoughtful way a municipality can increase their general tree canopy. Increasing tree equity scores takes time, money, and trust. Given the historically disproportionately less number of services, there is work involved on mending understandable hesitancies and showing that local government is here to listen to what communities need and want. To be successful, we need to lead with listening and follow up with program and polices changes that address those heard needs.

> ***Tree Ambassador Program***: One way to increase community cohesion and support is contracting a "tree ambassador" program. A Tree Ambassador Program is rooted in the simple idea that to close the urban canopy equity gap, governments must center the voices of people most impacted by this systemic inequity. This program is one example of a way to support community-led urban forestry efforts and compensate local-level, community education. The City of Littleton is applying for a grant in through the CO State Forest Service, funded by the Inflation Reduction Act, in 2023 in hopes of beginning a Tree Ambassador Program within our city.

URBAN FOREST GOALS AND STRATEGIC PLAN

Before laying out the City's long term forestry goals, it is important to review some of the immediate challenges that we will be facing amidst our efforts. Given the data we have received overlayed with historical trends, we believe that without intentional efforts the city could lose up to 10% of its existing canopy over the next ten years. Though this is projection is avoidable, there are some notable challenges on the horizon that we will need to overcome in order to sustain and start growing the urban canopy.

EXPECTED CHALLENGES

- ***EMERALD ASH BORER (EAB)***

What is the Emerald Ash Borer (EAB)? Emerald Ash Borer (*Agrilus planipennis* Fairmaire) is a devastating boring beetle that was first detected in Michigan (2002) and has since rapidly spread throughout much of the U.S. and Canada.

Background of EAB in Colorado. The emerald ash borer (EAB) has currently spread into 35 states, Colorado being the west most. It was first detected in Boulder (2013) due to the careless moving of firewood from a contaminated region. It has since spread north as far as Fort Collins and as far south as Arvada. Though the City of Littleton has not yet detected the borer, we actively prioritizing strategy options to sustainably protect our urban canopy. The extent and spread of the beetle continue to be monitored closely by Colorado State Department of Agriculture, Colorado State Forest Service, CSU extension and surrounding Front Range communities.

Ash Trees in Colorado: Ash trees are a huge part of the urban tree canopy throughout the Front Range. Ash (Fraxinus spp.) are estimated to make up 15%-20% of all trees in urban communities on the Front Range. They had proven to be a very hardy tree selection for harsh urban environments as well as tolerating our typical periods of drought. Additionally, ash species have naturalized here and can sometimes be found growing in open spaces and natural areas.

Ash Trees in Littleton: The City of Littleton currently maintains about 720 ash trees. 250 of those are on the Highline Canal and were not involved in the EAB management plan. From our 470 targeted trees, we plan to treat about 1/3 (150) of our ash trees in maintained areas. We expect EAB to reach the City of Littleton in the next 1-3 years. An internal EAB plan has already been developed and implemented. The City of Littleton plans to conduct a combination of chemical treatment, via systemic trunk injections, alongside a preemptive removal and replacement strategy. The goal is to preserve 1/3 of our healthiest ash population by chemical treatment. This totals to treating about 150 trees.

	Total Number	Estimated Cost Per Year	Total Estimated Costs by 2030
Current Ash	**470**		
Ash to be Treated	150	$9,000 / yr.	$72,000
Ash to be Removed	420	$50,000 / yr. for 8 years OR $100,000 / yr. for 4 years *rate depends on pest's aggression in C.O.L.	$400,000
New Trees to be Planted	50 / yr.	$10,000 / yr.	$80,000
Water Costs for Newly Planted Trees	50 / yr.	$5,000 / yr.	$40,000

Table 3. Estimated costs for Littleton treating 1/3 of the healthiest ash trees

- ***HIGHLINE CANAL (HLC)***

Littleton has taken responsibility of about 2 miles of HLC so far. These 2 miles contain about 870 trees that are 10in diameter at standard heigh (DSH) or greater. The High Line Canal serves primarily as a floodwater conveyance and is dry most of the year. Waters that trees relied upon no longer exist, hastening the decline and demise of many of the cottonwood, willow, and Siberian elm. Throughout this stretch, the only supplemental water that the indigenous trees may receive is runoff from landscape irrigation. There is little recruitment of the indigenous pioneer tree species. In canopy openings, successional species including elm, ash and hackberry are naturalizing. New

trees are being planted and regularly watered. With the aging canopy and lack of water, the trees will continue to decline. We are exploring an irrigation pilot program.

In partnership with the Canal Collaborative, the city has data on all the current and future Littleton stretches of the Highline Canal. SavATree was authorized to perform tree risk assessments along 55 miles of the High Line Canal. The Littleton reach is 3.71 miles long and with 929 trees inventoried. SavATree conducted risk assessments on all trees 12 inches in diameter and greater at standard height (DSH) within the 100-foot-wide Canal right-of-way using the Colorado Tree Coalition (CTC) tree risk management protocol. The assessments included categorizing trees into: High Bank Frame, Canal, Low Bank Frame, Trail, and Shoulder Frame and providing mitigation recommendations where necessary for each tree. Each tree risk assessment resulted in a recommended action. There were 526 trees recommended for reevaluation next inspection cycle, 14 recommended for reevaluation next growing season, 230 recommended for mitigation, and 159 trees recommended for removal (see chart).

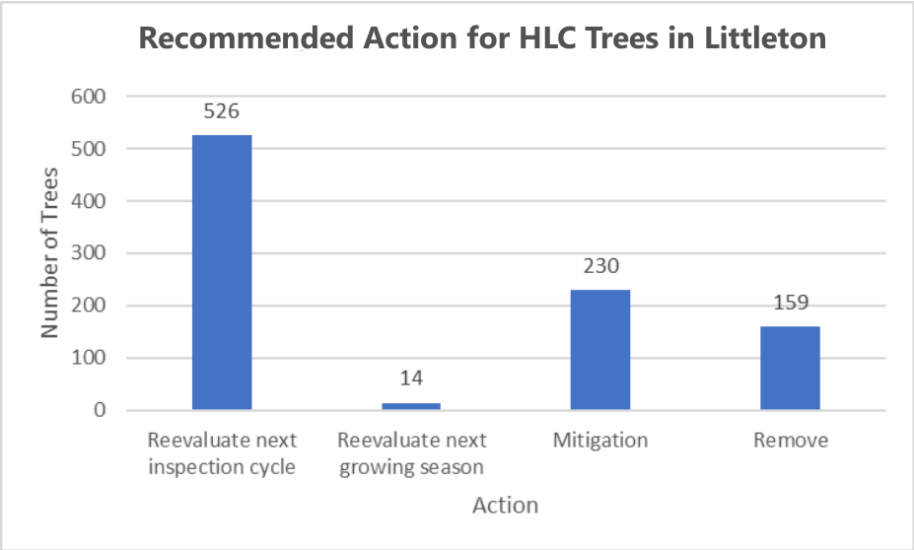


Figure 17 18. A chart of the arborist's recommended work to conduct on the HLC. 389 total trees requiting work.

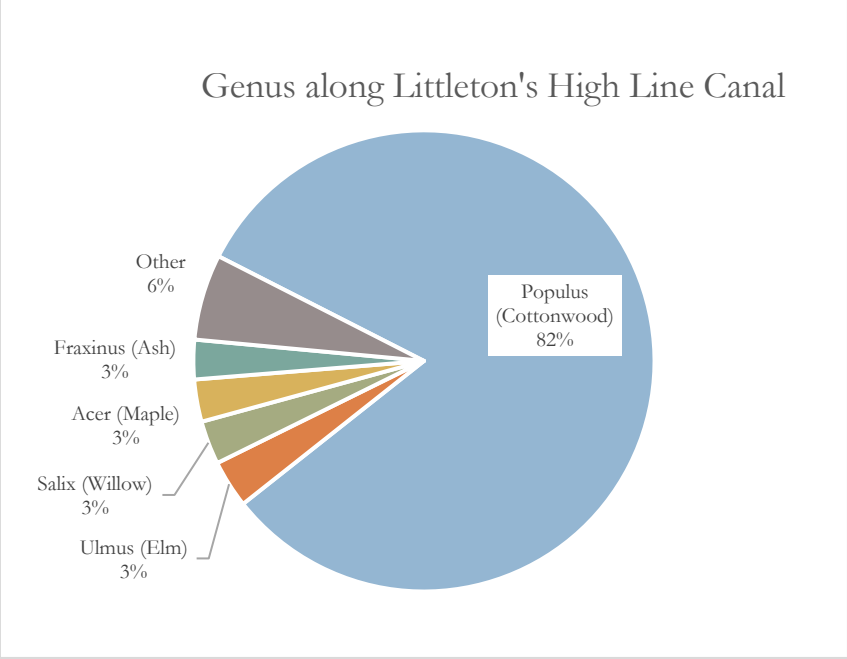


Figure 17

Lack of Species Diversity along the Highline Canal: Cottonwood trees make up 82% of our stretch of the HLC. Cottonwoods are vulnerable to drought, which leads to crown dieback and eventually death. Jacobi et al. (2017) conducted a long-term study on the HLC plains cottonwoods between 1997 and 2008. Findings concluded that plains cottonwood are relatively resilient to a single year drought. Moderately stressed trees can withstand considerable crown dieback (25%- 40%) and may recover the year after drought if sufficient water is available in the following year(s). However, it appeared that many mature cottonwoods along the canal were in decline

due to multiple years of successive drought that significantly affected tree health and will continue to do so in the future without mitigation.

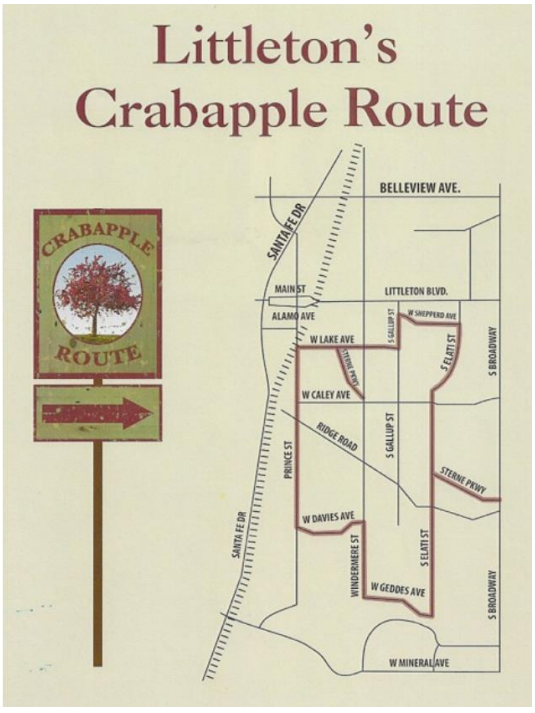
- ***DECLINING CANOPY***

Littleton is not alone in this. With the price of water increasing, a change in industry standards for how we irrigate and the harsh environments that urban trees are planted in, our canopies are in decline. We are already feeling the pangs of climate change and we, unfortunately, only expect for these volatilities to gain severity. We are being intentional now in prioritizing the planting of resilient species.

The City-wide tree risk assessment inspection resulted in an Overall Condition Index (OCI) for each tree. The OCI is a weighted average of the inspection's condition category indexes. The value is not attended to quantify risk, but rather to assign a ranking list of predictable hazards. The lower the value, the more hazardous a tree is considered. Averaging the OCI of a certain area (street, park, etc.) allows us to identify our areas of greatest decline and thus prioritize our highest needed area(s) to work. From the City's 2022 inspection update, the citywide average OCI score is 72.3. Therefore, we can determine maintenance in concentrated areas that fall below the city's average score.

For example, Bowles Ave. is one of our busiest roads. It contains our largest street trees compared to the other thoroughfares, and our second highest number of trees with a total of 218. However, the average OCI of only 66. That is below the city's overall average while also being heavily trafficked. Busy roads with low OCI rankings, like this, pose a hazardous threat to motorists, pedestrians, and equipment. Fortunately, we have been able to secure funding to begin hazard pruning and removal in 2023.

- ***CRABAPPLE ROUTE***



A legacy in the City of Littleton, it was important to us to identify ways to preserve this feature of the city while incorporating our other goals. Transitioning the route into a flowering tree route increases diversity which decreases susceptibility of pest and disease outbreak, increases pollinator use, and provides variety in planting sites. In early 2023, the Crabapple Association approved the change to incorporate additional flowering trees.

There are needs to be met to preserve this legacy. Many of the mature are over 40 years old and naturally aging out. Though new planting programs began in 2011, the efforts have not been tracked or maintained. Watering and early tree care maintenance takes a lot of time and intentionality. The signage is for the route is wearing away and needs to be replaced. And most importantly, there is no formal plan or inventory. As was the issue with the City's canopy, we cannot effectivley maintain our assets if we do not know what we have. We need to inventory the crabapple route and assess the health of the trees. After collecting the data we can expand

on our responsibility and goals as a City in how it pertains to supporting this organization's efforts. There nees to be a push for data collection, ongoing maintence, a plan with goals, and a clear distinction of the city's role.

- **LIMITED OWNED AND MAINTAINED LAND**

The biggest hurdle Littleton has ahead is the lack of land that is owned and maintained by the city. Of the 9000 total acres that was surveyed in the UTC, the city only maintains 80 of those acres. The two types of property that cover the most land in the city are residential and parks. A robust public engagement effort will be crucial to successfully increase canopy on residential properties. Outreach for this effort began in 2022 and is further detailed in the "public outreach and engagement" section of this document.

Regarding parks, in many municipalities, park land would be targeted for the easiest space to increase tree canopy. In Littleton, park land makes up 18% of land and only has 15% tree canopy held within. Littleton parks are maintained by South Suburban Parks and Recreation District through their forestry division. In order to increase tree canopy in Littleton, we will need to increase tree canopy parks. Currently, neither South Suburban's Master Plan nor Strategic Plan mention any level of forestry operations, canopy goals, or tree equity. As Littleton and South Suburban move to update their operating agreement, it will be crucial to find a way to increase canopy coverage within Littleton parks.

LONG TERM GOALS

The greatest goal for Littleton's Forestry division is to foster a sustainable and equitable urban canopy. Practically, this means focusing our outreach and money in areas that have been historically under-resourced. All too often in government models, the loudest complaints get the greatest resources. Though citizen concerns must be the highest priority for public servants, it should not lead to restrictions in providing resources and programs to our quantifiable areas of greatest need.

CANOPY GOALS

Canopy Goals: The City of Littleton has an ambitious goal of increasing total canopy percentage from 19.5% to 50% coverage within by 2090 (67 years). We will do this by sustainably increasing our canopy cover by at least 5% every 10 years. There are many factors to reaching this goal. Part of these goals are dependent on preserving our current canopy through code updates and preventative mitigation such as maintenance pruning and fertilization. We can assume that population growth in the City will continue to increase, therefore, it is imperative that regulations are in

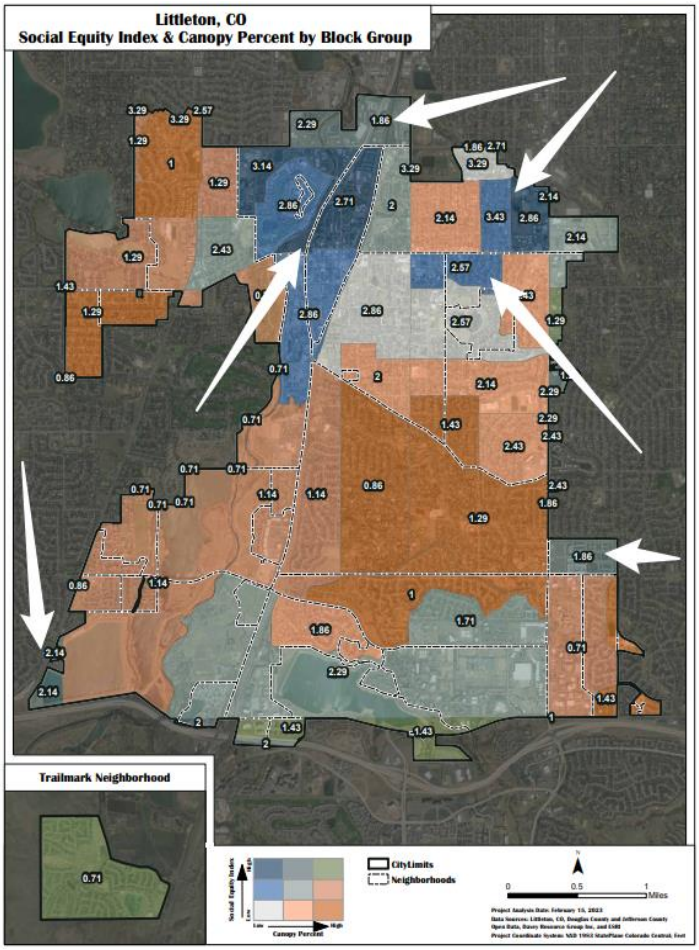
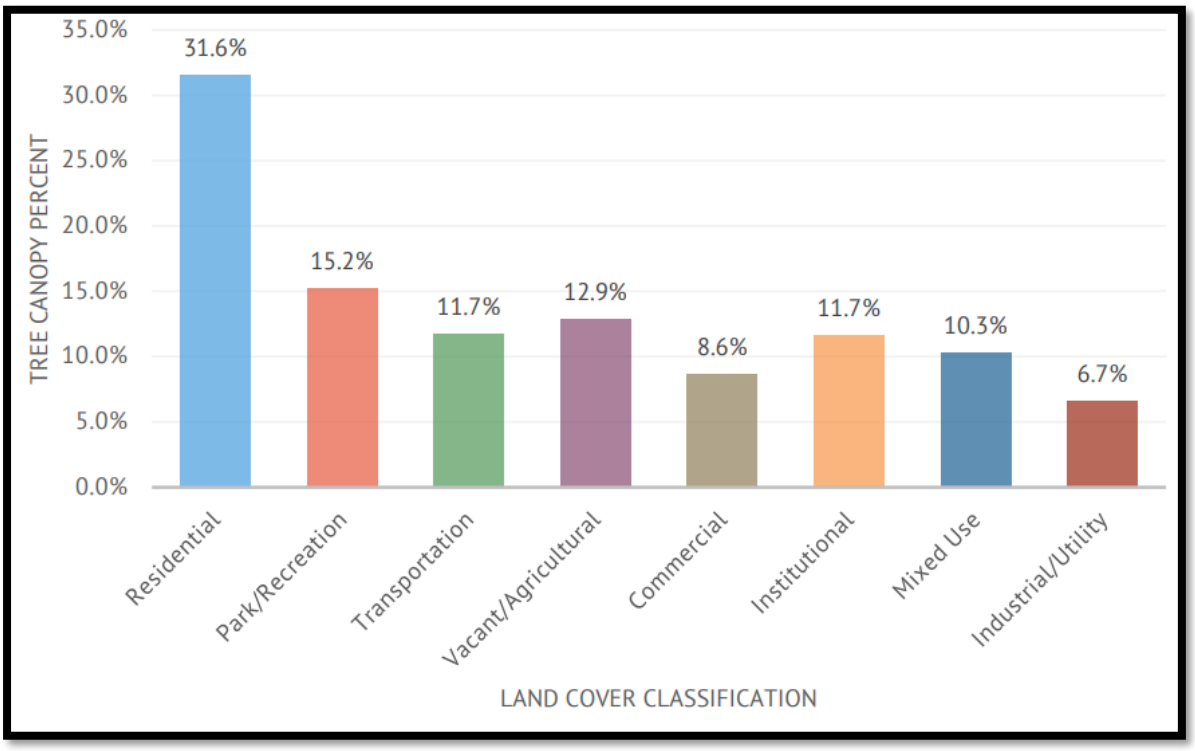


Figure 18 19. A map showing the City's target areas of focus using the Social Equity Index and Canopy Percent

place to protect the development and construction impacts in the urban forest. Another part comes from sustainable new planting efforts. This includes planting in suitable sites that allow full growth of trees, using the land use data to prioritize intentional planting locations, planting where irrigation is accessible, or installing irrigation, and only planting as many trees as staffing limitations allow. Though planting a tree is relatively cheap and fast, the necessary maintenance for long term success requires much time, knowledge, equipment, and physical involvement. Over time, we need: support from South Suburban Parks and Recreation to steward the park spaces in alignment with the City's canopy goals, increased staffing and equipment to preserve and maintain the growing canopy, and cohesive relationships with



partners that share in the long- term goal of environmental equity.

Canopy Goals are to be reached through:

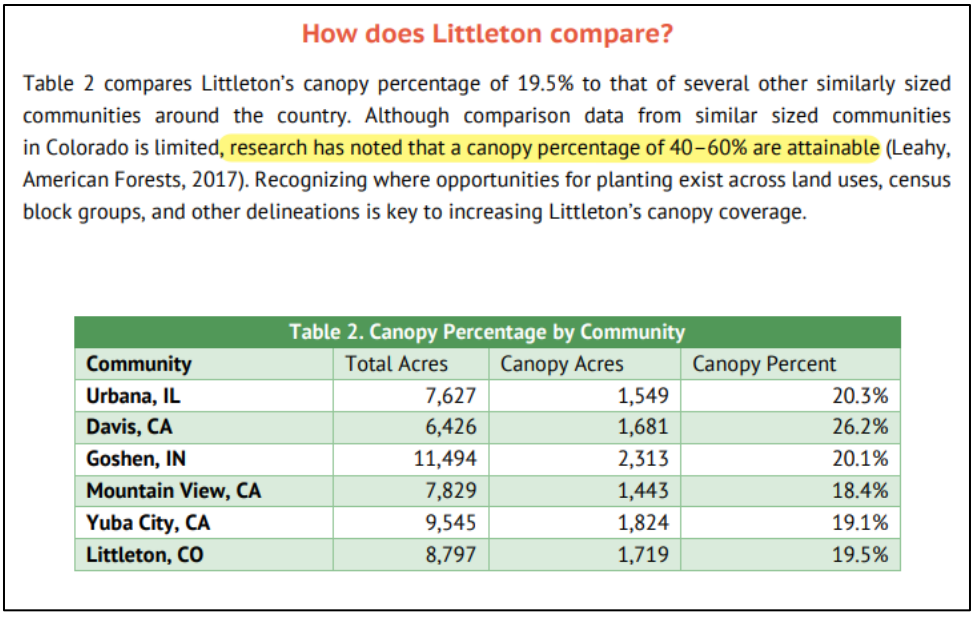
- Planting and Early Tree Care Development
  - Planting right tree in the right place
  - Prioritizing early tree care development
    - Watering, mulching, structure pruning, etc.
  - Supporting Residential tree plantings and maintenance through subsidy program
  - Updating code to require Commercial and Institutional properties to prioritize planting
    - Example, parking lot shade ordinances
  - Partnering with South Suburban Parks and Recreation to increase canopy cover in Littleton's parks
- Preserving the current canopy
  - Providing supplemental funding for ash treatment in private areas of high ash concentration
  - Update code to provide tree protection during development
  - Increased maintenance budget via staff and equipment or increased contractor dollars

- Inventory and Risk Assessment
    - Data allows us to determine maintenance cycles
    - Risk assessments allow us to prioritize safety and balance risk

Canopy Coverage Goals:

	Year	Tree Canopy Percent	Notes
Current	2023	20%	
Short- term goals	2030	20%	Given our risk assessment results (7% of city-maintained trees recommended for removal) and EAB approaching (~14% of the city's overall canopy) we will work to stabilize and maintain our current state
Medium- term goals	2040	25%	Hope to sustainably increase canopy cover by ~5% every 10 years. UTC reporting recommended
	2050	30%	
	2060	35%	
Long- term goals	2090	50%	Should have reached 50% total canopy goal. Maintain moving forward

The City of Littleton, Forestry division has a long-term goal to reach a total canopy cover of 50%. With sustainability as our top focus, we acknowledge that this goal will take time. Making a conservative estimation, at 5% canopy cover every 10 years, then we will reach our long-term goal by 2090. A few of the reasons we are keeping this goal more conservative include unexpected pest and disease outbreaks, a declining canopy, limited land ownership, and financial restrictions. Some of these concerns are further expanded on in the "Expected Challenges" section of this plan.



How does Littleton compare?

Table 2 compares Littleton's canopy percentage of 19.5% to that of several other similarly sized communities around the country. Although comparison data from similar sized communities in Colorado is limited, research has noted that a canopy percentage of 40–60% are attainable (Leahy, American Forests, 2017). Recognizing where opportunities for planting exist across land uses, census block groups, and other delineations is key to increasing Littleton's canopy coverage.

Table 2. Canopy Percentage by Community

Community	Total Acres	Canopy Acres	Canopy Percent
Urbana, IL	7,627	1,549	20.3%
Davis, CA	6,426	1,681	26.2%
Goshen, IN	11,494	2,313	20.1%
Mountain View, CA	7,829	1,443	18.4%
Yuba City, CA	9,545	1,824	19.1%
Littleton, CO	8,797	1,719	19.5%

Figure 20. A chart from Davey Recourse Group that compares canopy cover percentages in like sized communities.

Diversity Goals: Having a diverse tree canopy is a huge aid in promoting sustainability efforts. A city cannot have a sustainable urban canopy without prioritizing species and age diversity measures. Diversity guidelines are in place to promote variety of genera, species, and family as well as age of the canopy. This helps increase overall biodiversity, improve aesthetics, and reduce risk of extreme budget disruptions if widespread loss were to occur. Currently, The City of Littleton is experiencing the unplanned for financial impact of emerald ash borer attacking the genus of Fraxinus (14% of overall canopy). EAB is one of unfortunate examples that proves the correlation of increased diversity leading decreased costs. Therefore, we hope to follow a 5-10-20 diversity rule. This is an ambitious, but attainable, goal to reach for city- maintained trees.

Table 1. Example family, genus, and species.

FAMILY (15%)	Sapindaceae		
GENUS (10%)	*Acer*		*Koelreuteria*
SPECIES (5%)	*saccharinum*	*rubrum*	*paniculata*
COMMON NAME:	Silver maple	Red maple	Golden rain tree

***5-10-20 Rule**: The City of Littleton will strive to follow a 5-10-20 rule: you are to plant no more than 5% of the same species, no more than 10% of the same genus, and no more than 20% of the same family.*

The selection of trees necessitates much consideration. There are limiting factors such as nursery availability, litter production, biological restrictions (such as: plant tolerances, plant adaptability, upkeep responsibilities), ecological requirements (such as: local climate, future predicted climate, preserving native spaces and species), function requirements (such as: existing infrastructure, maintenance accessibility), and the ever-looming reality of the future climate changing.

Being in an urban environment there are unique challenges. The City of Littleton will promote tree percentage diversity, while first prioritizing sustainable choices. We will encourage sustainable infrastructure in planting locations be it integrated soils (ex: Silva cells in streetscapes), new irrigation installation, and guidelines that prevent new construction from creating unrealistic growing sites (ex: a City of Littleton Tree Manual for new development). We will consider drought tolerance, heat tolerance, pollution tolerance, longevity, pest susceptibility, maintenance requirements, tree litter, and species cost. Planting diverse is only successful if we plant the right tree in the right place.

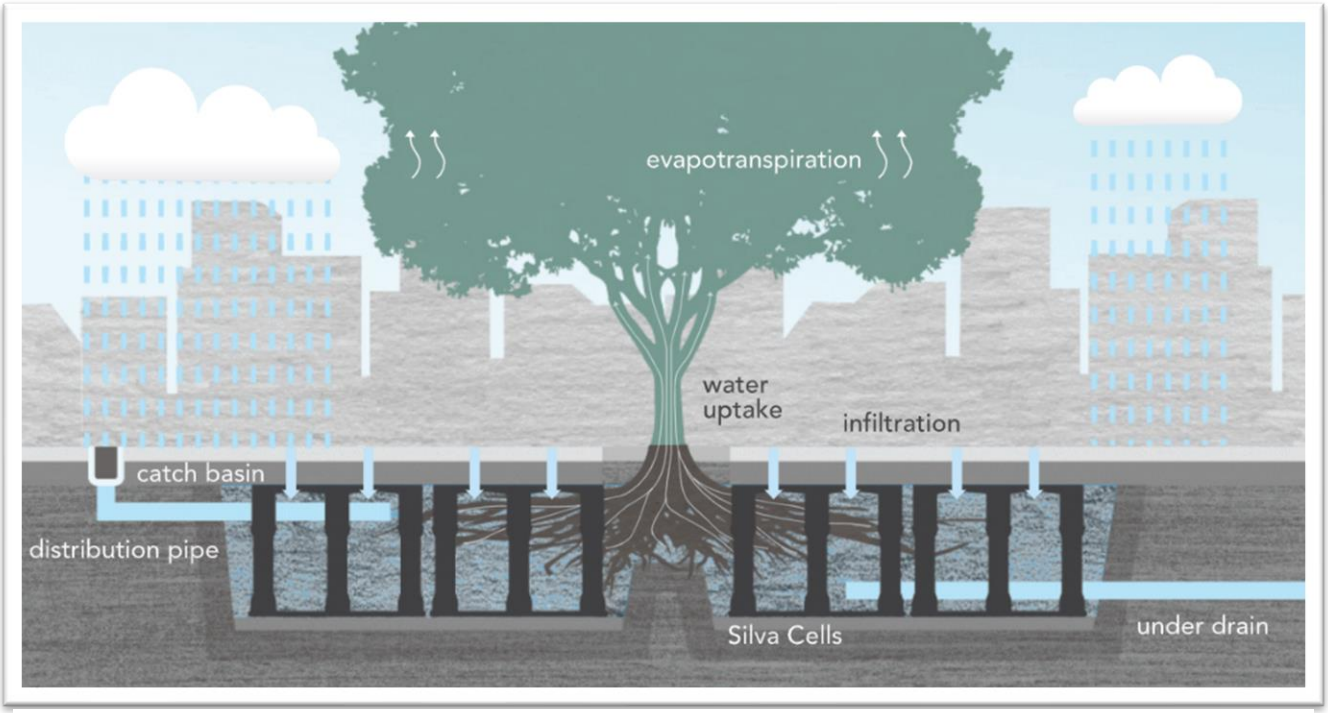


Figure 2021. An example graphic of a street tree planted utilizing Silva Cell technology

RISK REDUCTION

All trees come with an inherent risk. Lack of management over significant periods of time, particularly in the urban environment, increases that risk. Littleton has identified an action plan to reduce that risk.

1. **Citywide clearance pruning and hazard mitigation through major thoroughfares.**

The results of the risk assessment indicated that our major thoroughfares, contained higher over risk ratings than in other areas of the city. As previously noted, the OCI is a weighted average of the inspection's condition category indexes. Each tree is assigned a numerical value (the OCI) at the time of inspection. The value is attended to quantify risk. The lower the value, the more hazardous a tree is considered.

From the City of Littleton's 2022 inspection update, the City's overall average score is 72.3. However, many of our major thoroughfares are not meeting that mark. Busy roads with low OCI rankings pose a hazardous threat to motorists, pedestrians, and equipment. Safety of the public as well as city employees must be the highest priority.

Additionally, many of the trees along these roadways do not meet Littleton City code of 14' above roadways and 10' above sidewalks.

Littleton has already invested the resources to complete clearance pruning and hazard mitigation through the sections below.

Street Name	Total trees	Average OCI ranking	Action Year
Main Street	81	**60.2**	**2023**
Littleton Blvd.	122	**64.3**	**2023-2024**
Bowles Ave.	218	**66.1**	**2023**
Mineral Ave. (internal)	177	**66.1**	**2024-2025 (Some removals in 2023)**
Mineral Ave. ext. (east and west)	261	**67.6**	**2024-2025 (Some removals in 2023)**
Broadway	89	**71.8**	**2025**

2. Storm Action Plan

a. **Internal Work Plan:** A storm response plan was developed in early 2023 and presented to all of public works operations divisions. The storm response plan prioritizes how fallen trees and branches are addressed based on location and overall impact.

Location	Priority Ranking
1. **Traffic**: report anything that blocks traffic a. Major thoroughfares b. Tree maintained by City c. Tree on Private Property	**High Priority!**
2. Roads: Hanging hazards over streets	
3. **City Building Entrances**	**Medium Priority**
4. **Sidewalks:** Anything blocking or hanging low a. Public Property 1st **b.** Private Property 2nd	
5. Parking Lots- any blocking	
6. **Trails:** blocked	
7. Turf/ Parks a. Hazards b. Limbs Down	**Low Priority**
8. Native areas	

b. **Branch Drop for Community**: After a large storm when the community is struggling to clean up, we would like to provide a service option. Below are possible options for a branch drop based on research into other municipalities and partner agencies.

i. The city partners with A1 organics to utilize their facility using a reimbursement system. Reimbursement can be completed through submitting receipts to the

city's finance department. An alternative, done in other cities, is a rebate on a utility bill after submittal of receipt. Littleton would need to further explore technology and staffing needs to utilize this option.

ii. A permanent drop site is identified through the waste diversion study. Additional resources for hauling would need to be identified.

iii. Littleton does not offer a branch drop option.

c. **Emergency Storm Response Fund**: Large storms are happening more frequently due to climate change. It is recommended that Littleton identifies funding for emergency response to these storms.

URBAN FOREST COST/ BENEFIT ANALYSIS

CURRENT BENEFITS

According to the 2023 Urban Tree Canopy Assessment conducted by Davey Resource Group, Littleton's tree canopy cover provides a cumulative, **annual value of $717,216.** (USDA Forest Service, i-Tree Tools).

This value is qualified by analyzing the following ecosystem services:

Carbon: The trees sequester 1,550 tons of carbon, reducing the amount returning to the atmosphere as a greenhouse gas**. Annual value: $264,048**. Additionally, the trees currently store over 60,390 tons of carbon which provides an estimated benefit valued at $10.3 million.

Stormwater: The trees intercept and absorb about 18.3 million gallons of stormwater, reducing the amount entering the storm sewer system. **Annual value: $216,040.**

Air Pollution: The trees remove 1,714 pounds of carbon monoxide, 29,041 pounds of nitrogen dioxide, 67,556 pounds of ozone, and 3,336 pounds of sulfur dioxide from the atmosphere, helping to reduce atmospheric warming, improve air quality, and mitigate the public health effects from air pollution. **Annual value: $112,602.**

Figure 2122. The City of Littleton's current tree canopy is estimated to provide an annual value of **$717,216.** This number is found by quantifying these four ecosystem services.

Air Quality: Littleton's urban forest removes 39,731 pounds of dust, smoke, and other particles from the air, directly improving air quality and respiratory health (e.g., asthma). **Annual value: $124,526.** have been linked to many environmental, social, and economic benefits.

ECOSYSTEM BENEFITS	QUANTITY	VALUE
Annual benefits		
Air quality: Carbon Monoxide (CO removal (lb)	1,714 lbs	$1,143
Air quality: Nitrogen Dioxide (NO2) removal (lb)	29,041 lbs	$8,048
Air quality: Ozone (O3) removal (lb)	67,556 lbs	$102,973
Air quality: Sulfur Dioxide (SO2) removal (lb)	3,336 lbs	$438
Air quality: Particulate Matter (PM10) removal (lb)	39,731 lbs	$124,526
Carbon sequestration (tons)	1,550 tons	$264,048
Stormwater: avoided runoff (gal)	18,308,483 gals	$216,040
TOTAL ANNUAL BENEFITS		**$717,216**
Accrued benefits		
Carbon storage (tons)	60,390 tons	$10,300,306
TOTAL BENEFITS		**$11,017,522**

Current Costs: The total 2023 budget is $486,000 with approximately $200,000 of that used for personnel. The price includes a large push for emerald ash borer treatment, removal of undesirable ash candidates, and replanting efforts. To date, the City of Littleton has never had a street tree maintenance schedule. Therefore, this price also accounts for the expense of mature tree street clearance, removal, and pruning efforts.

Program	Annual Cost
Staffing	$200,000
Citywide Clearance Pruning	$100,000 (3 years only)
EAB	$121,000 (5 years)
Spring Tree Program	$15,000
High Line Canal	$10,000
Contractor Work (storm help)	$20,000
Tools, education, training, general operations and maintenance costs	$20,000
Total Annual Cost	$486,000

Additional Expected Costs: Growing the urban canopy is challenging. We've seen how lack of resources and planning can set a canopy into decline. Reactive work in forestry is notably more expensive and more impactful than proactive maintenance. In order to meet our canopy goals, additional resources will be needed. The UTC highlights the economic value that our canopy can provide. Additional canopy means additional economic value for the city. It is anticipated that over the next three years, an additional full-time employee (FTE) will be needed to meet goals. Currently, aside from staffing, the bulk of the forestry budget is geared towards stabilizing the existing canopy. As priorities shift and the operation focuses on growing the canopy, that budget will need to shift to accommodate those goals. Funding for additional trees, water and infrastructure, tools and equipment, and public engagement will make up the majority of the forestry budget.

ADDITIONAL FUNDING AND RESOURCES

Grant Opportunities: In recent years, grant funding options for urban forestry has grown. Currently, Littleton applies annually for grants through the Colorado Tree Coalition. These are generally small grants, not exceeding $5,000 and are used to aid in EAB injections or planting initiatives.

The 2022 Inflation Reduction Act allocated $1.5 billion to the Depart of Agriculture's Forest Service Urban and Community Forestry Program. This money will go directly to increasing equitable access to trees and green spaces in urban forests. Staff will be applying for two grants in 2023 to address canopy equity in Littleton. Staff will apply for these through the Colorado State Forest service in efforts to avoid a financial match. It has been communicated that any programs directly addressing equity are not expected to require a match.

The first grant through the IRA/ CO State Forest Service, will strive to reach an equally distributed, safe, and sustainable urban canopy in the City of Littleton by developing the Tree Fund Program. This program will work to develop trusting relationships with communities through education and listening to what the citizens both want and need. The funding, at $150,000, is expected to cover:

- Community outreach and survey
- 2 community paid tree stewards
- Money housed in a "Tree Fund"
    - Provide trees for citizens in low canopy areas
    - Aid in tree work for citizens in under resourced areas

The second grant will focus on improving and growing ROW canopy in under resourced communities. At $300,000, the division can still utilize city funds to focus on risk reduction without further growing the inequity in tree canopy for these communities.

Partnerships: Littleton already maintains many partnerships with non-profits, advocacy groups, like-minded organizations and private stakeholders. While not a reliable source of funding, opportunities have arisen to partner in forestry related initiatives. For example, in 2022 the city partnered with South Metro Land Conservancy to distribute trees to under resourced communities by utilizing events held in those neighborhoods.

PUBLIC OUTREACH AND ENGAGEMENT

A robust public outreach and engagement strategy will be necessary for achieve our long-term goals. The forestry division began public outreach in 2022 by increasing presence at community events and handing out information on EAB. Moving forward, both general education of urban forestry and targeted engagement will expand in 2023 with a focus on building trust with the community. We plan to utilize our internal Communications Department to meet many of these goals and rely on grant funding for areas that are beyond our staffing's capacity.

General Education

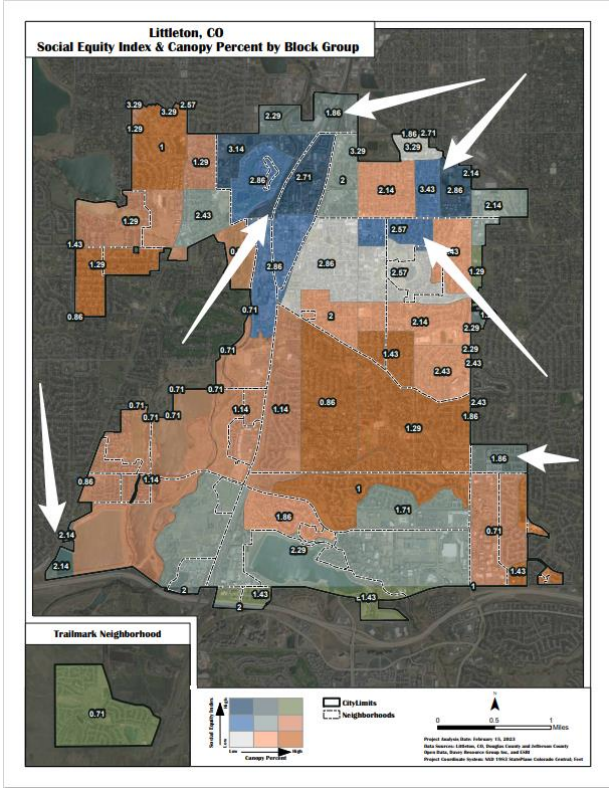
- *Increased presence at community events*: Staff will utilize the summer event season to start talking to the community about urban forestry in Littleton, including available resources, upcoming challenges, and homeowner responsibilities for tree care.

- *City Website*: Create a one-stop-shop for all things forestry related in the city. Citizens will be able to find information such as the spring tree program and other community programs, city code, and arborist licensing.

Targeted Engagement

- *Emerald Ash Borer*: As EAB grows closer, it is time to make sure the community understands the upcoming impacts. We will share educational materials and resources during events, on social media, and in the Littleton Report. Our role as the city is to provide non-biased, science-based options for treatments and removals. We hope to be able to provide supplemental funding applications for treatments, removals, and new plantings.
- *Community Survey*: As we move to create more community programs, we must first listen and understand what the community wants and needs. A community survey will help identify community needs and see where our goals align. A survey will be the first push to reach some of the under-resourced communities we have targeted in this plan.
- *Community Tree Stewards*: Pending the approval of grant funding, we would like to hire community tree stewards to assist in educational outreach as a way to support our tree equity goals.

CONCLUSION



Comparing the past 10 years of available data, The City of Littleton's canopy percent has dropped by over 5%. We believe this negative trend will continue without intentional efforts prioritizing tree preservation and increased plantings in targeted areas.

With a primary focus on both efficiency and fair distribution of environmental benefits for all, the City of Littleton's Forestry division recommends initial efforts to be determined by utilizing the "social equity index and canopy percent" map. This means focus begins in concentrated blue areas with high-ranking scores and moving correspondingly to equally address all areas within the city.

As discussed, though the City of Littleton's average tree equity score ranks higher than many areas in Denver metro, we are not immune to the trend of disadvantaged canopy cover percentages. Simply put, our environmental resources are not equally distributed. For too long, the tendency has been that

the louder the complaint, or the wealthier the neighborhood, the greater the resources provided. However, now that we have quantified these incongruencies, we have the potential to come together under the united front of making data driven decisions to prioritize impartial resources for all our citizens.

In total, 19.5% of the City of Littleton is shaded by trees. These trees provide city residents with $717,216 in annual benefits. Littleton's vision is to sustain the diverse urban forest on its public land by prioritizing, preserving, and growing tree canopy in public areas. It also seeks to encourage tree planting and preservation on private land and to distribute tree canopy more equally across the city so that all residents reap the full benefits of tree.

Littleton
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